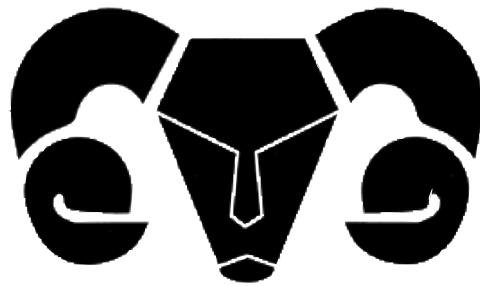


GLOBAL LIVESTOCK CRSP  
ANNUAL REPORT 1999



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# PREFACE

Each year, the Global Livestock Collaborative Research Support Program (formerly the Small Ruminant CRSP) publishes an annual report in compliance with grant requirements. The 1999 Annual Report documents work completed during the fiscal year, October 1998 - September 1999. 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 grammatical and format editing by the Management Entity. All individual reports give the name, address, telephone, fax number and email address of the principal investigator for that project. Inquiries are welcome.

A special thanks to Martha who has been of invaluable assistance in the production of this document.

Susan L. Johnson  
Annual Report Coordinator



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## FORWARD

*By Dr. Montague W. Demment  
Director, Global Livestock CRSP*

The annual report is a time to contemplate and comment. Considering the focus and trends in the development community, let me make a few observations. The components of development fall under three headings: technology, societal and human capital. Technology and its role in development are well understood and appreciated by the development community. Societal capital is presently receiving considerable attention especially in the global transition to democracy. Human capital development, once the mainstay of international assistance, has lost the attention of USAID as other more short-term mechanisms are sought to address development. The basic premise, I would argue, is that for development to occur and be sustained, all three must advance together, be logically connected to each other, and be adaptive in the larger regional and global arena.

Social capital can be defined as the institutions, ethics, morals, and operating rules that govern a group at the scale of interest: village, country, or region. One might think of it as the software of society, as opposed to its physical infrastructure. It is the markets, the banking systems, the ethics that govern their behavior, the behavior of the leaders and the workers. Development assistance programs have made major contributions to societal capital with their recent emphasis on the establishment of a business and governmental environment where laws, institutions and their functions have been defined and established. The US agenda

in Eastern Europe and the former Soviet Union invested heavily in the development of social capital.

Human capital is the fundamental capacity of the people to contribute to society. Without wishing to discuss the nature-nurture question, human capacity is a function of both the mental and physical capabilities of the people and the environment that adds skills to their natural capacities. Since individuals make their contributions largely through or with the assistance of their societal institutions, human and societal capital are closely linked. Because the integration of human capital into communal functions is the basis of society, I would argue that human capital development is the basis for the development of society's software and is fundamental in the incorporation of technology for economic growth. Emphasis on only building societal capital in the absence of capable human capital and without a complementary program to build such capacity is a clear recipe for failure.

While we have placed great emphasis on the survival of human beings (and rightly so) we must be responsible for the quality of the human capital that endures. The mental and physical capacities that enable children to contribute to a country's future are a critical factor controlling national development. Our CRSP has placed a major focus on child cognitive and physical development through our current micronutrient work in Kenya and Central Asia and our past

focus on women in poor rural households in East Africa, Southeast Asia and Latin America. We have learned that beyond survival a child needs a nutritional environment that is sufficiently diverse to allow full cognitive and physical development. The balance between creating human capital that contributes or costs society is a fine line largely determined by nutrition (and its interaction with health) and education.

After birth and through the child's life, a society invests in that initial human capacity to learn skills, develop creativity, establish motivation and understand the operating guidelines that make societal capital function. Lack of investment in human capital early in life will result in malnutrition, underdeveloped cognitive and physical capacities, and greater susceptibility to disease that will surely surface later in life to make development investments less effective in building societal capital. By ignoring the quality of those who survive, we trade creativity for cost; those who would contribute to society become those who cost society.

A social environment populated with bright, creative people is essential to allow technologies to flourish in developing countries. I believe that excellent technologies and well-crafted policy only succeed if there is an environment that supports their introduction and maintenance. For broad-based economic growth, technologies can not be developed and adopted without companies; companies can not succeed without banking and investment instruments; fiscal mechanisms require laws and codes of behavior and a population that understands and respects their functions. That understanding and acceptance is a result of education and training of a healthy and creative population. The foundation of development rests on human capital.

to do About Africa” (see our newsletter #??) he discusses the recent history of development policy. Foreign aid has succeeded, judged by accepted measures of development (average income, frequency of famine, declining poverty gap, increased role of women in the economy) in countries where a massive investment has been made in economic growth. Senior administrators at the time had the patience and conviction to build institutions that created the human capital that fueled economic growth in Asia. However, in Africa, Mellor observes, there has never been a similar investment in economic growth. “Foreign aid is now captive to a myriad of special interest groups...(child survival, vitamin A, microcredit {but excluding agriculture}, empowerment of women, environment, wildlife preservation).” Yet agriculture, which is the basis of most of Africa's economies and the foundation for economic growth, is largely absent from our foreign assistance agenda. While all these ancillary causes are laudable, he maintains that a lack of focus detracts from the ability to stimulate the basic economic process that would benefit these interests the most: increased wealth.

I would go further and suggest that a society supports growth primarily by creating a societal environment that takes full advantage of new technologies and innovations. Such a social environment is a direct result of investment in human capital and our development agenda needs to reflect that fact.

In a recent article by John Mellor “What 

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 with each team charged with refining their problem model through in-field explorations. To ensure grass roots input, over 20 regional workshops involving 35 countries were conducted during the assessment period. The teams submitted final proposals for a competition

## **THE GLOBAL LIVESTOCK CRSP**

### **AN OVERVIEW**

#### **INTRODUCTION**

The Global Livestock CRSP (formerly known as the Small Ruminant CRSP) has expanded its research to address important new topics in the international livestock development sector. The program, comprised of seven broad-based interdisciplinary projects, focuses on human nutrition, economic growth, environment and policy linked by a global theme of agriculture at risk in a changing environment. The projects involve researchers from 13 US universities, 3 international agricultural research centers and 69 foreign institutions. The program is active in three regions of the world: East Africa, Central Asia and Latin America.

#### **HISTORY**

Established in 1978 as the Small Ruminant CRSP, the Global Livestock CRSP is one of eight 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 US land-grant universities and collaborative partnerships with international organizations. Four characteristics ensure the effectiveness of this model: 1) Collaboration with US land-grant universities; 2) International training; 3) Long-term scientific relationships; 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

to be included in a proposal to USAID. The seven final projects are headed by University of California-Davis, University of California-Los Angeles, University of Wisconsin-Madison (2), Texas A&M University System, Utah State University, and Colorado State University. The process was designed to be problem driven and produced results oriented projects.

## A GLOBAL PROGRAM

The GL-CRSP global program builds effectively on complementarities between projects in different regions. Centered on a theme of managing risk in our unpredictable world, the program is developing the capacity to predict risk so it can be better managed, improving the tools to cope with risk, and contributing to the mediation of risk. 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. The model of risk management is most highly developed in our East African program where the four complementary projects cover prediction, adaptation and management of risk.

### *Predict the Future*

The project, *Early Warning System for Monitoring Nutrition and Livestock Health for Food Security of Humans in East Africa*, headed by Texas A&M University System (TAMUS), addresses risk by adapting already successful U.S. technologies to East Africa in order to increase the lead time on the forecast of drought and famine, and allow policy makers to visualize the impact of their interventions on food crises. The project combines predictive and spatial characterization technologies with the formation of a network of collection and measurement sites in East Africa. The data from these sites, in coordination with the Famine Early Warning System (FEWS) project, will allow 6-8 weeks of increased lead-time for drought forecasting.

### *Mitigating, Coping and Adapting to Perturbations and Change*

The project, *Integrated Modeling and Assessment for Balancing Food Security, Conservation and Ecosystem Integrity in East Africa*, headed by Colorado State University (CSU), addresses the relationship between pastoralists and wildlife conservation in the context of the unpredictability of semi-arid environments. This project will adapt models already in use in U.S. national parks to assist policy makers at the national and local level to establish approaches that are compatible with both pastoral life and conservation of biodiversity. The project intends to identify, in an integrated manner, the tradeoffs of different management decisions on wildlife conservation, livestock production and pastoralist food security and health.

The project, *Improving Pastoral Risk Management on East African Rangelands*, headed by Utah State University (USU), uses four systems to cope with risk and destock livestock in semiarid ecosystems: resource tenure, closer links to markets, rural finance and public service delivery. These activities represent mechanisms to allow asset diversification, improved ability to interact with markets, increased investment in rural institutions and commerce, and better capacity to cope with

an unpredictable environment. The impact of these alternatives will likely reduce conflict, improve the economic conditions of pastoralist and their communities, provide higher productivity and stability to their livestock systems and greater protection for the biodiversity in their environments.

The project, *Role of Animal Source Foods to Improve Diet Quality and Growth and Cognitive Development in East African Children*, headed by the University of California-Los Angeles (UCLA), targets mechanisms to cope with malnutrition of rural populations, particularly children. The project is definitively testing the link between animal source foods (ASF) and cognitive and physical development in children. Additional project work, after testing, will consider the effectiveness of different interventions in delivering ASF into the diets of children.

The Global Livestock CRSP is also active in Central Asia and Latin America. The Central Asia program addresses a rapidly changing and unstable political and economic environment, where little effort has been made, particularly in rural areas, to “cushion” the effects of transition to a market economy. The Latin America program faces sustainability issues, with a growing population, more firmly entrenched poverty, and a rapidly diminishing resource base.

In Latin America, the project *Livestock-Natural Resource Interfaces at the Internal Frontier*, headed by the University of Wisconsin-Madison (UW), deals with the impact of increasing human population on the conversion of forest and the management of integrated livestock systems that protect and use the biodiversity of these ecosystems. The importance of water emanating from the mountain forest is central to the project, which is organized at the watershed level. The project uses a strong community based involvement to address how to develop productive, profitable and environmentally sustainable food systems in marginal environments for livestock production.

The project, *Impacts of Economic Reform on the Livestock Sector in Central Asia*, headed by the University of Wisconsin-Madison (UW), acting in a region of major economic and political transition, strengthens the capacity of governments to formulate effective agricultural policies on ownership, use-rights, and institutional organization that engender stable and democratic societies. The project is introducing the genetic material and techniques to insure high rates of reproduction of appropriate genetic animal stock to allow adaptation to the new economic conditions. The approaches and technologies introduced by the project have regional significance for the economic growth of Central Asia and Russia.

The project, *Integrated Tools for Livestock Development and Rangeland Conservation, in Central Asia*, headed by the University of California-Davis (UCD), emphasizes both adaptation and mitigation. This project will have significant global and local impacts in four main areas: atmospheric CO<sub>2</sub> sequestration, rangeland conservation, enhanced productivity and sustainability of livestock systems, and human nutritional welfare.

### **PROGRAM GOAL**

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 met through collaboration between U.S. land-grant 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:

- To strengthen the ability of institutions in developing countries to identify problems in livestock production and develop appropriate solutions.
- To increase employment and incomes among livestock producers and associated value-adding agribusinesses.
- To improve livestock production while monitoring the effects of production on the environment and exploring the integration of production systems with the rational use of natural resources, such as wildlife.
- To enhance the nutritional status of targeted populations through increased availability and utilization of animal source products.
- To provide support to decision-makers in developing policies that will promote livestock production, marketing, and processing of animal products; human nutrition and child physical and cognitive development; and natural resource conservation and management.
- To identify, study, and strengthen communication systems (including but not limited to extension) among livestock producers, businesses, researchers, and consumers.

### **RESOURCES**

Funds for the GL-CRSP are granted for a five-year period by the United States Agency for International Development. A minimum cost-sharing contribution of 25 percent from participating US institutions is required. The projects also receive substantial contributions from host country collaborators and leveraged funds.

## 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 US 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 oversees the daily operations of the GL-CRSP.

The *Program Administrative Council* provides input on the overall program goals, recommends strategies for programmatic development and advises and concurs on the program budget.

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

The *External Evaluation Panel* provides objective evaluations of the CRSP programmatic

**Problem Statement and Approach.** In this activity our main goals were to document cattle herd dynamics over 17 years in an important pastoral system in Ethiopia, estimate economic losses

**IMPROVING PASTORAL RISK  
MANAGEMENT  
ON EAST AFRICAN  
RANGELANDS  
NARRATIVE SUMMARY**

This was the second year of work for this project. We believe it was a successful year. We began with a total of 13 broad objectives for research, outreach, training, and administration and were able to meet all of these. Year 2 was best characterized by five broad achievements: (1) Successfully hiring two new post-doctoral research specialists in pastoral economics and social conflict, who have spearheaded a rapid transition from broad, regional reconnaissance methods in field research during year 1 to a more local, detailed survey approach regarding risks faced by pastoralists and agro-pastoralists in eight stratified locations; (2) successfully holding our first biennial research and outreach workshop for Kenya and Ethiopia in Addis Ababa, attended by over 80 participants from three-dozen organizations—a major purpose of this meeting was to allow partners to debate and influence project direction; (3) submission of a USD \$388,000 outreach proposal to the Greater horn of Africa Initiative (GHAI), designed to complement core research activities on the GL-CRSP and the concomitant hiring of an outreach coordinator on other outreach funds secured from the USAID Mission in Ethiopia; (4) successful completion of research projects for three graduate students, with another

nine students moving steadily through their programs, both in East Africa and the USA; and (5) production of 24 publications including peer-reviewed manuscripts, popular articles, and a thesis and dissertation. These cover a wide range of topics from livestock marketing to risk management, food security, social conflict, and diversification of pastoral economies.

We have remained true to our original problem model. Work plans and outputs in year 2 are almost exactly on track with what we outlined in the original project proposal. In terms of creating a significant outreach capability, it could even be said that we are further ahead of where we thought we would be at this time. Team members have been very productive and creative with resources provided through the GL-CRSP. Overall, we see our progress as very positive given the obstacles imposed by the numerous challenges of working in East Africa today. In short, we believe our progress is related to one basic reason: we are dealing with the “right” issues.

**RESEARCH**

**Activity 1:**

*Diversification of Livestock Assets for Risk Management in the Borana Pastoral System of Southern Ethiopia, led by Solomon Desta and Layne Coppock with key participants including Christopher Barrett.*



due to wasteful animal mortality, and prescribe combinations of pastoral and non-pastoral asset holdings that could better conserve wealth and reduce risk for households in the system. These themes are very relevant to how improved risk management can lead to progress in pastoral development. This portion of our problem model has remained virtually unchanged during the course of our project. This research was founded on a doctoral dissertation project. Field work ended in 1997 and in 1998-9 was slated for data analysis write-up. Some empirical results concerning pastoral wealth stratification, economic diversification, and cattle herd dynamics were noted in the 1998 Annual Report. Herd dynamics from 1980-97 resembled a “boom and bust” pattern with large crashes in 1983-4 and 1991. The economic losses over cattle deaths was estimated at USD 380,000,000. Per capita cattle holdings have dropped 30% over this period and widespread poverty has been one result. For the past year we planned to conduct the portfolio asset analysis using quadratic programming, finish the dissertation and draft associated manuscripts.

**Progress.** We were largely able to complete this activity as planned. We completed a portfolio analysis based on risks and returns to cattle and holding assets as simple savings accounts in local banks as one example. Cattle assets were divided into four discrete forms: mature cows, mature males, immatures one to four years old, and calves less than one year old. Each sex and age class had distinct risk and return characteristics—cows were the most productive but suffered high rates of death loss during drought. Compared to other cattle, mature males were the least productive, but conversely had higher survival rates during drought. Risk and returns for holding assets in the Ethiopian banking system were based on data for variable interest rates and expert opinion. Three scenarios were used to create and contrast various asset

portfolios: (1) cattle alone, (2) cattle plus an “unsafe” bank, and (3) cattle plus a “safe” bank with improved marketing. The unsafe bank was assumed to suffer a 0.15 probability of crashing, with 100% loss of deposits. Both the safe and unsafe banks had interest rates on savings accounts ranging from 6 to 10% per annum; safe banks had no record of crashing, and this was consistent with performance of Commercial Bank of Ethiopia. Improved marketing involved higher prices for all classes of cattle and modest (i.e., 10%) reductions in mortality due to marketing bottlenecks.

The analysis confirmed that the third option—the mix of cattle with safe banking and improved marketing— was superior. The third option always yielded less risk per unit of return. Even the second option—the mix of cattle with the unsafe bank—yielded less risk per unit of return compared to cattle only for half of the portfolio combinations. These results were merely another illustration that cattle keeping is indeed a highly risky activity for people like the Boran, and that it could be desirable to identify complementary investment options that diversify the pastoral economy, better conserve wealth, and contribute to new development pathways. A cow-calf production system, in tandem with a safe rural financial system and improved market access, was the most efficient portfolio combination in this instance.

This activity has led to a completed PhD dissertation, one publication for the Sixth International Rangelands Congress, and several manuscripts drafted in 1999 for peer reviewed publication. See Training and Publications section for more details.

**Activity 2:**

*Sources of Risk and Risk Management among the Gugi of Southern Ethiopia, led by Wzo. Tibut Yirgu Asfaw and Kirsii Saaristo.*

**Problem Statement and Approach.** In this activity our main goals were to document major risks perceived and coping strategies used by the Gugi pastoralists and agropastoralists, a large and rarely studied group that resides north of the Boran in southern Ethiopia. Given the Gugi and Boran are neighbors and engage in trade and occasional conflict with each other, we felt the Gugi were an important society to investigate. Understanding how such people perceive risk and cope with problems is important for designing effective relief and development strategies. This activity was founded on a jointly conducted master's program. Field work began in late 1998 and no results were available for the 1998 Annual Report. Field work continued into early 1999 and data analysis and write-up occurred before mid-1999. Forty-six households were interviewed using a Participatory Rural Appraisal (PRA) method. There were 199 households in the immediate study area, which consisted of four Pastoral Associations (or PAs) at Tulawayu, Bilidim Rasso, Burkitu Magada, and Finchewa. The work depicted in this activity was consistent with efforts to collect base-line information. This supports our problem-model concept as originally designed.

**Progress.** We were largely able to complete this activity as planned. Results indicated that Gugi households were dependent on both crop (e.g., maize) and livestock production, with only a few totally reliant on cattle. Cattle provided the most important source of income followed by sheep. The cattle population was reportedly still low in 1998 as a result of high mortality in the 1991-2 drought. A low number of milking cows was also reportedly due to prevalence of tick-borne diseases. It was concluded that livestock

holdings were below subsistence levels and that the typical Gugi household was poverty stricken and poorly diversified. Economic links to the non-pastoral sector were almost nonexistent for the Gugi. Respondents noted that the major constraints on livestock productivity were drought and disease. Other problems included shortages of water, labor, and grazing land and loss of animals to thievery. Respondents ranked the following as the most important sources of risk: marketing, drought, livestock disease, lack of access to grazing, ethnic conflict, problems with wildlife, and livestock theft. Respondents were asked about what strategies they used to prepare for risks (ex ante). Most (54%) said that they did nothing—many people reportedly did not anticipate risks or were unable to prepare. About 33%, however, mentioned that maintaining a capacity to be mobile in response to drought is important. Only a small minority mentioned crop cultivation or search for wage employment as ex ante tactics. Respondents were asked how they cope with risk-related problems after they have occurred (ex post). In response to drought, 25% of respondents mentioned that they sold animals to buy food, while another 19% relied more on food aid. Only a small minority (<5%) either borrowed animals, sold honey, or earned wages. There was some variation in risk perception according to wealth class and gender. It was also reported that traditional sharing and reciprocity institutions were losing importance due to internal and external factors that increased pressure on resources. In conclusion, a couple key points can be made. First, the surveyed community has increasingly been forced into a marginal agropastoral production mode due to internal and external pressures. Second, the population currently lives in a very precarious situation where only a minority makes pro-active plans to deal with pending ecological or economic shocks. Reliance on food aid is an expectation among the population. This all translates into a

high likelihood of severe human hardship when the next drought comes.

This activity has led to a co-authored MS thesis and a popular article in the GL-CRSP Newsletter *Ruminations*. See Training and Publication section for more details.

### **Activity 3:**

*Participatory Risk Mapping for Targeting Research and Assistance, led by Kevin Smith, Christopher Barrett, and Paul Box.*

**Problem Statement and Approach.** Pastoralists in southern Ethiopia and northern Kenya face a myriad of risks including droughts, food shortages, animal losses, disease epidemics, banditry, ethnic strife, border closures, land loss to environmental degradation, population growth or land annexation and price volatility for livestock products. It is important to understand occurrence and spatial patterns of risk. A better understanding of the spatial patterns of risk can lead to better prescriptions for development interventions. This activity was an initial cornerstone of our problem-model approach, whereby participation of pastoralists could help re-orient research and development activities of the project. For this work we broadly defined risk as “exposure to undesirable consequences that people would avoid if they could.” We canvassed our entire study region for a year starting in March, 1998, through March, 1999. Results would help us confirm and refine our hypotheses and stratify sites for more-intensive research in the next phase of the project. Our post-doctoral associate (Smith) criss-crossed the study region and asked people to list and rank sources of risk they routinely faced. Data were geo-referenced for spatial analysis.

**Progress.** We were able to complete this activity as planned in the past year. In the 1998

Annual Report we noted some initial results from group interviews—these pointed to food insecurity, poor livestock markets, water shortages, and human and animal diseases as primary risks in the study region. The final database consisted of results from over 100 group interviews. Overall, the most common source of risk in 1998-9 was lack of food and lack of water. Threat of human diseases such as malaria was common during rainy periods in several locales. Threat of violent conflict was also often mentioned, prevailing along ethnic borders. There was a pervasive reliance on food aid in the region and many respondents were impoverished. A number of new towns and settlements have recently emerged. When we compared Ethiopia with Kenya a few patterns were evident. First, Ethiopians were more concerned with food shortages, while Kenyans were more concerned with water shortages. Ethiopians were more concerned with a lack of schools and poor availability of farming inputs, while Kenyans were more concerned with risk of wild animals raiding their crops. When we made gender comparisons, males were more concerned with risks for livestock prices and access to grazing, while women were more concerned with food shortages. Males and females were equally concerned about human health, access to clinics, and threat of violent conflict. When we made comparisons based on wealth class, the wealthier pastoralists were more concerned with water shortages for their herds. The poorer households, in contrast, were more concerned with lack of food, scarcity of clinics, prevalence of human sickness, and access to schools. Threat of conflict tended to be ranked higher by the poor compared to the wealthy, probably because the poor can lose all their livestock assets in one raid. When agropastoralists or farmers were compared to pastoralists, the farmers were not as concerned with food scarcity. People involved in cultivation were more concerned with crop failure, availability of crop inputs and tools,

and access to schools. Despite imperfections in our methodology, we feel the work has yielded valuable information on common types of risks perceived by our target population. Results suggest that location, wealth, and gender influence susceptibility to various forms of risk. The prevalence of food insecurity illustrates dysfunction of the traditional production systems in the face of growing populations and challenge of ecological and economic shocks. Results have helped us stratify our study region into six to eight sub-regions for detailed household and community-level study of risk in phase II.

This activity has led to two publications drafted for peer-reviewed journals, one project technical report, and one popular article for the GL-CRSP Newsletter, *Ruminations*. See sections 11 and 14 for details.

**Activity 4:**

*Marketing and Risk Management Perspectives for Pastoral East Africa, led by Deevon Bailey, Peter Little, and Christopher Barrett with key participants including Francis Chabari and Kevin Smith.*

**Problem Statement and Approach.** The ability of pastoralists to market their livestock products in a timely fashion and receive a fair price is essential for improving risk management at the household level, permitting an economic climate that fosters monetization, savings, investment, and lessens the threat of environmental degradation due to factors such as overgrazing. One key element of marketing is price risk. If prices are relatively stable, lucrative, and somewhat predictable over space and time, planning horizons for producers and traders are improved and marketing efficiency can be enhanced. If, however, prices are relatively volatile, low, and unpredictable, this provides

disincentives for producers and traders and market dysfunction can occur. The issue of pastoral marketing is vital for economic development and has been another unchanged cornerstone of our problem model. Essentially, regional and local opportunity to engage in markets can dictate the success or failure of local economic development initiatives.

We have addressed this component with a literature review of livestock and grain marketing for pastoral East Africa. This work will guide research priorities in phase II of the project. We have also embarked on an empirical analysis of livestock price dynamics, rainfall patterns, and quarantine records for our study region. We have initially focused on data sets provided by the GTZ Marsabit Development Project in northern Kenya. We hope to complement this work with data from southern Ethiopia in the near future.

**Progress.** We have been able to meet our targets for this activity in the past year. One major goal was simply to review the available literature and identify knowledge gaps on the performance of marketing systems, and propose research directions to fill those gaps. In the 1998 Annual Report we noted preliminary results from our empirical analysis of livestock price data for northern Kenya. Results indicated high variability, and hence risk, in weekly prices for livestock in these markets. Marketing costs are likely also high. This all provides significant disincentives for sellers and traders alike. In addition to empirical studies, the literature review completed in the past six months has revealed important knowledge gaps for pastoral livestock marketing. One conclusion is that given the importance of marketing, the existing literature is remarkably thin. We postulate from our literature review, however, that many factors probably contribute to marketing problems in our study area: (1) the multiple objectives pastoralists have for raising livestock (i.e., roles

as assets and income generators); (2) a legacy of limited private marketing capacity; (3) high environmental variation; (4) poor physical infrastructure; and (5) weak rural institutions for the dissemination of market information, price formation and contract enforcement, assurance of physical security, and services that offer preventative animal health care. These factors probably affect marketing in the form of high transaction costs, significant hold-up problems, and inelastic demand and supply. There are many ideas for marketing intervention by governmental and non-governmental institutions, but any intervention is speculative because of gaping holes for basic research on core behavioral and contextual elements of pastoral livestock marketing systems. We speculate that we have a good chance to make substantial contributions to advance knowledge on pastoral livestock marketing. We see five inter-related topics in need of exploration: (1) patterns of spatial and inter-temporal price transmission and market integration to establish the efficiency of existing marketing channels; (2) pastoral marketing behavior (i.e., response to changes in livestock price, food aid deliveries, climate forecasts, etc.); (3) effects of intra- and inter-household livestock ownership rights and exchanges on animal sales; (4) the relationship between animal disease control (particularly through quarantines), climate, and marketing dynamics; and (5) structure, conduct, and performance of the livestock marketing channel. We propose that survey approaches, both for households and traders, be used to answer these questions. We are interested in determining the relative risk associated with local and central markets since policy remedies are quite different for various types of markets. For example, if the source of market risk is primarily from central markets, then external shocks such as exchange rate risk, income shocks, or infrastructure bottlenecks may be the principal reason for price variability in livestock markets. If the

primary source of risk is in local markets, then improvements in local market infrastructure and information may help to reduce market risk. In addition, an investigation of the behavior of market margins among producers, wholesalers, and retailers will be conducted in phase II. We will also examine the impact of quarantines on livestock markets to determine the costs of quarantines and consequently the implicit benefits associated with programs designed to control or eradicate livestock diseases in the study area. This will be done by comparing relative prices at different market locations just preceding, during, and immediately following livestock quarantines. This will provide an estimate of the loss in revenue per animal in the quarantined areas and also the increased cost of meat in Nairobi. The purpose of this part of the analysis is to estimate the level of investment government should make in herd health programs.

This activity has led to one popular article in the GL-CRSP Newsletter *Ruminations*, one project technical report, and other material is being drafted for peer-reviewed publication. See Publication section for details.

#### **Activity 5:**

*Economic Diversification and Risk Management Among East African Herders, led by Peter Little with key participants including Barbara Cellarius and Kevin Smith.*

**Problem Statement and Approach.** The literature postulates that economic diversification is a key component of risk management. Economic diversification is also very relevant to development processes. The purpose of this activity was to provide an overview of pastoral income diversification issues, examine some potential cause-and-effect relationships using our own field data collected in the context of

Activity 3, and propose ideas for further work in phase II of the project. The topic of pastoral income diversification is another unchanged cornerstone of our problem model.

**Progress.** We have been able to meet our targets for this activity in the past year. In the 1998 Annual Report we noted that our initial review revealed a fairly substantial literature on factors affecting pastoral income diversification. In particular, our review found that pastoral income diversification is affected by resource pressure and the life-cycle stage of households. Pastoralists are very opportunistic in attempts to diversify their incomes. Options have included involvement in livestock trade, wage employment, shop-keeping, property rental and trade, gathering and selling of wild products, and farming. The literature indicates there are two main motives for income diversification. The first is a survival motive for poorer herders with insufficient resources to otherwise sustain themselves. Diversification activities for the poor include wage labor, petty trade, charcoal making, selling fire wood, and small-scale farming—this may involve up to 40% of pastoral households in East Africa. The second motive is an accumulation strategy for the wealthiest herders. These diversification activities include ownership of small businesses, larger-scale livestock trading, more lucrative forms of agriculture, and higher-paying wage labor—this may involve about 10% of pastoral households in East Africa. Middle-class households tend not to diversify, however, and maintain reliance on their traditional base of livestock resources. Our general postulate is that income diversification is probably increasing among the poorest households most affected by risk. Analysis of our field data confirm that diversification options for households tend to increase where rainfall is higher, distance to markets is lower, and level of education is higher. Prevalence of towns and settlements is thus very important for income

diversification opportunities. Socioeconomic data on 24 towns and settlements collected by Smith in the context of Activity 3 illustrate variation between southern Ethiopia and northern Kenya. Despite that most towns and settlements average around four thousand inhabitants, the average number of retail shops and wholesalers per town, respectively, is 26 and 0.2 for Ethiopia and 45 and 1.35 for Kenya. For average number of butchereries per town, Ethiopia has <2 and Kenya has 4.4. For average number of NGOs per town, Ethiopia has <0.4 and Kenya has 1.1. For primary and secondary schools per town, Ethiopia has 1.1 and 0.2, respectively, while Kenya has 1.8 and 0.5. Given the similar average population of towns between both countries, these numbers suggest greater economic activity and access to public education in Kenya compared to Ethiopia. This in turn suggests that options for pastoral income diversification could be expected to be higher in northern Kenya than southern Ethiopia.

**Activity 6:**

*Spatially Explicit Archive (Atlas) of the Study Region, led by Paul Box with key participants including Kevin Smith.*

**Problem Statement and Approach.**

Assessment of risk management needs and development options is facilitated using a spatial perspective. Recent advances in Geographic Information Systems (GIS) technology allow us to incorporate spatial display and analysis in our project. Our goal was to create a GIS template for the study region that could serve as a spatially explicit means of storing archived literature and field data. The template can also be used to help us analyze for spatial patterns in field data, with special reference to the risk mapping exercise described for Activity 3.

**Progress.** In the 1998 Annual Report we

noted that a series of GIS layers for the study region were compiled from public locations. The work is ongoing in terms of adding new geo-referenced information on households, communities, and settlements (Activities 3 and 5).

**Activity 7:**

*Detailed Assessment of Variability in Pastoral Risk Exposure, led by John McPeak, Michael Fleisher, Christopher Barrett, and Peter Little with key participants including Cheryl Doss, Nancy McCarthy, and Abdillahi Aboud.*

**Problem Statement and Approach.** Micro-level studies of variability in risk exposure among individuals, households, and communities are another step in documenting the predominant types of risks that threaten pastoral systems, the sources and interactions of those risks, and the social and economic consequences of vulnerability. Prescriptions for effective interventions are ultimately dependent on understanding the systems behavior of risk at a micro-level. This activity is another cornerstone of our original problem model.

**Progress.** Phase II of our research began in August, 1999. We began to create the nuclei for two, field-based field teams, one in northern Kenya led by Dr. John McPeak, and one in southern Ethiopia led by Dr. Michael Fleisher. To some extent field teams will incorporate work conducted by master's students at Egerton University in Kenya (see Training section below). We commenced to draft a standard, integrated survey instrument to be used across six to eight sites across our study region (three to four in each country). We also began to design ethnographic efforts to accompany the structured survey approaches. We expect that research will focus on five key areas, namely: (1) household and intra-household issues; (2) livestock marketing;

(3) rural financial institutions; (4) resource tenure and ecological dynamics; and (5) aspects of public services delivery systems.

### GENDER ANALYSIS

In the 1998 Annual Report we noted the key role that women can play in carrying out applied research and outreach. We also recognized the importance of women and youths in our target population of beneficiaries. Gender dimensions are thus reflected in terms of: (1) how our team is organized; (2) research questions and issues being pursued; (3) how training benefits are allocated; and (4) types of people participating in our outreach. For example, we have two female scientists on our team, namely Dr. Cheryl Doss of Yale University and Dr. Nancy McCarthy of ILRI. Both are economists. We are studying how risk affects female pastoralists differently from males. It is well known that perturbations in our study region often result in female-headed households being re-established nearer to towns and settlements. These are often the poorest households with few assets. These women heads of households are often forced to diversify their income-generating activities to survive, a phenomena noted above under Activity 5. These women are a major focus of our research and outreach efforts. We have given various forms of support to female trainees in our project. Two women (Tihut Yirgu Asfaw of Ethiopia and Kirsii Saaristo of Finland) were associated with Activity 2 above. They completed their master's degrees in rural development at the Agricultural University of Norway. A Kenyan woman (Ms. Winnie Luseno) was recruited in August, 1999, to matriculate in the PhD program in economics at Cornell. For our outreach network we have included roughly 52 organizations, with 25 in Ethiopia and 27 in Kenya. Senior women represent nine of these organizations in the network. We have also initiated a 10-member

review panel that will help guide outreach efforts. There are three senior women on this review panel including Ms Miriam Cherogony, a Kenyan specialist in rural finance, Ms. Allyce Kureiya, a Kenyan development specialist with GTZ in Marsabit, and Wzo. Felekech Lemecha, a senior administrator with the Oromia Research Service in Ethiopia.

### POLICY

In the 1998 Annual Report we noted several goals involving policy makers with our project. The first goal is to build a general awareness of our existence. A second goal is to “go on the offensive” regarding a few key risk management issues and bring relevant policy makers into our loop. A third goal is to actively involve some key policy makers in the decision-making process for our project—an example is inviting key policy makers to our workshops and having them sit on our new outreach review panel. We are in a continual process of identifying and contacting relevant policy makers. To achieve the first goal we have focused on public relations by distributing hundreds of copies of color brochures, workshop proceedings, and issues of *Ruminations*. For the second goal, we have contacted key individuals outlining the stance of the project on critical outreach issues and soliciting their support or participation. One good example is up-grading the road from Isiolo, Kenya, to Moyale, Ethiopia. We envision that improving this road could yield many benefits to help pastoralists better manage risks in our study region. Now is the time to set lines of communication in place. We have thus sent letters and/or e-mails espousing aspects of road improvement for northern Kenya to representatives of national and multi-national entities in-region. For the third goal, we are gradually involving key national or state decision makers as co-hosts of outreach workshops and

members of outreach panels.

### OUTREACH

In the 1998 Annual Report we noted that our outreach targets were evolving. We mentioned two main goals for outreach that remain at our core: (1) empowering pastoralists and agropastoralists within our study area to better manage risks at a local level; and (2) identifying key national and regional issues pertaining to policy, infrastructure, etc., which impinge on the ability of people to act locally to improve their circumstances. Our approach varies with the two goals. Policy overlaps with outreach in some cases. We have addressed the first goal through outreach activities through our outreach network of 52 governmental and non-governmental organizations. About half of these organizations are involved with grass-roots development within our study region. Typically each major town or settlement is home to one or more of these organizations. We use the outreach workshops to achieve consensus and coordination on local risk-management interventions. For example, workshop participants in Ethiopia and Kenya during 1998 independently agreed that out of a broad spectrum of choices, risk-management outreach priorities should be: (1) need for more effective education for pastoralists; (2) better means to facilitate pastoral marketing and investment; (3) better means to mitigate resource-based conflict; and (4) need for innovative pastoral economic diversification and development concepts. The next step taken during the past year to meet the first goal was to try to create a vibrant outreach arm—funded from outside GL-CRSP core resources—that would act regionally to harmonize best-bet efforts across southern Ethiopia and northern Kenya to improve pastoral welfare using risk management principles. A proposal was



submitted by the PI to the Greater Horn of Africa Initiative (GHAI) of USAID during June, 1999, to support a risk-management outreach program for two years for USD \$388,000. This proposal would cover an outreach coordinator (Dr. Solomon Desta) who would lead a joint Kenyan and Ethiopian outreach review panel (mentioned above) in prioritizing pilot risk management projects to implement using local development agents from our network. Participatory approaches are envisioned involving traditional socioeconomic structures of pastoral and agro-pastoral societies. The goals of the proposal are to use integrated risk-management interventions to simultaneously address food insecurity, resource-based social conflict, and economic growth. At the end of year 2 it was still unclear if the GHAI proposal would be funded. It is envisioned that if we are successful with the GHAI proposal, we would then seek bilateral mission funds to double or triple this funding base for outreach operations. As perhaps evidence of the latter point, we secured USD \$100,000 in seed funding for outreach operations from the USAID Mission in Addis Ababa. This funding allowed us to proceed in hiring Desta as outreach coordinator.

For the second goal, our approach is to first identify the issue, either through outreach or applied research. Then we begin an “information offensive” that takes the form of letter writing, publishing popular articles, and organizing meetings. For example, one regional issue that has been identified as crucial is up-grading the road between Moyale and Isiolo, Kenya. This has been identified through field reconnaissance and analysis of livestock marketing data. If this road were to be up-graded, numerous benefits could accrue to livestock markets, security, rural investment, etc. Another issue identified last year at the national level was the apparent lack of federal legislation in Ethiopia to allow formation of community credit unions in the

southern rangelands. The State of Oromia, however, had already published a proclamation that would allow such activity, and such a state-level initiative can proceed in the absence of a federal initiative. Issues still being pursued in this fashion include the blanket prohibition of prescribed fire as a range management tool in southern Ethiopia, which has contributed to bush encroachment and hence a loss of carrying capacity for cattle there. Another includes a plethora of cross-border issues that create bottlenecks between Kenya and Ethiopia concerning livestock trade. In our recent biennial workshop in Addis Ababa we linked to the BASIS CRSP and their borderlands research program in southern Ethiopia (described below), that can generate very useful information for policy makers and outreach.

To round-out outreach for year 2 we maintained our web page that outlines project activities, trip reports, training announcements, and other documentation for members of our outreach network in Kenya and Ethiopia.

#### **DEVELOPMENTAL IMPACT**

Perspectives on developmental impact remain the same as noted in the 1998 Annual Report. These are summarized below.

**Environment.** The benefits of our project to the environment tend to be more indirect rather than direct, and more medium- and long-term rather than short-term. Our basic position is that improved risk management will mitigate asset loss and poverty among pastoralists and agro-pastoralists. When poverty is mitigated, risk to the environment will lessen. For example, one tenet of our approach is that pastoralists need to make more pre-emptive moves to mitigate crisis induced by drought and growing human populations. One tactic is to sell some animals before a crisis occurs, and use the funds received

as household-level savings and community investments. The success of this depends on well-functioning markets, credit union formation, education, etc. The idea is that if such a tactic can be successfully used across a society, the rate of growth in stocking rates would be mitigated. This would reduce the specter of heavy stocking rates on the land during years of lower-than-average rainfall, which is the key window of time when range vegetation is degraded. The “boom and bust” in the cattle cycle would be dampened as a result. The build up in non-livestock capital and investment would then permit societies to diversify their economies. This diversification could spur growth of urban job opportunities and mitigate the incidence of poverty among pastoral and agro-pastoral households. Mitigating poverty would then reduce the specter of poor people being engaged in destructive activities such as charcoal making, harvesting of green fuel wood, and opportunistic cultivation.

**Agricultural Sustainability.** A sustainable agriculture is one where interventions are: (1) beneficial— or at least neutral— for the environment; (2) socially acceptable; and (3) economically profitable. The premise behind our project is that, left to their own devices, traditional pastoral or agro-pastoral production systems in our study region are unsustainable. For example, there is a loss of land to population growth and environmental degradation. There is an unraveling of the traditional social order in some cases, which can often be traced to resource restriction. There is abundant evidence that whether due to poor demand, bad infrastructure, and/or inadequate marketing strategies of producers, pastoralism in the region is typically unprofitable. Evidence of unsustainability includes things like the chronic need to feed tens of thousands of people in the region each year, the re-location of poor households nearer to towns and settlements

where they can engage themselves in petty trade to stay alive, and the increasing poverty and declining living standards of pastoralists in general. By coming up with risk management tools, which in part should allow pastoralists and agro-pastoralists to save and invest outside of their traditional sphere, the resulting investment surge for education and entrepreneurial activity in towns and settlements should primarily lead to growth of local economies with benefits for the environment, social order, and pastoral economy. As outlined immediately above, our risk management interventions range from neutral to positive for the environment, which conforms to the first criterion of sustainable agriculture. Accumulation of wealth and efforts to mitigate social conflicts should allow the social fabric to heal— poverty is bad for the maintenance of vibrant traditional cultures. This fits the second criterion. The third criterion is dealt with by several economic outcomes that vary in terms of the relevant time scale. Short-term benefits would include an expansion of local markets for pastoral products. Longer-term benefits would include allowing more pastoralists to emigrate out of the traditional sector due economic diversification and increased employment opportunities in towns and settlements. Facilitation of emigration is the ultimate humanitarian solution to the risk-management dilemma for pastoralists. This is because population growth reduces resources per capita and therefore increases vulnerability of populations to endogenous and exogenous shocks.

**Contributions to United States Agriculture.** The main contribution of this project to United States agriculture is primarily in terms of providing a “wake-up call” for research and extension professionals to the importance of risk management for the small to average-sized livestock producer. As will be

noted below, the need for risk management by American producers may be increasing as profit margins get slimmer and the social and economic complexity of agriculture increases. It is fair to say that a commodity perspective has been pre-eminent in agricultural research and outreach in the United States. This has contributed to a lack of a relevant systems approach that could better integrate academic disciplines and deal more-effectively with real-world problems. Risk management can be an important contribution in this regard. Risk management is simultaneously economic, social, and ecological. The ability to better manage risks is an important attribute of successful farmers and ranchers. While livestock producers in the United States are under no imminent threat of starvation or extreme destitution comparable to pastoralists in northern Kenya or southern Ethiopia, there are commonalities in terms of how risks are conceptualized and interact to cause problems. For example, it has been forwarded by Holechek et al. that beef producers in New Mexico should diversify their assets and investments to mitigate economic downturns that repeatedly result from cyclic fluctuations in beef prices. This is exactly the same concept that we have for East African pastoralists. Education and access to investments are the main constraints for New Mexico ranchers— similar to prominent implementation constraints for East African pastoralists. Whether drought cycles are predictable or not, and the possible influence of phenomena like El Niño on precipitation regimes, is a core issue of debate for agriculture in the United States as well as East Africa. Global trade affects the United States beef producer and the East African pastoralist. The advent of the North American Free Trade Agreement (NAFTA) could serve to dampen peak prices received by American cow-calf operators because of increased importation of cheaper Mexican beef. Research remains to be done that could confirm this widely held suspicion. The spectre

of NAFTA, however, probably influences behavior of American producers by increasing their perceived risk on prices and possibly discouraging production investment. Currently, the cross-border flow of live cattle is officially restricted between Ethiopia and Kenya. We do not know the rationale for this restriction, nor its effects on household economics on either side of the border. Answers to this will be provided by applied research on the GL-CRSP, which may shed new light on the costs and benefits of free trade in general— even as applicable to agriculture in the United States. Our project will communicate such findings and influence the American research community, and hence the United States agricultural community, through a variety of research and outreach publications.

#### **Contributions to the Host Countries.**

Contributions to our host countries will mostly be felt through our outreach activities (described above) and training of host-country nationals. Outreach will primarily have impact on project beneficiaries— pastoralists and agro-pastoralists— but it will also have impact on development professionals and their organizations that link to us directly. In the training sphere our past contributions have also included computers, books, and other technical materials to our main academic partner in Kenya, Egerton University. In year 2 we also sponsored two Egerton faculty members to attend the Sixth International Rangeland Congress in Townsville, Australia.

#### **Collaboration with IARCs and Other CRSPs.**

We collaborate extensively with the International Livestock Research Institute (ILRI) in both Ethiopia and Kenya. We typically hold our workshops at ILRI conference facilities. Some administrative and logistical support for field work is provided to us by ILRI. We have a link to the Livestock Policy Analysis Programme



(LPAP). Dr. Nancy McCarthy is an economist with LPAP who is also a member of our GL-CRSP team. The other CRSP we have links to is the BASIS CRSP. Drs. Peter Little and Christopher Barrett, Co-PIs on the GL-CRSP, and Prof. Abdillahi Aboud, regional co-leader of the GL-CRSP, are also co-leaders on the BASIS CRSP. The GL-CRSP and BASIS CRSP share an interest in policy and economic issues that deal with border relations. During our First Biennial Research and Outreach Workshop for Ethiopia and Kenya, held during July, 1999, in Addis Ababa, members of the Organization for Social Science Research in Eastern and Southern Africa (OSSREA) who are also funded by the BASIS CRSP, gave an important presentation on cross-border livestock trade in the southern and southeastern Ethiopian borderlands. Research by OSSREA and the BASIS CRSP along the border between Kenya and Ethiopia is vital for our project and we hope to expand our project interactions accordingly.

#### OTHER CONTRIBUTIONS

**Support for Free Markets and Broad-Based Economic Growth.** Interventions that will be advocated by our project will be in direct support of free markets and economic growth. Some of this has been previously described. This prominently involves linkages between markets and formation of benefits-oriented cooperatives to empower pastoralists at the local level. At our recent biennial workshop in Addis Ababa, one presentation dealt with outreach ideas to assist pastoralists form their own cooperative associations to spur development processes—the idea being that a local association could form and pool capital resources to first organize a community credit union. This would be an impetus for the group to procure production inputs and invest to improve their marketing capability to make themselves less vulnerable

to trading bottlenecks. A group, for example, could purchase a large truck and independently handle livestock shipping. The outreach entity would only provide the initial training and a few select inputs to get it rolling. The success of such an endeavor would rely heavily on the availability of livestock and grain markets and their efficiency of operation. Taken together, these elements all reflect the functioning of free markets, a role for agribusiness, and developing a capability for pastoralists to empower themselves using private enterprise.

**Contributions to and Compliance with USAID Mission Objectives.** Our project contributes to and complies with Mission objectives in each country by dealing with food security, economic growth, the environment, and privatization issues. We have solid contacts with prominent people in both USAID Missions.

**Concern for Individuals.** Our project incorporates a concern for individuals in several ways. One is through technical and advanced training opportunities, with a focus on host-country nationals at the master's and PhD level. Training details are given in a subsequent section. Other evidence is provided by how we have organized our applied research and outreach. For research, we realize that improved risk management will ultimately occur at the level of the individual. For outreach, priorities like public education, conflict mitigation, and formation of benefits-oriented cooperatives are testimony to the value we place on helping individuals improve their lives by being able to deal with risk by making more-informed choices.

**Support for Democracy.** Voluntary, benefits-oriented producer cooperatives are one form of grass-roots democracy in action. We have also been asked by our outreach partners,

in conjunction with helping formulate a broad program of improved risk management, to assist with the consolidation of a broad program of public education and awareness that will specifically culminate in helping pastoralists communicate their needs and desires with their locally elected representatives.

**Humanitarian Assistance.** Our program of applied research and outreach is the embodiment of humanitarian assistance. Outreach will, in large measure, help set an agenda to guide more research as well as outreach. Research will therefore be very relevant to solving problems related to the “human condition” in the study region.

#### LEVERAGED FUNDS AND LINKED PROJECTS

The International Livestock Research Institute has contributed USD 5,000 this year to our project in accommodation costs. Egerton University has again contributed about USD 7,200— this includes one month of salary support for both Aboud and Lusenaka (total = USD 1,600) and Egerton has waived USD 4,000 in annual tuition for four Kenyan students in the new masters program in the Department of Natural Resources linked to the GL-CRSP. They also have provided USD 1,600 in stipends for the Kenyans. Our grand total leveraging in-region is thus about USD 12,200. A project at Utah State University led by Dr. Paul Box entitled “A GIS-Based Cellular Automata and Individual-Based Model Simulation Environment,” has provided leveraging of another USD 10,000 in year 2.

Our project is linked to other efforts dealing with outreach and research. For outreach, we are developing linkages to a variety of local, grass-roots development projects in southern Ethiopia and northern Kenya. Prominent organizations in this network include The Oromia Agricultural Development Bureau in Ethiopia, GTZ (in Maralal, Marsabit and Negele), Save the

Children/USA, Norwegian Church Aid, and the Arid Lands Resource Management Project in Kenya. For research, our project has a link to several projects. Prof. Abdillahi Aboud and Drs. Peter Little and Chris Barrett, all project co-leaders in the GL-CRSP, also work with the BASIS CRSP. Dr. Nancy McCarthy is primarily associated with the Property Rights Project in the Livestock Policy Analysis Program (LPAP) at ILRI. In the United States, our project is linked to a new effort at Utah State University led by Dr. Paul Box entitled “A GIS-Based Cellular Automata and Individual-Based Model Simulation Environment.” This project will provide a GIS framework and spatial modeling capability for our analyses of our project region in northern Kenya and southern Ethiopia. Our project is also linked to an older effort at Utah State University funded by USDA-SARE led by Dr. Layne Coppock since 1995. This involves identification of prominent threats to the sustainability of Utah ranching operations. The need that Utah producers have for improved risk management is a major issue emerging from this work, and provides an important conceptual link between SARE and the GL-CRSP.

#### TRAINING

##### *Long-Term*

*(Note: The list below includes graduate students and post-doctoral associates who received full financial support from the GL-CRSP in year two as well as those who receive various forms of partial support in year 2. We received USD \$30,000 in funds from the USAID Mission*

*in Kenya to help support the GL-CRSP post-graduate program at Egerton University in year two.)*

**Completed:**

Solomon Desta. PhD in 1999. Range science (economics). Utah State University, Logan, Utah, USA.

Tihut Yirgu Asfaw. MA in 1999. Rural development. Norwegian Agricultural University, Norway.

Kirsi Saaristo. MA in 1999. Rural development. Norwegian Agricultural University, Norway.

Kevin Smith. Post-doctoral associate. 1998-9. Economic Anthropology. Department of Rangeland Resources, Utah State University, Logan, Utah, USA.

**In Progress:**

Hussein A. Mahmoud. PhD. Graduation expected in 2001. Economic anthropology. University of Kentucky, Lexington, Kentucky, USA.

John Tanguis. MS. Graduation expected in 2000. Natural resource social science. Egerton University, Kenya.

Clement Isiah Lenachuru. MS. Graduation expected in 2000. Natural resource social science. Egerton University, Kenya.

Mulugeta Shibru. MS. Graduation expected in 2000. Natural resource social science. Egerton University, Kenya.

Charles Lugo. MS. Graduation expected in 2000. Natural resource social science. Egerton University, Kenya.

Moses Esilaba. MS. Graduation expected in 2000. Natural resource social science. Egerton University, Kenya.

Barbara Cellarius. PhD. Graduation expected in 2002. Anthropology. University of

Kentucky, Lexington, Kentucky, USA.

Winnie Luseno. PhD. Graduation expected in 2004. Economics. Cornell University, Ithaca, New York, USA.

Amare Teklu. PhD. Graduation expected in 2004. Economics. Cornell University, Ithaca, New York.

Nancy McCarthy. Post-doctoral associate. 1998-?. Economics. International Livestock Research Institute, Nairobi.

John McPeak. Post-doctoral associate. 1999-?. Economics. Cornell University.

Michael Fleisher. Post-doctoral associate. 1999-?. Social Anthropology. Utah State University.

Solomon Desta, Post-doctoral associate. 1999-?. Outreach Coordinator. Utah State University.

***Short-Term (professional meetings):***

Attendance at the Sixth International Rangelands Congress, Townsville, Australia, July 19-23, 1999. The GL-CRSP paid for three people on the project to attend: Solomon Desta (Ethiopian), Abdillahi Aboud (Kenyan), and Frank Lusenaka (Kenyan).

First Biennial Research and Outreach Workshop for Kenya and Ethiopia, held at ILRI, Addis Ababa, Ethiopia, July 27-29, 1999. The purpose of this meeting was to bring together research findings and outreach achievements from phase I and then chart a course for the coming years. There were 83 participants from Kenya, Ethiopia, and the USA that represented some three dozen research, development, and relief organizations. A 53-pp proceedings was prepared and 150 copies were mailed out from Utah. We also combined this meeting with the second annual research planning meeting. This is an internal meeting involving GL-CRSP team members and our Kenyan and Ethiopian post-

graduate students attending Egerton University.

#### COLLABORATING PERSONNEL (RESEARCH)

##### *United States:*

Dr. Deevon Bailey, Professor, Department of Economics, Utah State University.

Dr. Christopher Barrett, Associate Professor, Department of Agricultural, Resource & Managerial Economics, Cornell University.

Dr. Paul Box, Assistant Professor, Department of Geography & Earth Resources, Utah State University.

Dr. Layne Coppock, Associate Professor, Department of Rangeland Resources, Utah State University.

Dr. Cheryl Doss, Assistant Professor, International Relations, Yale University.

Dr. Upmanu Lall, Professor, Department of Civil and Environmental Engineering, Utah State University.

Dr. Peter Little, Professor, Department of Anthropology, University of Kentucky.

Dr. Jon Moris, Professor, Department of Sociology, Social Work & Anthropology, Utah State University.

Dr. Allen Rasmussen, Associate Professor, Department of Rangeland Resources, Utah State University.

##### *Ethiopia:*

Dr. Simeon Ehui, Head, Livestock Policy Analysis Program, International Livestock Research Institute.

##### *Kenya:*

Prof. Abdillahi Aboud, Associate Professor and Dean of Faculty of Environmental Studies and Natural Resources, Egerton University.

Mr. Frank Lusenaka, Lecturer, Department of Natural Resources, Egerton University.

Dr. Daniel K. Too, Senior Lecturer and Chair, Department of Natural Resources, Egerton University.

Dr. P.K. Rono, Lecturer, Department of Sociology, Egerton University.

Dr. W.S.K. Wasike, Senior Lecturer and Chair, Department of Economics, Egerton University.

#### COLLABORATING INSTITUTIONS

The main collaborating institutions for year 2 are as follows:

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#### PUBLICATIONS

*(includes peer-reviewed articles, theses and dissertations and popular articles. Some for 1998 were not reported for year 1)*

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Ndofor, A. 1998. Evaluation of the potential for successful, grass-roots credit union development in the southern Ethiopian rangelands. *SR/GL-CRSP Pastoral Risk Management Project Technical Report No. 01/98*. Utah State University, Logan. 25 pp.

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Tihut Yirgu Asfaw and K. Saaristo. 1999. Risk management strategies of pastoral households: a case study of Guji-Oromo communities in southern Ethiopia. MS thesis. *Management of Natural Resources and Sustainable Agriculture*, Agricultural University of Norway. 109 pp.

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### ABSTRACTS AND PRESENTATIONS

*(here we list presentations given at venues outside of our own project workshops and GL-CRSP annual meetings. Note, however, that in the first biennial workshop mentioned in the Training section above under short-term training, 26 presentations were made. Sixteen of these presentations were made by GL-CRSP team members and 10 were made by invited participants. These presentations related to many of the published titles given in the previous section and are not listed here. For a summary of proceedings from this workshop, please see our web site at [www.nr.usu.edu/~sandukul/crsp](http://www.nr.usu.edu/~sandukul/crsp).)*

About, A. 1999. Building a community capacity for drought risk management among the Baringo herders of Kenya. Poster presented at the Sixth International Rangelands Congress, held 19-23 July, 1999, Townsville, Queensland, Australia. See also proceedings article cited in previous section.

Desta, S., Coppock, D.L., and C. Barrett. 1999. Opportunities for asset diversification in a livestock system: the case of the pastoral Boran of southern Ethiopia. Poster presented at the Sixth International Rangelands Congress, held 19-23 July, 1999, Townsville, Queensland, Australia. See also proceedings article cited in previous section.

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### COMMENTS

We feel we are rapidly increasing our profile throughout Kenya and Ethiopia. We are also increasing our profile and establishing improved relations with the USAID Missions in both countries.

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to investigate scenarios and the impacts of economic and environmental changes, and to assess both ecological and socioeconomic impacts of interventions, particularly as these relate to household food security. An animal disease model is being developed to assess the risks of transmission between livestock and wildlife.

**INTEGRATED MODELING  
AND ASSESSMENT  
FOR BALANCING FOOD  
SECURITY, CONSERVATION  
AND ECOSYSTEM INTEGRITY IN  
EAST AFRICA**

**NARRATIVE SUMMARY**

We are developing an integrated modeling and assessment system (IMAS) that integrates computer modeling, geographic information systems, remote sensing, and field studies to provide the information and understanding necessary to conserve biodiversity, wildlife, and ecosystem integrity while increasing pastoral food security. The IMAS quantifies the impacts of land tenure, enterprise scale, and conservation policy on four objective functions: livestock production, pastoral welfare, wildlife, and ecosystem integrity. The system will enable alternative policy and management strategies to be objectively explored, debated, implemented, and reassessed.

The IMAS includes an ecosystem model that spatially represents changes in plant and animal distributions and abundances over time, and the causal factors underlying livestock-wildlife interactions, in terms of plant growth and its responses to climate and grazing. Another model that describes cash-flow and dietary energy intake in pastoral households is being developed and linked to the ecosystem model

An application of the IMAS to the Ngorongoro Conservation Area, Tanzania was completed. Model experiments represented natural events or scenarios land managers might contemplate for NCA, and were selected in part to demonstrate the flexibility of IMAS methods. Questions addressed the effects of: 1) drought, 2) elevated livestock numbers, 3) improved veterinary care, 4) increased access to grazing lands, 5) changes in water supplies, and 6) growth in human populations and agriculture. The results of these analyses were demonstrated to project scientists, and modifications made where necessary.

Preliminary analyses suggest that the Maasai of the NCA are affected by wildlife conservation policies. However other factors such as landscape variation, distance to markets, and livestock disease incidence, etc. may also contribute to this human welfare variation. Wildlife is viewed as a potential source of disease to livestock. Although disease incidence varies with ecological setting, virtually all livestock are at risk from all wildlife diseases present in the NCA because of animal movements.

We are now conducting field studies of ecology, land use change, socioeconomic, and livestock-wildlife interactions in Kajiado District, Kenya. One study showed little evidence of severe competition for available resources between livestock and crops - if anything, there appears to be some degree of complementarity. Both crop and livestock enterprises appear to give relatively high rates of return to capital, and

most pastoralists and agro-pastoralists are able to derive their livelihood from the two enterprises. Another study documented land use trends such as: 1) sedentarization and government policies which favor a sedentary lifestyle; 2) conversion of dry season grazing areas to cultivation; 3) Privatization of land; and 4) displacement of pastoralists due to civil strife, drought, and cattle rustling.

Field and modeling studies of rangeland condition, livestock nutrition, and pastoral land use are thus providing the necessary information to assess disease, competition, and complementarity between pastoralists and wildlife for forage, water, and other resources. This information will be useful for developing more environmentally sustainable livestock systems in the wildlife rich areas of East Africa.

## RESEARCH

### Field Research

#### *Socioeconomic Field Research in Ngorongoro Conservation Area (NCA), Tanzania (Galvin, Magennis, Lynn, Ali)*

GLCRSP-supported field research in the Ngorongoro Conservation Area and in neighboring Loliondo District was concluded. We conducted fieldwork on land use, health and nutrition of Maasai pastoralists and looked at processes of livelihood diversification in the NCA and in Loliondo. This research was supported, in large part, by a US National Science Foundation grant to K. Galvin and J. Ellis.

Preliminary analyses on livelihoods suggest that the prime motivating factor involved in the diversification of livelihood strategies, especially the adoption of cultivation, is to reduce the

number of livestock sold to provide a pastoral family with non-livestock foods (mostly maize) and other necessities. In early 1999 cattle made up about 71% of total number of livestock held by a sample of Maasai living in the NCA whereas goats comprised 18% of the herd and sheep 11%. Cattle sales in 1999 was about 3.4% of the total cattle herd in 1998 relative to 5.6% in 1995. Small stock sold comprised about 0.4% of the herd in 1998 whereas in 1995 it was 2.2%. Reasons for selling animals were (1) to buy clothes, (2) to buy food, (3) to pay taxes, (4) to buy grain, (5) to buy veterinary drugs, and (6) to pay hospital bills. These data suggest that cultivation has had a positive affect on food security by reducing the proportion of livestock sent to markets. However, we compared the economic state of the Maasai in the NCA with their neighbors just north of the NCA and ascertained that Maasai in the NCA are not as well off in a number of measures of well being relative to Loliondo Maasai.

The livestock to human ratios for Loliondo and the NCA as measured by TLUs (Tropical Livestock Units) per person were assessed. (A TLU is a measure of total livestock biomass based on average weights of livestock of different species). In Loliondo people have more than three times as many TLUs per person ( $X= 10.3$ ) than the Maasai who live in the NCA ( $X= 2.8$ ) ( $p< 0.0009$ ). Moreover, Loliondo Maasai have, on average, agricultural plots whose size is triple ( $X = 0.3$  acres/person) that of the Maasai who live in the NCA ( $X = .1$  acres/person)( $p=0.002$ ). The majority of the NCA households (87%) are below the theoretical minimum of 6 TLUs per person needed for food security in pastoral populations (see Galvin 1992, Homewood 1992 for discussion on TLUs among pastoralists). The figure shows that a much lower percentage (42%) of Loliondo households is below this minimum (Galvin et al.1999, Lynn in progress).

Comparison of nutritional data among the NCA Maasai with those living in Loliondo where conservation policies are much less restrictive should illuminate whether the problems experienced by the NCA Maasai are typical of pastoral populations in the region or whether differences between the two regions are due to conservation policy and the attendant reduction in human economic welfare as argued by the NCA Maasai.

Comparison of weight, triceps skinfold, and Body Mass Index (BMI) among NCA and Loliondo adults shows that, on average, adults in Loliondo are slightly heavier, and have slightly greater BMI scores than their NCA counterparts. Triceps skinfold (TSF) measures are significantly less among the Maasai in the NCA, however, suggesting that their fat reserves are compromised. Children follow the same pattern as do adults. Maasai children, like the adults, are chronically undernourished and their growth status is poor relative to Western reference standards. For height, weight, height for age, weight for age, skinfold thickness, arm-circumference, and BMI, the Maasai consistently show values around the 5<sup>th</sup> percentile. Comparison of children in the NCA with those from Loliondo show a pattern of differences in nutritional status that mirror those seen in the adults. In Loliondo boys and girls of all ages are, on average, taller, heavier, and fatter, and have greater arm circumference than their NCA counterparts. These differences, though not large, consistently show that overall, the Loliondo Maasai exhibit better nutritional status than their NCA counterparts. Nutritional status differences appear to be a direct reflection of differences in economic levels between the two areas as measured by livestock holdings and acreage under cultivation (Galvin et al. 1999, Magennis and Galvin 1999).

Implications of these results suggest:

- The Maasai children from Loliondo tend to have higher anthropometric measures than children from the NCA.
- Adults of Loliondo also tend to show higher measures of nutritional status as measured by BMI scores. TSF measurements were significantly higher among Loliondo women and men than among adults in Ngorongoro.
- The Maasai of Loliondo clearly have more resources available to them as measured by livestock holdings and agricultural plot size. The NCA limits agricultural plot size (McCabe et al. 1997). In addition, conservation policy has placed restrictions on grazing zones in the NCA. This restriction, in addition to livestock disease impacts (Machange 1997) affect livestock productivity in the NCA.
- These results suggest that conservation policy affects resources available to the Maasai and this may influence nutritional status of the population, especially adults. Children in Ngorongoro tend to be better buffered from nutritional stress than are adults, a pattern common among pastoral populations (Galvin 1992, Galvin et al., 1994). Nevertheless, we do believe that overall the Maasai in Loliondo are in better nutritional state relative to their NCA counterparts.
- It appears from these initial comparisons that the Maasai of Loliondo possess a higher welfare status than do the NCA Maasai. At least some of this difference (crop acreage) is attributable to conservation policy. However other factors such as landscape variation, distance to markets, and livestock disease incidence, etc. may also contribute to this

human welfare variation. Analyses of these factors are underway.

*Livestock Management and Land Use in NCA, Tanzania (McCabe)*

During the early part of 1999 T. McCabe analyzed data relating to livestock ownership and sales for 40 herd-owners living in the NCA. This was data necessary to help construct the socio-economic model for pastoralists in the NCA. The total number of livestock in the sample was: cattle-3,399; sheep-523; goats-890. Total cattle sales were 116 which represented a 3.4% offtake. Total small stock sales were 6 which represented a 0.4% offtake. The 6 most common reasons for selling animals were (1) to buy clothes, (2) to buy food, (3) to pay taxes, (4) to buy grain, (5) to buy veterinary drugs, and (6) to pay hospital bills. McCabe also compared this with data collected in 1995 in order to get an idea about how representative this data was. The results were that cattle sales represented a 5.6% offtake and small stock sales a 2.2 % offtake. The same items showed up in the reasons for sales but in a slightly different order than the 1998 data. Based on these two samples McCabe feels quite confident that the 1998 data is representative of livestock sales and factors which influence a decision to sell livestock.

During late July and August McCabe continued his field research in the NCA. He concentrated on the process of livelihood diversification and historical land use patterns. Not all of this information has been analyzed yet, but preliminary analysis suggests that the prime motivating factor involved in the diversification of livelihood strategies, especially the adoption of cultivation is to reduce the number of livestock sold to provide a pastoral family with non-livestock foods (mostly maize) and other necessities. The historical information

on land use suggested that although only a few families lived in the Ngorongoro Crater, it was an important source of grazing and water for many people and their livestock living in the Olairobi and Nainokanoka areas.

*Livestock/Wildlife Disease Interactions in NCA, Tanzania (Rwambo, Grootenhuis, DeMartini)*

Participatory rapid appraisals to determine the priority diseases of livestock, the animal health constraints to livestock productivity and the community perception to wildlife as a potential source of diseases of livestock were conducted in the Ngorongoro Conservation Area (NCA). The pastoralists identified East Coast fever (ECF), ornilo (turning sickness), malignant catarrhal fever, anaplasmosis, contagious bovine pleuropneumonia, blackquarter, lumpy skin disease and anthrax as the most important diseases affecting cattle, sheep and goats. Since 1984, the incidence of tick-borne diseases including ECF and ormolu has increased drastically and the average mortality rate associated with the two tick-borne diseases was 18% in adults and 52% in calves under 12 months of age. This high mortality rate in itself could be responsible for the serious decline of cattle populations that has been observed in the NCA for a number of years. Tick-borne diseases, principally East Coast fever, were listed as responsible for the high calf mortality. During the study, it became apparent that there is very little information, if any, on cause-specific morbidity and mortality data on nearly all the livestock and wildlife diseases in the NCA.

The risk of transmission of diseases from wildlife to livestock was associated by livestock owners only with wildebeest. We were surprised to note that the community did not associate buffalo as a source of livestock disease, particularly as a source of ECF. Disease incidence

varied with the ecological setting, but, because of animal movements, virtually all livestock are at risk from all diseases present in the NCA. The annual removal of livestock from the short grass plains during the wet season to the intermediate and highland areas in avoidance of exposure to MCF virus being secreted from 2-4 months old wildebeest calves exposes livestock to high risks of transmission of tick-borne and infectious diseases. Although the disease risks are not evenly distributed in the NCA, the frequent migration of livestock in search of good pasture, water, salts, markets and in avoidance of specific diseases invariably leads to livestock being at risk of exposure to all the wildlife and livestock diseases. The situation is worsened by the concurrent migration of various wildlife species in search of pastures, water, and salts. However, the risk of transmission of some diseases including MCF, trypanosomosis, anthrax and blackquarter is confined to geographically defined areas where risk can be mitigated by avoidance albeit at the expense of availability of good grazing. This information on disease interactions will be useful in the development of a disease model for the integrated monitoring and assessment system (IMAS).

*Forage Range Survey and Monitoring Livestock Nutrition in NCA (Mwilawa, Runyoro, Moehlman)*

The objectives of this project are: 1) to identify forage range species and preferences by livestock for forage species, 2) to determine forage nutrient value, 3) to establish a protocol for pastoralists to monitor livestock nutrition. Analyses of these factors will support an effective system for early warning and crisis prevention by reporting of livestock nutrition and well-being in a timely manner. Through linkage to the GL-CRSP LEWS project, this information can be disseminated to managers and policy

makers at both local and national levels. This information will also be used in the IMAS models of livestock and wildlife nutrition and condition, and pastoral welfare.

The methods are as follows. Two grazing areas in the NCA were selected and are being sampled along transects. Pastoralists are being interviewed about forage species and their values to livestock. Forage samples are collected for nutrient analysis. Four pastoral households were selected along each sample route for fecal sampling and livestock condition assessment. Fecal sampling and livestock body condition scoring occurs on a monthly basis.

*Range Ecology Research in NCA, Tanzania (Kidunda, Maskini)*

This study investigated and quantified variables that affect the distribution patterns and utilization made on pastures by herbivores.

The study was carried out at Ngorongoro area in three locations i.e. the Crater, Malanja depression and Esilwa. The zones are: Short grass plains, Endulen-Kakesio woodland, Northern woodland, Nainokanoka, Ngorongoro Crater and the Northern Highlands Forest Reserve. The study was divided into two parts but were both assessed concurrently. Study one dealt with spatial distribution of grazing pressure by domestic and wild herbivores and study two focused on the assessment of range condition.

Forty samples were collected from the four locations in the Crater namely Seneto, Munge, Ngoitoktok and Lerai using a 0.25m<sup>2</sup> to get the actual production. Ten samples were collected from each location along a transect of one kilometer distance (one sample per 100 meters). A transect of 3km was sampled at Malanja and Esilwa thus making a total of 30 samples from

each area. Ten 0.25m<sup>2</sup> grazing cages were placed along side the sampled plots in each site and they were moved after eight weeks for determining utilization and potential production under reduced grazing pressure. All the sampled points were geo-referenced using a GPS unit for ease of further visits and comparisons. Soil samples were taken at an interval of 200m in each site.

This field study provided key information needed to assess livestock-wildlife interactions using the IMAS.

*Plant Biodiversity and Biomass in the NCA (Moehlman, Weisberg, Boone)*

A data set has been collected by Patricia Moehlman and her colleagues over many years, as part of the Ngorongoro Ecological Monitoring Program. The CRSP has offered support for analysis of this data using multivariate statistical analysis of species composition. Biomass data are to correlated to satellite vegetation greenness data (NDVI), to enable the use of satellite data for more spatially extensive biomass monitoring.

*Socioeconomic Field Research in Amboseli/Kajiado, Kenya (Mbogoh and Munei)*

In preparation for the Kenyan case study application of Savanna and the socio-economic module, fieldwork was undertaken in June-August 1999. A small survey was undertaken of the group ranches surrounding Amboseli National Park (the wildlife dispersal areas), with two primary objectives:

- To update existing knowledge about the economics of ranching compared with alternative income-generating activities, including ranchers' perceptions of the economic impacts of wildlife on ranching in these areas.

- To initiate collection of input data with which to parameterize the socio-economic module linked to the Savanna model.

The results of this survey work have been written up as a report entitled "*Study on wildlife, livestock and human interaction in Kajiado District in Kenya: results of the economic study*". The study focused on the Amboseli National Park wildlife dispersal areas encompassing the Kimana Group Ranch and the Mbirikani Group Ranch. The study sought to examine the economics of livestock keeping within the game reserves' wildlife dispersal areas, including a documentation of other economic activities that compete with livestock keeping in these areas, and magnitude of income and/or losses due to wildlife, ecotourism and other non-livestock keeping activities in these wildlife dispersal areas.

Pastoral livestock and other human economic activities have coexisted with wildlife in the East African rangelands for hundreds of years. This interaction has come under stress in the last few decades, and is turning into conflicts over the use of resources. These conflicts especially intensified after implementation of a land reform program that transferred pastoral trustlands into group ranches, individual ranches and private agricultural holding in the mid-1960s in Kajiado District. The change of property rights to pastoral rangelands from communal ownership to group ownership and recently to private ownership has brought the conflicts to a new level whereby the prospects for sustained coexistence is diminishing. The activities undertaken in this project attempt to evaluate the prospects for continued coexistence of pastoral livestock and other human economic activities by analyzing the nature of conflicts as well as identifying possibilities for resolving some of these conflicts, at least by searching for avenues of mitigating the costs imposed by wildlife on pastoralists and their economic



activities.

The study involved the following:

- A literature search and review of secondary data sources on the economics of ranching in Kajiado District;
- Design, testing, finalization and use of a simple survey instrument to elicit information from the ranchers/pastoralists on the economics of group and commercial ranches in Kajiado District;
- Data collection in the field using the survey instrument and through informal interviews.

Apart from informal discussions with relevant government officials and other stakeholders in the wildlife dispersal areas of the Amboseli National Park, a sample of 34 members of Kimana Group Ranch and 27 members of Mbirikani Group Ranch was randomly selected and interviewed to establish the status of individual livestock ownership within the group ranches and the associated costs and returns from the various economic activities undertaken by these members. The two group ranches are reasonably representative in terms of the mix of human economic activities carried on as well as ecological conditions. However, Kimana Group Ranch, the smallest of the six group ranches in Kajiado, was chosen as it reflects and represents the growing importance of agro-pastoralism. Kimana has the highest proportion of high-potential land and consequently a high proportion of cultivated area. Mbirikani Group Ranch, on the other hand, represents another extreme: although containing some pockets of high-potential land along the rivers, Mbirikani basically consists of arid grassland. These two group ranches give a sufficient representation of the nature of the

interactions between wildlife and livestock in the dispersal area of the Amboseli National Park, at least for an initial study.

The study elicited information on a wide variety of topics:

- Size, composition and infrastructure of the two group ranches;
- Household composition and food consumption aspects;
- Livestock holdings and typical herd compositions;
- Costs of livestock production with details on water use, acaricide costs, labor, grazing costs and veterinary care;
- Income to the group ranches from wildlife and ecotourism;
- Estimated costs of wildlife to the group ranches, including impacts of disease transmission from wildlife to livestock, death or maiming of livestock from attacks by wildlife, and human life losses or maiming following attacks by wildlife.
- Off-farm income;
- Farm-gate prices of inputs and outputs;
- Extent, inputs and outputs, and gross margins of crop enterprises engaged in.

These data are still being analyzed, but will provide some of the input data needed to adapt the socio-economic module to conditions in Kajiado District.

Tentative conclusions from the data indicate that there is little evidence of severe competition for available resources between livestock and crop production at both Mbirikani and Kimana Group Ranches. If anything, there appears to be some degree of complementarity. Manure from cattle/livestock keeping finds use in crop production. Both crop and livestock enterprises appear to give relatively high rates of return to capital, and most pastoralists

and agro-pastoralists are able to derive their livelihood from the two enterprises. There is a need for more detailed case studies in the survey areas in order to be able to verify and estimate the economics of ranching and crop production within the livestock dispersal areas of the Amboseli National Park.

*Livestock/Wildlife Disease Interactions in Amboseli/Kajiado, Kenya (DeMartini, Grootenhuis, Rwambo)*

We visited Amboseli NP and surrounding areas to study aspects of wildebeest biology related to MCF occurrence and we also have carried out some pilot surveys of livestock diseases in Maasai cattle. In discussions with David Western, we learned that the longevity of wildebeest is around 26 years with a mean lifespan of approximately 15 years. Mean lifespan is dependent on predator density. For instance in the NCA the predator density is higher and the mean lifespan is around 12 years as a result. The total wildebeest population is biased towards females. To what extent is not known. The populations dynamics are that 50% of the calves die in the first 10% of their lifespan, ie. in Amboseli within 1.5 years and in the NCA in 1.2 years. Of the adults, 50% die in the last 10% of their lifespan, ie. in Amboseli between 13.5 and 15 years and in the NCA between 10.8 and 12 years. Our observations indicated that less than 10 % of the population were newborn calves. At the end of May; the calves were not older than one month, indicating they were born in April. This is much later than generally reported. This can prolong the risk of exposure of cattle to MCF virus. wildebeest calve in the month of March. We interviewed some livestock owners: one had 35 cattle of which 5 died of MCF, another had 28 cattle and lost two to MCF. The wildebeest population in Amboseli starts to calve in March according to these spokesmen. They believe that the placenta is washed into gulleys

and poorly drained depressions; the water in these sites are considered the source of MCF infection in cattle. Other diseases mentioned as problems were: CBPP (Orkipei), Ormilo, foot and mouth disease, and tick borne diseases, particularly East Coast fever.

*Research on Maasai Livelihoods in Kaputiei/Kajiado, Kenya (Njoka)*

The thrust of the CRSP in Kajiado is to identify and support sustainable livelihoods which depend on the natural resource base in the ecosystem. Food security of the pastoralists is largely determined by the trends of the natural resources, the vulnerability context of their way of life and by the policies and institutional framework in which development interventions are carried out.

The current study was done in 1999 with the following main objectives:

- Assess the state of the natural resources in Kaputiei and determine the sustainability of the existing livelihoods based on the trend of the resource base;
- To evaluate the changes which has taken place since the livestock development initiatives in 1970's and 1980's.

This report is based on the Sustainable Livelihood Framework approach that focuses on the vulnerability context of people's environment, the livelihood assets that enable the people to adopt various livelihood strategies in order to survive in their environment. The Livelihood Assets include human capital, natural capital, social capital, physical capital, and financial capital. The transforming structures and processes determine the influence and access to these capitals. Government and private sector define policies, laws, culture, and institutions both at local, national and international levels

that establish an enabling environment for the evolution for sustainable livelihood outcomes. These livelihood outcomes are the end product of livelihood strategies that can be pursued in a facilitative good governance environment.

Trends influence the viability of livelihood strategies. The most important trends in Kajiado are the population trends and resource trends. The human population in Kajiado has been growing at 5.5% per annum between 1969 and 1979 and by 5.64% per annum between 1979 and 1989. The population in Kajiado has grown from 29,000 in 1948 to 68,000 in 1962, to 86,000 in 1969 and from 149,000 in 1979 to 259,000 in 1989. The population is projected to continue growing at over 5%.

The sustainability of livelihoods in the pastoral areas depend to a large degree on the natural resource base. In Kaputiei, the sustainable utilisation of the natural pasture is a crucial factor for livestock production. Ecological monitoring of the condition of grazing resources over the last three decades show that there has been a decline of quality of grazing resources especially in southern rangelands. The northern rangelands are more resilient to grazing pressure. The red soils in the south are more prone to water erosion than the black cotton soils.

#### Land use Trends.

1) Sedentarization of pastoralists: government policies which favor a sedentary lifestyle.

2) Conversion of dry season grazing area to cultivation- sedentary population are involved in shifting agriculture around their settlements which are usually located in the high potential area in ASAL.

3) Privatization of land is a growing trend as more people settle down and immigration continues. This has become more significant

as the governments in the region opt more individual land tenure system.

4) Displacement of pastoralists due to civil strife, drought impoverishment and cattle rustling menace.

5) Influx of farming communities in pastoral areas due to high population increase in high potential areas together with the effects of Land use changes in the highlands.

6) Deforestation of water catchment area increase water scarcity, soil erosion and pollution of rivers due as a result of agrochemicals.

The mobility of livestock and whole families during 1990's drought years is still practiced by 36% of the population. The grazing resources have been privatised and 27% of the population has fenced their land in 1999. This in contrast to the 1977 situation where no household had fenced the grazing resource. The families are now living in smaller settlements of closely related family members. Almost all the households are cultivating their land. In 1977, the level of livestock borrowing within the community was estimated at 28.6% (N=789 households), and 30.3% for cattle and small stock respectively.

**Range Ecology.** The Athi Kapiti range site in the north is in good range condition according to rapid reconnaissance survey conducted in 1999. This in line with the assessment done in 1977 where 66% of the range was in good to excellent condition, 27% in fair condition and only 7% in poor range condition (N=77 points at one km interval.) The range condition for livestock in central kaputiei has improved significantly under individual land tenure system. In 1977, 44% of the range was in good condition, 38% in Fair condition and 18% in poor condition. (N=100 points at one km interval). The range condition in South Kaputiei has not improved since the last assessment carried out in 1977 when 46% of points

sampled were in very poor to poor condition and 33% in fair and 21% in good condition.

#### **Wildlife /Human/Livestock Conflicts.**

Predation losses on domestic animals in 1999 survey are estimated at a 731 goats, 566 sheep, 364 heads of cattle, and 198 calves for a sample size of 90 households. The mean losses per household are calculated as 8.12(Confidence Interval, CI at 95%=1.98) goats, 6.34(CI=1.69) sheep, 4.03(CI=3.79)heads of cattle, and 2.20(CI=0.77) calves. The losses are inflicted by hyenas, leopards, and lions.

The value of predation losses at current prices are calculated as US\$15,595 for goats \$13,832 for sheep, \$62,089 for cattle losses and \$11,505 for calves. The total value sustained by 90 household is therefore estimated at US\$103,021 or an average of \$ 1,145 per household. These figures are solicited from the heads of the households and the prices used are their own prices. The pastoralists are not compensated for predation losses and there is general discontent among the people interviewed regarding the co-existence with wildlife. Many of them are now complaining about the crop damage, competition for grazing damage to fences and competition for water as well as disease transmission from wildlife to livestock. So far there are not shared benefits or losses by those who are benefiting from wildlife resource.

**Sources of Income among the Kaputiei Maasai.** Livestock related sources of income are the most important as would be expected. The sale of cattle is the most important source of revenue to meet household needs. Milk sale is an important activity and it is unfortunate that lack of organised marketing of milk is considered a serious problem by the Maasai. Land market has also emerged as source income to meet large hospital bills and school fees.

#### ***Rapid Field Assessment Protocols for Pastoral-Wildlife Ecosystems (Rainey, Reid, others)***

A rapid field assessment protocol is being developed to assess interactions between pastoralists and wildlife. This will provide data that are useful both for independent analyses, and for providing input into the IMAS models. This protocol will be cost-effective to implement, using systematic ground sampling on a spatial grid, and monitoring along transects. Fine-scale spatial interactions between livestock and wildlife, and in vegetation structure can be discerned. These fine-scale interactions are not detectable from aerial surveys, but are nevertheless very important. The method has been applied in Maasai-Mara, with financial support from other sources. The origins of the grid based approach are wildlife surveys M. Rainey conducted in the Maasai Mara to train American college students in field ecology. The walking transect method has been developed by Rainey at Melepo Hills, Kajiado District. It was successfully used to monitor wild dogs and other carnivore presence and predation on livestock, and shift a security situation in pastoral areas.

#### **IMAS Modeling and Model Development**

##### ***IMAS Software Development (Boone)***

An graphical user interface (SavView) is being constructed for the SAVANNA modeling

system. The interface will allow those not accustomed with ecological modeling to use the system, and to address common management questions (e.g., numbers of livestock, improved animal health) without input from modelers. The interface is being built without being specific to a particular adaptation of SAVANNA, to the degree possible. Therefore only small modifications will be required to apply the interface to a novel area. There are three primary portions of the interface, a parameters section allowing user input, a graphing section, and a mapping section. The graphing and mapping sections are perhaps 80% complete, leaving the section for user input requiring the most effort.

*Risk-Based Disease Model for Livestock/Wildlife Disease Interactions (DeMartini, Howe, Boone, Pelissier, Mariner)*

A risk based biased mixing model was developed, and used to evaluate the effects of spatial proximity on the probability of transmission of malignant catarrhal fever (MCF) virus, from wildebeest to cattle in the NCA. A methodology was developed for integrating disease models into geographic information systems (GIS) and remote sensing ecology models. Patterns of MCF occurrence in cattle were estimated for months between January and July, the period of shedding by wildebeest calves, over a 15 year period. The risk based biased mixing model allowed input of exposure values based on hourly estimates of virus survival in the environment, essentially creating an epidemiologic curve of exposure over weekly time steps. The SAVANNA ecology model provides input maps of wildebeest and cattle population density during the first week of each month for each 5 square kilometer cell of the NCA. Calculations for the probability of first infection in cattle were dependent upon infectiousness of MCF virus, proximity of

cattle to wildebeest, and the weekly values for exposure of cattle to the virus in the grazing areas. Simple probability calculations based on prevalence of MCF in cattle determined the length of time until complete saturation of MCF appeared in pastoral cattle as a result of exposure to virus excreted by wildebeest calves. Cattle exposed to MCF virus experience a high mortality rate but are a dead end host since there is no virus shedding from infected cattle. In this respect, the MCF model fits a simple growth curve with a Gaussian distribution of inverse half life decay, which simulates rapid spread of the virus as the probability of exposure increases, depending on virus survival in the environment. Risk mitigation in the MCF model is sensitive to spatial proximity of pastoral cattle with migrating wildebeest during the calving season. Currently, this model is being refined for MCF and modified to include other diseases, particularly rinderpest and East Coast fever. Application of the model in areas other than the NCA, such as the Kajjiado area of Southern Kenya and the Serengeti/Mara ecosystem are being investigated.

*Socio-economic Modeling (Thornton, Galwin)*

The objectives of this work are to; (1) develop a simple rule-based model that describes cash-flow and dietary energy intake in typical households in pastoral areas such as the Ngorongoro Conservation Area, Tanzania and Kajiado District, Kenya, (2) link the model to the SAVANNA ecosystem model to investigate scenarios and the impacts of economic and environmental changes, (3) use the linked model to assess both ecological and socioeconomic impacts of interventions, particularly as these relate to household food security.

Work continued on the socio-economics module for the Savanna model with scientists at

CSU and the University of Colorado. Thornton travelled to Colorado State University Natural Resource Ecology Laboratory (CSU NREL) in May 1999. A simple rule-based model was constructed and tested using data from previous studies and from the field work carried out in NCA during 1997 and 1998 under this project. The current model deals with three household wealth strata in NCA. The model is currently run in a stand-alone mode. Work is in progress to link it to Savanna output files, and ultimately the model will be fully integrated with Savanna. The model deals with simple household cash accounting and with dietary energy flows. Decision rules are predicated on the basis that the household has a target quantity of Tropical Livestock Units (TLUs) per person and a target cash income rate per month per person in the household.

The approach being taken is to use a small set of rules that govern the operation of the model, and then use the revealed characteristics of the model through simulations to adjust some of the key model parameters, so that the model behaves in a plausible fashion. For example, to model energy/food flow in the household, energy requirements of the household are calculated based on household size, age/sex ratios, and a proportion of the recommended daily allowances. This requirement is met from various sources: net milk energy (after any infrequent sales), diseased or dying animal meat, the household's own stock of maize, the household's own stock of crops other than maize, purchased maize and non-maize food, and handouts, if there is still an energy deficit. Similarly, cash flow levels in the household are monitored each time step and updated according to cash income from livestock sales, crop sales, wages, milk sales and gifts, craft income etc. Cash outgoings include food, household goods, very infrequent livestock purchases, and other payments out of the household.

Model refinement and linkage to the Savanna model will be undertaken early in 2000. Once this is accomplished, scenario analysis can be undertaken to answer questions such as the following:

- What will be the effects (socio-economic and ecological) if household maize cropping area increases?
- What are the likely impacts of a single drought, or of recurrent droughts in successive years?
- What are the likely impacts of changes in household targets for livestock numbers and cash?

Such information can be used to assess the impacts of possible future changes in the system in NCA, in terms of the effects on people, livestock and wildlife, and to help suggest ways in which negative impacts can be ameliorated and conflicts resolved.

#### *Land Use Modeling (McCabe)*

Throughout the year McCabe has been collaborating with Randy Boone on the aspects of the model that relate to the migratory patterns of people and livestock in the NCA. We have divided the NCA into blocks and are determining the percentage of livestock that move from one block to another during each month. He has also been working with Mike Cougenhour and Randy Boone on the rules based model for pastoral migration.

In addition McCabe has been working with the livestock disease modeling team on the development of the model for malignant catarrhal fever, which is transmitted from wildebeest calves to cattle during the months of

role in this aspect the model development has been to provide information on the location of the wildebeest migration and how this articulates with the movement of cattle throughout the year.

### *Ecosystem Modeling (Boone)*

An adaptation of the SAVANNA modeling system was completed for Ngorongoro Conservation Area, the results were assessed to the degree possible, and then a suite of 14 experiments, of six general types, were conducted. These experiments represented natural events or scenarios land managers might contemplate for NCA, and were selected in-part to demonstrate the flexibility of IMAS methods. The six types of questions addressed included the effects of: 1) drought, 2) elevated livestock numbers, 3) improved veterinary care, 4) increased access to grazing lands, 5) changes in water supplies, and 6) growth in human populations and agriculture. The results of these analyses were demonstrated to project scientists, and modifications made where necessary.

Compilation of GIS data for modeling in Tanzania is complete, with all layers in place. Minor modifications, such as updating climate data used in modeling, are all that remain. A series of maps from our GIS library were prepared for use by cooperators in the field, and are proving to be very useful. Analyses of long term remote-sensed NDVI data continue, tracing the dynamics of vegetation in the NCA, over a decadal time period. We have completed compiling NDVI used for visual analyses. Now we are conducting finer-scale analyses for use in comparisons to field data collected throughout NCA. We are using NDVI data to make comparisons to range quality and herbivore populations in NCA and Ngorongoro Crater. Patterns of vegetation biomass are reflected in the images, available since their first

acquisition in 1982, and should correlate with standing biomass. More detailed imagery from the mid-1990s is also being used.

### GIS Data, Analysis, and Modeling

#### *Kenya (ILRI - Reid, Okello)*

The following databases were collected or developed for the district: towns (major centres), roads (by categories), locational boundaries, human population data up to sub-location level (1979 and 1989), group ranch boundaries, wildlife management zones, soils, parks, rivers (and streams), and land use/land cover. Data on the distribution of water points was acquired from the Ministry of Water Resources.

Initial analysis of the Kajiado dataset was completed in 1998/99. This analysis focused on the effects of human activities on the abundance and distribution of wildlife and livestock from 1978 to 1998.

#### *Kenya (Boone)*

The Kajiado GIS data collected by the ILRI team and forwarded to CSU has been incorporated into our system. The ILRI team will also provide a vegetation map for the Amboseli Region, for use in SAVANNA modeling. In return, the CSU team has provided satellite imagery to the ILRI team. The SAVANNA modeling system was installed onto one computer at ILRI.

Maps were made and delivered, to support field research in Kenya.

#### *Kenya (Atieno)*

A study was undertaken to map out and document the land cover, the changes, their possible causes, and effects on vegetation species diversity and abundance within the Greater

Amboseli Ecosystem serving as a source of multiple resources but faced with conflicting demands, policies and management systems. Both Remote sensing, Geographic Information System and ancillary data together with ground-based techniques were applied. Cover change analysis was carried out between the years 1988 and 1998 using maps produced from Landsat TM scenes.

Land use-land cover maps for 1998 and 1988 were produced with an accuracy of 85.7% from which it was revealed that there have occurred tremendous land use/land cover changes coupled with significant differences in vegetation species composition, diversity and structure across the study site. Bushed grassland, cultivated land and water bodies increased from 45%(140,409ha) to 54%(167,572ha), 3.7%(11,469ha) to 11.5%(35,766ha) and 0.01%(31.2ha) to 0.24%(756ha) out of the total land area respectively. Vegetation cover however decreased generally from 96.3% to 88.247% during the ten year period. Bushed grassland and cultivated fields have significantly increased while the bushlands, grasslands and wooded grasslands reduced compared to 1988; in addition overgrazing, abandonment and erosion most likely have resulted in a change of wooded grassland and grasslands.

Four land use types were identified ranging from intensified rainfed agriculture on the mountain slopes; down slope expansion of sparse agriculture under more extensive land use system and extension of swamp-edge/riparian cultivation to increase in outside park tourism including campsites and wildlife sanctuaries. There occur overall landscape fragmentation and changing number, diversity and density of land cover patches due to changes in land use.

In conclusion, the study area has faced land use changes over the past decades. A large portion

has been converted to small-scale agriculture and some degraded in terms of vegetation resources as a result of overgrazing failing to take into consideration the vulnerability of the range ecosystem. In sum, declining vegetation cover, formation of erosional sites, abandonment of cropping fields, declining water availability, and wildlife reduction in number and species diversity can be seen to be the outcomes of recent land use changes, settlement, expanding cultivation and changing climatic conditions within the study area.

The Maasai pastoralists can now be seen to be expanding their small-scale agriculture into the swamps for their livelihood. However it would be ironical to believe that this is a sustainable way of food production since the swamps will continue to diminish and dry off as cultivation continues. This land use change consequently will have negative impacts on the existing biodiversity which will in turn negatively affect pastoral strategies involving mobility, and resource base especially as more dry grazing zones disappear. This presents a questionable scenario for the survival of pastoral production system considering the increasing human population pressure which will definitely seek more ways to increase food production.

### Progress Relative to Criteria for Evaluation

Our criteria for evaluation was stated in our 1999 Workplan as follows.

“This project can be evaluated in terms of our field, data, and modeling activities. Field activities should produce data sets which are useful for conducting an integrated assessment of pastoral wildlife interactions, GIS work at site and regional scales will produce data sets and analyses which are useful at both scales. The modeling efforts should progress to the point of being able to demonstrate that the model



based IMAS is a useful approach. The project can also be evaluated based upon the feedback we elicit from the region from policy makers in government agencies, representative of NGOs and decision makers.”

We believe we have been very successful on both counts. A list of the studies is provided below.

### *I. CRSP Field Studies*

- 1) NCA socioeconomics and nutrition - Galvin, Magennis, et al.
- 2) NCA land use and herding - McCabe
- 3) NCA livestock and wildlife disease - Rwambo, Grootenhuis, DeMartini
- 4) NCA range ecology - Kidunda and Mas-kini
- 5) NCA livestock nutrition and pastoral welfare - Mwilawa
- 6) Amboseli socioeconomics - Mbogoh and Munei
- 7) Amboseli livestock and wildlife diseases - Demartini, Grootenhuis
- 8) Kaputiei Maasai livelihoods - Njoka
- 9) Kaputiei range assessment - Njoka
- 10) Kiboko range assessment - Kinyamario and Mworira
- 11) Rapid field resource assessment protocol - Rainey, Reid
- 12) Policy - Kenya and Tanzania - Davis
- 13) Amboseli pastoral-wildlife - Worden, Western (in progress)
- 14) Amboseli pastoral land use and socio-economics - Burnsilver, Galvin (in progress)
- 15) Mburo Uganda pastoral-wildlife - Acen, Ellis (in progress)

### *II. Collaborative field studies (not supported by CRSP, but a 2-way exchange)*

- 1) NCA land use and human welfare - Lynn, Galvin
- 2) NCA socioeconomics and nutrition - Galvin, Magennis
- 3) NCA pastoralism - McCabe

- 4) NCA plant diversity and biomass - Moehlman, Weisberg, Boone
- 5) Greater Serengeti vegetation, land use, elephant impacts - Metzger, Sommerville, Coughenour, Ellis

### *III. CRSP Modeling and GIS Studies*

- 1) IMAS software development - Boone
- 2) NCA ecosystem model - Boone
- 3) Amboseli ecosystem model - Boone
- 4) Disease model - DeMartini, Howe, Boone, Mariner, Pelissier
- 5) Socio-economics model - Thornton, Galvin
- 6) NCA GIS and vegetation map - Moehlman, Boone, Kalkhan
- 7) NCA vegetation greenness dynamics using NDVI data - Boone, Moehlman
- 8) Greater Serengeti GIS - Boone, Lynne, Metzger, Kalkhan
- 9) Kajiado GIS - Okello, Reid, Boone
- 10) Amboseli GIS - Western, Boone, Atieno
- 11) Amboseli vegetation and land use mapping using Landsat data - Atieno

### *IV. Collaborative GIS and Modeling Studies (not supported by CRSP, but 2-way exchange)*

- 1) Kenya GIS - DRSRS and ILRI (Kruska, Reid)
- 2) East Africa GIS - Kruska and Reid (ILRI)
- 3) Greater Serengeti Ecosystem Modeling - Coughenour, Sommerville

### **GENDER**

The beneficiaries of the IMAS include pastoralist families, as well as other stakeholders in East African pastoral/wildlife systems. A measurable impact of the IMAS is increased food security for humans, including women

and children. Although pastoral women usually do not own livestock they do have control over food acquisition and distribution. Thus, they are an integral component of our project. As baseline data for the socio-economic submodel we interviewed Maasai women about household food security. Information on agricultural food production and livestock production, women's diet intake and health status was collected. All household members were assessed for nutritional status. This information will be used in the IMAS system to project the effect of changes in policy, management, economic or ecological conditions. If policy or management decisions are contemplated that suggest an increase or decrease the flow of income or food energy, we can, based on the current nutritional status indicators, suggest the impact of these decisions on human welfare and food security by sex and age.

There are several women involved in the project. The co-PI is female (Galvin) and there are two other US-based female researchers involved in the project (Magennis, Burnsilver). In addition, we have a female team member who is working in Kenya and is our regional coordinator (Reid) and another who is our site-coordinator for Tanzania (Moehlman). A PhD graduate student from Uganda (Acen), and MS student in Tanzania (Ali) are female. Our graduate students funded on other projects, but working in Tanzania and contributing directly or indirectly to the CRSP work are all female (Metzger, Lynn, Sommerville). A female was principal organizer of our REDSO-funded workshop in July (C. Wilson). It is likely we will employ a female post-doc part-time in the coming year (Christensen).

### POLICY

There is a distinction between policy makers and policy analysts/researchers. The

latter are appropriately involved in IMAS development but the former are involved at the stage where there are results from the IMAS and there are opportunities to ask questions of the model. In the early stages of the development of the IMAS, our efforts have been focused on the latter. Policy analysts/researchers are being involved in the stages of model building and testing. Policy makers have been kept informed of our progress.

The recent change in leadership at Kenya Wildlife Service has undermined, again, our efforts to establish a viable working relationship with KWS. Director D. Western was replaced by R. Leaky, who has since been replaced by Mr. Nehemia Rotich. We have not yet met with Mr. Rotich, however, he is a long-time acquaintance of one of our primary Kenyan collaborators, and we are optimistic that our ties with KWS can be renewed. We plan meetings this year.

Randy Boones gave a talk at KWS in July, which was well attended by KWS personnel.

Policy connections at the REDSO workshop (Nairobi, July 1999) included the attendance of Humphrey Kaburu from the Kenya Ministry of Environmental Conservation. He indicated there would be interest in the IMAS from within the Ministry. Alan Bornbush, Technical Advisor from USAID to KWS, participated, and offered to take the message to KWS. The new head of the Uganda Wildlife Authority (Robbie Robertson) was invited and intended to come but could not. He has since expressed considerable interest in the IMAS and is encouraging a visit to Uganda (planned for 2000). From Tanzania, E. Gereta, the senior ecologist from TANAPA was present.

Invited to the REDSO workshop were the Chairmen and Wardens of the Narok and

Trans-Mara County Councils. They were unable to attend, but expressed an interest in doing so. Our workshop facilitator and collaborator is in contact with these officials, and we aim to continue our efforts at communication (Ole Kamuaro).

We made outreach effort to policy makers in the Ngorongoro Conservation Area, Tanzania, by demonstrating the IMAS to NCA and others (eg. V. Runyoro Chief Ecologist NCA, Amiyo Tlaa Ecologist NCA, J.N. Mutalemwa, Engineer, Chief Manager, Works and Transport Dept. NCA.). There was political change at the NCA in 1999, including the sacking of the NCA Board of Directors, and Board Chairman by the Principal Secretary of the Ministry of Natural Resources. To date, the board has not been replaced, but we are poised to reestablish communications when that occurs.

A number of officials were invited to our Arusha mini-workshop in July, but did not attend. These included the The District Executive Director, Monduli District Council, The District Executive Director, Simanjiro District Council; Head, Department of Community Conservation, TANAPA; Head, Depart. Of Tourism, TANAPA; Director General, TANAPA; Acting Director General, TANAPA; Director of Planning and Research, TANAPA. The senior ecologist from TANAPA did attend, however.

Dr. J.K.K. Msechu, an official from the Ministry of Agriculture in Dar es Salaam attended our Sokoine University IMAS mini-workshop, and was very interested in further communication.

Our efforts to influence policy in Tanzania will develop further in 2000, when we meet with ministry personnel. We are encouraged that the new Director of Wildlife (Ministry of

Environment) is Mr. Emmanuel Severe who attended the GL-CRSP year-end conference at Tarangire N.P., Tanzania in December, 1998. In order for policy makers, specifically Ministries, to enter into an MOU with our project, they must see that we have established an institutional linkage in Tanzania. To this end, we are working with Profs. Nikundiwe and Feetham Banyikwa of the Univ. of Dar es Salaam to establish this linkage. Once in place, we aim to approach the Ministries.

### *Historical Land Use and Policy Changes in Kajiado, Kenya (R.K. Davis)*

Bob Davis conducted a review of the historical changes in policy and land use in Kajiado, since the inception of group ranches in 1968. Davis was in a unique position to provide key information to the IMAS project regarding these policy changes, since he was involved in conducting assessments which led to the land use shift to group ranches in the 1960's. Davis' report refers to a number of obscure, but influential papers and reports which would otherwise be difficult to obtain. He covers the following topics:

- Notes from Studies of Group Ranches in Kajiado District, Kenya (Reasons for the policy shift, and responses of pastoralist to the land use/policy shift in the early days of group ranching)
- Land use studies (Refers to early economic assessments of alternative land uses including ranching and tourism)
- Game cropping (survey of early ideas and why support for the idea has subsided)
- Sport hunting (the early economic returns, and concerns for its future, made moot by the sport hunting ban, but an option still worth considering)

*Trends in Governance (J. Njoka)*

In addition to the ongoing economic reforms, Kenya has also been going through the process of decentralising decision making to local level. In this context the policy of group ranch development which was started in the 1970's has been overtaken by the wave of change where production decision should be driven by private initiative. The relevant objectives in this trend as far as the pastoralists are concerned are:

- Decentralisation and participatory approaches of development creates good policy environment supporting for pastoral institutional building agenda;
- Democratisation trend is also creating and enabling environment to tackle issues of accountability and transparency.
- The objectives refer to a process which is not easy to measure. The status and environmental impacts of emerging pastoral institutions after the demise of group ranches need further study to determine the future of natural resource management.

**OUTREACH**

*Target - Potential End Users of the IMAS*

IMAS, the SAVANNA modeling system, and our experiments were demonstrated to East African scientists and managers at

a workshop entitled "Integrated modeling, assessment, and management of regional wildlife-livestock ecosystems in East Africa," held at the International Livestock Research Institute in Nairobi, in early July. A more technical demonstration of the work was given to ILRI technicians. Soon after, four demonstrations of IMAS were made throughout northern and central Tanzania (i.e., Arusha, Ngorongoro, Dar es Salaam, and Morogoro). Finally, IMAS and SAVANNA experimental results were demonstrated to personnel of the Kenyan Wildlife Service. All told, the IMAS project was introduced to over 100 East African land managers, scientists, and stakeholders. During demonstrations of our work, we received very positive feedback and encouragement. Some of the most ardent support came from those responsible for managing areas for which IMAS has yet to be applied (e.g., Tarangire National Park, Tanzania) but who struggle with issues the system can address.

A public web site was created for the IMAS project: (<http://nrel.colostate.edu/PROGRAMS/MIKEC/imas/>), and includes background information, personnel contacts, news, project descriptions, and products. Project descriptions and minor modifications to the site are still pending.

A private users web site was created for a 'Savanna Forum,' allowing current users of the model post questions and answers, and have discussions about its use.

*Target - Stakeholders*

We have contacted and informed key stakeholder groups such as pastoralist and wildlife organizations in Kenya and Tanzania

We have involved Prof. Bob Woodmansee in the project, to find ways to apply his Structured

Analysis Methodology (SAM) to the problem of livestock-wildlife interactions. The SAM is a structured approach to addressing stakeholder concerns in natural resource management.

#### *Target - NGOs*

In Kenya, we were pleased that AWF has shown a high degree of interest, facilitated by their representation at the REDSO workshops, and other discussions. We have encouraged this collaboration from the outset of the project. The new Director of AWF (P. Bergin) is fully informed. While in Tanzania we had discussions with Alan Kijazi at the African Wildlife Foundation and with Carol Sorenson, who is directing a large livestock development project for DANIDA in the NCA. T. McCabe had the chance to discuss the utility of the model to their projects in a bit more depth than we were able to do in the mini-workshops and model demonstrations.

### **DEVELOPMENTAL IMPACT**

#### **Environmental impact and agricultural sustainability**

##### *Ecosystem Modeling and GIS Analyses*

Livestock based agriculture cannot be developed in East Africa without careful consideration of environmental impacts. The potential for negative livestock-wildlife interactions is high if livestock development is insensitive to ecological responses. In addition to the potential negative effects on ecosystem processes which are vital to agricultural and ecological viabilities, there is a risk of financial losses through negative impacts on ecotourism - a primary source of revenue for the region.

The IMAS ecosystem and GIS models are

to be used to anticipate, and avert, the potential negative effects of livestock development on wildlife and ecosystems. The IMAS studies of land use change and the socioeconomic forces driving these changes will provide the basis for more informed management and policy decisions affecting the environment.

##### *Socioeconomics Modeling*

The socio-economic module is a contribution to the IMAS, whose major purpose is to assess the trade-offs of various management scenarios on wildlife and people in pastoral systems. The socio-economic module will provide a new dimension to IMAS scenario analyses.

Issues of human welfare vs. wildlife conservation remain political issues in Tanzania and elsewhere in East Africa. In Kenya we have the potential to update our understanding of group ranching and their economics, and land privatization, as these have been, and continue to be quite large political issues. It is important to monitor and interpret what is happening and this project can contribute to this. In Tanzania, Uganda and Kenya, land use surrounding world heritage wildlife reserves has intensified, and grazing lands have been increasingly converted to cropping. The IMAS includes assessments of the socioeconomic responses to these changes.

##### Contributions to U.S. Agriculture

The issues of livestock-wildlife and livestock-environment interactions are not unique to East Africa. Indeed many of the same issues occur in the U.S., particularly in the grazing lands of the Western U.S. We expect that the IMAS approach we are developing for E. Africa will be directly useful for livestock

based agricultural systems in the U.S. The other SAVANNA modeling projects funded by US Geological Service, National Park Service, Environmental Protection Agency, and Colorado Div. Wildlife have many of the same objectives as the work proposed here, particularly development and use of the same model for the purpose of managing ecosystems dominated by large herbivores. SAVANNA is being used to assess wildlife-livestock conflicts with respect to brucellosis in Yellowstone N.P. The model is being used to assess carrying capacity for wild horses, and interactions between wild horses and bighorn sheep in the Pryor Mountains, Montana. It is being used to assess land/resource-use interactions between wildlife and ranchers in Colorado.

#### *Animal Disease Modeling*

Epidemiologic modeling of tropical livestock/wildlife disease interactions benefits U.S. agriculture in at least two ways: 1) There is a persistent and increasing threat of introduction of infectious or parasitic diseases into the US from Africa. Increased knowledge of the manifestations, diagnosis, and transmission of these diseases will assist in their detection and control if introduced into the US. 2) One disease being modeled, malignant catarrhal fever (MCF), is an important disease of bison, cattle, and deer in North America. Outbreaks associated with African wildebeest in zoos have been reported, but the sheep-associated form of MCF is more common. Information about frequency and mechanisms of transmission as well as viral persistence in the environment in Africa will be of value as baseline information for the disease in North America. Comparison of the viral agents in each continent and their pathogenicity may lead to new strategies for diagnosis and control.

#### Contributions to Host Country

#### *Information for Improving the Balance Between Wildlife and Livestock*

The project provides information to the host countries that will be useful for developing livestock agricultural systems that minimize impacts on wildlife. This information takes several forms, including numerous field studies on rangeland ecology, socioeconomics, landuse, livestock ecology, and wildlife-livestock interactions described elsewhere in this report. We have also assembled useful GIS and remote sensing data sets that were previously unavailable. We are developing parameterized ecological simulation models that will provide information for policy and land use decisions. We are educating host country personnel to use these different forms of information.

#### *Disease diagnosis and control in East Africa*

The investigations on wildlife / livestock disease interactions in the NCA revealed that some wildlife diseases and several livestock diseases constrain pastoralism and cause conflict between livestock production and conservation of natural resources. To balance pastoralism and conservation of natural resources in the NCA there is a need to develop a sustainable livestock management program for the control of tick-borne and infectious diseases. A prerequisite of the development of such a program is the presence of a capacity to diagnose disease both in wildlife and livestock. Although some capacity to recognize clinical disease and provide treatment exists, there is a clear lack of diagnostic ability to deal with mortality epidemics in both livestock and wildlife. Through interaction in the field and communication, GL-CRSP project veterinarians provide assistance and encouragement to government veterinarians dealing with these important disease problems.

**Linkages and networking.** This project is linked to other external projects as described in Section 10 below. We are networking with

a wide array of institutions, projects, and initiatives as evidenced elsewhere in this report.

We have a linkage to the TAMU LEWS project by way of an arrangement for Angelo Mwilawa to conduct the fecal sampling protocol in NCA. Mr. Mwilawa is associated with both projects. The fecal samples are to be collected once a month beginning in August 1999. The fecal profiling is collected in two different routes. The scanning will be done either in Ethiopia where the machine has been installed already, or in Mpwapwa, when a machine is installed there.

An agreement was developed with the Kenya Department of Resource Surveys and Remote Sensing (DRSRS) to conduct a joint analysis of their rich aerial survey data.

**Collaboration with International Research Centers.** We are collaborating with the International Livestock Research Institute (ILRI) in a major way, as our budget allows. Our partnership with ILRI is highly valued, and has proven to be extremely productive. It has facilitated much of our work.

Livestock and the environment are becoming big issues for ILRI in particular so obvious benefits for ILRI to be heavily involved in such work as the CRSP. ILRI can provide benefits for the CRSP too in terms of infrastructure and access and expertise in specific areas.

In planning for future development of the disease model, discussions were held with Dr. John McDermott, an epidemiologist working at ILRI. He will examine and critique MCF map and will work with us on this and other models. Economic analysis of the cost of disease and its control will be an important component of the IMAS, and Dr. Phillip Thorton of ILRI indicated his willingness to work with Dr.

Grootenhius on this aspect later this year. We also met with Drs. Paul Rossiter, Chip Stem and Richard Kock, all veterinarians working with the FAO/OAU/EU PARC rinderpest project; they are willing to share data and insights on MCF and rinderpest in wildlife and livestock as our models are developed.

## OTHER CONTRIBUTIONS

**Support for Free Markets and Broad-based Economic Growth.** Free markets and economic growth can be enhanced by improving the balance between livestock-based agriculture and ecotourism. Neither livestock based agriculture nor ecotourism, can prosper without considering the sustainability of this balance. These two forms of market enterprise are intertwined, and codependent, in that pastoral economies do, or at least could derive necessary income from both sources. Ecotourism must be protected as a free-market enterprise in East Africa, because it generates a large amount of foreign income. Touristic expenditures are undoubtedly recycled many times in the regional and local economies.

**Contributions to and Compliance with Mission Objectives.** This project is concordant with Strategic Objective 2, of Country Missions of Tanzania, Uganda, and Kenya, which aims to promote agricultural productivity while conserving natural resources.

There was good communication with Dennis Weller, and Alan Bornbush at the Kenya mission in the last year. James Ndirangu was present at our REDSO workshop. We have recently briefed Meg Brown, Weller's replacement, and aim to work out ways to complement the Community-based Conservation projects. From the Tanzania Mission, R. Ruybal attended our IMAS demonstration in Dar es Salaam. He has now been re-posted, and we are planning to

meet with Dr. Pat Foster-Turley, who has just arrived. Our Tanzania Site Coordinator met with Dr. Ken Baum who is in charge of the EPIQ program and hence the USAID Tarangire Program.

**Concern for Individuals.** We are working with land users and land holders, mostly pastoralists, whose livelihood depends upon their continued ability to utilize the grazing ecosystem. We are eliciting input from these stakeholders about their concerns. We are also concerned with the wants and needs of people who place a high value on having wildlife populations and a healthy environment.

**Support for Democracy.** Our work supports democracy by increasing food security, by striving for compatibility in different forms of land use, and perhaps most importantly, by providing an objective source of information to any stakeholders, and to the public. Democracy cannot thrive, corruption and graft are more prevalent, and tyrants are more likely to wield power, in environments where people are in strife, where there is mistrust, and where there is an advantage for those able to spread propaganda.

**Humanitarian Assistance.** We provide humanitarian assistance when we can and when there is a great need, on an incidental basis while working in the field. However, we are not funded to provide humanitarian assistance on this project.

#### LEVERAGE FUNDS AND LINKED PROJECTS

Integrated Assessment of African Savannas through Spatial-Dynamic Vegetation and Land Use Modeling. U.S. National Science Foundation. M.B. Coughenour and J. Ellis, Principal Investigators. 1997-2000. \$450,000 for three years.

Land Use Change in East African Savannas: A case study in northern Tanzania. U.S. National Science Foundation, Anthropology Program. K.A. Galvin and J. Ellis, Principal Investigators. 1997-1999. \$200,000 for two years.

Responses to Climate Variability and the Utility of Climate Forecast Information for the Livestock Sector in the Arid and Semi-arid Zone, South Africa. NOAA Climate and Global Change Program. K. Galvin, J. Ellis and C. Vogel, Principal Investigators. 1998-2001 \$336,000 for 3 years.

Sequence Analysis of Ovine Herpesvirus 1-Associated with Bovine Malignant Catarrhal Fever. Objectives: Determine the sequence of the rhadinovirus associated with MCF. PI, DeMartini USDA Grant. No. 99-35204-7723. 8/1/99 - 7/31/01, 8% effort. \$187,000 total costs.

Peter Pelissier. Was supported for 3 months by CSU College of Veterinary Medicine and Biomedical Science to work with the GL-CRSP in developing the MCF model. He assisted in parameterization and baseline literature review for the model, and he made a field trip to Kenya in July, 1999.

Dr. DeMartini. obtained a USDA grant to analyze and compare the genome of the two viruses that cause sheep-associated and wildebeest-derived malignant catarrhal fever. Epidemiology surveys and studies of the disease are also being supported by smaller grants from the College Research Council of the CVMBS and the National Bison Association.

Three Landsat TM scenes (1995 and 1998) were donated by AFRICOVER, Nairobi for use by F. Atieno, an MSc. student on the project.

An agreement was developed with the



Dept. of Resource Surveys and Remote Sensing to conduct a joint analysis of their rich aerial survey data for the years, 1977, 1978, 1980, 1981, 1982, 1986, 1990, 1991, 1992, 1993, 1994, and 1998. This type of agreement is granted to very few projects, and reflects a substantial commitment by both parties. The data set includes information on over 60 variables, including the abundance and distribution of livestock and wildlife, vegetation, settlement, boreholes, crop cultivation, erosion, burning, and infrastructure.

*Applications of the IMAS-CRSP Methodology (Indirect Contributions)*

Large Mammalian Herbivores, Plant Interactions and Ecosystem Processes in Five National Parks. USGS. Biological Resources Division (BRD). Francis Singer, P.I. , M. Coughenour co-PI. \$683,000. 4/95-8/99.

Spatial Modeling of Yellowstone Bison and their Environments. USGS BRD. \$113,000. M.B. Coughenour, P.I. 5/98-5/02.

Dynamics of Tree-grass Interactions. National Center for Ecological Synthesis and Analysis. W. Parton, PI., M. Coughenour co-PI. Support for 3 workshops. 5/98-11/99.

The role of Habitat in the Decline of Mule Deer in Colorado: Research and Adaptive Management at Landscape Scales. Tom Hobbs, PI., M. Coughenour co-PI. Colorado Division of Wildlife. \$840,000. 9/99-9/03.

An Integrated Assessment of the Consequences of Climate Change for Rocky Mountain National Park and its Gateway. EPA-STAR. Tom Hobbs, PI. M. Coughenour co-PI. \$898,900. 7/99-6/02.

*Long Term*

In Progress:

Randy Boone, Postdoctoral Research Associate, Colorado State University - full support.

Jeff Worden, PhD. candidate , Colorado State University - full support.

Shauna Burnsilver, PhD. candidate, Colorado State University - partial support.

Joyce Acen, PhD. candidate, Ugandan, at Colorado State University, Ecology - full support.

Kris Metzger, PhD. candidate, Colorado State University, partial support for field work only.

Asha Salim Ali, MSc. candidate , University of Dar es Salaam, Architecture and Lands - support for field studies(under Prof. Nikundiwe).

Fred Atieno, MSc. candidate, University of Nairobi, Range Science - partial support (under Prof. Njoka).

Okello Onyango, GIS/modeling trainee, ILRI - salary.

Completed

John Mworira, MSc. candidate, University of Nairobi, Botany - support for field studies (under Prof. Kinyamario).

Mohamed Maskini, MSc. candidate, Sokoine University, Animal Sciences - support for field studies (under Prof. Kindunda).

*Short-Term*

Workshops

Integrated modeling, assessment, and management of regional wildlife-livestock ecosystems in East Africa. Workshop, Nairobi. July 6-9, 1999.

TRAINING



**Mini-Workshops**

Demonstration of IMAS and Discussions of Potential Uses in Tanzania, July 1999:

African Wildlife Foundation, Arusha  
Univ. Dar es Salaam  
Sokoini University, Morogoro

**Visiting scientists training**

Trained in the SAVANNA modeling system during their visits to Colorado State University:

Angello Milawa  
Prof. Feetham Banyikwa

**GIS training course**

A two-week GIS training course was developed and conducted at ILRI in April 1999. Nine participants attended: 6 from Kenya, 1 from Tanzania (3 were invited) and 2 from Uganda (3 were invited). The course was conducted by 6 GIS technicians from ILRI and DRSRS and was rated excellent by course participants.

**Technical training in SAVANNA - (training trainers)**

In July, the ILRI GIS analyst, Okello Onyango, travelled with the CSU CRSP team to Tanzania to learn how to demonstrate the SAVANNA model. Okello is the first of a team of African trainers who will be trained to lead demonstration of the model in East Africa.

The second is Prof. Mtalo from U. Dar es Salaam (in progress).

**COLLABORATING PERSONNEL**

*United States:*

Child, Dennis. Department Chair, Professor, Colorado State Univ., Rangeland Ecosystem Science Dept.

Coughenour, Michael. Senior Research Scientist, Associate Professor (Affiliate), Advising Faculty Colorado State Univ., Natural Resource Ecology Lab., Rangeland Ecosystem Science Dept., Graduate Degree in Ecology

Davis, Robert, Senior Associate Univ. of Colorado; Institute of Behavioral Science

DeMartini, James. Professor Colorado State Univ., Pathology Dept.

Ellis, James. Senior Research Scientist, Associate Professor (Affiliate), Advising Faculty Colorado State Univ., Natural Resource Ecology Lab., Rangeland Ecosystem Science Dept., Graduate Degree in Ecology

Galvin, Kathleen. Senior Research Scientist, Assistant Professor, Advising Faculty Colorado State Univ., Natural Resource Ecology Lab., Anthropology Dept., Graduate Degree Program in Ecology

Howe, Rodney. Research Scientist. USDA-APHIS, Fort Collins. CO.

Magennis, Ann. Associate Professor, Colorado State Univ., Anthropology Dept.

Mariner, Jeff. Veterinarian. Consultant. Fort Collins.

McCabe, Terrence. Assistant Professor, Associate Director, Univ., of Colorado, Anthropology Dept., Institute of Behavioral Science

Pelissier, Peter. Veterinarian. Consultant. Fort Collins.

Rittenhouse, Larry. Professor, Colorado State Univ., Rangeland Ecosystem Science Dept.

Woodmansee, Bob. Professor, Colorado State Univ., Rangeland Ecosystem Science Dept.

*Kenya:*

Else, James. Veterinarian, Wildlife Consultant.

Grootenhuis, Jan. Veterinarian, Consultant

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Kruska, Russell. International Livestock  
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Munei, Kimpe. Univ. of Nairobi, Agric.  
Econ. Dept.

Njoka, Jesse. Professor, University of  
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Okello Onyango. International Livestock  
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Rainy, Michael. Explore Mara Ltd.,  
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International Livestock Research Institute

Western, David. African Conservation  
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#### *Tanzania:*

Banyikwa, Feetham. Adjunct Faculty,  
Research Associate . Univ. of Dar es Salaam,  
Syracuse University

Kidunda, Rashidi. Assistant Professor.  
Sokoine Univ.

Kijazi, Allan. African Wildlife Foundation.

Mwilawa, Angello. Livestock Research  
Scientist, Ministry of Agriculture and  
Cooperatives, Zonal Research and Training  
Center

Moehlman, Patricia. Biologist, Consultant.  
The World Conservation Union - IUCN, Equid  
Specialist Group

Nikundiwe, Alfeo. Professor, Principle and  
Professor, College of Architecture and Lands,

University of Dar es Salaam

Runyoro, Victor. Ngorongoro Conservation  
Area Authority.

#### *Uganda:*

Acen, Joyce. Graduate Student, Colorado  
State University.

#### **COLLABORATING INSTITUTIONS**

African Wildlife Foundation

Colorado State University

Colorado University

International Livestock Research Institute

Kenya Agricultural Research Institute

Kenya Department of Resources, Surveys and  
Remote Sensing

Kenya Wildlife Service

Ngorongoro Conservation Area Authority

Ololepo Hills Grazing Association

Serengeti Wildlife Research Institute

Sokoine University

Tanzania Ministry of Agriculture

University of Dar es Salaam

University of Nairobi

#### **PUBLICATIONS**

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on land cover, vegetation species abundance  
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Howe, R., R. Boone, J. DeMartini, T. McCabe, M. Coughenour. 1999. A spatially integrated disease risk assessment model for wildlife/livestock interactions in the Ngorongoro Conservation Area of Tanzania

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Njoka, J. 1999. Sustainable Livelihoods of Maasai Kaputiei of Kajiado District of Kenya.

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#### ABSTRACTS AND PRESENTATIONS

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#### COMMENTS

*Comment from an anonymous member of our team in Kenya (and a concern of all of us).* There is no memo of understanding with anyone in Kenya as far as we know. KARI and ILRI have not signed an MOU. This means that CRSP could be accused of operating illegally. Therefore we cannot report anything on host country contributions.

Although we have made efforts to influence policy, it has proven difficult with our expertise and resources. Professional lobbyist and public relations experts working on behalf of the whole African GL-CRSP might be necessary to achieve the desired impacts.

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#### APPENDIX

We have trained or are training 1 post doc, 4 Phd students, 4 MSc students, and 1 technician. We have conducted or are

conducting 20 collaborative field studies and 14 collaborative modeling or GIS studies. We have developed an information base and modeling capability that heretofore did not exist about the natural resource management of the Ngorongoro wildlife-pastoralist ecosystem, and are in the process of doing the same for the Kajiado Kenya. We have developed a decision support system, inclusive of a computer model, a GIS data base structure, and a field sampling protocol, to assess interactions between livestock and wildlife. We have provided opportunities for at least seven senior African scientists to collaborate with American scientists, including trips to the USA. We have increased host country capacities for making informed decisions by providing new scientific information about livestock-wildlife ecosystems. Policy analysts and policy makers are either involved or have been informed of our results.

#### **PRINCIPAL INVESTIGATORS**

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decision-making abilities.

Experiments with alternatives include farm management plans, pasture improvement, reduced chemical use, agro-forestry, and communal vegetable gardens and tree nurseries. These small actions are selected to maximize family resources, diversify the sources of family income, and reduce the environmental impacts of current practices. Our studies of the natural ecosystems in which these families are living will help to design ways to integrate their activities into these systems so as to

## **LIVESTOCK-NATURAL RESOURCE INTERFACES AT THE INTERNAL FRONTIER IN LATIN AMERICA**

**SPANISH TITLE: "PLANIFICACION  
LOCAL AGROPECUARIA Y DE LA  
NATURALEZA"(PLAN)**

### **NARRATIVE SUMMARY**

This project is working with rural farming communities in forested mountainous areas of Latin America to improve the quality of life in those communities and to improve the conservation of the natural forests and watersheds of those areas. Our strategy is to promote land use and livestock management that is sustainable at the family level and the community level and sustainable for the environment at the level of the watershed and the region. Livestock are a significant part of the problems of these agro-ecosystems as well as part of the potential solutions. To understand how to reduce the impact of livestock on the environment and how livestock might contribute to a better life for these rural people, we must understand the bio-physical and socio-cultural-economic context of these systems.

The project work is organized around four principal goals: 1) Identify the potentials and limitations within the community for sustainable management of natural resources

and livestock, and improvement of quality of life. 2) Generate local participation in planning, implementing, and monitoring current and alternative practices. 3) Evaluate current practices of livestock and natural resource management and develop alternatives. 4) Establish long-term, on-going, local community planning for natural resource and livestock management.

The methodological spirit for program design and implementation is both interdisciplinary and participatory. Knowledge, expertise, and process are to be drawn from different biological and social science perspectives, from universities and NGOs, and from the local communities. The project is focused toward communities and the process explicitly involves and incorporates the people of the communities. Since this program seeks to work with those groups that are most in need, however, our principal beneficiary groups will be small producers, resource-poor families, women, and ethnic minorities.

Within the context at a local community, the realities of local residents must be understood and their active participation engaged in the joint search for possible alternatives. This joint search for viable and sustainable economic alternatives has pointed towards three main strategies: 1) diversification of economic activities and production systems, 2) increase in equity among the actors in the communities and within families (e.g., increase in women's access to resources and roles in decision-making), and 3) improved community organization and

maintain the natural services of the watersheds and to conserve the rich natural biological diversity that constitute resources for them and the world as a whole.

We are working with community and family groups and leaders to foster and support community organization. Community planning, assisted by the Project, could transform a diverse array of small activities into a sustainable whole.

## RESEARCH

### **Problem Statement and Approach.**

This project is working with communities in forested mountainous areas of Latin America to improve the quality of life for small land-holders through land use and livestock management that is sustainable at the family level and the community level and sustainable for the environment at the level of the watershed and the region. We have been using livestock as a primary target to integrate multiple approaches toward solution of environmental problems in these regions. The project work is organized around four principal goals: 1) Identify the limitations and potentials within the community for sustainable management of natural resources and livestock and improvement of quality of life; 2) Evaluate current practices of livestock and natural resource management and experiment with alternatives; 3) Generate a participatory process for planning, implementing, and monitoring current and alternative practices; 4) Establish a long-term, on-going, community-planning process for natural resource and livestock management.

The problem model and approach have not been changed; however, our perspectives on how to approach sustainability and alternatives on a community-specific basis are evolving as is discussed below for specific activities. This is particularly evident in our discussion under

Activities 2.1 and 2.2 below and under section 5 on Gender.

**Progress (summary by activity).** Progress and significant findings are described below for each activity. Relative to the original proposal, all our objectives were reduced in scope and delayed in implementation. Nevertheless, we feel we have made extraordinary progress under the circumstances. Conceptual changes in our approach and corresponding modifications in our activities are discussed below.

### *Activity 1.1. Complete community autodiagnostic studies.*

Ecuador's autodiagnostic study of the local communities of the project had been completed in year 1; Bolivia and Mexico's were completed as scheduled in year 2 (In all three areas, autodiagnostic work with some peripheral communities still remains to be done). The first set of autodiagnostic studies were expanded with studies of local perceptions, social stratification, and family economic strategies in all three countries and will continue in year 3. There have been specific social stratification studies in two communities in Bolivia, a colonization study and a social stratification and perception study in Ecuador, and a perception and gender/labor study in Mexico (these studies contribute directly to Activities 2.1 and 2.2).

These studies have been extremely informative and have created the knowledge basis on which to design an effect process for developing appropriate actions in each community. In the words of our Bolivian team: "In order to understand or estimate the socio-economic and cultural criteria for livestock management, it is absolutely necessary to understand the cultural and historical context of [the study] sites." It is this understanding that we have been effectively building on and using.



Our principal accomplishments and new understandings of the community situations aggregate into the following three topics:

1) *Local awareness:* Awareness and interest in the goals of the project and active involvement by a number of local residents has been one of the principal results of the autodiagnostic and perception studies in the communities, particularly in Ecuador and Bolivia where the participatory approach has been most effectively applied. Previously existing political problems in the communities of the Zenzontla Ejido in Mexico, and the present lack of Mexican team members trained in social sciences and participatory approaches has hampered efforts to create broad scale participation in the project. We are working on this through greater work by UW team members in Mexico (Eakright, Zepeda, Lastarria, and Moermond) and, in the future, by researcher exchanges, bringing key team members from Bolivia and Ecuador to work in Mexico and by creating better opportunities for recruiting new Mexican team members with community development experience.

2) *Community organization:* The autodiagnostic study and perception studies in all three countries have shown that the lack of effective community organization and decision-making mechanisms is a major impediment to community planning. Our studies have identified a number of causes for this lack of organization that differ among the study areas according to factors such as culture, history of colonization, market forces, and political situation among others. These results are already serving to guide the design and development of new and future activities under Activity 4.1.

The autodiagnosics highlighted the need for institutional agreements between different

actors to guarantee an effective development process (this underscores the importance of Activity 4.3) . For example, in Bolivia in the Rio La Sal watershed, the process of creating the autodiagnostic study and the results of the study became a mechanism of negotiation between the local communities (Fuerte Santiago and Rio La Sal) and the municipality (Entre Rios) to define areas where government and other institutions could intervene. The new Bolivia Law of "Popular Participation" places responsibility for environmental management in the hands of local communities and requires a locally formed community committee (OTB's, Organizacion Territorial de Base) to prepare a preliminary management plan for their community. The autodiagnostic provided the basis for preparation of such a document jointly by the Bolivia team, local residents, and local officials. This document was presented formally to the president of the municipality, and has created a formal basis for participation of Project PLAN with the local communities under the auspices of the municipality.

3) *Culture, social stratification and land tenure:* Identification of the different social and cultural groups of actors in each of the areas has greatly influenced our own perceptions and ideas of the nature of the problems to be solved and of possible points for intervention toward mutual goals. Among the different groups in each site, there are huge differences in their perceptions and their personal agendas. There are cultural differences between colonists and indigenous peoples (Guarani) in Bolivia and between newly arrived colonists and long term residents with two or more generations in the area. There are strong differences in social stata and land tenure with absentee landlords, large local landowners, small landowners, squatters, and landless people in all three regions.

*Activity 1.2. Collection of secondary and*

*scientific data.*

PLAN had accumulated considerable information about the project areas and the bio-physical, socio-economic and historical context of the occupation and land use patterns in the area. This Activity while obvious and necessary has become increasingly focused on the needs of the different activities that follow. Nevertheless, two studies illustrate specific activities/studies that support the work of the project: 1) in Ecuador, Heifer Project International (HPI) commissioned two consultants to prepare a study from existing documents and data on the history and patterns of colonization of the Rio Cosanga area over the past 3 decades (Ospina, P., and A. Carrillo. 1999. "Tendencias de los procesos de colonizacion en Cosanga (1970-1998)"). Similarly, a diverse group of investigators at IMECBIO including PLAN participants summarized existing studies and data to assess the patterns in change in land use and cattle raising activity in 4 regions of the Sierra de Manantlan reserve (Louette, D., L. M. Martinez R., R. D. Guevara, J. A. Carranza M., R. Genoveva J., E. Casillas G., J. P. Esparza C., P. Gerritson. 1998. "Cambio de uso del suelo y actividad ganadera en 4 regiones de la Reserva de la Biosfera Sierra de Manantlan (1971-1998)"). Both of these papers serve as valuable background for Project PLAN.

*Activity 1.3. Store information in GIS databases.*

PLAN now has a considerable GIS databases in all three country areas on the bio-physical nature of the landscapes including maps of topography, watershed/drainage

patterns, vegetation/land cover, land use and land use change, soils, soil erosion, and soil potential/vulnerability. General socio-economic information including population distribution, transportation, access to services, etc. are at various stages of being incorporated in the databases.

*Activity 2.1. Socio-economic-cultural evaluation of current practices; selection of alternatives.**Activity 2.2. Participatory evaluation of ecological processes and productivity of agro-ecosystems.*

We now see these two activities as overlapping. Part of the information and understanding of both activities has been developed through the autodiagnostic and follow-up studies discussed under Activity 1.1. At this early stage, an important finding is in how our preliminary studies have contributed to the conceptual development of the overall project strategy:

Participatory approach and learning as a two-way process: One of the findings of this work is that our own ideas for alternatives, even if based on study of the local situation, are not likely to succeed unless they coincide with local needs and desires and local abilities and realities. This is a critical perspective that cannot be ignored.

Project PLAN at this stage must be seen as a preliminary study whose purpose is to understand the bio-physical, socio-economic and cultural context of the project. Within the context at a local community, the realities of local residents must be understood and their active participation engaged in the joint search for possible alternatives. Local recognition of social, economic, and environmental problems is

present as well as the strong desire to find useful alternatives to improve the situation. Scenarios for sustainable use of natural resources will need to be rethought and oriented differently within each local sector of our study area, in accord with the needs, desires, and possibilities of the local groups.

The deeper recognition of the necessity of this perspective has led us to redesign our approach to selection of alternatives, to think of our approach again as one of process rather than definition, and to broaden our scope of consideration of what might constitute alternatives. We have gradually and progressively moved toward the working hypotheses that the solution for viable and sustainable economic alternatives and the reduction of environmental impacts will be through two main strategies: 1) diversification of economic activities and production systems, and 2) increase in equity among the actors in the communities and within families (e.g., increase in women's access to resources and roles in decision-making; please see a more detailed discussion of this concept in the Gender section).

While participation and trust continue to grow in the communities in Bolivia and Ecuador, the community residents in the Zenzontla Ejido in Mexico have been very slow to adopt project initiatives and have not yet participated in an equal way in the selection of alternatives. This is due in part to the previous existing community political divisions, failures of other earlier development projects, and the inability of the Mexico team to institute a broadly participatory approach because of a lack of resources and a lack of availability of researchers experienced in participatory approaches.

*Activity 2.3. Scientific evaluation of ecological processes and impact of livestock.*

*Forage patterns and regeneration of vegetation (forests and pastures)*

1A) Vegetation Regeneration Plots: In Mexico, 10 sets of vegetation regeneration plots (livestock exclusion plots paired with open grazing plots, 2 paired sets in each of 5 vegetation types) were established in August 1997 and have been monitored monthly since. Although the analyses are not yet completed, the plots are showing interesting results and will give useful insights into the effects of cattle grazing on native vegetation. In Ecuador, five plots have now been established. The initial plots in Ecuador are located primarily in pasture sites. In these sites, they have already been used with local farmers as a means to discuss impact of livestock and strategies for pasture improvement, especially using native forage species.

In Bolivia, sites for establishment of regeneration plots in both project watershed areas were selected this past summer. Local farmers in the Rio La Sal watershed provided advice for the siting of those plots. In the Tomatirenda watershed, Guarani villagers personally led us to sites they thought would be more appropriate and which have been chosen for establishment. These plots are currently being established.

The protocol and methodology for the selection of plot sites, the size and placement of the plots, and analysis and monitoring of vegetation changes in the plots have followed those first applied in Mexico. Exchange of researchers among the sites and a work session to discuss the methodology at our all-project conference in Mexico in September, 1999, have ensured the comparability of this study. Initial impressions have convinced us of the value of this method for several purposes: 1) for scientific assessment of impact of livestock

on natural vegetation, 2) as a means to assess possible improvement in livestock management in forest and pastures, and 3) as a participatory, educational tool to facilitate collaboration with local farmers.

1B) Cattle foraging studies: In Mexico, we designed a mini-study of cattle foraging behavior carried out by a local student. Cattle were continuously followed and monitored for an entire day to determine diet, forage species selection patterns, daily movement patterns, and habitat use. Preliminary assessments of the data show interesting patterns of cattle use. The cattle are primarily browsers in this area and show distinct preferences for particular slopes and habitats for feeding and for resting. This information will be useful for habitat impact assessment and for designing management practices. The surprising value of this mini-study has led us to plan for comparative studies in the other countries.

*Activity 2.3. Scientific evaluation of ecological processes and impact of livestock.*

*Avian biodiversity in response to vegetation change; importance of keystone species*

2A) Bird Conservation strategies—Mexico: Bird species are excellent subjects for studies of environmental impact due to their visibility, diversity, and importance as ecological indicators. We have completed two different preliminary studies of bird species at very different scales. i) Gap analysis: The first was a study of the likely distribution and conservation status (“gaps” in protection) of endemic bird species of western Mexico within the broad region of our study (southwestern Jalisco). This study demonstrated that the largest number of endemic species are found in low elevation deciduous dry tropical forests and that extremely little of this critical habitat type is

under protection. What is more, this vegetation type is one of those most frequently used by humans and has been extensively fragmented and converted for agriculture. Extensive cattle raising relies on pastures converted from these forests during dry season and on the forests as feeding areas in the rainy season (see comments under Activity 2.3 Part 1 above).

ii) Impacts on bird species composition: The second study was the assessment of bird species diversity in forest fragments and of the influence of vegetation structure on bird community composition and population status within the immediate area of our project: the Zenzontla Ejido. We selected 8 study sites, each with paired transects for censusing birds and for measuring vegetation composition and structure. We used standard bird census methods so that the censuses are directly comparable to other studies and so that they can be easily repeated to monitor changes over time. Measures of vegetation structure at each census site will allow us to assess the influence of vegetation change on bird communities and populations. Our preliminary results have shown that a number of endemic species regularly occur in the riparian forest fragments scattered through our study area.

The next stage of this research will be to determine if these forest fragments are able to maintain reproductively successful populations of these birds species (=population sources) or not (=population sinks). If these forest fragments are population sources, then a land use policy to protect the integrity of these riparian fragments will contribute to the protection of these unique species. However, if they are population sinks, then we would recommend that the conservation interests of Mexico will need to consider creating protected areas on the few remaining larger expanses of this tropical dry forest habitat. The results of our research will

provide the information to decide among two very different conservation strategies. Similar studies are planned for Ecuador and Bolivia and study sites have been identified.

2B) Studies of keystone species: Birds can serve multiple roles as “keystone species” where they play an important ecological role. This is true of fruit-eaters that disperse seeds (e.g., quetzals, toucans, trogons, and the Spectacled Bear), for pollinators (e.g., hummingbirds), and for carrion-eaters (e.g., the Andean Condor). Some of these species also serve as important conservation species in terms of image (flagship species) or in terms of the size of the conservation area needed for conserving them (umbrella species). Both the endangered Andean Condor and the Spectacled Bear are key examples of such species that occur in the broad project area. Systematic studies of keystone bird species, study of the Condor, and study of the Spectacled Bear have all been proposed for Ecuador. The Condor and Keystone bird species studies both received funding this summer and will begin preliminary field work in January 2000. The Spectacled Bear study is expected to begin field work next summer.

*Activity 2.4. Characterization of effects of livestock on production and on landscapes.*

Several clear understandings of the effect of livestock on these varied landscapes have emerged. In the Mexico and Bolivia sites, we have yet to encounter any forest stand without obvious evidence of livestock use. This is to say that livestock use of forests—pigs, horses, and, especially cattle—is extensive and encompasses the forested habitats of these zones. In Ecuador, the pattern is somewhat different; however, due to the extreme wetness of the zone. Nevertheless, in all three areas, livestock have a strong and extensive impact on the ecosystems. Pastures as currently managed in all three

areas are almost uniformly unproductive with little value for livestock production and severe consequences with respect to soil degradation, reduction of quality of ecosystem services, and loss of biodiversity.

The marginality of livestock socially and economically also appears apparent from preliminary studies. The dairy production system our project zone in Ecuador is marginal and may soon disappear as a viable enterprise. In contrast, cattle production is on the increase in Mexico. Although cattle production there also appears marginal for many farmers, the lack of evident alternatives may be a primary contributing factor. More detailed economic studies of livestock activities and alternative economic options are needed at the level of the family and the region; preliminary studies along these lines are in progress.

The recommendations all point to diversification of economic strategies including possible emphasis on smaller livestock. Local coordination of diversification, market analyses, and support for small enterprise development are indicated.

A Stella model of the livestock, agriculture, forest landscape interactions has been constructed and is being refined by Sanchez in Mexico. We hope that this model will prove useful for assessing the impact of alternatives and changes in the current system. If the model proves useful in this regard, we hope to adapt it to be applied in the other countries.

*Activities Experimenting with Alternatives:*

*Activity 2.5. Experiments with alternatives to improve livestock production and reduce impacts.*

*Activity 2.6a. Experiments with soil management practices.*

*Activity 2.6b. Experiments with communal, shade house vegetable production.*

*Activity 2.6c. Experiments with agro-forestry/farm woodlots*

In our search for appropriate alternatives, the host country teams have broadened their scope to experiment with production alternatives that complement agricultural/livestock activities and that provide additional sources of production for home use and/or market. The aggregate of these activities is intended to diversify incomes, to improve local living standards, and to reduce impact on the environment. Activities 2.5 and 2.6a existed in earlier drafts. Activities 2.6b and 2.6c were added to illustrate actions that have been developed in response to local needs.

Currently these activities are limited; but taken together, these all have a part to play in two overlapping programs: a) these are means to increase family resources and diversify family incomes, and/or b) these are means to decrease the costs and reduce the environmental impacts of current practices. The strategies to improve the sustainability of these small farming families need to encompass all their activities; what we need to do is to integrate these separate, pilot actions/experiments into coordinated plans of the communities.

1) Soil erosion practices: In Mexico, the project is continuing previous work to reduce soil erosion by placing the numerous rocks in the field in lines following the contours of the field. Although this method will not stop soil erosion, the lines of rocks act as minimal filter dams reducing the speed of run-off and holding back some sediment along the rock line. Moving the rocks to these lines also helps to open more cultivation space between contour lines. This practice has been widely adopted and

is continuing to be used by local farmers.

2) Agro-forestry: In Mexico, the project has established a tree-nursery working with several native species of locally well-known trees that can be used for green manure, for livestock forage, and for poles and wood in the future. Interested local participants collect wild seeds of the desired trees for the nursery, and the Mexican team developed techniques for germinating seeds of species that had been difficult to plant. Seedlings of selected tree species are planted along the rock contour lines in corn fields. As the seedling grow they will increase the strength and effectiveness of the contour lines in controlling soil erosion; several species will provide green manure with their leaves and some species are nitrogen-fixing. After the crop harvest, cattle are allowed in the fields to feed on post-crop waste. It is at this time that some of these trees will provide additional forage sources for the cattle. In addition, as the trees grow larger they will provide poles or other useful materials. Last summer 2000 tree seedlings were planted; however, draught killed all the seedlings. Nevertheless, six farmers are participating again this year and planted some 6000 seedlings.

3) Improved corn production through reduced use of chemicals: In all the sites, corn (maize) is an important crop providing food for livestock and for local consumption by people. Although corn is a widespread crops, it is also a poor source of income due to low and variable prices. In Mexico, the Project team has established a set of field trial plots with a factorial design to develop and demonstrate cultivation methods that use local races of corn and that reduce the use of pesticides, herbicides, and fertilizers. These methods include selective weeding, encouragement of “good weeds” that reduce pest damage to the corn and/or provide nutrients to the soil, and use of corn waste and

other sources of green manure. The experiments are intended to demonstrate methods that produce better yields in rain-fed fields, lower costs through reduction in use of expensive chemicals, and less environmental damage through that reduction in chemicals used. If successful, this approach is another mechanism to achieve the objectives of Activity 4.1.

4) Pasture improvement: In Ecuador: Methods for pasture improvement are an important priority for local livestock farmers participating with the project. Ecuadorian team members are supporting a series of practices to improve livestock pastures. These include experiments with a mix of two population exotic plants locally valued for good pastures (Kikuyo grass from Africa and Lotus from New Zealand), promotion of diversification of forages using native species, and construction of drainage canals in water-logged pastures. Within the context of these experiments, emphasis has been on a more holistic approach to pasture improvement considering the combined elements of pasture quality, soil potential, and livestock requirements.

5) Farm management plans: In Ecuador, the Project team has worked with a group of local farmers to develop individual management plans for their farms. Using techniques and expertise available to the team along with linkages with government services (e.g., for soil sample analysis), the team members have worked with local farmers to produce three individual farm management plans that promote better more sustainable land uses and practices. In the absence of a strong community for planning, this technique is intended to use individual model cases and encourage farmer support groups to spread the application of sustainable, holistic, scientific land use planning and management.

6) Improvement of the genetic stock of

local livestock. Laboratory work in preparation for this has been proceeding at the UW. The techniques necessary to apply this approach successfully continue to be refined. Although appropriate and feasible communities and producers have been identified as potential sites for a pilot project, limited funding has significantly delayed the field implementation of this initiative.

7) Communal shade house vegetable production: In Ecuador, following on an earlier Peace Corp project initiative, the Ecuador team has supported the continuation and expansion of a multiple family cooperative (now 8 families) growing a wide variety of quality vegetables and herbs for local consumption and for market. Not only are these vegetables serving as an additional source of income, they are enriching the quality and variety of local family diets. In addition, the positive experience and benefit of working together has made this cooperative one core group for additional activities: the three farm management plans that have been developed are for three families of this group. In Mexico, a more recent experiment has been established by the project team. They are intending to develop a cooperative among women to grow shade house vegetables as well as a variety of medicinal plants used by local families. This idea has considerable promise and could easily be taken over by women groups in the community which would also foster additional good will and cooperation.

8) Farm woodlots: In Ecuador, a tree nursery has been established in one community which now has nearly 6000 plants of four tree species intended for a variety of uses such as poles, timber, and fruits. This is intended to provide an additional source of income, but also to reduce pressure of extraction of timber from natural forests, especially illegal cutting within the ecological reserve. In Mexico, the tree nursery established for agroforestry tree

species also includes trees to produce timber and fruits. These trees will be planted with the ultimate intent of converting some fields to woodlots or orchards. Several native trees in the Zenzontla area produce fruits that are collected from the wild by women and children and sold in markets for a temporary profit that is a higher per unit effort than other productive activities including cattle raising. Planting small mixed groves of such trees within villages could increase this potential source of income for families. In Bolivia, each homestead contains one to four local types of citrus trees. These trees produce more than can be used locally, but marketing of the fruits or processed fruit products is an option to consider.

9) Living fences: In Bolivia within the Tomatirenda watershed, it is a common practice to make corrals and fences entirely of wood trunks cut from the surrounding forests. This is due to a lack of expensive wire and the need to make solid fences to keep goats and pigs out of crop fields. These fences represent serious inroads in the decreasing forest areas of the watershed. The Bolivia team is working with the Guarani on communal fields to replace these solid wood fences with solid living fences of a native spiny cactus that is common in the forest and can be grown readily from cuttings.

#### *Activity 2.7. Analysis of landscape using GIS*

PLAN now has a considerable GIS database in all three countries on the bio-physical nature of the landscapes in all three country areas including maps of topography, watershed/drainage patterns, vegetation/land cover, land use and land use change, soils, soil erosion, and soil potential/vulnerability.

These maps form the basis of information to identify land use problems, trends, and potentials at the scale of the region including the small watersheds of the project. These maps constitute an invaluable support for land use planning and for assessment and monitoring. Other studies, particularly socio-economic studies, will take advantage of the GIS to incorporate other factors to allow more meaningful spatial analyses of interactions among multiple factors in explaining current patterns and assessing possible future scenarios.

The landscape/watershed scale is particularly important for planning the multiple types of production activities that could be sustainably incorporated into the agro-ecosystems of these communities. Community planning, assisted by the Project, could transform a seeming smorgasbord of activities into a sustainable whole.

#### *Activity 2.8. Preparation of educational and training materials.*

Limited project materials for educational purposes has been prepared; however, the activities in this area and understanding of its importance is increasing in the overall project. In Bolivia, a brochure explaining the goals and objectives of the project was prepared and used to raise initial awareness and interest in the project. The Bolivia team in collaboration with Erick Roth of CIEC have developed an educational strategy, with the initial studies to be implemented in year 3. It is hoped that the initial strategy developed by CIEC and the Bolivian team in the project area will provide an example to be applied in the other countries in the future.

In Mexico, a physical model of the Zenzontla watershed area was constructed and is ready for educational use. The Mexican team,



however, at this time is not in a position to develop an educational strategy. However, given the extremely limited formal education services currently available in Zenzontla, this could be an excellent opportunity for the Project to make a valuable impact. Additional funds could make this possible.

In Ecuador, extensive educational activities have been taking place with many meetings, talks, and presentations with diverse groups: school children, local residents, and local leaders. In addition, our Ecuador team, with FUNAN taking the lead, has been key in revising the basic curriculum of the Agricultural High School in Baeza to incorporate environmental issues and adapt to specific issues pertinent to the ecological and social situation of the municipality. The goal of the curricular restructuring has been to institutionalize an environmental ethic in the region's young population, which should lead to a sustained and integrated environmental movement in the area.

This area of our work is now seen as even more important for the goals of the project and will be a much higher priority in the proposed years 4-6.

*Activity 3.1. Monitoring socio-economic and cultural factors of current and alternative practices.*

*Activity 3.2. Monitoring soils, livestock, and landscape and the impact of alternative practices.*

The bio-physical/land use work (see Activity 2.7) has identified a number of potential key indicators of land use, soil quality, vegetation

changes, etc.; however, with limited funds we have not had the time or personnel to develop a monitoring scheme for these. Specific activities such as the vegetation regeneration plots and the bird censuses are designed to be monitored; nevertheless, we need to develop a systematic monitoring plan including socio-economic factors and designed to be carried out by local participants. The designing of a monitoring system is a new priority we have identified for year 3 with the intention that we would implement it in the proposed years 4-6.

*Activity 4.1. Establish a process to formalize local community planning activities*

This Activity remains a central objective and was intended to be developed over time as possible and as appropriate with most work on this intended in years 4-6. As discussed under Activity 1.1 under "Community Organization", our work has identified a critical lack of mechanisms for community decision-making, negotiation, and planning in all three country project sites. From our findings we have identified factors that inhibit community organization and opening for participation with particular groups and situations. With this information, we are now beginning to develop strategies to work with community and family groups and leaders to foster and support community organization.

*Activity 4.3 Develop networks and relationships with local government agencies, NGO's, and others.*

In both Ecuador and Bolivia, the project has been involved with making linkages between local community and community groups and the local government, especially at the municipality level (a key level of regional administration in these countries). In Bolivia this is illustrated by the assistance of the Project

in developing a community area environmental development plan for the communities of Fuerte Santiago and Rio La Sal in Bolivia (see Activity 1.1, par. 2 under Community Organization) and by the establishment of a convention with the Community Assembly of Guaraní people of Tarija to implement project PLAN in the Tomatirenda watershed.

In Ecuador, FUNAN is working with the Municipality of Baeza which has jurisdiction over the project area. The municipality and other local authorities have been included in a campaign of environmental education aimed at increasing environmental awareness. This training provided to important decision-makers has opened the door to public analysis of environmental problems in the region, the search for solutions, and a greater participation of politicians and governmental workers in environmental issues and campaigns. As a result of this effort, the Baeza municipality has created a department dedicated solely to resolving environmental problems. This, FUNAN hopes, will institutionalize environmentalism at the level of local government, and result in more permanent efforts towards sustainable development in the region.

In Mexico, there are long established linkages between IMECBIO and the communities of the Zenzontla Ejido, the government administration of the Sierra de Manantlan Biosphere Reserve that includes the large portion of the land area of the Ejido, and the municipality of Tuxcacuesco that includes Zenzontla. Local previously existing political problems within the community, however, currently present difficulties for community participation in the project. It will be a challenge of PLAN to work with the various groups involved to develop a more favorable situation for community participation and planning. This will be a priority in future work.

#### *Activity 4.4. Outreach to and exchange with other communities in the region and in the U.S.*

We still plan to initiate a “farmer to farmer” exchange of information by inviting U.S. farmers who are involved in environmental and water issues of management to attend our year end meeting/workshop to talk to local researchers from all three countries and to talk to local farmers in the host site of the conference. However, limited funding has forced us to delay this planned “farmer to farmer” exchange. Nevertheless, we still find this idea exciting and worthwhile; we hope to incorporate this type of exchange in our proposed years 4-6.

#### **GENDER**

##### *Gender: Women and men as targets of the project.*

During the past two years, one of the central missions of project PLAN has been to analyze and search for appropriate ways in which to equitably and fairly incorporate and support both men and women of all ages through project initiatives. However, this mission can not be imposed upon the communities in their efforts to plan their own development and participation. While keeping respect for cultural differences, we have attempted to raise awareness of the importance of all social groups including both men and women, by incorporating gender as an analytical theme in most investigative efforts and using both men and women as research informants. Most notable of these efforts are the auto-diagnostics of all three countries as well as all research of a social, economic, cultural, and/or historical nature.

In addition to raising gender awareness,

studies which take into account gender and age of research subjects have been key in understanding dynamics characteristic of target populations, such as their varying production strategies, their levels of organization, their differing perceptions and motivations. They have been useful in deconstructing the household as a unit of analysis, exposing important differences in strategy, organization, and perception between members within a single household. Finally, using gender as an analytical tool has been useful in identifying potential bottlenecks for well meaning initiatives meant to incorporate women, a group often overlooked by agricultural outreach and extension.

We now have a series of studies incorporating gender in progress in each region; some key examples are listed here: Ecuador: 1) Productive strategies and local perceptions of natural resources, 2) Relationship networks and social capital in the Cosanga River watershed, 3) Trends and processes of colonization in the Cosanga River watershed. 4) Household productive and reproductive diversification, impact on environment of different activity portfolios, carried out in Cosanga River watershed; Bolivia: 1) Historical inventory of La Cueva and Tomatirenda, 2) Analysis of productive and household strategies in the Tomatirenda and Rio La Sal watersheds and 3) Local perceptions of wealth; Mexico and Ecuador: 1) Analysis of time use, intrahousehold resource distribution and decision-making, and participation in project activities, carried out using the same methodology in Zenzontla, Mexico, and in the Cosanga River watershed in Ecuador.

Even more important than including women as research subjects, and yet lagging behind in compliance, is the equal participation of women in project activities which put them in a position of power over decision-making

and income generation both in their households and communities. This type of inclusion has been very difficult, considering the cultural, generational and educational barriers to female participation that exist in all of the project communities. Considering these barriers, each step forward is significant, and some should be highlighted. In Zenzontla, Mexico, one of the twelve principal project participants is a female head of household who donates her irrigation fields for the corn experimentation as well as her family labor for agroforestry work. She also is the main force behind the establishment of a community medicinal herb garden in collaboration with project personnel. In Bolivia, a community group in charge of planning, mapping and officiating territoriality and land conflicts in the La Sal River watershed is headed by a woman, and two of its six members are women. Finally, in the Cosanga River watershed in Ecuador, 31% (15 / 49) of the project participants are women.

Project PLAN recognizes that a necessary condition for sustainable development of these watersheds is the achievement of equity among different actors in the watersheds, and therefore strives to “even the scales” between men and women, of all ages, ethnicity, and socio-economic levels. PLAN is developing the working hypothesis that the diversification of household productive activities will provide alternatives to the traditional dual production strategy of corn and cattle and in turn decrease the negative environmental effects of these activities on the vegetation, soil, and water resources of these watersheds. PLAN is also developing the related working hypothesis that household activity diversification that places more resources and decision-making control in the hands of women will result in more investment in women and children thereby enhancing the quality of livelihoods and opportunities of families and generally

promoting more familial and community well-being than the expansion of activities under male control. For these reasons, PLAN is actively seeking ways to promote the development of more organizational and income-generating opportunities for women and young people in all three of its project sites.

*Gender: Women and men as project collaborators*

Overall, among the 55 collaborating personnel, 15 are women. At the UW-Madison, two of nine collaborating professors and scientists are women. However, those two are key among the five currently most active participants. The project's assistant coordinator is a woman, and five of the eight UW students whose research was supported by the project this past year are women.

In the past year, two key women leaders (Carmen Josse from Ecuador and Dominique Louette from Mexico) left for personal reasons unrelated to the project) thus reducing the number of women in director/coordinator positions, women still play a strong role in the coordination and implementation of project initiatives. In Mexico, three of fourteen professionals involved in the project are women, one, Maria del Rosario Pineda L., at an administrative level. One of the three students from Mexico supported by the project is a woman. In Ecuador, two of our collaborating institutions, Terranueva and FUNAN are both headed by women, and Kattia Hernández of Heifer Project-Ecuador is the assistant to the country coordinator taking on many of the coordinator responsibilities for PLAN. In Bolivia, two of the twelve professionals are women, one of which, Pilar Lizarraga, in charge of coordinating the social/community aspects of the project, has had a strong influence in advances in Project PLAN in Bolivia as well

as the entire project. The natural leadership abilities of both Pilar Lizarraga and Kattia Hernández were demonstrated during the five day conference in México this past September, as they collaborated with the project's principal coordinator to organize and facilitate the last two days of the conference that included the planning of the project for the proposed years 4-6.

**POLICY**

Key local counterparts (IMECBIO in Mexico, FUNAN in Ecuador, CER-DET and ZONISIG in Bolivia) have authority to work in the region and have working agreements with local authorities and communities. These established contacts and linkages have been and will be maintained and developed as avenues through which to address policy issues arising during the implementation of Project PLAN.

In Mexico, the completion of the participatory diagnostic of the Ejido of Zenzontla was concluded with an open public meeting with community leaders, the president of the municipality, the director of the administration of the reserve, and the rector of the University of Guadalajara – CUCSUR in attendance. The meeting brought forth issues and problems highlighted in the diagnostic to serve as a basis for open dialogue. This allowed local people the opportunity to express frustration and make requests directly to authorities, and allowed authorities to make amends and resolve certain longstanding problems, most notably those of potable water and electricity. IMECBIO's facilitation of the open forum bridged a gap between the community and governmental authorities as well as between institutions working in the area. This bridge has continued to allow for dialog among the community members, project researchers, and local authorities, leading to some sorely needed

infrastructure improvements in the area and a greater understanding between all actors in the watershed.

Highlighting one of the important linkages between organizations working in Zenzontla, IMECBIO has a collaborative working agreement with, and has received supporting funds from SEMARNAP-INE, the government agency that administers the biosphere reserve that encompasses the main part of our site. This agreement involves the promotion of terracing on steep fields through the placement of rocks and the planting of selected tree saplings along contour lines. The purpose of this activity is to improve soil conservation, increase the stability of terracing, and enrich the soil with nitrogen fixing leguminous trees. Sergio Graph, the director of the Sierra de Manantlan Biosphere Reserve under SEMARAP-INE and his deputy Gomez Martinez both participated formally in our all-project conference in Mexico in September, 1999. We are hoping to develop a closer working relationship with SEMARNAP-INE in the future.

In Ecuador, FUNAN is working directly with INEFAN, the government agency in charge of natural resources and the administration of the Reserva Ecologica Antisana, for which our project area is a buffer zone.

Also, FUNAN is working with the Municipality of Baeza which has jurisdiction over the project area. The municipality and other local authorities have been included in a campaign of environmental education aimed at increasing environmental awareness. This training provided to important decision-makers has opened the door to public analysis of environmental problems in the region, the search for solutions, and a greater participation of politicians and governmental workers in environmental issues and campaigns. As a result

of this effort, the Baeza municipality has created a department dedicated solely to resolving environmental problems. This, FUNAN hopes, will institutionalize environmentalism at the level of local government, and result in more permanent efforts towards sustainable development in the region.

Finally, FUNAN has been key in revising the basic curriculum of the Agricultural High School in Baeza to incorporate environmental issues and adapt to specific issues pertinent to the ecological and social situation of the municipality. The goal of the curricular restructuring has been to institutionalize an environmental ethic in the region's young population, which should lead to a sustained and integrated environmental movement in the area.

In Bolivia, the project has a collaborative relationship with the administration of the Tariquia Natural Wildlife Reserve of the General Direction of Biodiversity in the Ministry of Sustainable Development and Planning, since the project area is found within the reserve's buffer zone. ZONISIG, is working at the project site under a convention with the Municipality of Entre Rios to assist land planning in the region including the area of both watersheds involved in the project.

In the two communities of the La Sal River watershed, the project is generating a process of reconstruction of the watershed's local organization, and this process has produced a formal communal management plan. This plan is fulfilling the requirement for the creation of community plans under the new Bolivian Popular Participation Law. It will be discussed in depth with local institutions responsible for land planning in accordance with Bolivian legal norms. Project PLAN has also established a Convention with the Community Assembly of Guaraní people of Tarija to implement project

PLAN in the Tomatirenda watershed.

Generally, investigative work in all three countries' project sites regarding activities 2.1 and 2.2 of the project's work plan has produced a picture of production systems in the watershed taking into consideration social, economic, and cultural constraints. This work has and will identify policy and market factors that have impacts on current land use and production practices and strategies of the target communities and watersheds. Taking into account the wealth of information already compiled, measures which may improve the policy environment is being developed and will be completed in subsequent years of the project.

#### OUTREACH

Outreach to farmers, farming families, and local community members: Outreach is an implicit element in the approach and objectives of this project: Objective 3: "to generate a participatory process for planning, implementing, and monitoring," and Objective 4: "to establish a long-term community planning process for natural resource and livestock management," require education and open exchange of information and ideas from the initiation of the project.

**1) Education strategy:** To accomplish this, our Bolivian partner, CIEC (Interdisciplinary Center for Community Studies) designed a strategy to guide the development of outreach/ education components for four key target groups: 1) authorities and local leaders, 2) farmers, producers, and resource users, 3) families (parents and children), and 4) local teachers and students. Lack of funding has delayed the incorporation of education components; nevertheless, Erick Roth of CIEC has worked with the Bolivia team in Tarija and the Ecuador team to create two workshops. These workshops

included not only participants from our partner organizations but also delegates from the communities found in the area of influence of the project. This educative strategy developed took into account the following aspects:

- Creation of the educative proposal according to the project's goals.
- Definition of primary educative needs that justify the implementation of the educative component.
- Identification of potential receptive communities for the educative program.
- Consideration of topics and educative contents to be considered by the program.
- Appropriateness of possible didactic support material to be produced.
- Prioritization of the activities to be carried out in a short term, according to the advance of the rest of the components, along with responsibilities and a tentative schedule.

This comprehensive strategic and participatory approach to education is rarely incorporated explicitly and effectively into development projects. Nevertheless, the severe limitation of funds has prevented us from implementing this strategy. At the end of the second year, we can now see more than ever the importance of a comprehensive education program.

**2) Educational Activities:** Education activities in the project area remain strong in Ecuador; however, we have not had the resources for a more project focused, comprehensive program. The Bolivian team in conjunction with CIEC is planning on initiating the research phase of an education program in the third year. In Mexico, lack of resources and available personnel as well as political difficulties in the target communities have delayed the creation of an education strategy for that area. However, Salvador Garcia of the Mexico team guided the

construction a three-dimensional model of the Zenzontla Ejido watershed area. This was the first of these models to be constructed for the project. When the model was shown to residents of our study area, they immediately recognized the landscape and could identify the location and aspect their and other peoples' fields. The model demonstrated the instant recognition and identification with their home landscape as we had expected. We now need models of our other areas and an education program that can use this special tool to its full advantage.

**3) Information Exchange:** Informal discussion of project objectives and exchange of information happens regularly as part of our project activities, especially in Bolivia and Ecuador. A special opportunity for broader exchange of information occurred during our first all-project meeting in Mexico in September, '99. A special meeting of all the project participants in the community study area allowed local residents to observe and question a series of project activities in the field. This was followed by a slide show of our project activities in Mexico, Ecuador, and at the two sites in Bolivia attended by more than 100 residents. This show allowed residents an opportunity to see what was being done with other communities in other countries and to question directly the team members from those countries. The unprecedented turnout and very positive response as well as the kind of questions posed confirmed the interest and value in this type of exchange. The experience was followed by a list of recommendations for follow up work by all the team members participating in this event (see p. 1, 6-7 in the GL-CRSP fall '99 newsletter).

Outreach with other communities and with farmer planning groups in the U.S.: Outreach with other communities in the regions of our target communities was scheduled to

begin in the second three years of the project. We had, however, originally planned with Heifer Project's U.S. and Canada program to sponsor participation of delegates from Hispanic farmer planning groups in New Mexico and Texas at our annual project meetings so that they could witness the approach and experiences we are having with sustainable natural resource and livestock planning with the rural farming communities of our sites. The first meeting originally had been planned for the end of the first year in Mexico. Reduction in funds forced us to delay this meeting until the end of the second year. With the severe limitation of our funds, we did not have funds to bring the Heifer Project farmers to our all-project workshop/conference in Mexico. The U.S. farmers would have had an opportunity to see our approach in action and would have been able to exchange ideas and experiences directly with host-country farmers. The experiences of U.S. farmers participating were intended to be communicated among the 40 groups of farmers in the Heifer Project's U.S. and Canada program. We think that this type of exchange would be valuable for farmers on both countries, but need additional funds to make this connection feasible. This will be a component in our proposal for years 4-6.

#### DEVELOPMENTAL IMPACT

##### Environmental impact and relevance:

*a) Biodiversity:* All three of our sites are in areas that are in buffer zones of nature reserves with international significance in terms of uniqueness and value of their biodiversity. Better land use practices in these areas will play a direct role in enhancing the stability and security of the nature reserves as well as contributing to conservation of biodiversity of the sites themselves, thereby enhancing the prospects of

conservation of valuable biological resources on a regional scale.

The relevance of natural biological diversity to these projects is complex and many fold. Five examples from our work in year two will illustrate this.

1) Bird Conservation strategies—Mexico: Our research has shown that that our study area is rich in Western Mexico endemic bird species and that the tropical dry deciduous forests that contain the majority of these species are being highly fragmented and modified. Virtually none of this critical habitat is protected as a nature reserve. Our recent research has shown that a number of endemic species regularly occur in the riparian forest fragments scattered through our study area. The next stage of this research will be to determine if these forest fragments area able to maintain reproductively successful populations of these birds species (=population sources) or not (=population sinks). If these forest fragments are population sources, then a land use policy to protect the integrity of these riparian fragments will contribute to the protection of these unique species. However, if they are population sinks, then we would recommend that the conservation interests of Mexico will need to consider creating protected areas on the few remaining larger expanses of this tropical dry forest habitat. The results of our research will provide the information to decide among two very different conservation strategies. We believe that the forest fragments are likely to be population sources; in which case, our overall land use planning strategy could have additional important conservation benefits.

2) Pasture enrichment—Ecuador: Pasture improvement is an important concern of farmers in our study area. The Vegetation regeneration plots in Ecuador are situated in pasture areas and have been serving as a means to promote

the potential nutritive value of the rich diversity of native forage species regenerating in the plots.

3) Database of non-timber and timber forest products—Ecuador: The Ecuador team is producing a database of all useful plants that occur in the area of the project. This database which now includes ?? plant species will serve as a valuable resource for inventory and assessment of the value of the biological resources of the area and as a source for ideas for capitalizing on local resources available for local benefits and possible local economic gain.

4) Watershed protection—Bolivia: Assessment of bird communities in different vegetation types in the study area has led to a diagnosis of particular native mid-altitude montane riparian forests being nutrient poor systems with extremely low capacity for recovery from disturbance of the plant cover. As such these forests have little value for agriculture or forestry, but great value for protecting the upper watershed of the streams that feed the agro-ecosystems below them. The forest appears to be uncut and harbors forest bird species that would be expected in the more extensive areas of montane forest.

5) Eco-tourism—Bolivia: One farmer is attempting to preserve a special river oxbow habitat with a rich variety of water birds including species which are rare in the area due to loss of habitat and unrestricted hunting. This farmer has hopes that we could help identify the value of the site for bird-watchers and to promote visits of bird-watcher tourists from the capital city. The beauty of the place, the special species that could be easily viewed, and the accessibility of the site could serve as an minor attraction for eco-tourism. Even a very small economic supplement from occasional eco-tourists could be significant in supporting the protection of this private reserve.



*b) Ecosystem services:* The approach to sustainable land use promoted by our project would contribute directly to reducing erosion and to maintaining ecosystem services within the watersheds of the study sites. The water from these regions is critical to the surrounding regions in all three countries where there are simultaneously problems of water shortage and flooding due to watershed degradation at similar sites within these regions. Water availability and quality are important basic concerns in all three sites, but especially in Bolivia and Mexico. The potential value of land use planning in helping deal with this concern is perhaps the most important secondary benefit that our project has to offer these communities. (See the linkage with biodiversity under example 4) in the previous section).

**Agricultural Sustainability.** Our project is designed to incorporate the concepts of ecological sustainability by focusing on land use practices and how they change the productive and service options of the land. Conditions, changes, and trends in key properties of different soil and vegetation types under particular land management practices will be monitored. By using appropriate indicators whose interpretation and applicability is clear to both farmer and scientist, farmers and their communities will have the basis for making decisions that would lead to sustainable land use to maximize the long-term productive options available. Defining and evaluating sustainable management strategies for these tropical sites cannot be a single time prescription. Sustainable use will require a farmer/community monitoring system that is cheap and easy and that provide practical feedback to guide individual and community planning. This said, these indicators and monitoring system were scheduled to begin in years 2 and 3. Reduction in funds in years 1 and 2 reduced the scope and timing of

identification of indicators and implementation of a pilot monitoring system.

**Contributions to U.S. Agriculture.** Our approach, including indicators of sustainability and a farmer/community-based monitoring system, would be of use and interest in aiding farmers to achieve a more ecological integration of natural forest systems and agricultural and livestock production. Our direct attempt at establishing this link was through a “farmer to farmer” exchange arranged through Heifer Project’s U.S. and Canada program. As described under section 7, “Outreach”, the U.S. farmers would have had an opportunity to see our approach in action and would have been able to exchange ideas and experiences directly with host-country farmers. The experiences of U.S. farmers who would participate were intended to be communicated among the 40 groups of farmers in the Heifer Project’s U.S. and Canada program. We expect to include this exchange in our proposal for years 4-6.

#### **Contributions to Host Country.**

**1) Benefits to environment and sustainable development.** The host countries will benefit from 1) conservation of unique natural systems and associated biodiversity, 2) reduction in further degradation of ecosystem services and water quality and stability in critical watersheds, and 3) enhanced quality and stability of life for rural communities in areas of poverty and instability. Sustainable management of natural resources and livestock production at the scale of the watersheds of our project will directly contribute to these benefits. At the end of two years, however, we are at the very earliest stages of understanding and assessing the situation and at early stages of enrolling local farmers and communities in the project and its goals and approach.

## 2) Strengthening host country educational institutions.

*Ecuador:* Our Ecuador team, with FUNAN taking the lead, has been key in revising the basic curriculum of the Agricultural High School in Baeza to incorporate environmental issues and adapt to specific issues pertinent to the ecological and social situation of the municipality. The goal of the curricular restructuring has been to institutionalize an environmental ethic in the region's young population, which should lead to a sustained and integrated environmental movement in the area.

*Mexico:* Two of the UW students from Mexico, Sarahy Contreras and Oscar Cardenas who were supported through and working with Project PLAN, are now in the position of researchers/professors at the University of Guadalajara-CUCSUR teaching and continuing research as formal participants of Project PLAN.

*Bolivia:* Two students of Universidad Autonoma Juan Misael Saracho in Tarija have been doing research for their Licenciatura degrees supported by Project PLAN under the supervision of Jorge Ruiz who in addition director of Zonisig and strong participant in Project PLAN is also a professor at the Universidad Autonoma. We have plans to involve more host country university students in our project in the future in all three countries.

## 3) Strengthening capacity for host country to create sustainable development and solve environmental problems and conservation/development conflicts.

PLAN's host country partners are largely rural development or conservation NGO's. One, Heifer Project International—Ecuador, is a local branch of a U.S. based international NGO. All the others are in-country local regional NGO's. Mexico is an exception with our partner being a national

university. This is a special case in that the IMECBIO institute within the University of Guadalajara—CUCSUR was created with a mandate for conservation and development oriented research and actions within the Sierra de Manantlan Biosphere Reserve.

*Mexico:* Project PLAN by its comprehensive, interdisciplinary nature and by its participatory collaborative approach has been and will create opportunities for the IMECBIO institute to assist their own research plans within the region of our study area. IMECBIO has also recently begun a new timely and instantly popular interdisciplinary undergraduate degree in ecology and natural resources management. Project PLAN provides an excellent opportunity for undergraduate thesis research for the new wave of students attracted to this unique and exciting degree program.

*Ecuador:* The Ecuador team has emphasized in their annual report that one major result of this project has been the formation of a research/working group of four NGO's that is clearly identified and committed to work in the watersheds of our study area. The open exchange of ideas and close collaboration among these NGO's is very unusual and has two major benefits: 1) researchers from the four NGO's with different backgrounds have all gained in knowledge and perspective from the interdisciplinary focus on the full set of cross-cutting themes of the project, and 2) the positive working environment that has developed among them, has put them in a position to collaborate more broadly on other issues and projects within the region.

*Bolivia:* The researchers from the NGO's of Bolivia have benefited similarly to those in Ecuador through the positive interactions of the participants. Two special examples deserve recognition: 1) ZONISIG, a government

and Netherlands Cooperation project of Bolivia, has benefited from the holistic vision interdisciplinary approach of Project PLAN in the manner in which they are approaching their other sustainable development planning projects within a larger area of the same region. Jorge Ruiz, Director of ZONSIG said the "The experience of Project PLAN has been very useful in municipal planning." 2) Several of the NGO participants have seen through the approach of Project PLAN the value and necessity of research as part of rural and regional development and have formed a new holistic, interdisciplinary research group under the name "Comunidad de Estudios JAINA." PLAN hopes that it will be possible to support the initial establishment of this unique research NGO in the second three year phase of the project.

#### **Linkages and Networking.**

a) Within target countries: This project has already fostered and strengthened linkages among the partner organizations in Ecuador and Bolivia.

b) International linkages among the three target countries: With sites in three widely separated countries with differences in biotic and cultural situations, we have been working to enhance both the quantity and rapidity of exchanges via an email link "PLAN" which allows information to be posted to all main participants including those from other universities and groups outside the project countries. We have worked to generate a real partnership in a common project with input from all partners. All three project country teams have now chosen their own country coordinator and manner of coordination and representatives of each country have and will continue to attend the GL-CRSP annual conferences. We also have established valuable linkages among the four main teams in Wisconsin, Mexico, Ecuador and Bolivia.

We have been working to expand the exchange of researchers among the three areas. This emerging network of interaction will provide a more fertile basis for entry of other interested participants and organizations. The initial and ongoing policy of frank, open sharing of information and mutual trust has played no small part in building a strong, committed multi-country partnership with a shared vision.

**Collaboration with international research centers (IARCS) and CRSP's.** The start of our project in Ecuador came at a time when the SANREM-CRSP was under review and not open for considering collaboration. Our restricted budget during the first two years has not allowed much opportunity for joint activities. We will explore options for future exchange with SANREM through our Ecuador team partners.

#### **OTHER CONTRIBUTIONS**

**Compliance with Mission objectives.** At the U.S.A.I.D. Missions of both Ecuador and Bolivia, we were informed that our project coincides closely with the Mission's objectives and that, in both countries, our sites are in areas of high priority.

**Concerns with individuals, democracy, and humanitarian assistance.** The goal of our project is to increase the quality of life of families of poor rural communities and to foster community-based planning of sustainable land use. The majority of our clients are small producers and many of the people in our regions came as colonists from resource-poor areas. This project offers direct assistance to these farmers and their communities. Our goal of participatory community-based planning is directly an activity that will enhance decision-making abilities of the local people at the scale

of their communities. This is promoting and effecting democratization.

#### LEVERAGE FUNDS AND LINKED PROJECTS

We have obtained substantial funds from the University of Wisconsin-Madison well beyond the matching funds (this includes three 12 mos graduate student research assistantships and \$5,000 in travel funds). In addition, we have been actively applying for other grants as well as applying resources from other grants when possible. Our target country partners have been able to accomplish several project objectives with funds for other projects with overlapping, compatible objectives. The list of funds obtained for or applied to objectives of this project and the amounts are listed below.

##### *UW-Madison-based grants:*

USIA “NAFTA” Grant for a U.S., Canada, Mexico exchange: “Partnership for Environmental Stewardship” P.I.s: Thomas Yuill (UW-Madison), Eduardo Santana C. (CUCSUR, U. de Guadalajara), and Michael Moss (U. of Guelph). This project funded some work of Project PLAN. (The concept of the livestock-natural resource project was originated under this “environmental partnership” in 1995.) . ~\$9,000

Babcock Institute for International Dairy Research and Development. “Cross-breeding to improve dairy cow genetics in Ecuador.” Jack Rutledge, P.I. \$15,000

UW-Madison, NAVE Summer Research Grants in Latin America and the Iberian Peninsula: “The introduction of intensive livestock management and its effects upon different households in the Zenzontla Ejido, Jalisco, Mexico,” Alexis Eakright, P.I. \$1,500

UW-Madison, J. J. Davis Fund, 

Department of Zoology: “Abundance and distribution of birds in grazed habitats of Zenzontla, Sierra de Manantlan Biosphere Reserve, Mexico,” Yoyi Hernandez, P.I. \$2,000

Bioreserva del Condor Project of USAID and TNC (The Nature Conservancy): “Hummingbird pollination and conservation of Andean biodiversity.” Robert Bleiweiss, P.I. \$10,000

Bioreserva del Condor Project of USAID and TNC (The Nature Conservancy): “Behavioral and geographical ecology of Andean Condors in Ecuador.” Robert Bleiweiss, P.I. \$25,000

##### *Host Country-based grants:*

##### Mexico

UC MEXUS-CONOCYT Collaborative Grant: “Sustainable livestock management in forest ecosystems in the Sierra de Manantlan Biosphere Reserve.” John W. Menke, Original P.I.; Emilio Laca, Current P.I., Agronomy and Range Science, UC-Davis, Lazaro Sanchez, IMECBIO, CUCSUR, Universidad de Guadalajara, Co-P.I. We submitted this proposal with John Menke and our Mexican counterparts. This grant was successful. With John’s retirement, Emilio Laca agreed to take over the P.I. role at UC-Davis and to begin a small collaboration with our project at the Mexican site initially. \$14,999

DFID (UK Department of International Development) “Programa de desarrollo agroforestal Sierra de Manantlan”, Enrique Jardel, P.I. This large project funded several aspects of PLAN work as well as other work directly useful to PLAN objectives. 14,210

SEMARNAP-INE: “Development of a system of agroforestry in the Ejido of Zenzontla

as an option to improve systems of cultivation on slopes.” Lazaro Sanchez, P.I. \$2,105

Fondo Mexicano para la Conservacion de la Naturaleza: “Conservacion de la biodiversidad y la ganaderia extensiva: bases para una ganaderia sustentable compatible con los objetivos de la reserva de la biosfera Sierra de Manantlan.” Lazaro Sanchez, P.I. \$3,315

IMECBIO (Insituto Manantlan de Ecologia y de la Conservacion de la Biodiversidad), CUCSUR (Centro Universitario de la Costa Sur), UDG (University of Guadalajara): “Sustainable agriculture in the region of Zenzontla through appropriate use of natural resources.” Lazaro Sanchez, P.I. \$2,282

IMECBIO (Insituto Manantlan de Ecologia y de la Conservacion de la Biodiversidad), CUCSUR (Centro Universitario de la Costa Sur), UDG (University of Guadalajara): “Management of natural resources in the Ejido of Zenzontla: development of a holistic model.” Lazaro Sanchez, P.I. \$6,694

### Ecuador

PROBONA: “Proyecto Cosanga” FUNAN (Fundacion Antisana). \$16,000

Convenio FUNAN-OIKOS: “Educacion ambiental en Cosanga”. \$4,000

Convenio FUNAN-ECOCIENCIA: “Investigacion sobre el oso Andino y educacion ambiental en Cosanga”. \$40,000

### Bolivia

Cooperation del Gobierno de los Paises Bajos (The Netherlands Government Cooperation with Bolivia), “Proyecto del zonificacion agroecologica y establecimiento

de una base de datos y red de sistemas de informacion geographica en Bolivia.” This project funded GIS, mapping and land cover/land use work in a large area that included the Project PLAN sites. The quantity listed is an estimate of the portion that was expended in the PLAN study sites. ~\$30,000

World Bank, Red de Reduccion de la Pobreza y Gestion Economica, El Grupo Sobre la Pobreza, “Consultas con los pobres.” This project paid for work on social stratification in the area of Project PLAN that contributed to this large World Bank project and to the objectives of PLAN. \$2,000

*Total Leveraged Funds: \$198,105*

### TRAINING

The following students have been funded or partially supported by our project for thesis studies useful to the objectives of the project.

#### *Degree*

*[These students were not supported by USAID funds; but their degree research is designed to contribute directly to this project. Some are provided a small amount of support in the form of partial support for travel and/or field costs.]*

Adautt, Samuel. B.S. June 2000. Climate

and Botany: Evaluation of pasture productivity and impacts on natural vegetation, Tomatirenda watershed, Bolivia. Universidad Autonoma Juan Misael Saracho. Bolivia

Cardenas-Hernandez, Oscar. M.S. completed Dec. 1998. Conservation Biology and Sustainable Development: Analysis of changes in land cover and land use from 1971-1993, Zenzontla, Sierra de Manantlán Biosphere Reserve, Mexico. Institute for Environmental Studies, University of Wisconsin-Madison. USA

Cardenas-Hernandez, Oscar. Ph.D. June 2001. Land Resources: Effects of government policies and market forces on land use decisions; comparative study of six communities in Sierra de Manantlán Biosphere Reserve, Mexico. Institute for Environmental Studies, University of Wisconsin – Madison. Exchange with University of Guadalajara – CUCSUR. USA / Mexico

Contreras-Martinez, Sarahy. M.S. completed Jan. 1998. Conservation Biology and Sustainable Development: Gap analysis, conservation of birds in Western Jalisco, including the Sierra de Manantlan Biosphere Reserve, Mexico . Institute for Environmental Studies, University of Wisconsin-Madison. USA

Eakright, Alexis. M.S. (Double) Aug. 2001. Conservation Biology and Sustainable Development; Agricultural and Applied Economics: Socio-economic evaluation of technology adoption and participation, Zenzontla, Sierra de Manantlán Biosphere Reserve, Mexico. Institute for Environmental Studies and Dept. Of Agricultural and Applied Economics, University of Wisconsin – Madison. USA

Erdmann, Joshua. Ph.D. June 2003. Zoology: Ecological interactions of keystone fruit-eating bird species and fruiting plants, Cosanga, Ecuador. Dept. of Zoology, University of Wisconsin-Madison. USA

Esparza, Juan Pablo. B.S. Feb. 1999. Ecology and Natural Resources: Habitat use and foraging patterns of livestock in Zenzontla, Sierra de Manantlan Biosphere Reserve, Mexico . IMECBIO, CUCSUR, University of Guadalajara. MEXICO

Flores, Nelson. B.S. June 2000. Climate and Botany: Evaluation of pasture productivity and impacts on natural vegetation, La Cueva, Bolivia. Universidad Autonoma Juan Misael Saracho. Bolivia

Galasso, Louise. M.S. May 2001. Conservation Biology and Sustainable Development: Ecological and economic analysis of crop raiding by Spectacled Bear, Cosanga, Ecuador. Institute for Environmental Studies, University of Wisconsin - Madison. USA

Hernandez, Yoyi. M.S. May. 2000. Conservation Biology and Sustainable Development: Abundance and distribution of birds in grazed habitats of Zenzontla, Sierra de Manantlan Biosphere Reserve, Mexico. Institute for Environmental Studies, University of Wisconsin-Madison. USA

Men, Hong Hseng. Ph.D. Jan. 2000. Animal Science: Control of maturation of oocytes in cattle, and cryopreservation of oocytes in cattle. Dept. of Animal Science, University of Wisconsin-Madison. USA

Rojas, Kari. M.S. May 2000. Agricultural and Applied Economics: Socio-economic evaluation of technology adoption and participation, Cosanga, Ecuador. Dept. of Agricultural and Applied Economics, University of Wisconsin - Madison. USA

### *Non-Degree*

Freddy Chavez. Certificate July 1999. Community Forestry. Centro de Estudios Superiores Univeritarios, CERES-F TPP (FAO). Bolivian

Pilar Lizarraga. Certificate July 1999.

Community Forestry. Centro de Estudios Superiores Univeritarios, CERES-FTPP (FAO). Bolivian

Carlos Vacaflores. Certificate July 1999. Community Forestry. Centro de Estudios Superiores Univeritarios, CERES-FTPP (FAO). Bolivian

### *Workshops and Conferences*

Conference/Workshop: "Planification Local Agropecuaria y de la Naturaleza (Local Planning for Agriculture, Livestock, and Nature)"

Location: IMECBIO, CUCSUR, Universidad de Guadalajara, Autlan, Mexico

Dates: 27 September—2 October, 1999

Participants: 31 of the active participants of the project (16 from Mexico, 3 from Ecuador, 6 from Bolivia and 6 from Wisconsin)

Institutions: UW-Madison and all but one of the regional institutions of the project were represented.

Purpose: Presentation and review of progress of each regional group; exchange of experiences, ideas, commentary, etc.; visit to the Mexico project site; and planning for the second phase of the project.

Although we did not have sufficient funds to budget for this conference, we realized in spring, 1999, that a meeting of the principal participants from all four teams was needed. We rebudgeted travel money for participants to travel to Mexico, some travel money was contributed by our NGO partners in Bolivia, and the University of Guadalajara-CUCSUR provided the funds to host the conference in Mexico. This all-project conference served as a very important means to unite the four teams and to plan future directions and research together. A description of this conference is in the GL-CRSP fall '99 Newsletter.

### **COLLABORATING PERSONNEL**

#### *Ecuador:*

Baez, Sara. TE – Terranueva. Director of Terranueva. Lawyer, Anthropologist. Advice on anthropological perspectives and participatory work. Ecuadorian

Ballesteros, Hector. HPI - Heifer Project International – Ecuador . Veterinarian. Animal Science. Implementation of livestock genetic improvement with J. Rutledge of UW. Ecuadorian

Calispa, Fabián. TE. Agroecologist, Sustainable agriculture. Evaluation of livestock production, pastures, and agroecosystems. Ecuadorian

Fuentes, Patricio. CDC. Botanist. Botanical support and research of non-timber forest products. Ecuadorian

Hernandez, Katty. HPI. Anthropologist. Community auto-diagnostics, community participation and organization, environmental perspectives. . Ecuadorian

Larrea, Fernando. HPI. Coordinator. Director of HPI-Ecuador. Anthropologist. Analyses of community production strategies, impacts of social and cultural aspects of sustainability. Development of community diagnostic methods. Coordination of project and advice on integrated community development approaches. Ecuadorian

Mosquera, Gustavo. FUNAN – Fundación Antisana. Technical Director. Biologist. Directs projects related to resource management around the Antisana Reserve. Biodiversity studies and environmental education. Ecuadorian

Murillo, Isabel. FUNAN. Sociologist. Community studies, social work, environmental education. Ecuadorian

Pedro Ponce. CDC. Director. Biologist. Support in application of mapping and GIS.

Ecuadorian

Manuel Serano. FUNAN. Forester. Research support, impact of natural resource use on vegetation. Ecuadorian

Victor Utreras. FUNAN. Biologist. Research support, animal biodiversity studies. Ecuadorian

*Bolivia:*

Adautt, Samuel. ZONISIG - Proyecto Zonificación Agro-ecológica y Establecimiento de una Base de Datos y Red de Sistema de Información Geográfica en Bolivia – Tarija. Student of Climate and Botany. Evaluation of pasture productivity and impacts on natural vegetation. Bolivian

Castro, Miguel. CER-DET - Centro de Estudios Regionales para el Desarrollo de Tarija. Director of CER-DET. Lawyer. Legal aspects of land tenancy. Institutional support of development projects. Bolivian

Espinoza, Linder. ZONISIG . Forester. Forest resources, non-timber forest products. GIS applications, evaluation of land use and natural resources. Bolivian

Flores, Nelson. ZONISIG. Student of Climate and Botany. Evaluation of pasture productivity and impacts on natural vegetation. Bolivian

Lizárraga, Pilar. CER-DET. Economist, Anthropologist. Design and conduct community auto-diagnostics. Socioeconomic analyses and methodological support, perspectives studies, participatory work and community organization. Land tenure. Bolivian

Lozano, Angelo. ZONISIG. Researcher. Evaluation of natural vegetation and livestock forage. Bolivian

Montaño, Blanca. CER-DET. Psychologist. Auto-diagnostics and community planning. Gender analysis, participatory work. Bolivian

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**PUBLICATIONS**

No formal publications yet; however, our Host country collaborators have now produced 16 substantive documents for the project. These documents total over a thousand pages and are all in Spanish. None of these is yet formally published; however, a number of these are publishable, and others can be developed into publications. If we can find the funds, we would like to translate into English those with the broadest interest for publication. An initial list of fourteen of these documents was provided

with our Workplan for year 3 (July, 1999).

#### ABSTRACTS AND PRESENTATIONS

Presenter: T. Moermond, University of Wisconsin-Madison

Location and Date: Society of Conservation Biology Annual Meeting, University of Maryland, College Park, Maryland, USA, 15 June, 1999

Title of presentation: “What is “integrating conservation and development”? Redefining and extending the concept.”

Abstract: “The approach of integrating conservation and development is now widely being applied. Labeled as ICDP’s or ICAD’s, such projects have had mixed assessments, often lack the basis for evaluation, and lack a clear definition. The definition of the approach and its sphere of application has been narrowly interpreted to apply only to sites with high biodiversity. The approach of a Latin American project targeted at sustainable management of livestock in montane forests will be used as an example to create the rationale for a new definition of integrating conservation and development to be applied across a wide spectrum from pristine environments to agricultural and urban settings. The rationale for this extension will be based upon 1) the 90-95% of landscapes that will not be in reserves, 2) the role of biodiversity in maintaining the integrity of exploited ecosystems, and 3) the value of biological resources for human welfare. The definition proposed entails a sliding scale of the relative importance of the conservation vs. development components of the approach. This more comprehensive application of the concept is offered a) as a more pragmatic and effective approach to sustainable development and b) as a needed strategy for the global conservation of biodiversity.”

Presenter: T. Moermond, University of Wisconsin-Madison

Location and Date: IMECBIO in the University of Guadalajara-CUCSUR, Autlan Mexico, 8 June, 1999: Delivered at a special public speaker series on Natural Resources, Conservation and Development for the Week of the Environment (Semana del Medio Ambiente 1999)

Title of presentation: “Manejo de ganaderia y conservacion de diversidad biologica en bosques secos neotropicales.” The talk presented Project PLAN, interdisciplinary, goal-oriented approach and its particular application to Mexico (talk delivered in Spanish to about 100 people—faculty, students, and public)

#### COMMENTS

Our initial proposal was for over \$350,000 per year for the three years. The budget we actually received was \$120,000 for year 1 and \$100,000 for year 2. The original budget was a tight budget for what we had planned. The reduced budget has been as thin a fishline—just enough to hold the project together and to make some gains if we don’t pull too hard.

The UW team initially realized and has remained convinced that the critical importance of maintaining the ability of our target country partners to operate. In years 1 and 2, we have provided the largest shares possible to our three host country teams, leaving a skeleton travel budget for the participation of UW team members. Without at least minimal operation capabilities of the host country teams, there would have been no community situation in which the UW researchers could have worked. The host country teams remain the on-the-ground foundation of this work: they have developed and maintained working relationships with

the local communities, and they have carried out the majority of primary collection of data. Our host country institutions and researchers are among our primary targets for strengthening; they will remain working with the local communities to extend the benefits and successes of the project in the future.

The results of the first two years have shown that our target country partners were able to make considerable progress given the minimal amount of funding; however, the funding limitations still prevented them from doing as much as planned in the original proposal. Mexico was able to survive with few funds from the project because of the availability of DFID moneys applicable to compatible objectives for the first two years; however, those funds have now terminated.

Fortunately, the University of Wisconsin-Madison did NOT scale back their substantial leverage funds despite our cut. Fortunately also, enough of the money was flexible to cover the minimum researcher salaries needed with funds that had been allocated for graduate student support on the project. This was allowed to continue through year 2.

We have continued without the original Post-doc and 2 additional graduate students as well as without the planned support for local Latin American university students. Lack of funding has greatly reduced the ability of UW researchers to participate and has virtually stalled or eliminated opportunities for U.S. researchers outside the UW to participate.

Our model and operation, despite severely limited funds, difficulties in communication among four countries, and over-worked partners, has succeeded beyond our expectations. We have developed and maintained strong, connected, and committed

researcher teams in our host countries. The initial base of the project that we have created would now attract participation of other U.S. researchers if additional funding were available. We are all convinced that with more resources, we really could accomplish what we have proposed.

privatization in Kazakhstan was reviewed in year two through primary materials gathered in country, through secondary literature and with the assistance of the Associate Director of the Kazakh Association of Private Farmers. He was brought to Wisconsin for a series of interviews

**IMPACTS OF ECONOMIC  
REFORM  
ON THE LIVESTOCK SECTOR OF  
CENTRAL ASIA**

**NARRATIVE SUMMARY**

The project has two goals. First to expand understanding of the new forms of farm organization that are emerging and the economic and legal context in which this is occurring. Second, to develop technical options that increase the productivity of the livestock sector in environmentally friendly ways, specifically by increasing the meat productivity of the sheep flock.

The first round of field surveys of farm organization in Kazakhstan, Kyrgyzstan and Uzbekistan were concluded in September 1998, and analysis of the questionnaires proceeded during year two. As part of our outreach strategy, a major conference was held in Almaty in January 1999, to provide a forum for our research teams and other scholars working on related issues. A number of government officials attended, the Minister of Science opened the conference, and there was widespread media coverage. A Russian-language book with the proceedings was published and distributed in the region, one copy going to Kazakhstan's President Nazarbayev from the Minister of Science.

A second round of surveys was conducted

between April and September 1999. Uzbekistan was dropped from the surveys because there has been very little movement toward private farming there, and because of budget cuts in year two. The questionnaires for year two were significantly revised in a number of ways. The general approach in many sections of the revised questionnaire was to provide a structure for intensive, qualitative interviews, and to decrease the emphasis on detailed quantitative data. This change was prompted by the desire to obtain a deeper understanding of the dynamics of the situation, and also by the great diversity found in the first year's data and by the field team's reports of widespread misreporting by respondents on key variables such as animal ownership, income and expenditures.

In the fall of 1999, we conducted the first marketing study of animal product processors and wholesalers. The focus was on dairy and meat marketing in and around Almaty. A broad overview was obtained of the marketing situation, case studies of two leading firms were developed, constraints were identified and recommendations presented. This study was one springboard for the UW workshop, "Doing Business in Central Asia: the Case of Agribusiness," held in Madison in November 1999. Follow-up studies are being planned with two Kazakh professors of agricultural economics who attended UW-Madison in fall, 1999, on a USDA grant.

The legal framework for agricultural

and also, as part of outreach, to give him the opportunity to meet with relevant counterparts and experts, e.g., the President of the Wisconsin Farm Bureau; the leaders of the World Council of Credit Unions (headquartered in Madison); the Director of the UW Center for Cooperatives; the Regional Director of ACIDI/VOCA; and so forth.

The goal of the sheep work is to increase the meat productivity of the national flock of Kazakhstan that traditionally has been focused on wool production. In the second year of the project, the sheep component has focused on: 1) evaluation of lambs born from prolific breeds of rams for growth, 2) implementation of management techniques to decrease lamb mortality and 3) evaluation of amino acids as components of ram semen diluents.

A flock of Kazakh Finewool ewes was inseminated in 1997 and 1998 with semen from rams of the Kazakh Finewool, Kazakh Prolific, U.S. Polypay and U.S. Rambouillet breeds. The Kazakh Prolific was developed by crossing Kazakh Finewool with the prolific breed of Finnish Landrace. The Polypay, also, is very prolific and is a four-breed cross containing both finewool breeds and the Finnish Landrace. The Rambouillet is the major finewool breed in the U.S., and the particular Rambouillet used in this project carry the FecB gene for increased ovulation rate. All two-way cross ewes resulting from these matings should have a greater prolificacy than the Kazakh Finewool ewes. The Rambouillet crosses should have comparable fleeces to the Kazakh Finewool whereas the Kazakh Prolific and Polypay crosses should have coarser fleeces.

Lambs were born from the above matings in the springs of 1998 and 1999 and have been compared for growth. In general, lamb growth rates have been greater for lambs sired by the two

U.S. breeds of Rambouillet and Polypay than for the two Kazakh breeds. Lamb growth is a factor in determining weight of lamb meat produced per ewe per year, but it is not as important a factor as the number of lambs raised per ewe per year. The real value of these breeds for improving the meat production of Kazakh sheep will be determined once the ewe lambs reach sexual maturity and enter lamb production. The ewes born in 1998 will lamb for the first time in the spring of 2000. However, the increased growth rate of the U.S. genetics seen in the early part of this study is a positive attribute.

A third group of Kazakh Finewool ewes will be inseminated with semen from the four breeds of rams in the autumn of 1999, and the third set of experimental lambs will be born in the spring of 2000. This will be the last group of experimental lambs born from the four breeds of rams. The first group of ewes born in 1998 will lamb as two-year-olds in the spring of 2000. In the spring of 2001, the ewes born in 1999 will lamb as two-year-olds and the ewes born in 1998 will lamb as three-year-olds. In the spring of 2002, the ewes born in 2000 will lamb as two-year-olds, the ewes born in 1999 will lamb as three-year-olds and the ewes born in 1998 will lamb as four-year-olds. The lambing data accumulated from 2000 through 2002 will give an accurate comparison of the four breeds (Kazakh Finewool, Kazakh Prolific, Rambouillet, Polypay) for lamb production under the production conditions of Southeastern Kazakhstan.

In 1998, we reported high lamb mortality rates in some groups of ewes at the Aksengerskoe farm where our first experimental lambs were to be born. This was attributed to a very harsh winter and short feed supplies that resulted in pregnant ewes that were in very poor body condition at the time of lambing and who gave birth to very small and weak lambs. Also,

sanitation at the time of lambing was less than optimum. Considerable steps were taken in 1998/1999 to rectify the problems that occurred in 1998. Ewes were well-fed during pregnancy, 7% tincture of iodine was used on the navels of all lambs shortly after birth, antibiotics were used to treat early signs of lamb pneumonia and generators and fuel were provided to generate electricity so that ewes and lambs could be checked at night. These steps resulted in very high lamb survival rates in 1999.

A flock of 300 ewes that included 144 ewes that lambed to our experimental inseminations lambed between April 5 and May 15, 1999 and gave birth to 360 lambs. Only twenty-six of these lambs died (7.2% death loss). Six lambs were aborted, 5 lambs were stillborn and 15 lambs died after birth - most from pneumonia. In another flock on the same farm that lambed from March 20 to April 15, 1999 ewes gave birth to 235 lambs and only 2 lambs died (.9% death loss). These data show that given reasonable, but not extensive inputs, lamb losses can be kept to minimal levels.

A series of extensive studies evaluating diluents for the freezing of ram semen containing four different amino acids were conducted. The addition of amino acids to the diluent increased motility of frozen-thawed semen at the time of thawing and within 1.5 hours after thawing and tended to improve pH of the semen. The amino acids tended to act as a cryopreservative and were generally as good as glycerin, the common cryopreservative used in freezing diluents for ram sperm. In these laboratory studies, the amino acid arginine tended to be a superior diluent additive over the amino acids betaine, glutamine and proline. An insemination trial with 50 ewes compared frozen-thawed control semen and arginine-added semen. There were no significant differences in % returns to estrus or % ewes lambing between the two semen

diluents. However, ewes inseminated with the semen with arginine did have higher numerical values for both traits. It is planned to repeat this study in 1999 with a larger number of ewes to increase the power of the test to detect differences between treatments.

## RESEARCH

**Problem Statement.** Privatization of Central Asia's livestock sector continues to yield new forms of farm organization with considerable variation in physical assets, farm membership, decision-making structure, access to markets and credit and relationships to government and to other farm units. Some forms of organization, especially the larger ones, appear to be transitory, leading to creation of other forms. The legal environment also continues to evolve as does the administrative implementation of relevant law.

The challenges to livestock development start with this ongoing disequilibrium and the uncertainty it engenders. New farm organizations struggle to develop effective production and marketing strategies, often with economic decision-making responsibility thrust on individuals with no relevant experience. In other cases, especially on larger units, some farm leaders are not interested in the farm's success, but simply seek to convert assets to cash for investment elsewhere. The depressed national economies limit market opportunities, and the infant banking sectors do not provide adequate credit options. Legislation stops short of providing for full land ownership, and much of the farm population is unaware of what rights they do have under the new laws. Illegal fees extracted by government officials add to the cost of doing business from the farm all the way to the consumer.

Even in this difficult environment, one can see pathways toward development of the



livestock sector, and, indeed, some enterprises are succeeding. Our research hopes to identify such pathways and also to garner lessons learned from successful enterprises. Thus our focus continues to be on understanding (a) the diversity of new farm organizations and (b) the re-emergence of marketing and credit systems that serve the livestock sector. These were two of the three priorities stated in our Workplan for 1998 - 1999. The activities specified toward that end were to revise the core questionnaire, identify new field sites and conduct the second round of field surveys, all of which have been accomplished.

Another priority in our 1998/1999 workplan is to pursue research that will help transform the critically important sheep sub-sector toward much greater reliance on meat as the key to profitability. Sheep numbers in Kazakhstan have been in a free-fall since the country became an independent state. Numbers have decreased from approximately 30 million head in 1990 prior to independence to approximately 13 million head in 1998. Unprofitability of the sheep sector has been one reason for the drastic decrease in sheep numbers. After World War II, the local coarse-wooled meat sheep of Kazakhstan were largely replaced with finewool sheep of Merino-type in order to provide raw wool for the Russian textile industry. The Kazakh Finewool was a new breed developed in the 1950s and 1960s for its wool production. Economic collapse in Russia and a glut of wool on the world market selling at very low prices has left Kazakhstan with few markets and unprofitable prices for its fine wool. Therefore, there has been little economic incentive to maintain sheep numbers. A second reason for the recent decrease in sheep numbers is due to the privatization of agriculture. When sheep were privatized in the early 1990s, they were the major liquid assets of many farmers and were sold or bartered in order to obtain other

agricultural inputs and household necessities. Farm families also consumed many sheep as food. Still today, many of the large cooperative or joint-venture farms pay their members and farm workers with sheep because money is in short supply. The liquidation of the national breeding flock has resulted in a large supply of sheep meat at reasonable prices available in the market place. However, this cannot continue because the decrease in breeding sheep numbers will eventually result in a shortage of sheep meat in the market place.

Since finewool sheep have low reproductive rates (approximately 1.25 lambs born per ewe lambing), increases in population numbers are slow. An increase in the number of lambs raised per ewe in finewool flocks can result in an increase in the number of replacement females produced in order to help rebuild national flock numbers as well as an increase in the amount of lamb meat produced per ewe. With a higher reproductive rate, fewer ewes are required to produce the same amount of lamb meat. This results in less feed required to produce a kg. of lamb meat and less pressure on range lands and other feed resources.

In collaboration with the Center for Sheep Selection and Genetics (CSSG) of the Kazakh Scientific Research Technological Institute of Sheep Breeding (Sheep Breeding Institute), a study is being conducted to evaluate the effectiveness of Kazakh and U.S. breeds of sheep to increase lamb production of Kazakh Finewool flocks through an increase in the number of lambs born per ewe. A flock of Kazakh Finewool ewes was inseminated in 1997 and 1998 with semen from rams of the Kazakh Finewool, Kazakh Prolific, U.S. Polypay and U.S. Rambouillet breeds. The Kazakh Prolific was developed by crossing Kazakh Finewool with the prolific breed of Finnish Landrace. The Polypay, also, is very prolific and is a four-

breed cross containing both finewool breeds and the Finnish Landrace. The Rambouillet is the major finewool breed in the U.S., and the particular Rambouillet used in this project carry the FecB gene for increased ovulation rate. All two-way cross ewes resulting from these matings should have a greater prolificacy than the Kazakh Finewool ewes. The Rambouillet crosses should have comparable fleeces to the Kazakh Finewool whereas the Kazakh Prolific and Polypay crosses should have coarser fleeces.

More basic studies aimed at improving diluents for freezing ram semen have also been conducted with the goal of improved conception rates from artificial insemination with frozen-thawed semen. Artificial insemination of sheep with fresh and frozen semen is common in Kazakhstan. The development of improved diluents that give high conception rates with frozen-thawed semen will allow the semen from desirable rams to be used at locations throughout Kazakhstan and other Central Asian countries.

**Progress.** Progress is discussed in three categories: (1) Evolution of New Forms of Farm Organization; (2) Marketing Animal Products; and (3) Increased Lamb Production from Kazakh Finewool Flocks.

### *Evolution of New Forms of Farm Organization*

This section presents (A) an overview of the legal framework in which agricultural privatization is occurring; (B) highlights of our analyses of the new farm entities that are emerging; and (C) preparations for and implementation of the second round of field surveys. The 1998-1999 Workplan only lists activities for (C), however, during year two we also worked on analyses for (A) and (B).

#### *The Changing Legal Context*

The bulk of Kazakhstan's population, the Prime Minister [Nurlan Balgimbayev] said, is not ready for the privatization of land "either morally or materially."<sup>1</sup>

"If tomorrow I adopt a law on land, those who have money would buy it out. You would turn into a labor force," Kazakh President Nazarbayev told farmers. "We have a law under which land is leased for 99 years with option of inheritance. What is it if not ownership. Lawyers would probably find an interpretation for this law which would allow them to put up the rented land as collateral for loans," he said.<sup>2</sup>

These statements came in August 1999 as the government recalled from parliament a draft law for land privatization. It is no wonder that Kazakh farmers are uncertain about their property rights.

One of our objectives has been to understand the legal and administrative context in which agricultural privatization is occurring. Toward this end, a research assistant collected materials while in Almaty briefly for other business in 1998. He was to return for intensive work but decided instead to leave the university and enter the priesthood. We have continued to gather materials and review the secondary literature, and we have worked with KazAgro, the association of Kazakh private farmers, to broaden our understanding of these issues. We have made most headway on Kazakhstan for which a brief overview is presented below.

In 1990, an administrative order of the USSR provided the basis for Kazakhstan's 1990 Law on Peasant Farms, intended to create private family farms. Members of the established hierarchy were the primary beneficiaries.<sup>3</sup> Land was available for use, but not ownership. Directors of the kolkhozes and sovkoves were

to help organize these new units and provide funding for equipment. By 1992, about 350 peasant farms had been established, mostly by farm managers, technical agricultural staff and party functionaries. They benefited from cheap prices for equipment and many are now wealthy.<sup>4</sup> This small beginning is considered the first phase of Kazakhstan's agricultural privatization.

In January of 1993, Kazakhstan adopted its new constitution, and in it declared the state's exclusive ownership of land and other natural resources. This is consistent with the constitutions of the other Central Asian states.<sup>5</sup>

The second phase of Kazakh agricultural privatization, from 1993 to 1996, started with the March 5, 1993, Presidential Decree on Privatization in the Agricultural Sector. The decree calls for completion of "denationalization and privatization of enterprises of the agro-industrial complex in the years 1993 - 1995." It establishes the absolute right for a member of [a kolkhoz or sovkhoz] staff to withdraw from the enterprise and be allotted a share of land and a property share in accordance with established procedure for organizing a peasant farm.<sup>6</sup>

While the right to establish peasant farms is guaranteed, the decree gives prominent mention to formation of joint-stock companies, and this, in fact, is the dominant form that privatization took. The change was largely in name only. The old organizational structures remained in place. Much of the change that did occur resulted in accumulation of assets by farm managers. Farm leaders and local administrators did not actively publicize the new rights of farm members to leave and establish their own enterprises, and, on the contrary, attempted to minimize the exercise of these rights.

The World Bank summarizes this process as follows:

During the main period [1993 - 1996], officials and farm managers orchestrated the process, giving little information to other rural people. On most farms, land and property shares were allocated to people, but rarely distributed. On some farms, most of the land was allocated to the raion [local governmental unit], rather than to farm members.<sup>7</sup>

A Presidential Decree in March 1994, exacerbated the tendency for farm directors to gain control of their enterprises. Farm directors with at least 20 years of service were granted 10% of the farm's saleable assets and were given another 10% for temporary use up to five years. The remaining 80% was to be distributed among the farm members.<sup>8</sup> The World Bank notes that many farm directors also sought control of that 80%:

Most farm managers sought to increase their holdings. In some cases, they bought or leased shares straightforwardly; in other cases, they coerced members to lease or transfer their shares to them in return for the promise to pay wages or to guarantee employment.<sup>9</sup>

Zhambakin, Associate Director General of KazAgro, observes that during this period, farm members who wanted to leave and establish their own farms had considerable difficulty doing so. The farm directors gave them poor land and attempted to dissuade them in other ways. Those who remained on the descendants of the Soviet enterprises, Joint Stock Companies or Limited Liability Enterprises, exercised little control. Hakims, local governmental leaders, recommended enterprise leaders. Members voted, but rarely voted against the Hakim's choice. If they did, the new leader would be hamstrung by the local government.<sup>10</sup>

On December 22, 1995, President Nazarbayev issued Edict No 2717, "Concerning

Land.” This facilitated use rights for farm members, but it stopped short of granting ownership. On the contrary, it reasserted that,

In accordance with the Constitution of the Republic of Kazakhstan, land shall be in the state ownership.

While provisions were made for a variety of private use rights and ownership, the use of land for collateral and in mortgages was still unclear. This edict was followed by two more in early 1996: No. 2727, “On the State Registration of Immovable Property” and No. 2723, “On the Mortgage of Immovable Property.” Analysis of these latter Edicts by Varanese and Grekov indicates a continuing lack of clarity on the issue of using land for collateral.<sup>11</sup>

By the end of 1996, many Joint Stock Companies and Limited Liability Enterprises were bankrupt and began to break up. In some cases managers appropriated the farm herds and converted them to cash. In other cases, the assets were distributed among members, often in groups of up to 50.<sup>12</sup> In late 1996 and early 1997 the Department of Agriculture conducted an information campaign informing farm members of their rights and encouraging formation of private farms.<sup>13</sup> This marks the start of what may be termed the third phase of Kazakh agricultural privatization.

The third phase of privatization has seen a rapid increase in the number of peasant farms. Between 1996 and 1998, 50,000 new peasant farms were created.<sup>14</sup> In contrast the total created between 1991 and 1996 was 30, 785. Nonetheless, 85% of the country’s arable land and about 65% of the rural population are still in the large enterprises directly descended from the kolkhozes and sovkhozes.

To stimulate the formation and success

of peasant farms, the government passed the Peasant (Farmer) Farm law in March 1998. This specifies a peasant (farmer) farm as having less than 50 workers on average. The law establishes legal rights, and provides a variety of incentives for peasant farms. These incentives include preferences in selling commodities to the state to fill “state needs,” reduced taxes, simplified financial reporting, information services, etc.<sup>15</sup> More recently, the government continues to grapple with the issue of land rights, as indicated in the quotes presented at the start of this section.

### *New Farm Entities*

The transition away from Soviet-era farm organization is most advanced in Kyrgyzstan and Kazakhstan. Much less progress has been made in Uzbekistan. This section reviews the evolution in Kazakhstan and then discusses aspects of the current situation in all three countries.

Kazakhstan entered independence with 2,055 large state farms (sovkhozes) and 430 smaller collective farms (kolkhozes). The sovkhozes averaged about 80,000 hectares, of which 14,000 were cultivated. The kolkhozes averaged about 9,800 ha. of cultivated land. Management structures were similar in the two enterprises.<sup>16</sup>

The early stages of privatization were largely cosmetic, as these enterprises became “private” in name (most commonly as joint stock companies) but with little other change.

State ownership passed to workers and management with the same physical infrastructure, management, and organizational structures, and trading relations intact.<sup>17</sup>

As the push for privatization accelerated between 1993 and 1996, other forms of

organization emerged, including (a) large units labeled limited liability enterprises and producer cooperatives that represented large pieces of the former kolkhoz, sovkhoz or joint stock company, and (b) small private household/family farms.<sup>18</sup> Many joint stock companies continued to exist as well. Leaders of the joint stock companies tend to be the leaders of the former kolkhozes and sovkhozes. Leaders of the limited liability enterprises and producer cooperatives were recommended by local Hakims, often from the technical staff of the former kolkhoz or sovkhoz. Large farms have historically been a source of revenue for local government personnel, who, thus, today encourage their continuation and attempt to maintain control over them.

Most workers stayed on these large units rather than striking out on their own private family farms. In part this was a result of coercion, discouragement or withholding of information by the farm leaders and local government officials. In part, it reflected the worker's assessment of the slim chances for success of an individual farmer - a farmer with little experience in economic decision-making, with limited access to market channels that were dominated by the large enterprises, with virtually no access to credit, and with weakening consumer demand as a result of the country's post-independence recession.

By the end of 1996, most joint stock companies and limited liability enterprises were failing. New bankruptcy laws forced many to dissolve. The state pressured these failing entities to distribute their assets among the workers. At this time, many leaders of the large entities sold for personal gain whatever assets they could appropriate. Of the assets that were distributed, relatives of the farm leaders got disproportionately large shares. Even though the large units were failing and are now in bad shape, the majority of workers remain on

them. By mid-1997, the World Bank counted approximately 9,000 large farming units in Kazakhstan.<sup>19</sup>

The number of peasant (farmer) farms, as they are known in Kazakhstan, increased sharply in the past few years, growing from 30,785 in 1996 to 42,523 by January 1, 1997 and 81,697 by January 1, 1998.<sup>20</sup> (Of these, only 53,000 are working farms. The rest are just on paper or are just gardens around homesteads.<sup>21</sup>) Some characteristics of these farms follow:<sup>22</sup>

Families per farm: Of the 42,523 peasant farms existing in January 1997, 63% had just one family, 27% had 2 to 3 families, 6% had 3 to 5 families and 4% had more than 5 families.

Land per farm: For 1998, KazAgro reported that the average peasant farm had 355 hectares, with farms in the southern irrigated zone being less than 150 ha. and those in dry north and central areas up to 1800 ha. Nationwide, the size distribution of peasant farms was: 25% with less than 35 ha; 8% from 35 to 100; 40% from 100 to 500; 14% from 500 to 1,000; and 13% above 1,000.

Livestock per farm: The average livestock holding included 5 head of cattle and 17 sheep and goats. The distribution of sheep holdings was as follows: 72% had less than 50; 10% had 50 to 100; 9% had 100 to 200; 7% had 200 to 500; and 2% had over 500.

Autoconsumption: These farms consume a large portion of the animal products they produce. In 1998 home consumption accounted for about 47% of meat, 64% of milk and 39% of wool.

The 1998 law on peasant farms recognizes three forms of peasant farm: (1) A single owner to whom family members have transferred

their shares; (2) A family whose members share in ownership; and (3) An association of families, related or not, each with their shares of ownership. Zhambakin and our West-Kazakhstan survey team judge the latter to be unstable.

The broad, national picture above is reflected in the findings of our field teams. In the early stages of independence, the changes in farms were in name only, and most workers stayed on the renamed large units. However, the few members who did separate in the early 1990s were in the fortunate situation of leaving units that had considerable assets compared to the situation later. Thus some of these early independent farmers left with enough assets to launch successful farms.

The expanded exodus from the large units started in 1996. However, by this time, those large units were impoverished, having suffered the end of state subsidies and perhaps the thinly cloaked theft of resources by farm leaders. Thus, many of the workers who left in the past few years did so with a much smaller portfolio of assets. This prompted some to join together, since they felt they could not make it alone.

Our field researchers suggest that at present it is useful to start with a broad three-part classification of livestock raising farms in Kazakhstan: (1) Large units organized as joint stock companies or limited liability associations or agricultural production cooperatives, i.e., the direct descendants of the kolkhozes and sovkhozes. Besides size, they have in common the old system of clear division between livestock held by the individual and livestock held in common by the enterprise. (2) Peasant farms with one family or with a small number of related families. Livestock on these farms is held in common as the property of the whole group. Individuals do not keep their own animals.

(3) Peasant farms formed by families that are not related. This has some similarity to the large units in that some animals are kept under individual control and some are under common control. However, all members know how many animals they contributed to the common herds, they take a closer interest in the management of the common herd, and they have the easily exercised right to withdraw their animals from the common herd.

The greatest prospects for success seem to rest with the second category, especially the larger of them. Prospects are further enhanced where there are nonfarm sources of income. This is especially important now that credit is largely unavailable. The nonfarm income helps finance farm operations. The smaller, individual peasant farms operate as subsistence units. Many are too small to earn a livelihood and hence sell their animals to finance current consumption. Eventually they will either leave for the city or hire out as farm laborers.

The third category is seen as transient. First, they started because each household was too poor to go it alone. But six poor households together are still six poor households. Second, there is a tendency for the members to devote relatively little energy and care to the common efforts. Local officials predict that those households with greater ambition will leave to work on their own and that the group enterprises will fail.

Among the large units descended from kolkhozes and sovkhozes, those with significant income sources in addition to their own farm production seem most likely to survive. Some of these units rent farm services while others have various commercial ventures.

Our Kyrgyzstan survey team found the situation there not very different from that in

Kazakhstan. In one district studied, all the farms were descended from one large state farm. In 1993 this state farm was converted into a joint stock company which collapsed by 1996. At present there are three types of farms: Associations of Peasant Farms, Farming Households and Individual Peasant Farms.

The Association seems to be the successor of the once powerful state farm that consisted of five villages. The Association consists of half of one village with 1280 people. Each person is allotted 0.6 ha. or about 3 - 4 ha. per family. The Association controls the dryland cultivation and the pastures. Only 47 of the Association residents work on the farm under contract. The rest have limited connection with the farm except to receive wheat as compensation for their share of the land cultivated (126 kg. per ha.). Most of the income for the Association families comes from their personal plots, stock raising, seasonal labor in sugar beet production, trade, transport, hired work and pensions.

All of the state farm's sheep and goats were parceled out in 1993. In 1996, when the Association was formed, it received 226 cattle from the joint stock company that succeeded the state farm. However, winter starvation reduced that number to 127, and by 1998 only 43 remained, many of the rest having been used to pay debts or in lieu of wages in the absence of cash.

The Association is headed by a former member of the state farm's administration who has experience in financial management. In addition to the aforementioned problems leading to declines in the cattle herd, he lists the following problems: the need to repay to the state the debt inherited from the joint stock company from which the Association was formed; the impossibility of receiving credit because of their debt; difficulty obtaining mineral fertilizer; and

low milk prices.

The Farming Homestead and Individual Farms appear to be similar, with the exception that among the former are cooperatives formed by family members. The heads of these family farms are often former leaders or technicians of state farms who obtained machinery and animals at little or no cost when the partition of the state farms occurred. Most of the country's livestock is in these private entities. In one district studied, the official statistics show the sheep flock declining by more than half between 1995 and 1998.

In another district, one of the state farms was transformed into a joint stock company that still operates as such. It has 225 shareholders and there are 70 workers under contract. In another district studied, the state farm was one of the first privatized. All of the buildings were destroyed, the parts being taken for private use. (We saw the remains of a state farm in Kazakhstan where a similar process had taken place.) Some former members of this farm joined together in cooperatives of 20 to 30 households, while the others farmed individually.

Another researcher in Kyrgyzstan, not part of our project, reports another process.<sup>23</sup> In the early 1990s, the sovkhos studied was charged by the state with supporting itself. One of its three component villages withdrew and formed its own cooperative. The other two villages stayed together for one season and then met to decide on the future. They chose to break the farm into individual parts. Most members coalesced into *dyikan charba*, enterprises based on patrilineal groups or families.

Our survey team found the situation in Uzbekistan quite different. In the sheep raising region studied, privatization had really not taken place. *Kolkhozes* were in the process of being

divided into three or four smaller units called shirkats centered on one of the several villages in a kolkhoz. These retain much the same structure as the former state farms. Shepherd-members do not have any greater freedom to determine their own affairs. The shirkat leaders have more independence from state control, and this is often exercised to the detriment of the members. Where a kolkhoz might have an administrative apparatus of 14 people with 420 working on livestock production, a shirkat would have 6 in administration and 90 working on livestock.

The shepherd-members of shirkats list the following problems: poor transportation (e.g., 3 days to walk sheep to market); abusive and corrupt shirkat management; low prices for meat, pelts, wool and milk; lack of pedigree sperm; no access to credit; limited access to markets and bribes extracted by local market authorities. Most shepherds had very little information about the new laws regarding privatization and even less of a concept of private ownership and management.

The field surveys conducted in year one were completed in September, 1998. Data entry and preliminary analysis were carried out in year two. The high variance found for most variables confirms the diversity we have observed. It also sharply limits the statistical inferences one may make. As indicated in our initial plans, these data will be used for general descriptive purposes, rather than for detailed input/output analysis.

Some highlights from the preliminary data analysis for Kazakhstan and Kyrgystan are presented below followed by a table with data from a small subset of the variables.

1. Respondents had a high level of education; more than 3/4 having secondary or higher education and a considerable portion have

gone on to more advanced training and/or university.

2. Farms in the dry northwest of Kazakhstan are considerably larger than those in the irrigated and wetter southeast.
3. Animal products were the dominant source of farm income for the farms selected.
4. Most respondents reported decreases in their animal holdings over the past several years.
5. The concept of a market for land is not well established among the respondents.
6. Hired labor is relatively rare in SE Kazakhstan and most common in Kyrgyzstan.
7. Most animal products are consumed on the farm rather than marketed.
8. Barter is fairly common for meat, more so in Kazakhstan than in Kyrgyzstan.
9. Most respondents in NW Kazakhstan rarely observe hunger in their village, whereas most respondents in SE Kazakhstan often observe it.
10. Husbands dominate decisions about livestock, but husbands and wives commonly share in decisions about the family budget.
11. Few respondents report land shortage or poor pastures as major problems.
12. Most respondents report the following major problems: lack of credit; marketing (low prices and limited access); high prices for fuel and transport; lack of state policies supporting agriculture.

#### *Preparation for and Implementation of the Second Round of Field Surveys*

The Workplan for 1998-1999 called for three activities related to the second round of field surveys. They have all been completed as



## SELECTED DATA FROM 1998 FARM SURVEYS

|       | Northwest Kazakhstan Single Household Farms                         | Northwest Kazakhstan Multiple Household Farms | Southwest Kazakhstan Single Household Farms | Southwest Kazakhstan Multiple Household Farms | Northwest Kazakhstan Single Household Farms | Southwest Kazakhstan Single Household Farms | Northwest Kazakhstan Private Farms | Northwest Kazakhstan Private Farms Members of a Unified Regional Farm |
|-------|---------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------|-----------------------------------------------|---------------------------------------------|---------------------------------------------|------------------------------------|-----------------------------------------------------------------------|
|       | n=23                                                                | n=33                                          | n=41                                        | n=41                                          | n=33                                        | n=33                                        | n=52                               | n=10                                                                  |
| 1.8   | EDUCATION (% of respondents)                                        |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | None                                                                |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 0                                                                   | 0                                             | 2.5                                         | 0                                             | 0                                           | 2.1                                         | 0                                  | 0                                                                     |
|       | Primary                                                             |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 28.1                                                                | 9.2                                           | 12.5                                        | 12.5                                          | 3.2                                         | 12.4                                        | 3.8                                | 0                                                                     |
|       | Secondary                                                           |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 80.9                                                                | 48.4                                          | 87.5                                        | 87.5                                          | 88                                          | 88                                          | 57.7                               | 80                                                                    |
|       | 13                                                                  | 43.4                                          | 17.5                                        | 17.5                                          | 43.4                                        | 13.8                                        | 33.5                               | 40                                                                    |
|       | Lack (Mean #)                                                       |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | Total                                                               |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 2.1   | 982                                                                 | 2400                                          | 118                                         | 118                                           | 45                                          | 45                                          | 13                                 | 2.7                                                                   |
| 2.11  | Resumes not for use (% of respondents)                              |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 33.3                                                                | 39.5                                          | 4.2                                         | 4.2                                           | 4.2                                         | 4.2                                         | 17.3                               | 30                                                                    |
|       | INCOME SOURCES (Mean %)                                             |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.1.a | Animal Husbandry                                                    |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.1.b | Crop Production                                                     |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 93                                                                  | 93                                            | 74                                          | 74                                            | 73.8                                        | 73.8                                        | 54                                 | 87                                                                    |
|       | 2.27                                                                | 7                                             | 28.95                                       | 28.95                                         | 21.5                                        | 21.5                                        | 48                                 | 93                                                                    |
|       | LIVESTOCK HOLDINGS (Mean #)                                         |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.1   | Total                                                               |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.2   | Sheep                                                               |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 177                                                                 | 994                                           | 40.5                                        | 40.5                                          | 48                                          | 48                                          | 103.4                              | 24                                                                    |
|       | 135                                                                 | 315                                           | 42.3                                        | 42.3                                          | 33                                          | 33                                          | 31.8                               | 13.8                                                                  |
|       | CHANGE IN LIVESTOCK HOLDINGS IN PAST TWENTY FIVE YEARS (% of farms) |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.1.1 | Total livestock increased                                           |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.1.2 | Total livestock decreased                                           |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.1.3 | Total livestock unchanged                                           |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 11.1                                                                | 10.7                                          | 11.4                                        | 11.4                                          | 5.8                                         | 5.8                                         | 41.5                               | 20                                                                    |
|       | 50                                                                  | 80.7                                          | 7.4                                         | 7.4                                           | 83.1                                        | 83.1                                        | 30                                 | 50                                                                    |
|       | 27.8                                                                | 28.8                                          | 17.1                                        | 17.1                                          | 11.2                                        | 11.2                                        | 19.5                               | 30                                                                    |
| 3.2.1 | Sheep increased                                                     |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.2.2 | Sheep decreased                                                     |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
| 3.2.3 | Sheep unchanged                                                     |                                               |                                             |                                               |                                             |                                             |                                    |                                                                       |
|       | 4.3                                                                 | 14.3                                          | 12.3                                        | 12.3                                          | 5.3                                         | 5.3                                         | 21.8                               | 10                                                                    |
|       | 45                                                                  | 57.1                                          | 74.4                                        | 74.4                                          | 81.3                                        | 81.3                                        | 52.9                               | 40                                                                    |
|       | 40                                                                  | 28.8                                          | 12.3                                        | 12.3                                          | 12.3                                        | 12.3                                        | 25.5                               | 50                                                                    |

|       |                                                       | Northwest<br>Kazakhstan<br>Single<br>Household<br>Farms<br>n=23 | Northwest<br>Kazakhstan<br>Multiple<br>Household<br>Farms<br>n=33 | Northwest<br>Kazakhstan<br>in Single<br>Household<br>Farms<br>n=41 | Southwest<br>Kazakhstan<br>Single<br>Household<br>Farms<br>Cooperatives<br>n=33 | Northwest<br>Kazakhstan<br>Private<br>Farms<br>n=32 | Northwest<br>Kazakhstan<br>Private<br>Members of<br>a Unified<br>Peasant<br>Farm<br>n=10 |
|-------|-------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------|
| 3.5.1 | long-haired camels increased                          | 17.4                                                            | 18.7                                                              | 19.5                                                               | 12.4                                                                            | 42                                                  | 10                                                                                       |
| 3.5.1 | long-haired camels decreased                          | 43.5                                                            | 55.8                                                              | 48.8                                                               | 81.3                                                                            | 32                                                  | 30                                                                                       |
| 3.5.1 | long-haired camels unchanged                          | 30.4                                                            | 27.3                                                              | 37.3                                                               | 25.3                                                                            | 38                                                  | 60                                                                                       |
| 3.6   | CHANGE IN TOTAL LIVESTOCK IN PAST<br>YEAR (% of 2005) |                                                                 |                                                                   |                                                                    |                                                                                 |                                                     |                                                                                          |
|       | Decreased                                             | 58.5                                                            | 82.9                                                              | 72.2                                                               | 88.7                                                                            | 47.8                                                | 71.4                                                                                     |
|       | Increased                                             |                                                                 |                                                                   |                                                                    |                                                                                 |                                                     |                                                                                          |
|       | UNCHANGED                                             |                                                                 |                                                                   |                                                                    |                                                                                 |                                                     |                                                                                          |
|       | SHEEP HOUDINGS AND DYNAMICS (HEADS)                   |                                                                 |                                                                   |                                                                    |                                                                                 |                                                     |                                                                                          |
| 9.1   | Total                                                 | 88                                                              | 117                                                               | 43                                                                 | 38                                                                              | 83                                                  | 90                                                                                       |
| 9.2   | Total ewes                                            | 42                                                              | 110                                                               | 25                                                                 | 22                                                                              | 42                                                  | 53                                                                                       |
| 9.4   | Muttons or muttons                                    | 3.3                                                             | 4.4                                                               | 1.7                                                                | 1.1                                                                             | 1                                                   | 3.1                                                                                      |
| 9.5   | Breeder ewes                                          | 1                                                               | 9                                                                 | 0.9                                                                | 1.3                                                                             | 2.2                                                 | 1.9                                                                                      |
| 9.8   | Artificially inseminated ewes                         | 0                                                               | 3.8                                                               | 0.5                                                                | 0.38                                                                            | 0                                                   | 0                                                                                        |
| 9.7   | Staggers                                              | 2.8                                                             | 8.8                                                               | 1.7                                                                | 1.3                                                                             | 0.3                                                 | 1.2                                                                                      |
| 9.12  | Wethers born naturally                                | 1.8                                                             | 5.4                                                               | 2.9                                                                | 0.95                                                                            | 0.19                                                | 0.7                                                                                      |
| 9.13  | Substituted for meat or wool                          | 7.5                                                             | 42.7                                                              | 11.3                                                               | 4                                                                               | 42.2                                                | 47.6                                                                                     |
| 9.14  | Bought for personal use                               | 11                                                              | 14                                                                | 12.8                                                               | 10                                                                              | 12.8                                                | 47.6                                                                                     |
| 9.15  | Sold live                                             | 8                                                               | 15                                                                | 8                                                                  | 8                                                                               | 8                                                   | 47.6                                                                                     |
| 9.20  | Foreign health and                                    | 5                                                               | 51                                                                | 24                                                                 | 19.7                                                                            | 32                                                  | 47.6                                                                                     |
| 9.21  | Received additional feed for                          | 22                                                              | 22                                                                | 32                                                                 | 39                                                                              | 19                                                  | 47.6                                                                                     |
| 9.22  | raised in stalls                                      | 49                                                              | 109                                                               | 20                                                                 | 31                                                                              | 1.7                                                 | 47.6                                                                                     |
|       |                                                       |                                                                 |                                                                   |                                                                    |                                                                                 |                                                     |                                                                                          |
|       | LEADERS (% of respondents)                            |                                                                 |                                                                   |                                                                    |                                                                                 |                                                     |                                                                                          |
| 13.1  | total ownership of winter pasture                     | 82.8                                                            | 94.7                                                              | 14.8                                                               | 83.8                                                                            | 38.9                                                | 0                                                                                        |
| 13.1  | total ownership of summer pasture                     | 82.8                                                            | 94.7                                                              | 22                                                                 | 84.8                                                                            | 7.7                                                 | 0                                                                                        |
| 13.1  | total ownership of chopland                           | 13                                                              | 15.8                                                              | 34.1                                                               | 84.8                                                                            | 98.2                                                | 100                                                                                      |
| 14.1  | land can be bought and sold                           | 39.1                                                            | 18.4                                                              | 2.4                                                                | 1                                                                               | 9.8                                                 | 10                                                                                       |

|       |                                                          | N.23                                                    | N.26                                                      | N.41                                                    | N.50                                                                       | N.52                                        | N.10                                                                                    |
|-------|----------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------|
|       |                                                          | Northwest<br>Kazakhstan<br>Single<br>Household<br>Farms | Northwest<br>Kazakhstan<br>Multiple<br>Household<br>Farms | Southwest<br>Kazakhstan<br>Single<br>Household<br>Farms | Southwest<br>Kazakhstan<br>Single<br>Household<br>Farms in<br>Cooperatives | Northwest<br>Kazakhstan<br>Private<br>Farms | Northwest<br>Kazakhstan<br>Private<br>Farms<br>Members of<br>United<br>Private<br>Farms |
| 14.2  | Land cannot be sold due to mortgage in the city          | 28.1                                                    | 28.9                                                      | 25.1                                                    | 28                                                                         | 28                                          | 20                                                                                      |
| 14.3  | No real market for land                                  | 52.2                                                    | 38.9                                                      | 30.2                                                    | 28                                                                         | 13.5                                        | 20                                                                                      |
| 14.4  | Land can be used but not sold                            | 29.1                                                    | 19.4                                                      | 100                                                     | 28                                                                         | 28.5                                        | 20                                                                                      |
| 15.4  | Legal restrictions of walls                              | 21.2                                                    | 54.1                                                      | 40                                                      | 29.8                                                                       | 0                                           | 20                                                                                      |
|       |                                                          |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
|       | HOUSEHOLD   % of farms                                   |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
| 17.1  | Price below year-round                                   | 12                                                      | 1.9                                                       | 1.2                                                     | 4                                                                          | 19.2                                        | 0                                                                                       |
| 17.1  | Price below winter                                       | 0                                                       | 2.8                                                       | 0                                                       | 2                                                                          | 2.8                                         | 0                                                                                       |
| 17.1  | Price below spring                                       | 0                                                       | 0                                                         | 4.9                                                     | 4                                                                          | 26.5                                        | 20                                                                                      |
| 17.1  | Price below summer                                       | 20.4                                                    | 21.1                                                      | 1.2                                                     | 4                                                                          | 24.8                                        | 10                                                                                      |
| 17.1  | Price below fall                                         | 0                                                       | 0                                                         | 9.8                                                     | 3                                                                          | 48.2                                        | 20                                                                                      |
| 17.4  | Use real estate below                                    | 8.1                                                     | 5.2                                                       | 14.8                                                    | 11.1                                                                       | 28.5                                        | 40                                                                                      |
|       |                                                          |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
|       | DISPOSAL OF FA. RM PRODUCE   mean %                      |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
| 20.1  | Consumed on farm                                         |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
|       | Meat                                                     | 40                                                      | 28                                                        | 81.5                                                    | 81                                                                         | 80                                          | 84                                                                                      |
|       | Milk                                                     | 28                                                      | 21.1                                                      | 28                                                      | 28                                                                         | 12.5                                        | 88                                                                                      |
|       | Wool                                                     | 80                                                      | 81.5                                                      | 94                                                      | 28                                                                         | 54                                          | 12                                                                                      |
| 20.2  | Sent abroad                                              |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
|       | Meat                                                     | 25                                                      | 41                                                        | 45                                                      | 0                                                                          | 13.5                                        | 10                                                                                      |
|       | Milk                                                     | 0                                                       | 20                                                        | 0                                                       | 0                                                                          | 0                                           | 0                                                                                       |
|       | Wool                                                     | 0                                                       | 0                                                         | 0                                                       | 0                                                                          | 20                                          | 0                                                                                       |
|       |                                                          |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
|       | HOUSEHOLD   IN THE YOUNG<br>% of respondents (age 16-30) |                                                         |                                                           |                                                         |                                                                            |                                             |                                                                                         |
| 20.15 | At home                                                  | 0                                                       | 0                                                         | 0                                                       | 1                                                                          |                                             |                                                                                         |
| 20.15 | Other                                                    | 11.1                                                    | 3.8                                                       | 81                                                      | 10.1                                                                       |                                             |                                                                                         |
| 20.15 | Sent abroad                                              | 22.2                                                    | 28.8                                                      | 24.1                                                    | 24.1                                                                       |                                             |                                                                                         |

|       |                                        | Northwest<br>Kazakhstan<br>Single<br>Household<br>Farms | Northwest<br>Kazakhstan<br>Multiple<br>Household<br>Farms | Southeast<br>Kazakhstan<br>Single<br>Household<br>Farms | Southeast<br>Kazakhstan<br>Multiple<br>Household<br>Farms | North<br>Kazakhstan<br>Private<br>Farms | North<br>Kazakhstan<br>Private<br>Farms | North<br>Kazakhstan<br>Private<br>Farms |
|-------|----------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
|       |                                        | N-23                                                    | N-23                                                      | N-23                                                    | N-23                                                      | N-23                                    | N-23                                    | N-10                                    |
| 23.15 | Family                                 | 81.1                                                    | 80.7                                                      | 81.9                                                    |                                                           | 81.1                                    |                                         |                                         |
| 23.15 | Partner                                | 5.8                                                     | 1.1                                                       | 0                                                       |                                                           | 0                                       |                                         |                                         |
|       |                                        | N-23                                                    | N-23                                                      | N-23                                                    | N-23                                                      | N-23                                    | N-23                                    | N-10                                    |
|       | WHO MAKES DECISIONS   % of respondents |                                                         |                                                           |                                                         |                                                           |                                         |                                         |                                         |
|       | Alone/Unlocked                         |                                                         |                                                           |                                                         |                                                           |                                         |                                         |                                         |
| 21.1  | Hub and                                | 80.9                                                    | 80.9                                                      | 81.2                                                    |                                                           | 80.9                                    | 80.9                                    | 80                                      |
| 21.1  | Wife                                   | 8.7                                                     | 5.8                                                       | 0                                                       |                                                           | 3                                       | 3                                       | 10                                      |
| 21.1  | Hub and wife jointly                   | 13                                                      | 5.8                                                       | 26.7                                                    |                                                           | 25.8                                    | 13.3                                    | 30                                      |
| 21.1  | Parents                                | 8.7                                                     | 0                                                         | 0                                                       |                                                           | 2                                       | 3.8                                     | 10                                      |
| 21.1  | Jointly with parents                   | 8.7                                                     | 5.8                                                       | 8.9                                                     |                                                           | 7.1                                     | 9.8                                     | 10                                      |
|       | Alone/Unlocked                         |                                                         |                                                           |                                                         |                                                           |                                         |                                         |                                         |
| 21.2  | Hub and                                | 13                                                      | 26.3                                                      | 15                                                      |                                                           | 10.1                                    | 8.2                                     | 30                                      |
| 21.2  | Wife                                   | 21.7                                                    | 2.7                                                       | 7.3                                                     |                                                           | 18.2                                    | 0                                       | 10                                      |
| 21.2  | Hub and wife jointly                   | 43.5                                                    | 84.9                                                      | 80                                                      |                                                           | 58.8                                    | 38.5                                    | 50                                      |
| 21.2  | Parents                                | 17.8                                                    | 0                                                         | 0                                                       |                                                           | 1                                       | 3.8                                     | 0                                       |
| 21.2  | Jointly with parents                   | 4.3                                                     | 8.1                                                       | 7.3                                                     |                                                           | 8.1                                     | 11.5                                    | 10                                      |
| 28    | WHO MAKES DECISIONS   % of respondents |                                                         |                                                           |                                                         |                                                           |                                         |                                         |                                         |
|       | Alone/Unlocked                         |                                                         |                                                           |                                                         |                                                           |                                         |                                         |                                         |
|       | Share of land                          | 4.3                                                     | 5.3                                                       | 7.3                                                     |                                                           | 7.3                                     | 20.3                                    | 0                                       |
|       | Share of tools                         | 4.3                                                     | 13.2                                                      | 4.5                                                     |                                                           | 43.9                                    | 19.8                                    | 10                                      |
|       | Share of feed                          | 8.7                                                     | 10.5                                                      | 27.3                                                    |                                                           | 29.8                                    | 19.8                                    | 40                                      |
|       | Animal diseases                        | 0                                                       | 3.8                                                       | 12.3                                                    |                                                           | 15.3                                    | 15.7                                    | 10                                      |
|       | Feed of livestock                      | 17.8                                                    | 21.1                                                      | 100                                                     |                                                           | 98                                      | 82.7                                    | 30                                      |
|       | Highways                               | 28.1                                                    | 51.8                                                      | 87.3                                                    |                                                           | 19.8                                    | 50                                      | 22.2                                    |
|       | Lack of money                          | 52.2                                                    | 50                                                        | 95                                                      |                                                           | 100                                     | 58.9                                    | 10                                      |
|       | Lack of credit                         | 39.7                                                    | 83.2                                                      | 95                                                      |                                                           | 100                                     | 88.7                                    | 17.8                                    |
|       | Poor insurance                         | 4.3                                                     | 7.3                                                       | 5                                                       |                                                           | 18.8                                    | 7.8                                     | 0                                       |

|                                                          | Northwest<br>Kazakhstan<br>Single<br>Household<br>Farms | Northwest<br>Kazakhstan<br>Multiple<br>Household<br>Farms | Southeast<br>Kazakhstan<br>Single<br>Household<br>Farms | Southeast<br>Kazakhstan<br>Single<br>Household<br>Farms in<br>Cooperatives<br>or<br>State Farms | Northern<br>Kyrgyzstan<br>Private<br>Farms | Northern<br>Kyrgyzstan<br>Private<br>Farm<br>Members of<br>a United<br>Peasant<br>Farm |
|----------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------|
|                                                          | N=23                                                    | N=38                                                      | N=41                                                    | N=99                                                                                            | N=52                                       | N=10                                                                                   |
|                                                          | 4.3                                                     | 21.1                                                      | 10                                                      | 4.1                                                                                             | 9.8                                        | 0                                                                                      |
| Lack of roads                                            | 9.7                                                     | 10.5                                                      | 7.5                                                     | 9.2                                                                                             | 43.1                                       | 50                                                                                     |
| Lack of transportation                                   | 21.7                                                    | 34.3                                                      | 72.5                                                    | 86.7                                                                                            | 19.8                                       | 10                                                                                     |
| Lack of electricity                                      | 21.7                                                    | 13.2                                                      | 100                                                     | 100                                                                                             | 80                                         | 44.4                                                                                   |
| Lack of investments                                      |                                                         |                                                           |                                                         |                                                                                                 |                                            |                                                                                        |
|                                                          |                                                         |                                                           |                                                         |                                                                                                 |                                            |                                                                                        |
| 29 MAJOR PROBLEMS REPORTED<br>(% of respondents) (Cont.) |                                                         |                                                           |                                                         |                                                                                                 |                                            |                                                                                        |
| High prices for fuel and transport                       | 65.2                                                    | 81.8                                                      | 100                                                     | 100                                                                                             | 80.4                                       | 90                                                                                     |
| Low prices for agricultural products                     | 73.9                                                    | 92.1                                                      | 100                                                     | 100                                                                                             | 70.8                                       | 40                                                                                     |
| Absence of marketing cooperatives                        | 30.4                                                    | 57.9                                                      | 71.9                                                    | 76.5                                                                                            | 82.4                                       | 40                                                                                     |
| Lack of government land                                  | 13                                                      | 18.4                                                      | 23.1                                                    | 18.4                                                                                            | 72.5                                       | 40                                                                                     |
| Inability to acquire technology & equipment              | 17.4                                                    | 34.2                                                      | 45                                                      | 64.8                                                                                            | 66.7                                       | 70                                                                                     |
| Inability to sell products profitably                    | 65.2                                                    | 55.3                                                      | 97.5                                                    | 100                                                                                             | 86.3                                       | 50                                                                                     |
| Inability to sell land                                   | 0                                                       | 2.8                                                       | 7.9                                                     | 2.1                                                                                             | 15.7                                       | 10                                                                                     |
| Lack of state support policies                           | 80.9                                                    | 80.5                                                      | 97.5                                                    | 100                                                                                             | 48                                         | 50                                                                                     |

discussed below.

**Revision of the core questionnaire for the field surveys (Workplan Activity 1).** This work began with the regional research team in Almaty, before and after the January 1999 conference. It benefited from the field team's assessment of how well the various parts of the first year's questionnaire worked, and it reflected our wish to get greater detail on (a) the dynamics of new farm creation and organization, and (b) the marketing process.

The regional researchers, all of whom have considerable field experience in the area, identified a number of problem areas with the first year's questionnaire. First, farmers were under-reporting livestock numbers. Spot checking with neighbors and simply walking the farm made this apparent. Second, annual income and expenditure data were, at best, good guesses. Such problems are quite common with "one-shot" surveys. Thus, as stated in our Annual Report for 1997 - 1998, we will use these data for general indications of farm scale, but not for detailed input/analysis. This limitation also applies to acreage data, but for a different reason. Many farmers do not have a sense of private holdings and hence questions about the extent of their own property were undoubtedly subject to varying interpretations by respondents. This was not a language problem, since our teams spoke the local language, but rather it reflects the recent and continuing evolution of new property rights, the varying ways that local administrations are applying the new national laws and the limited spread of information from the government to the farmers.

The first year's questionnaire was revised into two separate questionnaires - one for the head of an individual household and one for the head of a group farming enterprise. There is considerable expansion of the sections on farm organization and on marketing. These

new, expanded elements are designed primarily to structure qualitative interviews more than as a tool for gathering precise quantitative data. Thus, there are questions like: "Why and how did you first start farming with this group enterprise? What were you doing before this enterprise was formed? Why did you change? Why did you leave the kolkhoz/sovkholtz? Why are you farming in a group rather than by yourself?" "Who makes the decisions for the group and how are decisions made about choice of farming activities, labor assignments, marketing and other farm matters?" Such questions are followed by a large number of blank lines to record responses.

**Identification of new field survey sites in Kazakhstan, Kyrgyzstan and Possibly Uzbekistan (Workplan Activity 2).** New sites were identified in Kazakhstan and Kyrgyzstan. Field research was discontinued in Uzbekistan for two reasons. First, our first year's survey confirmed that there has been very little progress toward new forms of farm organization in Uzbekistan. Many of the former state enterprises remained in place with only name changes. Where reorganization occurred it was into "shirkats" which largely replicate the Soviet state enterprises but on a smaller scale. The second reason to drop Uzbekistan stems from the budget cut. We decided to concentrate the lower level of resources on the two countries that could reveal more about how the agricultural economy is evolving away from the Soviet structures. The new sites in Kazakhstan and Kyrgyzstan are shown in the Box 1.

**Second round of field surveys (Workplan Activity 3).** Field surveys were carried out by three teams, two in Kazakhstan and one in Kyrgyzstan). The surveys were conducted between April and September, 1999. The number of questionnaires administered in each location is shown in the box below.

chain in the future.

Becker and Company is a large processor that holds a dominant position in the important boiled sausage market segment in the Almaty

*The Nature of Marketing Channels for Milk and Dairy Products in Kazakhstan, 1999*

*Box 1: Field Surveys Conducted in 1999.*

region. Becker sells 6.5 to 7.0 tons of sausages daily through 28 company shops in the Almaty area and markets additional sausage through retail stores.

Two mid-sized plants include Balapan Farms (canned pork producer) and Accept Agro's Talgar Slaughter House (integrated beef feeder and processor). Both have significant growth potential if constraints limiting their operations can be overcome. Balapan Farms faces credit constraints and Accept Agro fears that it will be difficult for the firm to obtain adequate numbers of feeder bulls.

With the exception of Becker and possibly Balapan Farms and Accept Agro, much of the remainder of the livestock and meat marketing and processing sector in the Almaty region of Kazakhstan fits Porter's description of a fragmented industry.<sup>24</sup>

Becker and Company and a processor associated with Ramstor supermarkets have integrated backward into hog production to safeguard supplies of pork. The Ramstor affiliate feared that there would be few hogs left in Kazakhstan by 2002 or 2003.

While integration backward into production and meat imports by marketing firms are orthodox adjustments of the type predicted by Porter, these adjustments may further reduce livestock numbers in Kazakhstan.

Small livestock farmers possess little bargaining power relative to dealer-wholesalers and processors. If trends in Europe and North America spread to the Almaty region, expect the bargaining power of supermarkets to increase relative to others in the marketing

**QUESTIONNAIRES ADMINISTERED**

**Individual Enterprise  
SITE  
Household  
Leader**

Kazakhstan

Aktiubinsk Oblast

Mugodzharsk Region

18

Temirsk Region

78

Baiganinsk Region

61 53

Uilsk Region

8

Alginsk Region

1

West-Kazakhtan Oblast

Symsky Region

43 11

Karatobinsky Region

10 5

Dzhangalinsky Region

14 4

Kyrgyzstan

Issyk Kulskaia Oblast

Ak-suiszkii Region

3 1

Dzhety-Oguzskii Region

19 2

Tonskii Region

52 3

Narynskaia Oblast

Kochkorskii Region

43 3

*Marketing of Animal Products*

Marketing of animal products is being studied at the farm level and at the processor-to-retailer level. The first study at the processor-retail level in the Almaty environs was conducted in 1999 by Saulesh Esenova of the Institute of Oriental Studies under the direction of UW Professor William Dobson. Professor Dobson will direct subsequent studies to be carried out by Aslan Naurzgaliyev of West-Kazakhstan Agrarian University and Askar Khamzin of Astana Agrarian University, two agricultural economics professors who spent the fall semester at UW under a USDA grant.

The Esenova-Dobson study focused on the following marketing-related characteristics for livestock, meat, milk and dairy products:

- Elements of the economic and business environment that shaped marketing channels for these products.
- The nature and condition of marketing channels for the products.
- Key constraints to efficient marketing performance for the products.
- Policy and technology interventions that would improve the performance of firms marketing these products.

The study's major findings are as follows:

*The Nature of Marketing Channels for Livestock and Meat in Kazakhstan, 1999*

There are approximately a dozen mid-sized and small sausage/meat processing plants located in or near the city of Almaty. There are more than 100 (mostly tiny) additional sausage plants in Almaty.



meat, milk and dairy product markets as the markets undergo the transition from socialist to market-based systems.

The number one constraint is the decline in livestock numbers. The decline in livestock numbers reflects impacts of the transition away from large, state farms to smaller farms, withdrawal of certain agricultural subsidies and depressed economic conditions. This constraint contributes to developments such as excess capacity in meat and dairy processing and processor concerns about obtaining adequate livestock and milk supplies. Some meat processors have dealt with the problem of inadequate supplies by integrating backward into hog production and importing meat. While these represent rational adjustments on the part of processors, their actions may contribute to further reductions in domestic livestock supplies. Whether it will be profitable for processors to produce a large percentage of the hogs they slaughter and import larger quantities of meat is unclear.

Shortages of credit at acceptable interest rates and repayment terms have limited the ability of meat and dairy processors to expand output. Some livestock and milk processing firms have chosen to rely largely on retained earnings to expand output. Heavy reliance on retained earnings can be counted on to stunt the growth of processing and marketing firms. Of course the credit problem is not unique to livestock, meat, milk and dairy processing and marketing firms. It presumably affects firms throughout Kazakhstan's economy.

Marketing and processing firms voiced complaints about the high costs and uncertainties created by government and bureaucratic practices. Abuses of veterinary practices affecting livestock and milk producers and meat processors were among the most frequently

mentioned problems. The tax incentives were mentioned as a problem because there was uncertainty about the availability and continuation of the incentives. A Food Master official complained of "grey imports" which enter the country and compete with Food Master dairy products without being subject to tariffs. Dairy processors noted the high cost of importing needed packaging material from Finland and Germany, attributing the high cost to tariffs and devaluation of the Tenge.

Weak consumer demand for value added meat dairy products reflects, in part, the recessions affecting Kazakhstan's economy and the lower purchasing power of consumers during the transition to a market economy. Food Master, for example, reported that the demand for its branded yogurts was reduced by the recession in 1999. Like the credit problem, demand shortfalls are not unique to the livestock, meat, milk and dairy sectors. However, such shortfalls do reduce profits in much of the marketing chains and reduces firms' incentives to introduce new products that would be welcomed by consumers. This problem may be self-correcting if the general economy begins to grow vigorously.

A Food Master official said that his biggest challenge was to obtain skilled personnel for marketing and quality control work. Such personnel are needed to do sophisticated work on matters such as package design and to ensure that consumers receive products of consistently high quality. Skilled marketing and quality control personnel are needed to build brand loyalty.

Constraint No. 6 is important but one that should be self-correcting. Many of the developments that have limited livestock and milk production and have impaired the performance of marketing and processing

In 1999, eight dairy processing plants operating in or near the city of Almaty processed a total of about 200 tons of milk per day.

Dairy farming in the Almaty region does not appear to be in a downward spiral. Moreover, milk processing in the region is not fragmented to the same extent as meat processing.

Food Master is the dominant dairy processing firm in the Almaty region. The firm claims to have about a 60% market share for the main products that it markets in the Almaty region. The firm processes about 40 tons of milk daily in the Almaty and Yessyk plants.

Food Master has literally changed the structure of milk markets in the Almaty region by establishing 28 milk collection stations for smaller milk producers in the region. These collection stations and price incentives that Food Master gives small producers have encouraged more of these producers to stay in business and have helped the processor obtain adequate milk supplies.

SMAK Company Ltd. produces ice cream and fluid milk products. The firm has capacity to produce 30 to 40 tons of milk per day but in 1999 could obtain only about 15 tons of milk per day from farmers.

Agro Products began operations processing two tons of milk per day but in 1999 had substantially larger operations. The firm sells fluid milk products, cream cheese desserts and ice cream. Most of the firm's fluid milk products are sold through a chain of kiosks and lesser amounts through retail stores.

Both SMAK and Agro Products find that it is expensive to obtain needed imported dairy product packaging material, in part because of the devaluation of Kazakhstan's currency in April 1999 and the 20% tariff on imported fluid milk packaging materials.

Foreign firms and new entrants from elsewhere in Kazakhstan might sell increased amounts of ice cream and hard cheese in the relatively prosperous Almaty market.

Based on their study, Esenova and Dobson identify a number of constraints to and recommendations for efficient marketing.

#### *Constraints to Efficient Marketing Performance*

The key constraints to efficient marketing performance for the livestock, meat, milk and dairy product sector in the Almaty region of Kazakhstan are a product of the business and economic environment that has emerged in Kazakhstan during the transition to a market economy. The closely related constraints in approximate order of importance include the following:

1. The large decline in livestock numbers in Kazakhstan during 1991 to 1999.
2. Shortages of credit for marketing and processing firms at acceptable interest rates and repayment terms.
3. Government and bureaucratic practices affecting (a) veterinary inspections, (b) tax incentives for expansion of livestock, meat, milk and dairy production and processing and (c) tariffs.
4. Weak consumer demand for value added meat and dairy products.
5. Shortages of personnel with sophisticated marketing and quality control experience relating to meat and dairy processing.
6. Lack of experience on the part of producers and processors with market conditions that have emerged in the livestock,

most meaningful. The system need not be the rigid system existing in Soviet times which divided all meats into several categories with corresponding prices. But grades and standards are needed to supplement those of the current pricing arrangements for livestock in the Almaty region which arrangements give farmers few incentives to produce high quality products. The main mechanism is rejection of diseased livestock and rejection of livestock that fail to meet a minimum quality hurdle.

The government could have a direct role in reducing regulatory abuses—especially those relating to veterinary inspections. While we do not have complete information on the extent of abuses by veterinary and sanitary inspection services, the complaints were voiced sufficiently often that we think there is something to them. If true, the Almaty City Veterinary Officials who collected two to three kilos of high quality meat in order to perform a safety inspection provide an example of an egregious abuse that could readily be corrected by proper administrative oversight. On a related point, Becker and Company pleaded for a bureaucracy that does not create requirements which interrupt the smooth running of our business. We are mindful of the difficulty of correcting regulatory and bureaucratic abuses, but there are some which need to be remedied.

Time and experience will help farmers and processors adjust to a market economy. Universities and other educational institutions will presumably generate additional personnel trained in marketing and quality control.

### *Increased Lamb Production from Kazakh Finewool Flocks*

**Growth of 1998-born lambs.** The experimental lambs born in 1998 were grazed on summer mountain pastures in Southeastern Kazakhstan near the border with Kyrgyzstan

owned by the Aksengerskoe farm in Almaty oblast. The lambs were weighed and weaned on the mountain in August 1998 at approximately 3 months of age. The ewes and lambs came down from the mountains in September to the Aksengerskoe farm. The lambs were moved to the Sheep Breeding Institute where they were weighed at monthly intervals through May 1999 and evaluated for wool traits and subjective classification.

Lambs were maintained in open-fronted pens. Initially they were fed .8 kg. of wheatgrass hay and .4 kg. of whole barley per head per day. As the lambs grew, the level of feeding was increased until it reached 1.2 kg. wheatgrass hay, 1.4 kg. corn silage and .9 kg. of whole barley per head per day.

Presented in Table 1 are the weights of the lambs sired by the four breeds of sire. Weaning weights of the Rambouillet-sired lambs were approximately 3 kg. greater than the weaning weights of the lambs sired by the other three breeds of sire. The lambs lost weight or gained very little from weaning at 3 months-of-age until 4 months-of-age. This is probably due to the fact that the lambs were walked from the mountain pastures to the Aksengerskoe farm and trucked to the Sheep Breeding Institute during the one-month period between these two weights. Twelve-month weights tended to be heaviest for lambs sired by the two U.S. breeds (Rambouillet and Polypay).

Lamb growth is a factor in determining weight of lamb meat produced per ewe per year, but it is not as important a factor as the number of lambs raised per ewe per year. The real value of these breeds for improving the meat production of Kazakh sheep will be determined once the ewe lambs reach sexual maturity and enter lamb production. However, the increased growth rate of the U.S. genetics seen in the early part of this study is a positive attribute.

firms will be self-correcting. As people gain additional experience with the workings of a market economy, they will know what to expect in terms of market adjustments. The key will be to keep the livestock and meat industries, in particular, from shrinking excessively prior to the time that the experience is gained.

*Policy And Technological Adjustments That Would Improve Marketing Performance*

Several key constraints affecting the livestock, meat, milk and dairy product markets in the Almaty region spring from problems with Kazakhstan's general economy. For example, weakness in demand is a deep-seated problem that will be remedied in part by macroeconomic policies that promote growth and stability of the economy and create a favorable business environment. Economic growth and demand also will revive as people adjust to living in a market economy.

The credit constraint described above will not be quickly or easily remedied. Marketing officials interviewed recommended that credit subsidies be provided for farmers and processors. However, credit subsidy programs are expensive and difficult to administer in an even-handed fashion. The credit problem for farmers is exacerbated by the fact that farmland cannot be used as collateral for loans. Probably the best remedy is for the government to provide the most favorable environment that it can for joint ventures involving foreign firms that would supply equity capital and domestic firms. While Becker and Company and Food Master represent success stories involving foreign firms that entered into joint ventures with Kazak firms,

the success of these firms diminishes chances for other foreign firms to enter the Almaty region. However, there are undoubtedly attractive niches for foreign joint venture partners, especially for products that cannot be easily imported.

The decline in Kazakhstan's livestock herd will not be easily reversed. Improvements in general economic conditions will slow the slaughter of the herd since fewer farmers would be so strapped for cash that they will liquidate herds. However, livestock and meat processors will need to return to farmers' higher prices for livestock before there will be incentives for a turn around in livestock production. Dealer-wholesalers and meat processors might find it advantageous to create win-win situations similar to one created by Food Master for small milk producers. This may necessitate establishing integrated cattle and hog raising systems where farmers share more fully in the profits from livestock raising. Large meat processors such as Becker and Company might find it profitable to enter into such integrated arrangements rather than raising more livestock on the firm's own farm.

Both livestock and milk processing firms may find it profitable to enter into production contracts with farmers to a greater extent than is done now. These contracts could provide limited price guarantees for farmers and give farmers incentives to provide dependable supplies to processors. With appropriate modifications, the incentives used by Food Master to encourage small milk producers to be consistent milk suppliers might have applications in the livestock and meat industry of Kazakhstan.

Livestock farmers need additional market information which would be distributed mostly by radio and newspapers. However, a system of grades and standards probably would be needed to supplement such information to make it

Table 1. Weights and Daily Gains of Lambs born in 1998 and Sired by Kazakh Finewool, Kazakh Prolific, Rambouillet and Polypay rams

| Daily gain from | Sex of     | No. of | Weight + s.e., Kg. At: |             |             |                |
|-----------------|------------|--------|------------------------|-------------|-------------|----------------|
|                 | Lamb       | lambs  | Weaning<br>(3 Mo.)     | 4 mo.       | 12 mo.      | 4 to 12 mo., g |
| Kazakh Finewool | Ram        | 13     | 23.8 ± 1.05            | 23.8 ± .34  | 52.3 ± .88  | 118            |
|                 | Ewe        | 17     | 22.0 ± 1.36            | 21.9 ± .30  | 36.7 ± 1.98 | 60             |
|                 | Ave./total | 30     | 22.9                   | 22.8        | 44.5        | 89             |
| Kazakh Prolific | Ram        | 12     | 23.3 ± 1.33            | 23.5 ± .28  | 51.3 ± .89  | 116            |
|                 | Ewe        | 14     | 22.4 ± .91             | 21.5 ± .32  | 36.5 ± 1.25 | 62             |
|                 | Ave./total | 26     | 22.8                   | 22.5        | 43.9        | 89             |
| Rambouillet     | Ram        | 14     | 26.6 ± .88             | 26.2 ± .90  | 55.0 ± 1.6  | 120            |
|                 | Ewe        | 17     | 24.8 ± .75             | 23.0 ± .50  | 39.0 ± 1.7  | 70             |
|                 | Ave./total | 31     | 25.7                   | 24.6        | 47.0        | 95             |
| Polypay         | Ram        | 6      | 23.0 ± 1.22            | 24.0 ± 2.15 | 52.8 ± 2.9  | 120            |
|                 | Ewe        | 9      | 22.7 ± 1.03            | 23.0 ± .90  | 41.7 ± 2.1  | 77             |

of their lambs are presented in Table 3. The ewes gave birth to an average of 1.24 lambs per ewe lambing. Birth weights were greatest for Rambouillet-sired lambs and least for the K. Prolific-sired lambs. Since birth weights are positively correlated with body weights at later ages, the Rambouillet-sired lambs will be predicted to have the heaviest body weights at later weights. If this actually occurs, the results would be in general agreement with the growth results from the lambs born in 1998.

**Lamb Survival in 1999 (Workplan Activity 7).** In 1998, we reported high lamb mortality rates in some groups of ewes at the Aksengerskoe farm. This was attributed to a

very harsh winter and short feed supplies that resulted in pregnant ewes that were in very poor body condition at the time of lambing and who gave birth to very small and weak lambs. Also, sanitation at the time of lambing was less than optimum. Considerable steps were taken in 1998/1999 to rectify the problems that occurred in 1998. Ewes were well-fed during pregnancy, 7% tincture of iodine was used on the navels of all lambs shortly after birth, antibiotics were used to treat early signs of lamb pneumonia and generators and fuel were provided to generate electricity so that ewes and lambs could be checked at night. These steps resulted in very high lamb survival rates in 1999.

**Analysis of DNA samples from lambs sired by Rambouillet rams for genetic markers linked to the FecB gene to help in differentiating between carrier (FecB+) and non-carrier (Fec++) animals (Workplan Activity 5).** Blood samples were collected and the DNA extracted in Kazakhstan. Samples were sent to the University of Wisconsin-Madison. The DNA samples will be sent to a commercial laboratory in New Zealand that has a proprietary DNA test for genes linked to the FecB locus that is more accurate than DNA tests available in other laboratories.

**Artificial insemination of ewes in 1998 (Workplan Activity 6).** In November and December 1999, 400 ewes were inseminated on the Aksengerskoe farm, Zhambylskii District, Almaty Oblast, Kazakhstan by Dr. Nurlan Malmakov. Fresh semen was used from Kazakh Finewool and Kazakh Prolific rams owned by the Sheep Breeding Institute and frozen semen was used from Polypay and Rambouillet rams owned by the University of Wisconsin-Madison.

Cervical insemination of the ewes was conducted with the use of a semi-automatic syringe fitted with an illuminated flashlight and vaginal mirror. Ewes detected in estrus by a vasectomized ram were inseminated at least twice - once in the morning (0800 to 1000) and again in the evening (1600 to 1800). Ewes with a prolonged estrus were inseminated a third time. The frozen semen was in .25 ml pellets in a 1:4 ratio of semen:citrate diluent and was thawed at a temperature of 38° to 40°C. Approximately .20 ml. of frozen-thawed diluted semen or .10 to .15 ml. of fresh undiluted semen were used at each insemination.

Results of the insemination are presented in Table 2. The conception rates for the ewes inseminated with fresh semen from the Kazakh rams were approximately twice the conception rates of ewes inseminated with frozen-thawed semen from the U.S. rams. This is as expected since frozen-thawed semen has a lower fertilizing ability compared to fresh semen.

**Ewe Reproduction and Lamb Birth Weight.** The reproductive rate of the ewes inseminated in 1998 and the birth weights

Table 2. Conception rates of Kazakh Finewool Ewes Artificially Inseminated in 1998

| ITEM                              | BREED OF RAM |             |             |         | Total |
|-----------------------------------|--------------|-------------|-------------|---------|-------|
|                                   | K. Finewool  | K. Prolific | Rambouillet | Polypay |       |
| No. of ewes inseminated<br>400    | 52           | 53          | 199         | 9 6     |       |
| No. of ewes with known abortions  | 2            | 1           | 2           | 0       | 5     |
| No. of ewes which lambled to A.I. | 33           | 26          | 50          | 35      | 144   |
| No. of pregnant ewes to A.I.      | 35           | 27          | 52          | 35      | 149   |
| Conception to A.I., %             | 67.3         | 50.9        | 26.1        | 36.5    | 37.2  |

Table 3. Ewe Reproduction and Lamb Birth Weight in 1999

| Breed of ram    | No. ewes<br>Lambled | No. of lambs born: |      |      | Lambs born/<br>lambled | Birth Weight $\pm$ s.e. |
|-----------------|---------------------|--------------------|------|------|------------------------|-------------------------|
|                 |                     | Total              | Rams | Ewes |                        |                         |
| Kazakh Finewool | 33                  | 42                 | 22   | 20   | 1.27                   | 3.43 $\pm$ .121         |
| Kazakh Prolific | 26                  | 32                 | 14   | 18   | 1.23                   | 3.21 $\pm$ .124         |
| Rambouillet     | 50                  | 60                 | 31   | 29   | 1.20                   | 3.67 $\pm$ .095         |
| Polypay         | 35                  | 44                 | 24   | 20   | 1.26                   | 3.44 $\pm$ .098         |
| Total/average   | 144                 | 178                | 91   | 87   | 1.24                   | 3.47 $\pm$ .052         |

Table 4. Percentage Motile Sperm and Absolute Indicator of Survival Rate for Different Diluents

| Item                      | Diluents        |                 |                 |                 |                 |
|---------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                           | Control         | Arginine        | Betaine         | Glutamine       | Proline         |
| at thawing                | 42.5 $\pm$ 1.97 | 54.3 $\pm$ 2.48 | 51.8 $\pm$ 2.02 | 53.6 $\pm$ 1.80 | 54.3 $\pm$ 2.23 |
| after 1.5 hrs             | 42.1 $\pm$ 2.08 | 53.8 $\pm$ 3.28 | 50.0 $\pm$ 3.35 | 51.7 $\pm$ 3.00 | 53.3 $\pm$ 2.86 |
| after 3.0 hrs             | 36.8 $\pm$ 2.30 | 46.4 $\pm$ 3.40 | 44.6 $\pm$ 2.80 | 35.7 $\pm$ 5.64 | 45.7 $\pm$ 2.87 |
| after 4.5 hrs             | 28.8 $\pm$ 5.19 | 36.3 $\pm$ 5.47 | 26.7 $\pm$ 4.82 | 27.9 $\pm$ 6.84 | 29.9 $\pm$ 7.37 |
| after 6.0 hrs             | 22.9 $\pm$ 5.89 | 27.1 $\pm$ 5.94 | 19.1 $\pm$ 5.40 | 18.2 $\pm$ 4.90 | 17.9 $\pm$ 5.19 |
| after 7.5 hrs             | 17.2 $\pm$ 5.75 | 18.0 $\pm$ 5.11 | 10.2 $\pm$ 3.73 | 8.3 $\pm$ 3.60  | 10.4 $\pm$ 3.44 |
| after 9.0 hrs             | 4.6 $\pm$ 2.18  | 5.2 $\pm$ 2.62  | 5.3 $\pm$ 1.67  | 5.5 $\pm$ 2.43  | 5.9 $\pm$ 1.87  |
| <b>Absolute survival:</b> |                 |                 |                 |                 |                 |
| Value                     | 250 $\pm$ 28    | 308 $\pm$ 29    | 269 $\pm$ 22    | 267 $\pm$ 26    | 282 $\pm$ 25    |
| % of control              | 100             | 123             | 108             | 107             | 113             |

Table 5. pH for Different Diluents Diluents

| pH of:                 | Control        | Arginine       | Betaine        | Glutamine      | Proline        |
|------------------------|----------------|----------------|----------------|----------------|----------------|
| Diluent                | 6.7            | 6.7            | 6.7            | 6.7            | 6.7            |
| Cooled Semen           | 6.52 $\pm$ .03 | 6.62 $\pm$ .02 | 6.46 $\pm$ .02 | 6.44 $\pm$ .02 | 6.44 $\pm$ .02 |
| Frozen-thawed<br>Semen | 6.74 $\pm$ .05 | 6.69 $\pm$ .01 | 6.59 $\pm$ .05 | 6.63 $\pm$ .05 | 6.63 $\pm$ .06 |
| Incubated semen*       | 5.97 $\pm$ .16 | 6.10 $\pm$ .08 | 5.72 $\pm$ .13 | 5.81 $\pm$ .13 | 5.87 $\pm$ .14 |

In addition to the 144 ewes which lambed to the artificial insemination for our experiment, an additional 156 ewes lambed in this flock between April 5 and May 15, 1999. These 300 ewes gave birth to 360 lambs. Only twenty-six of these lambs died (7.2% death loss). Six lambs were aborted, 5 lambs were stillborn and 15 lambs died after birth - most from pneumonia. In another flock on the same farm that lambed from March 20 to April 15, 1999 we gave birth to 235 lambs and only 2 lambs died (.9% death loss). These data show that given reasonable, but not extensive inputs, lamb losses can be kept to minimal levels.

**Range management and summer ewe and lamb nutrition practices recommended in August 1998 (Workplan Activity 8).** - Due to budget cuts, we have not been able to continue Dr. Steven Sharrow's involvement in the project so his specific recommendations for research on range management and sheep nutrition have not been implemented. However, the need to provide better nutrition of pregnant ewes recommended by him and Dr. Gessert in 1998 was implemented in 1998/99 with positive improvements in lamb survival.

**Use of Amino Acids in Ram Semen Diluents (Workplan Activity 9).** Five freezing diluents were compared: a basic sucrose-complex medium as the control diluent and four diluents composed of the control diluent plus 80 mM of added arginine, betaine, glutamine, or proline. Ejaculates from three Australian Merino rams were collected and divided into five equal parts. Each part was diluted at a ratio of 1 part semen:4 parts diluent with one of the five diluents and frozen in liquid nitrogen. The frozen semen was thawed and incubated at 37°C, and sperm motility, sperm survival and semen pH were determined at 1.5 intervals until 9 hours post-thawing. Results are presented in Tables 4 and 5.

At thawing and 1.5 hrs after thawing, the four diluents with an amino acid added each had greater ( $P < .05$ ) percentage of motile sperm than the control diluent (Table 4). After 9 hours of incubation, there were no significant differences between the diluents for percentage motile sperm, but slightly higher numerical values were obtained for the diluents with added amino acids. The same trend was observed for the index of absolute survival. These data suggest that the addition of amino acids to the freezing diluent will result in a greater percentage of motile sperm shortly after thawing which may result in a greater conception rate from artificial insemination. Arginine generally resulted in greater motility and survival than the other three amino acids. The semen with the arginine diluent had a higher ( $P < .05$ ) pH than all other diluents at cooling (Table 5) indicating superior buffering properties that may relate to its superior motility.

A study was conducted to determine if the mode of action of the amino acids on improving sperm motility in frozen-thawed semen was as a cryopreservative. Six diluents were produced: 1) control B sucrose-based with 4% glycerin as a cryopreservative, 2) control medium with no glycerin and 3 to 6) control medium with no glycerin but with 80 mM added arginine, betaine, glutamine or proline. Ejaculates were divided into 6 parts with each part diluted to a ratio of 1:4 with each of the six diluents. Diluted semen was frozen in liquid nitrogen, thawed at 37°C and sperm motility determined on thawed samples. Results are presented in Table 6. All four of the diluents with added amino acids had sperm motility levels that were greater ( $P < .05$ ) than the control diluent without glycerin indicating that the amino acids do serve as effective cryopreservatives. Also, only the diluent with the amino acid betaine had motility significantly lower than the control diluent with glycerin indicating that arginine, glutamine and



Table 6. Motility (%± s.e.) of Frozen-Thawed Semen in Diluents Without Glycerin and with Added Amino Acids

| Control w/glycerin | Control w/o glycerin | Arginine w/o glycerin | Betaine w/o glycerin | Glutamine w/o glycerin | Proline w/o glycerin |
|--------------------|----------------------|-----------------------|----------------------|------------------------|----------------------|
| 41.4 ±1.44         | 34.2 ±1.05           | 42.7 ± 13.17          | 12 ± 1.17            | 39.9 ± 1.06            | 39.6 ± 100           |

from 1998 to 1999 where the experimental sheep are kept, is an example of an effective outreach effort. Dr. Mary Gessert, a private sheep veterinarian from Wisconsin, visited Aksengerskoe farm in 1998 during the start of the lambing season. She estimated lamb mortality to be 15 to 30% during the time she was present. Due to implementation of some of her suggestions, lamb mortality dropped to 12% in the flock of experimental ewes that lambed after she left. In 1999, lamb mortality varied from 1 to 7%, which was a significant drop from 1998. The reduced lamb mortality was accomplished through very simple means - better feeding of pregnant ewes and better sanitation during lambing.

An important part of our outreach strategy is bringing research results to the attention of key policy makers, leading members of the scientific establishment who influence policy makers and others. The activities listed below have contributed to that objective.

Table 7. Semen Frozen with a Diluent containing Arginine

| Item                                                          | DILUTENT |          |
|---------------------------------------------------------------|----------|----------|
|                                                               | Control  | Arginine |
| No. of ewes inseminated                                       | 25       | 25       |
| Ewes not exhibiting estrus within 18 days after insemination: |          |          |
| No.                                                           | 17       | 18       |
| %                                                             | 68       | 72       |
| Ewes which lambed:                                            |          |          |
| No.                                                           | 13       | 15       |
| %                                                             | 52       | 60       |

**Conference in Almaty, January 1999.** The conference had the objective of (a) reporting our research results and the work of other scholars studying related topics, and (b) providing a forum for discussion of agricultural privatization in Kazakhstan and development of the livestock sector. The Minister of Science and Higher Education opened the conference with a speech emphasizing the importance of the research. In attendance were leaders from the Ministry of Agriculture and from research institutes dealing with livestock.

**Media coverage of the conference.** Our Kazakh team members stimulated considerable media coverage of the conference. This included the following:

K.U. Medeubekov. TV “Shakhar” January 12, 1999 interview with correspondent in the Kazakh language on the theme “On the Meaning for the Science Community of Kazakhstan Scientific-Productive Conference on the Situation of the Livestock Sector in the

proline may be as effective as cyropreservatives as glycerin. The diluent with arginine had the highest numerical value for motility.

Given the desirable laboratory results obtained with diluents containing arginine, an insemination trial was conducted to compare the conception rates of ewes artificially inseminated with frozen-thawed semen containing the control diluent (sucrose-based) or the control diluent with added arginine (sucrose-based with 80 mM of arginine).

Ejaculated semen from Australian Merino rams was diluted in a ration of 1:2 (semen:diluent) and frozen in liquid nitrogen. Frozen semen was thawed at 38° to 40°C. Cervical insemination of 50 Kazakh Finewool ewes (25 ewes per treatment) was done with a semiautomatic syringe and vaginal mirror. Ewes detected in estrus were inseminated with .2 ml of thawed semen in both the morning and evening from October 27 to 29, 1998. Ewes with a prolonged estrus were inseminated a third time.

Results are presented in Table 7. There were no significant differences in % returns to estrus or % ewes lambing between the two semen diluents. However, ewes inseminated with the semen with arginine did have higher numerical values. It is planned to repeat this study in 1999 with a larger number of ewes to increase the power of the test to detect differences between treatments.

#### GENDER

The following team members active in 1998-1999 are female:

Meruert Abuseitova, Project Coordinator based in Almaty

Saulesh esenova, Marketing Researcher in Kazakhstan

Olga Naumova, Field Researcher in NW Kazakhstan

Saniya Sabnaeva, Field Researcher in NW Kazakhstan

Two of the three graduate assistants working on the project in Madison with UW funding are women - Liba Brent and Michelle Hartner-Abaza.

The questionnaire gathers information on decision-making within the family. It appears that men dominate decision-making regarding livestock. However, husbands and wives seem to share decision-making about their budget.

#### POLICY

The project started with interviews of policy makers in Kazakhstan, Kyrgyzstan and Uzbekistan. In Kazakhstan, we have maintained closest contact with the Minister of Science, Dr. Shkolnik. He has now become Minister of Industry. In that position he should be especially interested in our findings about the agroprocessing industries through our marketing research. In Kyrgyzstan, the closest policy contact is with K. N. Kenenbaev, Head of the Government Fund for the Support of Small and Mid-Sized Businesses.

The January, 1999, conference in Almaty included policy makers from the Kazakhstan Ministry of Agriculture: K. M. Otarov, Deputy Minister, and S. S. Satigulov, Head, Department of Animal Husbandry.

#### OUTREACH

**Lamb Survival.** The improved lamb survival in the flocks of the Aksengerskoe farm

Department of Agriculture of the Republic of Kyrgyzstan: "Work of the Ethnological Expedition of the University of Wisconsin-Madison on the Study of the Contemporary Situation of the Livestock Sector in Kyrgyzstan, 1999."

K.U. Medeubekov, D. Thomas, K.M. Kasymov, N.I. Malmakov. *New Methods for Increasing the Genetic Potential of Kazakh Finewool and Meat-pelt Sheep in Reproduction and Meat Production*. Report at the Development Meeting of Scientific Advice KazNITIO. Almaty, August, 1998.

K.U. Medeubekov. *On the Scientific-Production Activities of the Agricultural-Genetic Center for Sheep Production of KazNITIO*. Communication at the conference of the Presidium of the Kazakh Academy of Agricultural Sciences (NATSAI). Almaty, November, 1999, March, 1999.

K.U. Medeubekov. "Sheep Raising of Kazakhstan: Reality and Perspectives" Report on the International Conference (of Scientific-Production) on the Problem of Sheep Raising on the Approach of the 21st Century. May, Almaty, 1999.

K.U. Medeubekov, K.M. Kasymov, N.I. Malmakov. *Appearance, Discussion on the Theme: Social-economic Questions and Reforms of Kazakhstan and Their Effects on the Conditions of Sheep Raising in Kazakhstan*. At a seminar for partner/specialists of the Ministry of Agriculture of the Republic of Kazakhstan, leaders of oblast-level departments of agriculture (and livestock) and heads of special certified farms, certified sheep farm cooperatives, and societies associated with raising and the realization of pedigreed sheep. Almaty, June 26-27 1999.

N. Masanov. Discussion "Does Kazakhstan Need Private Ownership of Land". Political

party of Kazakhstan, July 1999.

N. Masanov. Discussion "Optimization of Government Politics in the Sphere of Economics". Political party and NPO. Almaty, March, 1999.

**Research Paper Series.** We have started a Russian-language research paper series entitled *The Central Asian Livestock Sector in Transition*. It is distributed throughout the region. The first two volumes are:

O. Naumova. 1999. "The Structure of Livestock Farming in West-Kazakhstan Oblast."

S. Klyashtornyi. In Press. "Changes in the Livestock and Pastoral Sector in Kyrgyzstan".

**KazAgro**, the Kazakh Association of Private Farmers, attempts to assist private farmers by working with the government for key legislation and policies, by offering a variety of services and by working with external donors. We have developed a long-term relationship with Dr. Zhambakin, KazAgro's Associate Director. As an investment in his capabilities, we brought Dr. Zhambakin to Madison for a series of meetings in 1999. He met with the Director of the Wisconsin Farm Bureau Federation (an organization with very similar objectives to KazAgro's), the Director of Technical services of the World Council of Credit Unions (KazAgro has identified credit as the leading constraint facing private farmers), the Director of the regional ACDI/VOCA office, the Director of the UW Center for Cooperatives, the UW Associate Dean for Extension, the Cenex Cooperative, the Land Tenure Center, the Babcock Institute for International Dairy Development, the farmers' market, a family farm, a cheese factory and others.

#### DEVELOPMENTAL IMPACT

Republic". 12-13 January, 1999.

K.U. Medeubekov. Appearance on the TV show "Kazakhstan 1" 13 January 1999 in Kazakh language. On the theme - Sheep -Economic Meaning for Village Inhabitants.

K.U. Medeubekov. TV "Shalkar", special program "Village Hour" January 18, 1999 show on the theme "How to Increase Sheep Herd Size on the Peasant Farms with High Quality Products."

K.M. Kasymov. TV "Shalkar", May 23, 1999 show on the theme "Situation and Perspectives on Raising Half-Finewool Sheep in Kazakhstan.

K.U. Medeubekov Clip on the international conference "Current Conditions of the Livestock Sector in Kazakhstan and Perspectives on Their Development". ATE, Jan. 13, 9am.

M. X. Abuseitova Clip on the international conference "Current Conditions of the Livestock Sector in Kazakhstan and Perspectives on Their Development". TV "Xabar" Jan 12, 9pm.

M. X. Abuseitova Clip on the international conference "Current Conditions of the Livestock Sector in Kazakhstan and Perspectives on Their Development". TV "Raxat" Jan 12, 5pm.

M. X. Abuseitova Clip on the international conference "Current Conditions of the Livestock Sector in Kazakhstan and Perspectives on Their Development". TV "Raxat" Jan 13. 7pm.

M. X. Abuseitova Clip on the international conference "Current Conditions of the Livestock Sector in Kazakhstan and Perspectives on Their Development". Astana, Jan 12, 10pm.

M. X. Abuseitova Clip on the international

conference "Current Conditions of the Livestock Sector in Kazakhstan and Perspectives on Their Development". Radio of the Republic, Jan 12 6pm:

M.X. Abuseitova Clip on the joint project "Impacts of Economic Reform on the Livestock Sector in Central Asia". Radio "Shalkar", special program "Village Hour", January 19, 3 pm.

The weekly newspaper Panorama, No. 2, January 15, 1999, "An International Conference on the State of Animal Husbandry in the republic Took Place at the Academy of Science."

The Science of Kazakhstan, No. 2, January 16-31, 1999, "The Experience of [our] Ancestors, State Support, and the achievements of modern science Can Stabilize Animal Husbandry.

**Publication of our second book**, The Kazakhstan Livestock Sector in Transition to a Free Market, in Russian, presenting the Almaty conference proceedings. This 320-page volume has been distributed widely in Central Asia.

**Presentations and briefings for government agencies.** These include the following:

S. Klyashtornyi. 06/26/99: Bishkek, Government Support Fund for Small- and Mid-sized Businesses under the leadership of the Republic of Kyrgyzstan: "On the Results of the Work of the Ethnological Expedition of the University of Wisconsin-Madison to Study the Contemporary Situation in the Livestock Sector." 1998.

S. Klyashtornyi. 07/18/99: Bishkek, The Department of Agriculture of the Republic of Kyrgyzstan: "Contemporary Situation and Perspectives on the Development of the Livestock Sector in Kyrgyzstan"

S. Klyashtornyi. 08/26/99: Bishkek,

Emilio Laca, principal investigator for the UC-Davis Central Asian GL-CRSP project, has led the development of a project to be led by ICARDA and ILRI on livestock development in Central Asia. The project is seeking funding, but the System-Wide Livestock Program of the CGIAR system has allocated approximately \$300,000 of one-time money to get the project started. The two Central Asian GL-CRSP projects have been asked to be involved in this project as well.

Dr. Nurlan Malmakov, in-country co-investigator on the sheep portion of this project, is also a co-investigator on an ODI, U.K project looking at changes in farm structure and management as a result of decentralization led by Carol Kerven. His experience gained from this project has contributed to his value to the ODI project. In addition, he and Dr. Iain A. Wright of the Macaulay Land Use Research Institute, United Kingdom have submitted a project proposal to the European Union to improve prolificacy in local Kazakh and Kyrgyz Fat-Tail sheep that is modeled after the prolific sheep project of our GL-CRSP project.

The Land Tenure Center is studying land privatization in Kazakhstan under a subcontract with the British Know How Fund. We are in close communication with the Center's lead researcher on this project, Dr. Malcolm Childress.

The USDA Faculty Exchange Program awarded UW a grant to bring two Kazakh and two Russian agricultural economics professors to Madison for the fall semester, 1999. UW Professor William Dobson directed their program. As a result of their training and the close relationship they developed with Professor Dobson, the Kazakh professors will collaborate in the marketing research in 2000.

Over \$103,300 in leveraged funds were obtained to supplement the project in year two. These consist of the following: \$71,401 from the University of Wisconsin as salary for three half-time graduate assistants and for travel; \$14,867 from the Babcock Institute for International Dairy Research and Development to support Professor Dobson's marketing research; and \$17,500 from the USDA to support the aforementioned two Kazakh agricultural economics professors in residence fall semester 1999 at UW (this is half the total grant, the other half being attributed to support for two Russian professors at UW on the same program).

#### TRAINING

Nurlan Malmakov and Kenes Kasymov received training at the University of Wisconsin-Madison and the U.S. Sheep Experiment Station, Dubois, Idaho from August to September, 1999 in ram semen collection and freezing and management of prolific sheep under range conditions.

Arin Crooks, M.S. student with David L. Thomas, was supported with University of Wisconsin-Madison funds allocated to this project. He will complete his M.S. degree in February 2000 working with the biological and economic advantages of prolific sheep.

Three UW graduate students continue to work on the project under UW funding. They are David Weber, Liba Brent and Michelle Hartner. All three have good Russian language skills and experience in the former Soviet Union. All three are writing their theses on other subjects, but they are gaining quite a bit of knowledge about livestock development in Central Asia.

This project attempts to increase lamb production so Kazakhstan can increase its sheep numbers and increase its lamb meat production at the same time, while improving the efficiency with which range and feed resources are used. Thus the project has a positive effect on economic development at the same time that it has a positive impact on the environment and promotes agricultural sustainability. We will not know if the prolific breeds used in this study can improve the production of lamb meat production until the first experimental ewes lamb in the spring of 2000. If the prolific cross ewes do result in an increase in lamb meat production, they will require a lesser number of ewes to produce a given amount of lamb meat compared to a flock of lower prolific Kazakh Finewool ewes. This reduces the forage needed to produce a kg. of lamb meat and results in less overgrazing and less degradation of rangelands.

Results of this experiment have direct application in the U.S. Much of the sheep industry of the Western and Southwestern U.S. is based on the production of finewool sheep. Due to low world wool prices and loss of a government subsidy on wool in 1995, wool sheep production is unprofitable, and U.S. sheep numbers are falling. U.S. sheep producers in the range states need to switch their emphasis from wool to lamb production, and increased prolificacy of the flocks is one way for them to increase lamb meat production.

The farm surveys are intended to help policy makers by expanding their information about the new forms of farm organization that are actually emerging and how they are faring. Our detailed, on-the-ground surveys are useful supplements to the national statistics and ad hoc observations that often define the limits of information reaching policy makers. In addition, to the extent that local officials have

a stake in certain forms of farm organization, that stake may affect the information they pass to national agencies.

The marketing studies play a similar role, but may have more rapid, direct impacts in that they deal with a more concentrated set of institutions and companies. Recommendations from the marketing surveys may be implemented more easily and quickly than those dealing with millions of rural inhabitants living and working on over one hundred thousand farms.

### OTHER CONTRIBUTIONS

This project has a major focus on the following elements listed under this section: (1) free markets and broad-based economic development (i.e., agribusiness and private enterprise); (2) concern for individuals; and (3) support for democracy. The marketing research assesses the constraints to efficient processing and marketing of animal products, and it provides an initial set of recommendations. This will be developed further with follow-up studies in year three. The farm surveys are documenting the evolution of new forms of organization and the ways in which different individuals (e.g., former state farm leaders versus workers) are advantaged and disadvantaged by different aspects of the process. The structure of land ownership, the control of other rural assets, and the extent of agribusiness monopolization all have a bearing on the development of democracy in the region.

### LEVERAGED FUNDS AND LINKED PROJECTS

This project plus the UC-Davis GL-CRSP project in Central Asia are partners with ICARDA and ILRI in the IFAD project "Integrated Feed and Livestock Production in the Steppes of Central Asia" for a three-year period starting on October 1, 1999. The project is funded for \$1.5 million, and the GL-CRSP will receive \$250,000.

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Under the aforementioned USDA program, two Kazakh agricultural economics assistant professors received training in agribusiness during fall semester, 1999. The two are Aslan Naurzgaliyev of West-Kazakhstan Agrarian University and Askar Khamzin of Astana Agrarian University. The classes they attended included: International Business; Marketing Research; Managerial Economics; Agricultural Trade and Environmental Policies; and Farming Systems Management. In addition to course work, they visited area agribusiness enterprises, state and local government, the Chicago Board of Trade; area farms; and state extension offices. They will be using their training to revise course offerings in their home university. Dr. Dobson will be visiting them under the USDA grant, and they will be collaborating with Dobson on our marketing research.

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#### APPENDIX

Summary of Accomplishments in Year Two, 1998/1999

- Analysis of the changing legal context for agricultural privatization in Kazakhstan.
- Analysis of the evolution of new farm entities in Kazakhstan since 1991.
- Preliminary typology and analysis of new forms of farm organization in Kazakhstan, Kyrgyzstan, and Uzbekistan.
- Farm surveys in Kazakhstan, Kyrgyzstan, and Uzbekistan in 1998 (384 farms); and in Kazakhstan and Kyrgyzstan in 1999 (432 farms).
- Field study of animal product marketing in and around Almaty, Kazakhstan in 1999.
- Analysis of the marketing environment for animal products in and around Almaty.
- Case studies of Kazakhstan's leading dairy company and one of its leading meat companies.
- Preliminary identification of constraints to and recommendations for more efficient marketing of animal products.
- Evaluation of the growth of 1998-born experimental lambs.

- Artificial insemination of 400 ewes with semen from high prolific sheep and controls.
- Analysis of reproductive rates and lamb birth weight of experimental sheep.
- Improvement of lamb survival rates on a large state farm (7% in one flock and 1% in another).
- Identification of superior diluents for ram semen in artificial insemination.
- A major conference in Almaty, January 1999 (20 papers presented).
- Publication of a 320-page Russian language book with conference proceedings and additional papers, distributed widely in the region (25 papers).
- Initiation of Russian-language research paper series.
- Nine presentations of research results to government.

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However, simultaneous to the introduction of private property in land, a moratorium on private purchase/sale of land for up to 5 years was introduced (based on parliamentarian's fears that rapid sell-offs of agricultural land will take place). So neither the formal land market nor the mortgage credit system is developing while the moratorium continues. There is a lot of interest in cancelling the moratorium, but nothing has happened yet. (Childress, Malcolm, Personal Communication, 1999).

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allows these to gradually hand over animals to shepherds through the leasing system. This leasing system gives shepherds the opportunity to gain experience to find the most cost-effective methods of managing and marketing livestock without having to own the whole herd. This system should

**LIVESTOCK DEVELOPMENT AND  
RANGELAND  
CONSERVATION TOOLS FOR  
CENTRAL ASIA  
NARRATIVE SUMMARY**

Recent market changes and privatization caused imbalances and dramatic reductions of agricultural stocks, production and productivity in Central Asian Republics (CAR). Central Asia represents a large region in the center of the Eurasian continent that encompasses the territories of Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan. Rangelands occupy nearly 80% of the territory and provide the main source of forage for livestock. Sustainability of extensive production and human nutritional welfare were negatively impacted. Division of state and collective herds into smaller private units caused erosion of animal stocks that started in the early 1990's and is in contrast with the long-term increase of livestock population in the region. The decline in livestock numbers can be attributed to the deterioration of the terms of trade for producers. Lack of winter forages, collapse of marketing networks and poor maintenance of livestock water wells have resulted in hand-harvesting of range plants for feed and fuel and concentration of livestock around populated areas and active wells. In spite of declining livestock numbers, rangeland degradation is accelerating near surface water and populated areas. Thus, this project addresses the immediate need to improve

welfare of small landowners, and to prevent further deterioration of rangelands. We take an integrated multidisciplinary approach to improve the welfare of herders that involves not only on-farm solution of technical aspects, but also the assessment of alternatives and policy instruments to support them.

The GIS and Basic Resources subproject serves as the basis for regional application and modeling of research results. The main activity of this component is the creation of a GIS for Kazakstan, Turkmenistan, and Uzbekistan. Information is used for direct dissemination and as a basis for the other modules or subprojects. During the second year of the project we expanded the GIS for Kazakstan and started the compilation and digitization of data for Turkmenistan. A significant amount of time and resources were devoted to training, equipment, and acquisition of maps and weather information.

The main objectives of the Range Forage and Carbon Flux subproject are to: 1) quantify annual net primary production (ANPP) on representative Central Asian rangelands and 2) assess the role of Central Asian rangelands in the global carbon budget. Accurate estimates of ANPP from these rangelands will provide important information on carrying capacity to sustain livestock production in the region. These estimates are also important for evaluating whether Central Asian rangelands are net sources or sinks for atmospheric CO<sub>2</sub>. Degradation of

rangelands and other ecosystems of Central Asia will likely result in a substantial release of CO<sub>2</sub> and other trace gases to the atmosphere with possible effects on the global CO<sub>2</sub> balance. On the other hand, rational management and improvement of these rangelands will not only increase their productivity to satisfy growing needs of the population, but also probably allow these lands to be a significant sink for atmospheric CO<sub>2</sub>, contributing to a reduction in anthropogenic inputs of CO<sub>2</sub>. Our studies in Central Asia will provide data necessary to quantitatively assess the role of Central Asian rangelands in the global carbon budget. Activities during 1999 resulted in the successful measurements of CO<sub>2</sub> fluxes in three sites which support the hypothesis that rangelands can sequester atmospheric carbon.

Under the Animal Production subproject, we conducted extensive analysis of data gathered in 1998. These data were distributed to collaborators in the region, and a comprehensive report was prepared. Results confirm that most of livestock production in Kazakhstan takes place at a subsistence level and is most limited by availability of forages during the winter and early spring. Smallholder livestock production is largely dependent upon range forage. Rangelands are overgrazed near villages and underutilized in more remote areas because of severe problems in availability and cost of transportation and livestock water. Alternative sources of feed are limited or not existent. Current breeding schedules lead to calving and lambing in mid-winter to early spring. Given the severe winter feed shortages reported in the central semidesert and southern foothills, it seems imperative that the breeding period be adjusted to reflect range forage availability in these regions. In the northern dry steppe. Outreach efforts to demonstrate the potential benefits of a later breeding schedule may increase understanding of this readily available means to

coordinate livestock demand with range forage availability.

Activities in the Socio-Economics component of the project focused on the analysis of marketing of livestock. In Kazakhstan, the question of spatial integration of livestock markets was addressed because it has many policy implications. Without marketing orders, support prices, subsidies, and any kind of policy measures, the only platform on which producers perform their activity is the marketplace. The degree of market integration was studied with econometric models. Then, the behavior of the lamb market, which showed good integration, was simulated by constructing a regional equilibrium model. The model was used to preliminarily test the effects of policies to improve transportation alternatives. Investments in the transportation systems would be favorable to the livestock sector and welfare of the general population, particularly when investments emphasize transportation by roads instead of train, and when the price elasticity of supply is increased by investment in livestock technology, production infrastructure, and credit.

In Turkmenistan, studies of the livestock sector indicated that state-owned enterprises are progressively and steadily ceding the sector to private producers and traders. State organizations face serious lack of cash and are not commercially oriented. Thus, they cannot reorganize into financially-viable entities and should not be further supported. Meanwhile, the private sector, both at the level of small-scale traders and large-scale manufacturing firms, is expanding without hindrance from the government. However, a sudden withdrawal of the state from livestock production would create problems as has been evident in Kazakhstan, where livestock numbers plunged after rapid privatization of herds. The minimal amount of state support still given to production units

be fostered by providing technical help and operational credit to those who lease animals. The wool market is suffering extremely deflated prices, because state organizations no longer provide wool grading and cleaning services. These services, as well as local cleaning and spinning of wool should be developed. Traders involved in marketing live animals have few constraints. A steady domestic demand for meat makes profit margins attractive. Trade is unrestricted, and costs are mainly in buying spare parts for the ancient trucks used to transport animals. However, traders indicated that one of their main problems was to get enough high quality feed to fatten animals. Although a private feed market exists, there is ample room for improvement of quality and reduction of costs through technical change.

## RESEARCH

### **Problem statement and approach.**

Recent market changes and privatization caused imbalances and dramatic reductions of agricultural stocks, production and productivity in Central Asian Republics (CAR). Sustainability of extensive production and human nutritional welfare were negatively impacted. Division of state and collective herds into smaller private units caused erosion of animal stocks that started in the early 1990's and is in contrast with the long-term increase of livestock population in the region. The decline in livestock numbers can be attributed to the deterioration of the terms of trade for producers. Lack of winter forages, collapse of marketing networks and poor maintenance of livestock water wells have resulted in hand-harvesting of range plants for feed and fuel and concentration of livestock around populated areas and active wells. In spite of declining livestock numbers, rangeland degradation is accelerating near surface water and populated areas. Rangelands of CAR may

constitute a significant part of the "missing sink" that attenuates the increase in atmospheric carbon dioxide. Thus, there is an immediate need to improve welfare of small landowners, and to prevent further deterioration of rangelands. We take an integrated multidisciplinary approach to improve the welfare of herders that involves not only on-farm solution of technical aspects, but also the assessment of alternatives and policy instruments to support them. Alternatives will be evaluated from the point of view of human welfare, sustainability, impacts on the global carbon budget, and economic profits. A GIS model incorporating ecological and policy scenarios will be used to explore the regional impacts of various technical alternatives.

The original plan for the 1998-99 year included:

1. creation of GIS for Turkmenistan (TK) and Uzbekistan (UZ), and expansion of the GIS for Kazakstan (KZ),
2. continued measurements and modeling of carbon dioxide flux in rangelands,
3. analysis of results of surveys and modeling of livestock enterprises from KZ,
4. rural surveys of human welfare and production systems in TK and UZ,
5. implementation of intensive monitoring in a series of agricultural enterprises in KZ, and
6. dissemination of results to the government and producers.

Geographical information systems similar to the one created for KZ were planned for TK and UZ. Survey data was to be analyzed to test the relation between production system, rangeland condition, and human nutritional welfare, as well as to determine productivity and production bottlenecks. CO<sub>2</sub> flux data would continue to be gathered in Kazakhstan, Turkmenistan and Uzbekistan, and data were

to be used to parameterize empirical range productivity models. Surveys were planned to be conducted in Turkmenistan and Uzbekistan to quantify production system, resources, and human nutrition. Role of animal agriculture in rural family welfare and hypotheses about the main proximate and ultimate constraints to profitable and sustainable animal production were planned to be tested with the data. Based on the results of the formal survey, 9-12 enterprises were going to be selected in Kazakhstan for intensive monitoring during 2 years and later application of new technological packages that address identified problems. Results were going to be presented to agencies and producers in a series of reports, brochures, and audio-visual media.

There were significant departures from the originally proposed plan. First, it was determined that a more significant effort in training local scientists and technicians was necessary. Workshops and formal training were implemented with GL-CRSP and additional leveraged funds. Second, it was not possible to conduct rural surveys in Uzbekistan. Local collaborators were not willing to make a research agreement within this project until the blanket MOU between the GL-CRSP and Uzbekistan was signed. This MOU was not signed in time to conduct research in the 98-99 fiscal year. As a result of this, a significant portion of funds were not spent and were returned to the ME. Surveys were conducted in Turkmenistan as planned. Third, we were unable to start the on-farm monitoring activities because of lack of time to coordinate with ICARDA. Fourth, based on the results of the survey conducted in 1998 in Kazakhstan, a new survey was conducted to re-visit a sample of the original households and conduct a study of livestock market integration in Southern Kazakhstan. Fifth, a detailed spatial sampling of soils was conducted in Northern KZ to determine the

relationship between topography, management, and landscape position on soil organic carbon, erosion, and temporal variability of grain yield. The results will quantify the losses of carbon due to erosion and cropping, and will establish a basis for assessing risk reduction and carbon sequestration by integration of animal and crop production at the appropriate scale. In simple terms, we hypothesize that it is possible to improve soils, remove atmospheric carbon and reduce enterprise risk by incorporating livestock production in areas where soils and topography are not well suited for continuous grain production.

### *GIS for Kazakstan and Turkmenistan*

**Progress.** The GIS database for Kazakstan was expanded significantly by incorporating a large time series of weather information and several remote sensing layers (NDVI). Both weather and NDVI are currently being tested to determine different approaches to perform spatial extrapolations of forage productivity, CO<sub>2</sub> flux, and risk associated with weather and landform. Maps of experimental areas in Northern Kazakstan have been digitized at very high resolution for analysis of effects of topography on snow and rainfall distribution in relation to erosion and wheat yield.

The GIS of Turkmenistan has been started with layers containing political boundaries and rangeland types. A database with detailed weather information was also created.

The activities in this module were significantly complemented with a series of training workshops. K. Olmstead traveled to Tashkent, Almaty and Ashgabat where she conducted hands-on workshops on GIS, digitizing, CartaLynx, and IDRISI. Representatives from four host-country institutions received the training.

### *Measurement and Modeling of CO<sub>2</sub> flux (RF module)*

**Progress.** The four Bowen ratio systems at each of the three measurement sites in Central Asia (Karnap, Uzbekistan; Karrykul, Turkmenistan; and Shortandy, Kazakhstan) were installed during early spring for the 1999 growing season. Field data for CO<sub>2</sub> fluxes and associated micrometeorological characteristics were collected continuously at 20-minute intervals. These data were routinely transferred electronically to Logan, Utah, where they are processed into five-day segments. Data were evaluated for reliability, and any equipment malfunctions were identified and collaborating scientists notified. The segmented data sets were subsequently used to calculate daily integrals of CO<sub>2</sub> flux. These data were electronically sent to Dr. Gilmanov at South Dakota State University who evaluated the relationships between micrometeorological characteristics and rates of CO<sub>2</sub> flux. These relationships will be used to develop predictive models of CO<sub>2</sub> flux for each site. Work proceeded as planned with no modifications. A full technical report of the carbon flux measurements is available upon request. (See web site <http://glcrsp.ucdavis.edu> or write the Management Entity).

### *Smallholder livestock systems in KZ*

A significant part of the analysis of the data gathered during the survey conducted in 1998 was completed, and published as a MS Thesis authored by A. Breuer (2000). This thesis contains a wealth of analyses and information about the characteristics of household and smallholder production units in Kazakstan. A copy of this thesis is available upon request.

Three main aspects of livestock production were studied:

1. Characteristics of farms in crop production, feed availability, and rangeland use;
2. Livestock management calendar and relation between forage demand and supply;
3. Spatial pattern of use and ecological condition of rangelands.

This study of smallholder livestock and range management practices led to the following conclusions:

- Smallholder livestock production today is largely dependent upon range forage. Efficient use of rangeland forage is limited because of multiple factors that impede movement of animals to areas far from villages. Alternative sources of feed are limited or not existent.

In the early 1900's, the vast range resources of Kazakstan supported a livestock population somewhat larger than the present national herd. At that time, a semi-nomadic system of livestock herding enabled use of the best available forage for each season. In order for smallholders today to use seasonally-available forages on a large scale, a system of structured nomadism reminiscent of that used on collective farms, but geared to independent producers, may be appropriate. This system would need to include means of livestock transportation, a network of wells across diverse range types, and support for the everyday needs of herders. Currently, some smallholders and larger production units with significant livestock herds practice limited movement of livestock without government-provision of these services. Thus, it appears that market-driven migration may also develop. An important government role in this situation would be monitoring and regulation of grazing to preserve range health. Now that land privatization is underway, range tenure could become a barrier to the use of seasonally-available forages. On rangelands

where considerable fluctuations in range yield are the norm, systems which enable flexible use of the best forage resources available tend to be more productive and stable than sedentary systems. Incorporation of flexible grazing options in range management in Kazakhstan is key to achieving sustainability. The fact that the country and legislation to regulate land use are in transition constitutes a challenge but also an opportunity to properly plan the use of rangeland resources at a regional scale.

- Supplemental energy fed in the non-grazing period from December-March is far below maintenance in the central semidesert and southern foothill regions, but exceeds maintenance in the northern dry steppe region.

Because feed scarcity is common, smallholders should endeavor to take full advantage of limited supplemental feed resources by feeding livestock primarily when range forage cannot supply adequate nutrition. Improvement of forage quality through cultivation of high value feeds, where possible, and haying at optimal maturity would boost smallholder production capacity. Basic hay storage facilities would also limit nutrient loss from exposure to sun and precipitation. Because smallholders are limited by lack of machinery, land ownership, and irrigation water supply, the formation of cropping and haying cooperatives could enable smallholders to work land more effectively. As agricultural input markets become further developed, smallholders may also have increasing options to purchase better quality feed.

- Current breeding schedules lead to calving and lambing in mid-winter to early spring.

Given the severe winter feed shortages reported in the central semidesert and southern foothills, it seems imperative that the breeding

period be adjusted to reflect range forage availability in these regions. In the northern dry steppe, as well, it appears that alteration of the breeding schedule would enable rangelands to provide a far greater proportion of livestock energy requirements. Reproductive success may also increase with better feeding. Outreach efforts to demonstrate the potential benefits of a later breeding schedule may increase understanding of this readily available means to coordinate livestock demand with range forage availability. The extended duration of the breeding season in all regions, in light of low livestock holdings per household, suggests that households may need better control of breeding to effect this change.

- Weaning rates are average to high in the central semidesert and southern foothills, but low in the North.

Weaning rates in all regions can be improved by increasing lactation through synchronization of lambing and calving with range forage availability. In the northern dry steppe, smallholder breeding schedules require that reproductive females be sheltered and fed for a protracted period between calving and lambing and the beginning of the grazing season. Current energy stores and livestock housing do not appear to be able to sustain weaning success at this time of the year. Modification of the breeding schedule would lead to more rational use of rangelands to meet livestock demand and should also improve weaning success.

- Despite the vast rangeland resources of Kazakhstan, past dependence upon an external system of forage provision and farm organization, as well as adaptation to a sedentary lifestyle means that smallholders are unprepared to use ranges beyond the village periphery.

Empowering smallholders to manage their livestock with available resources may

occur through extension efforts. With greater knowledge of means to avoid overgrazing of surrounding range communities, smallholders would gain the ability to design more appropriate grazing systems to fit their individual needs. Development of participatory village and raion-level grazing management bodies could help to structure grazing among multiple users of common range areas. Organized cooperation among villagers to move animals should have significant economies of scale and thus, could make a larger rangeland resource base and a wider market available to villagers who otherwise can only produce at a subsistence level by using nearby pastures.

- Ranges just 6 to 10 km from the village appear to have negligible grazing loads, while those closer are subjected to heavy grazing pressure.

Use of ranges further from the village appears to be limited by labor, transport, and water availability. Distribution of livestock just beyond these boundaries could enable more even use of rangelands. The reliance upon ranges at the village periphery may signal a break down in traditional systems of common herding of household livestock. Organization at the village-level to introduce grazing rotations may alleviate current grazing pressure on rangelands near villages. As herds increase, integrated methods to support increasing forage demand and maintain range health must be employed. On a national scale, this will require development of the transportation and water supply infrastructure to allow use of remote range areas.

- Transect data revealed a greater proportion of annual and alkaloid-containing species on ranges at village outskirts than at distances beyond 3 km.

The poor range quality at the village

periphery may be linked to current grazing practices because overgrazing near watering points during the Soviet era should be reflected by all transect distances. Distribution of livestock across a larger area of rangelands is necessary to prevent continued degradation. Ranges near villages, because of their proximity to winter housing, may be best reserved for winter grazing, while distant ranges are more readily accessible during warmer times of the year.

### *Livestock market integration in Southern Kazakhstan*

Our activities focused on the collection of information regarding the livestock sector in Kazakhstan and preliminary attempts to identify major economic issues related to the sector. Following revision of available information, including a review of the data collected in the survey during the previous year, one of our Ph.D. students traveled to Kazakhstan to observe livestock sector institutional arrangements and to better identify the constraints faced by farmers in their production activities. The student, Mimako Kobayashi, visited Kazakhstan during August-September 1999. She spent about 4 weeks in interviewing individual farmers and collecting basic economic data in Southern Kazakhstan.

A key component of economic reconstruction since Independence from the Soviet Union has been introduction of a market system. In the agricultural sector, the marketing order system was eliminated and input subsidies were terminated. This means that the prices of inputs to and outputs of agricultural production are to be market determined. In practice, particularly given the economic recession that has prevailed throughout the ex-Soviet Union since its dissolution, input prices are higher and output prices are lower. The sharp decline in the output/input price ratio has caused a

sharp reduction in output. This decline has been exacerbated by an increase in uncertainty and control over land, animal and machinery property rights and the reduced functioning of many state agencies that previously played an important role in input supply and output processing and distribution.

A natural question that arises is the extent to which the newly introduced market system is efficiently functioning. We set out to test one aspect of this, i.e. whether the livestock market is spatially integrated. A complete report of the research and analysis is available upon request or at the GL-CRSP web site. The fundamental question is whether livestock markets in different parts of Kazakhstan are appropriately linked so that producers/consumers can be confident that they are equally well off if they sell in their local market as opposed to shipping their products to more distant markets. These tests are carried out using statistical methods developed in the economic literature for this purpose.

Markets in Southern Kazakstan were analyzed by econometric and simulation methods. Both the current degree of spatial integration and simulated effects of investment in transportation infrastructure and local disturbances in supply were investigated. Preliminary results show that livestock markets show substantial spatial integration. We found this finding somewhat surprising, but it has important implications that basic market framework is functioning and that the reasons for Kazakhstan's livestock problems are likely to fall in other areas. Simulation exercises indicated that investments in the transportation systems would be favorable to the livestock sector and welfare of the general population, particularly when investments emphasize transportation by roads instead of train, and when the price elasticity of supply is increased by investment in livestock technology, production

infrastructure, and credit. Not unexpectedly, livestock development in the region will depend on a concerted effort that considers the global picture. These preliminary results indicate that livestock development will not have a significant response to any single intervention or policy modification by itself.

Individual farmers are trying hard to adjust to market changes. Since they are often stuck with the current resource endowment (for example, agricultural land is currently non-tradable, only tractors available are of Soviet size (very large), credit availability is limited for new investment, etc.), farmers need to improve their management and agricultural skills, increase their level of capitalization (the small scale of many farmers is a severe constraint), and develop new mechanisms for sharing capital goods that impose large overhead costs, such as machinery.

It was also found that cooperation among farmers in resource use and management is far more frequent in livestock production than in crop production in Southern Kazakhstan. An analysis of the reasons for this difference would give some ideas about how agricultural production should be reorganized, and will be considered as a research subject for the activities in 99-00. Questions include: what would be the most efficient farm size?; what kind of technology should be developed?; how should land reform would be implemented? These questions will be addressed with a game theoretic approach.

#### *Studies of livestock production and marketing systems in Turkmenistan*

Drs. Carol Kerven and O. Soyunova performed independent but coordinated studies



of the livestock sector in Turkmenistan during the summer of 1999. These studies were designed to describe the current level of development and structure of livestock production and marketing. In addition, producers were interviewed to determine their perception of the most limiting factors for their activities. Both studies were completed and results were preliminarily analyzed.

In her report, Dr. Kerven reports that marketing of livestock and their products is being increasingly privatised as a result of government policy as well as by default, as the state no longer exerts complete control over product distribution channels. The state still intervenes in price mechanisms and through financial support to state organisations involved in raising or selling livestock products. The market is not therefore totally decontrolled. Willing buyers and sellers within government and private sectors find ways to get around the state controls. Knowledgeable informants suggest that deals can always be done and prices are negotiable, as is also implied from data in this report showing the differentials between official and actual prices paid.

State organisations in the livestock sector are gradually being phased out, but find themselves in a difficult situation common in transitional economies. They are desperately starved of operating capital while retaining obligations to pay staff and other overheads. Their marketing strategies are therefore aimed at maintaining cash flow. These organisations also lack modern business practices - for example cost/benefit analysis - to run efficiently under market conditions. They equally lack processing facilities required to export their commodities profitably. They are required to value livestock products at unrealistic prices in relation to the open market, which encourages under-the-table dealing. Being state organisations, they

are also required to accomplish sometimes contradictory policy targets such as increasing livestock numbers as well as the area of wheat cultivated, which means reducing fodder production as irrigated land area is limited. As state organisations, they are also prey to demands from higher authorities to supply goods without payment. Officials in state organisations are usually quite candid about all these shortcomings, but unsure of how to improve the situation.

Under such conditions it is not possible for state livestock organisations to reorganise themselves into financially-viable entities. Meanwhile the private sector, both at the level of small-scale traders and large-scale manufacturing firms, is expanding without hindrance from the government. Therefore, one may expect that the private sector will soon take over the remaining market segments still controlled by state organisations.

State marketing organisations are not oriented to commercial objectives, and are not pro-active in seeking new markets. Since they are inefficient but powerful competitors to the private sector, further support to these organisations is not warranted.

The immediate withdrawal of the state from the production side of the livestock sector would create further problems, as has been evident in Kazakhstan (Kerven 1999). The minimal amount of state support still given to *dihan birlishik* (the production units) at least allows these to gradually hand over animals to shepherds through the leasing system. Under the leasing system shepherds can experiment for several years to find the most cost-effective methods of managing and marketing (Lunch 1999). If the *dihans* were suddenly dismantled and their assets distributed, many shepherds could not make a viable livelihood from

a small flock given present market prices, especially for wool. The result would probably be a sharp decline in animal numbers and a concentration of remaining animals into fewer hands. Unemployment and meat prices would rise, as fewer people would be raising fewer animals. It is therefore recommended that some support to state production enterprises be continued until such time as their shepherds have adjusted to the new market conditions.

For shepherds, the greatest problem in marketing their livestock products lies in the extremely low price for wool paid to producers. Wool from the Turkman Sarja sheep breed is of the coarse type considered by national experts as the best wool for carpets. While there is demand for this type of wool from other countries (e.g. India, Pakistan), there are insufficient commercial companies competing with each other within Turkmenistan to buy wool from producers, to bid up the price. The state organisations which still control a large share of the wool market undervalue the wool received from their shepherd employees. Such wool as is exported is sold at much higher prices than received by producers, through the state marketing system. Moreover, producers now have to sell their sheep wool directly without benefit of cleaning or grading, as these functions are no longer performed by the sovkhos. Sale of unsorted and dirty wool further devalues the price received. The potential for exporting raw or processed camel wool has also not been developed (in Mongolia, for example, camel wool is well-processed and yields export revenue).

Dihan livestock professionals and shepherds argue that village-level wool-processing facilities would improve the quality and thus the price for wool received by producers. While several private wool-processing factories have opened up very recently, these are located in the cities. There

is still a need for newly-privatised shepherds to be able to grade and clean their wool before selling on to commercial firms, in order to obtain higher returns. Local processing facilities could include dyeing and spinning wool for making into carpets, which would further raise the value of wool to shepherd families.

For entrepreneurs involved in marketing live animals, there appear to be few constraints. There is a steady domestic demand for meat and profit margins are attractive. Trade is unrestricted, and costs are mainly in buying spare parts for the ancient trucks used to transport animals. As profits increase, more successful traders will undoubtedly be able to upgrade their vehicles. However, all traders mention the difficulty of obtaining good-quality fodder to fatten animals for resale. High-quality feed concentrate (Kombicorn) is no longer available, and traders find that residues of grain and cotton processing contain fewer nutrients than previously in the Soviet period. Processing and storage of fodder crops is also less than ideal. While a private market in fodder has developed, the quality and cost of fodder production could be further improved with technical support.

Businesses involved in exporting wool and karakul pelts face a number of challenges at present. Interest rates are high, technical and marketing expertise is lacking. The owners of such businesses are keen to make international contacts which would increase their sales and profits, but do not always know how to make these connections. Provision of technical and marketing information, as well as low-interest loans, would be a vital step towards helping these new private firms to become more commercial.

Dr. Kerven summarizes that there is both need and potential for developing the commercial livestock marketing sector in Turkmenistan. The government is steadily giving

up control, as production and marketing have become privatised. Small-scale shepherds need to be able to gain more value from selling wool, if they are to be able to remain in production. Traders need to be able to buy better fodder to provide urban consumers with higher-quality animals. Business people need information, advice and credit to take full advantage of the new commercial environment. The deserts of Turkmenistan have long been able to support livestock whose wool and pelts are highly valued elsewhere. This capacity should not be wasted in the future.

The complete technical report by Dr. C. Kerven is available upon request or at the GL-CRSP web site.

### *Dissemination of results*

A complete database with the results of the survey conducted in 1998 was distributed to collaborators, together with the software necessary to use the database (FileMaker).

Results of all aspects of the project were formally presented at the 1999 Annual Meeting of the LDRCT, which took place in Tashkent, Uzbekistan, during 15-18 March 1999. Over 40 participants from a variety of institutions, representatives of host country governments, and representatives of USAID participated in the meeting. The meeting, which emphasized the establishment of a strong connection between research and impacts, was reported in the public press of Tashkent. Proceedings are being edited for publication in Russian with English translations. A complete list of participants and the meeting agenda are in Appendix 2.

The PI and other members of the research team visited government and farmers institutions in Kazakstan, Uzbekistan and Turkmenistan.

Host country scientists were briefed and consulted on the progress and plans of the project.

In response to comments from farmers and local authorities, we distributed the Russian version of the GL-CRSP newsletter to those villages that were visited in 1998.

The following articles were published in the popular press and included information and results from the present project:

Reviving agriculture in Central Asia, by P. Bailey. *Dateline*, UC Davis, 26 Feb 1999, page 3.

The distant graze. International ag program takes stock and re-, by P. Bailey. *Dateline*, UC Davis, 30 January 1999, page 3.

The heat is on, by D. Weinshilboum. *The Enterprise*, Davis, California, 13 June 1999, page C1.

Natural Resource Conservation, by B. Agzamov. *People's Voice*, Tashkent, Uzbekistan, 18 March 1999.

Global Livestock CRSP Represented at HPI Human Nutrition & Livestock Symposium. *Ruminations* Fall 1998, page 15.

Annual Meeting Held in Tashkent. *Ruminations*, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 1.

NIDFF in Turkmenistan Hosts GIS Training Workshop, by K. Olmstead. *Ruminations*, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 6.

Carpenter and Grivetti Present Poster at FASEB, by M. Carpenter. Ruminations, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 19.

Cropping Systems and Ecological Analysis in North Kazakhstan, by A. Wolf. Ruminations, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 2.

Carbon Cuts and Techno-Fixes, by Robert Kunzig Carl Zimmer. Discover Magazine, June 1998 (see <http://208.226.13.177/archive/output.cfm?ID=1456>)

Scientific articles and abstracts are reported in the appropriate sections.

#### GENDER

Data from this project will provide information that will benefit both the male and female portions of the general population in the region. Results from the project will hopefully encourage women in host countries to become involved in further research that will enhance rangeland primary productivity, develop the livestock sector, and affect regional policies.

This project raised \$500 of leveraged funds to support collaborative research with female rangeland researchers in Kazakstan.

Because adult male family members were often in the field, we frequently interviewed the female household head during the market survey of Southern Kazakstan. Local women also actively participated in the field survey by providing services of translation, and interpretation.

This project has continued to support

women at all levels: as direct beneficiaries of the research results, as employees to support regional activities (Sidelnikova, Nabat, Raushan, Lydia), as collaborating scientists (Abouva, Karbayeba, Shabanova, Kerven, Soyunova, Lebed, Gaziantz), as graduate students (Breuer, Carpenter, Olmstead, Kobayashi), and as student assistants (Nash, Gavrilets, Darmina, Wilson, Kaur).

#### POLICY

Important linkages developed in the past and reported last year continued to operate. This year, we successfully concentrated in furthering our connections with scientists and government institutions in Uzbekistan.

Although Kazakhstan is ahead of the other two countries in terms of reforms, it still does not have well-developed agricultural policies. Local researchers are trying hard to construct such policies. The development of additional objective information at both the aggregate market and also the individual farmer level – and policy analysis that could be based on such information - would be extremely useful for future agricultural policy making. In our analysis of results, we are gravitating towards a spatial analysis of limitations to livestock development and economic growth; a point well illustrated by the analysis of market integration. This type of analysis should allow optimization of development funds and of policy design.

One of the aspects of our research that has attracted the most interest from policy-makers has been the study of Central Asian rangelands as potential carbon sinks. We envision that if we continue this effort, it is realistic, albeit optimistic, to develop a technological package for range management and livestock production that produces agricultural commodities and carbon “credits.” International and regional

scientists and policy-makers are just beginning to seriously consider agricultural ecosystems as potential sites for mitigation of climate change. We have taken steps to inform regional scientists and policy-makers about these possibility, and have obtained significant leveraged funding to create a regional network for carbon flux measurement and modeling. One of the main goals of this network is to enhance the regional human capacity so the participating countries can rely on their own scientists for the expected future negotiations and measurements that will be necessary. This aspect of our project received very strong (moral) support from the Central Asia USAID Mission.

#### **OUTREACH**

The problem of quantifying the magnitude of CO<sub>2</sub> flux and assessing the carbon sequestration potential in principal rangelands of Central Asia were acknowledged to be of prime importance by administrators at a number of key governmental, research and management institutions in Kazakhstan, Uzbekistan and Turkmenistan, including ministries of the environment/nature conservation, academies of sciences and leading agricultural, land management, and rangeland research institutes. During visits to the region in spring 1997 and 1998, the institutions interested in receiving the data and modeling results from the CO<sub>2</sub> flux subproject included: Kazakhstan (Ministry of Science; Academy of Science; National Academic Center for Agrarian Research; Ministry of Agriculture), Turkmenistan (Academy of Sciences; Regional Center for Prevention of Desertification; Ministry of Natural Resources and Environmental Protection; Research and Production Center of Ecological Monitoring), and Uzbekistan (Ministry of Agriculture, Institute of Karakul Sheep Breeding). The extension approach adopted in the CO<sub>2</sub> flux

subproject will be based upon: 1) informing the target institutions and individuals about the results of the CO<sub>2</sub> flux evaluations at the three monitoring stations; 2) sharing quantitative models to predict CO<sub>2</sub> flux rates as functions of environmental factors and management decisions; and 3) discussing with the target institutions the resultant maps of CO<sub>2</sub> flux rate and estimated carbon sequestration potentials derived from combining flux models with the GIS of basic ecological resources of the Central Asian states.

During the Livestock Production study, Mimako Kobayashi had a number of formal and informal discussions/collaborations with local economists and other government agency staff regarding economics issues and policy.

#### **DEVELOPMENTAL IMPACT**

Obtaining information of the magnitude and distribution of CO<sub>2</sub> fluxes in the principal rangeland types of Central Asia has direct relevance to understanding the environmental situation in Central Asia and its improvement through scientifically based management decisions. For example, the 30-year long study of carbon balance of the chernozem soils in northern Kazakhstan conducted at the Barayev Institute of Grain Farming (Shortandy, Kazakhstan) indicated a 25 to 30 percent reduction of humus reserves under cultivation. Transformation of at least part of these lands (especially in the region of marginal agriculture in northern and central Kazakhstan) into managed pastures constitute a significant reserve of carbon sequestration that could minimize subsequent wind and water erosion. In Uzbekistan the opposite process of plowing desertified steppes and semidesert rangelands in the foothill zone for wheat production is taking place.

Estimation of the potential effect of these processes on the carbon balance of the affected

soils (where presumably a substantial loss of soil organic matter will take place through accelerated wind and water erosion of those light-textured, loess soils) will help in making wise decisions regarding the management of foothill ecosystems. The desert shrub rangelands of Turkmenistan are being over-exploited by year round grazing. Data concerning the seasonal dynamics of ecosystem productivity from continuous CO<sub>2</sub> flux measurements will provide critical information necessary to make rational decisions concerning the management of forage resources. The RF subproject has established close links with the USDA-ARS Rangeland CO<sub>2</sub> Flux Network, including the sharing of data processing algorithms. Results of the CO<sub>2</sub> flux research on the rangelands of Central Asia will be used to compare and inter-calibrate flux measurements and models in the steppe and semidesert regions of the western U.S. The RF subproject also cooperates with the International Center for Agricultural Research in Dry Areas (ICARDA), which contributed expertise, equipment, and resources to the establishment of the CO<sub>2</sub> flux station in Uzbekistan. Scientists from ICARDA who contributed to the project in 1999 included: Drs. Gustave Gintzburger, Rick Tutwiler, Luis Iniquez, and Mustapha Bounejmate.

Degradation of rangeland is one of Kazakhstan's most urgent problems. Since livestock prices are low and transport costs are high, it is usually unprofitable to produce livestock in geographic locations that are far from major urban centers (except for subsistence production). Since land is generally held in some type of communal property framework, a large proportion of Kazakhstan's livestock are now found within a fairly short distance of urban areas, and the livestock range in this region is degraded. In contrast, potentially productive ranges farther from urban areas are underutilized and not degraded. Our analysis

will provide some understanding regarding how, with expected changes in input (including transportation prices) and output prices, a growing proportion of Kazakhstan's rangeland can be economically and sustainably exploited.

Large agricultural enterprises and specifically the large state farms that previously accounted for the bulk of Kazakhstan's agricultural output have largely broken down. Many of their assets have been distributed or sold to previous workers, or simply consumed in the case of livestock. As a result, a large number of individual farmers have come into existence, though most of these farmers possess little capital (livestock, machinery) and few are skilled in farming. Few at all have prior experience with how to work within an economic market framework. It seems unlikely that large state enterprises provide a future for the agricultural sector. Issues of management expertise, trust, access to capital, and the like are very difficult. While individual farmers (as opposed to large enterprises) have a great potential to increase agricultural production, great efforts are needed to create a more positive framework within which these farmers and their farms can develop profitably and efficiently. Our analysis is focusing on the effort to better understand the strategies currently being followed by smaller farmers, the constraints that they face in achieving higher productivity and efficiency, and developing helpful policy recommendations. Part of this analysis will focus on the conversion of common or state land to individual use, whether by sale or lease. Our analysis, focusing on individual farmers, will fill such gaps in the knowledge of the behavior of small farmers, which would lead to direct improvement of government infrastructure and policy and, indirectly, the welfare of independent farmers.

#### LEVERAGE FUNDS AND LINKED PROJECTS

Scientists with USDA-ARS at Logan, UT

(Drs. Douglas Johnson and Nick Saliendra) and Dubois, ID (Drs. Harvey Blackburn and Wolfgang Pitroff, who recently left Dubois) are participating in a joint sheep/range project in Central Asia with scientists from ICARDA (Drs. Gus Gintzburger and Euan Thompson previously, and now more recently Drs. Rick Tutwiler, Luis Iniguez, and Mustapha Bounejmate). The RF subproject has benefited considerably by significant in-kind support from the USDA-ICARDA project. This includes support to purchase and install two Bowen ratio systems at the Karnap Site in Uzbekistan, fencing and security guards to secure the CO<sub>2</sub> monitoring site, a vehicle for travel to and from the research site, and a portable shelter at Karnap for research and security personnel. Salary support for two Uzbeki field scientists was provided through the USDA-ICARDA project. Support from the USDA-ICARDA project for CRSP-related research in Central Asia is estimated to be about \$60,000. In addition, USDA salary and benefit support for Johnson (10% time) on CRSP-related activities is estimated to be another \$12,000. Thus, a total of about \$72,000 has been leveraged through interaction with the USDA-ICARDA project.

This project obtained leveraged funds from ALO and UC Davis to train regional scientists and enhance the regional human capacity for measurement and modeling of carbon fluxes. This grant is completely complementary with LDRCT, and it included over \$90,000 in cash and \$110,000 of in-kind matching funds from UCD and regional institutions. The first phase of the ALO project will finish in April 2000, when six scientists will have spent about four months in training in the US.

#### TRAINING

In March 1999, Dr. Saliendra traveled to Turkmenistan and Uzbekistan and provided

on-site training in the installation, operation, maintenance, and trouble-shooting of the Bowen ratio equipment. Central Asian scientists who participated in this training included Drs. Nasyrov and Mardonov (Uzbekistan) and Dr. Dourikov (Turkmenistan). Drs. Johnson, Gilmanov, and Saliendra assisted in the preparation of a proposal entitled "Enhancement of Human Capacity for a Network of Carbon Dioxide Flux Studies in Central Asian Rangelands", which was selected for funding by the Association Liaison Office for University Cooperation in Development (ALO) through USAID. All scientists involved in the RF subproject took an active role in this training activity at Logan, UT and Davis, CA, December 1999 – March 2000.

Karen Olmstead traveled to Tashkent, Almaty, and Ashgabat, where she conducted workshops on the use and creation of GIS. More than 10 regional scientists and technicians participated actively in these workshops. The workshops were described in detail in an article published in *Ruminations* (Spring 1999).

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#### ABSTRACTS AND PRESENTATIONS

Johnson, D.A., T.G. Gilmanov, N.Z. Saliendra, M. Nasyrov, G. Gintzburger, E.A. Laca, and R. Tutwiler. 1999. Uzbek steppe could help fight global warming. GCTE Focus 3 "Food and Forestry" Conference, 20-23 September 1999, University of Reading, United Kingdom.

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In addition to the abstracts listed above, fourteen papers were presented in the LDRCT Annual Meeting and will be published.







## GLOSSARY

|                  |                                                                                    |
|------------------|------------------------------------------------------------------------------------|
| <b>AARD</b>      | Agency for International Research and Development, Indonesia                       |
| <b>AAU</b>       | Addis Ababa University                                                             |
| <b>ABS</b>       | American Breeders Society                                                          |
| <b>ACIAR</b>     | Australian Centre for International Agricultural Research                          |
| <b>ADG</b>       | Average daily gain                                                                 |
| <b>AFPC</b>      | Agricultural and Food Policy Center                                                |
| <b>AFRNET</b>    | African Feed Resources Network                                                     |
| <b>AGRIS</b>     | International Information System for the Agricultural Sciences and Technology, FAO |
| <b>AID</b>       | Agency for International Development, Washington D.C., USA                         |
| <b>AIGACAA</b>   | Asociacion Integral de Ganadevos en Camelidos de los Andes Altos                   |
| <b>ALRMP</b>     | Arid Lands Resource Management Project                                             |
| <b>AMREF</b>     | African Medical Research Education Foundation                                      |
| <b>ANP</b>       | Applied Nutrition Program                                                          |
| <b>ANPP</b>      | Annual Net Primary Productivity                                                    |
| <b>AP</b>        | Animal Production                                                                  |
| <b>ARC</b>       | Agriculture Research Council                                                       |
| <b>ARD</b>       | Association for Rural Development                                                  |
| <b>ASARECA</b>   | Association for Strengthening Agricultural Research in Eastern and Central Africa  |
| <b>ASF</b>       | Animal Source Foods                                                                |
| <b>ASP</b>       | Agrosilvopastoral                                                                  |
| <b>ASPADERUC</b> | Asociacion para el Dasarolla Rural de Cajamarca                                    |
| <b>AT</b>        | Assessment Team                                                                    |
| <b>ATI</b>       | Appropriate Technology International                                               |
| <b>ATW</b>       | Assessment Team Workshop                                                           |

|                   |                                                                                                    |
|-------------------|----------------------------------------------------------------------------------------------------|
| <b>AWF</b>        | American Wildlife Federation                                                                       |
| <b>B</b>          | Barbados Blackbelly Sheep                                                                          |
| <b>BASIS CRSP</b> | Broadening Access and Strengthening Market Input Systems Collaborative<br>Research Support Program |
| <b>BC</b>         | Barbados x Sumatra Sheep                                                                           |
| <b>BIFAD</b>      | Board for International Food and Agriculture Development                                           |
| <b>BPP</b>        | National Rubber Research Institute, Indonesia                                                      |
| <b>BPT</b>        | Balai Penelitian Ternak, Bogor, Indonesia (Animal Husbandry Research<br>Institute)                 |
| <b>BR</b>         | Basic Resources                                                                                    |
| <b>BW</b>         | Body weight                                                                                        |
| <b>CAP</b>        | Common Agricultural Policy                                                                         |
| <b>CAR</b>        | Central Asian Republics                                                                            |
| <b>CARDI</b>      | Caribbean Agricultural Research and Development Institute                                          |
| <b>CARE</b>       | Cooperative for American Remittance to Europe, Inc.                                                |
| <b>CATIE</b>      | Centro Agronomico Tropical de Investigacion y Ensenaza                                             |
| <b>CBE</b>        | Commercial Bank of Ethiopia                                                                        |
| <b>CBPP</b>       | Contagious Bovine Pleuropneumonia                                                                  |
| <b>CCPP</b>       | Contagious Caprine Pleuropneumonia                                                                 |
| <b>CDC</b>        | Centro de Datos para la Conservacion                                                               |
| <b>CEDEP</b>      | Centro de Estudios para d'Oesarrollo y la Participacion                                            |
| <b>CER-DET</b>    | Centro de Estudios Regionales para el Desarrollo de Tarija                                         |
| <b>CGIAR</b>      | Consultative Group on International Agricultural Research                                          |
| <b>CHDC</b>       | Child Health and Development Center                                                                |
| <b>CIAT</b>       | Centro Internacional de Agricultura Tropical                                                       |
| <b>CIDICCO</b>    | Centro Internacional de Informacion Sobre Cultivos de Cobertura                                    |
| <b>CIEC</b>       | Centro Interdisciplinario de Estudios Comunitarios                                                 |
| <b>CIESTAAM</b>   | Center for Economic, Social, and Technology Research on World                                      |



|                  |                                                                                 |
|------------------|---------------------------------------------------------------------------------|
|                  | Agriculture and Agribusiness                                                    |
| <b>CIP</b>       | Centro Internacional de la Papa - International Potato Center                   |
| <b>C/LAA</b>     | Caribbean/Latin American Action                                                 |
| <b>CLAS-UMSS</b> | Centro de Levantamientos Aerospaciales y Aplicaciones de SIG                    |
| <b>CNA</b>       | Confederacion Nacional Agropecuario                                             |
| <b>CNCPS</b>     | Cornell Net Carbohydrate and Protein System                                     |
| <b>CNG</b>       | Confederacion Nacional Ganadera                                                 |
| <b>CONDESAN</b>  | Consortio para el Desarrollo Sostenible de la Ecoregion Andina                  |
| <b>CORAF</b>     | Conference de la Recherche Agronomique des Responsable Africains et<br>Francais |
| <b>CP</b>        | Crude protein                                                                   |
| <b>CPV</b>       | Capripox virus                                                                  |
| <b>CRES</b>      | Center for Resource and Environmental Studies                                   |
| <b>CRIAS</b>     | Coordinating Research Institute for Animal Science, Indonesia                   |
| <b>CRSP</b>      | Collaborative Research Support Program                                          |
| <b>CSIRO</b>     | Commonwealth Scientific and Industrial Research Organization                    |
| <b>CSU</b>       | Colorado State University                                                       |
| <b>CT</b>        | condensed tannins                                                               |
| <b>CURLA</b>     | Centro Universitario Regional del Litoral Atlantico                             |
| <b>d</b>         | day                                                                             |
| <b>DANIDA</b>    | Danish International Development Agency                                         |
| <b>DOM</b>       | Digestible Organic Matter                                                       |
| <b>DM</b>        | Dry Matter                                                                      |
| <b>DPG</b>       | Dual Purpose Goat                                                               |
| <b>DPIRP</b>     | Drought Preparedness Intervention and Recovery Program                          |
| <b>DSS</b>       | Decision Support System                                                         |
| <b>EE</b>        | Effective Environment                                                           |
| <b>EEC</b>       | European Economic Community                                                     |

|                |                                                                                               |
|----------------|-----------------------------------------------------------------------------------------------|
| <b>EEP</b>     | External Evaluation Panel                                                                     |
| <b>EHNRI</b>   | Ethiopian Health and Nutrition Research Institute                                             |
| <b>ELISA</b>   | Enzyme linked immunosorbent assays                                                            |
| <b>EMBRAPA</b> | Brazilian National Agency for Agricultural Research                                           |
| <b>ENNIV</b>   | Peruvian Living Standards and Measurement Survey                                              |
| <b>ENSO</b>    | El Nino and Southern Oscillation                                                              |
| <b>EPG</b>     | Eggs per Gram                                                                                 |
| <b>EPIC</b>    | Erosion Productivity Import Calculator                                                        |
| <b>EU</b>      | Edgerton University                                                                           |
| <b>EW</b>      | Extension Worker                                                                              |
| <b>FA</b>      | FARM Africa                                                                                   |
| <b>FAO</b>     | Food and Agriculture Organization, United Nations                                             |
| <b>FCC</b>     | Fertility Capability Classification System                                                    |
| <b>FD</b>      | Full-day                                                                                      |
| <b>FEWS</b>    | Famine Early Warning System                                                                   |
| <b>FIRA</b>    | Fideicomisos Instituidos en Relacion con la Agricultura                                       |
| <b>FLACSO</b>  | Facultad Latinoamericana de Ciencias Sociales                                                 |
| <b>FMD</b>     | Foot and Mouth Disease                                                                        |
| <b>FOSS</b>    | First in Food Analysis                                                                        |
| <b>FUNAN</b>   | Fundacion Antisana                                                                            |
| <b>GANL</b>    | Grazingland Animal Nutrition Laboratory                                                       |
| <b>GIS</b>     | Geographic Information System                                                                 |
| <b>GO</b>      | Government Organization                                                                       |
| <b>GPS</b>     | Global Positioning Systems                                                                    |
| <b>GSE</b>     | Greater Serengeti Ecosystem                                                                   |
| <b>GTZ</b>     | Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation) |
| <b>h</b>       | hour                                                                                          |

|                |                                                                 |
|----------------|-----------------------------------------------------------------|
| <b>H</b>       | St. Croix Sheep                                                 |
| <b>ha</b>      | Hectare                                                         |
| <b>HC</b>      | St. Croix x Sumatra Sheep                                       |
| <b>HEM</b>     | Hemicellulose                                                   |
| <b>HH</b>      | Household                                                       |
| <b>HPI</b>     | Heifer Project International                                    |
| <b>HSPC</b>    | Human Subject Protection Committee                              |
| <b>HW</b>      | Health Worker                                                   |
| <b>IADB</b>    | Inter-American Development Bank                                 |
| <b>IAP-MU</b>  | International Agriculture Programs - Missouri University        |
| <b>IAR</b>     | Institute for Agricultural Research                             |
| <b>IARC</b>    | International Agricultural Research Center                      |
| <b>IBTA</b>    | Instituto Boliviano de Tecnologia Agropecuaria                  |
| <b>ICA</b>     | Instituto Colombiano Agropecuaria, Colombia                     |
| <b>ICARDA</b>  | International Centre for Agricultural Research in the Dry Areas |
| <b>ICIPE</b>   | International Centre of Insect Physiology and Ecology           |
| <b>ICRAF</b>   | International Centre for Research on Agroforestry               |
| <b>ICRISAT</b> | International Crops Research Institute for the Semiarid Tropics |
| <b>ICRW</b>    | International Center for Research on Women                      |
| <b>IDIAP</b>   | Agricultural Research Institute of Panama                       |
| <b>IDRC</b>    | International Development Research Centre (Canada)              |
| <b>IEMUT</b>   | French Tropical Veterinary Institute                            |
| <b>IFAD</b>    | International Fund for Agricultural Development                 |
| <b>IFPRI</b>   | International Food Policy Research Institute                    |
| <b>IGADD</b>   | International Governmental Authority on Drought and Development |
| <b>IICA</b>    | Interamerican Institute for Cooperation in Agriculture          |
| <b>IIML</b>    | Integrated Information Management Laboratory                    |
| <b>IIN</b>     | Instituto Investigacion Nutricional                             |

|                 |                                                                     |
|-----------------|---------------------------------------------------------------------|
| <b>ILRAD</b>    | International Laboratory for Research on Animal Diseases            |
| <b>ILRI</b>     | International Livestock Research Institute                          |
| <b>IMAS</b>     | Integrated Modeling and Assessment System                           |
| <b>IMECBIO</b>  | Instituto Manantian de Ecologia y Conservation de la Biodeversidad  |
| <b>INCALAC</b>  | Industria Cajamarquina de Lacteos                                   |
| <b>INCAP</b>    | Instituto de Nutricion para Centro America y Panama                 |
| <b>INEGI</b>    | Instituto de Estadistica, Geografia e Informatica                   |
| <b>INIA</b>     | Instituto Nacional de Investigacion Agrarias                        |
| <b>INIFAP</b>   | Instituto Nacional de Investigaciones Forestales y Agropecuarios    |
| <b>IP2TP</b>    | Installation for Research and Assessment of Agricultural Technology |
| <b>IPB</b>      | Bogor Agricultural University                                       |
| <b>ISLP</b>     | Integrated Small Livestock Project                                  |
| <b>ISNAR</b>    | International Service for National Agricultural Research            |
| <b>JESS</b>     | Jubba Environmental and Socioeconomic Studies                       |
| <b>KARI</b>     | Kenya Agricultural Research Institute                               |
| <b>KCB</b>      | Kenya Commercial Bank                                               |
| <b>KDPG</b>     | Kenya Dual Purpose Goat                                             |
| <b>KDRSRS</b>   | Kenya Department of Resource Surveys and Remote Sensing             |
| <b>KEVEVAPI</b> | Kenya Veterinarian Vaccine Production Institute                     |
| <b>kg</b>       | kilogram                                                            |
| <b>KLDP</b>     | Kenya Livestock Development Program                                 |
| <b>KNP</b>      | Katavi National Park                                                |
| <b>KRTISB</b>   | Kazakh Research and Technological Institute of Sheep Breeding       |
| <b>Ksh</b>      | Kenya Shilling                                                      |
| <b>KUSCCO</b>   | Kenya Union of Savings and Credit Cooperatives                      |
| <b>KWS</b>      | Kenya Wildlife Service                                              |
| <b>KWVA</b>     | Kenya Women's Veterinary Association                                |
| <b>LAC</b>      | Latin American Countries                                            |

|              |                                                                                           |
|--------------|-------------------------------------------------------------------------------------------|
| <b>LAI</b>   | Leaf Area Index                                                                           |
| <b>LDC</b>   | Lesser Developed Country                                                                  |
| <b>LEWS</b>  | Livestock Early Warning System                                                            |
| <b>LINDA</b> | Livestock Information Network Development for the Americas                                |
| <b>LPRI</b>  | Livestock Production Research Institute                                                   |
| <b>LS</b>    | Livestock                                                                                 |
| <b>LU</b>    | Livestock Units                                                                           |
| <b>M</b>     | Composite Population Sheep: 25% St. Croix, 25% Barbados Blackbelly,<br>50% Sumatran Sheep |
| <b>MALDM</b> | Ministry of Agriculture, Livestock Development and Marketing                              |
| <b>MCF</b>   | Malignant Catarrhal Fever                                                                 |
| <b>ME</b>    | Management Entity                                                                         |
| <b>MIAC</b>  | MidAmerica International Agricultural Consortium                                          |
| <b>MOA</b>   | Ministry of Agriculture                                                                   |
| <b>MOH</b>   | Ministry of Health                                                                        |
| <b>MOU</b>   | Memorandum of Understanding                                                               |
| <b>MUCIA</b> | Midwest Universities Consortium for International Agriculture                             |
| <b>NAARI</b> | Namulaonge Agricultural and Animal Production Research Institute                          |
| <b>NAFTA</b> | North American Free Trade Agreement                                                       |
| <b>NARO</b>  | National Agricultural Research Organization                                               |
| <b>NARS</b>  | National Agricultural Research System                                                     |
| <b>NCA</b>   | Ngorongoro Conservation Area                                                              |
| <b>NCRSP</b> | Nutrition Collaborative Research Support Program                                          |
| <b>NCSU</b>  | North Carolina State University                                                           |
| <b>NDF</b>   | Neutral detergent fiber                                                                   |
| <b>NDVI</b>  | Normalized Difference Vegetation Indices                                                  |
| <b>NES</b>   | Nucleus Estate Smallholder                                                                |
| <b>NFTA</b>  | Nitrogen Fixing Tree Association                                                          |

|              |                                                          |
|--------------|----------------------------------------------------------|
| <b>NGO</b>   | Non-Governmental Organization                            |
| <b>NIH</b>   | National Institute for Health                            |
| <b>NIRS</b>  | Near Infrared Reflectance Spectroscopy                   |
| <b>NIS</b>   | Newly Independent States                                 |
| <b>NOAA</b>  | National Oceanographic and Atmospheric Administration    |
| <b>NRC</b>   | National Research Council                                |
| <b>NRCS</b>  | Natural Resources Conservation Service                   |
| <b>NREL</b>  | Natural Resource Ecology Laboratory                      |
| <b>NRN</b>   | Natural Resources Network                                |
| <b>NSDV</b>  | Nairobi Sheep Disease Virus                              |
| <b>NSF</b>   | National Science Foundation                              |
| <b>OAU</b>   | Organization of African Unity                            |
| <b>ODA</b>   | Overseas Development Administration                      |
| <b>ODI</b>   | Overseas Development Institute                           |
| <b>OMD</b>   | Organic Matter Digestibility                             |
| <b>OMI</b>   | Organic Matter Intake                                    |
| <b>OPC</b>   | Ovine pulmonary carcinoma                                |
| <b>OPMM</b>  | Outreach Research Project at Membang Muda                |
| <b>OPP</b>   | Outreach Pilot Project                                   |
| <b>OPS</b>   | Outreach Project for the Sosa                            |
| <b>ORP</b>   | Outreach Research Project                                |
| <b>OvLV</b>  | Ovine lentivirus                                         |
| <b>PA</b>    | Participatory Appraisal                                  |
| <b>PAC</b>   | Program Advisory Committee                               |
| <b>PAR</b>   | Photosynthetic Active Radiation                          |
| <b>PCV</b>   | Packed Cell Volume                                       |
| <b>PEM</b>   | Protein-Energy Malnutrition                              |
| <b>PENHA</b> | Pastoral and Environmental Network in the Horn of Africa |

|                |                                                                     |
|----------------|---------------------------------------------------------------------|
| <b>PI</b>      | Principal Investigator                                              |
| <b>PL480</b>   | Public Law No. 480                                                  |
| <b>PM</b>      | Problem Model                                                       |
| <b>PRA</b>     | Participatory Rural Appraisals                                      |
| <b>PROMETA</b> | Proteccion del Medio Ambiente Tarija                                |
| <b>PRR</b>     | Proyecto de Reconstrucion Rural                                     |
| <b>PSICA</b>   | Information System and Agricultural Census Project                  |
| <b>PVO</b>     | Public Volunteer Organization                                       |
| <b>RAINAT</b>  | Research and Assessment Installation for Agricultural Technology    |
| <b>REDSO</b>   | East African Region US AID                                          |
| <b>RERUMEN</b> | Latin American Network of the Small Ruminant CRSP                   |
| <b>RF</b>      | Range Forage                                                        |
| <b>RFA</b>     | Request for Assistance                                              |
| <b>RFP</b>     | Request for Proposals                                               |
| <b>RGR</b>     | Rukwa Game Reserve                                                  |
| <b>RH</b>      | Relative Air Humidity                                               |
| <b>RIAP</b>    | Research Institute for Animal Production, Bogor, Indonesia          |
| <b>RISPAL</b>  | Latin American Network for Animal Production Systems Research, IDRC |
| <b>RS</b>      | Remote Sensing Technologies                                         |
| <b>RS</b>      | Resident Scientist                                                  |
| <b>RSG</b>     | Ranching Systems Group                                              |
| <b>RVFV</b>    | Rift Valley Fever Virus                                             |
| <b>S</b>       | Sumatra Sheep                                                       |
| <b>SA</b>      | Small Animals                                                       |
| <b>SACCAR</b>  | Southern African Centre for Cooperation in Agricultural Research    |
| <b>SAGAR</b>   | Secretaria de Agricultural, Ganaderia y Desarrollo Rural            |
| <b>SALTICK</b> | Semi-Arid Lands Training and Livestock Improvement Centres of Kenya |
| <b>SARI</b>    | Selian Agricultural Research Institute                              |

|                 |                                                                                     |
|-----------------|-------------------------------------------------------------------------------------|
| <b>SBPT</b>     | Balai Penelitian Ternak, Sei Putih, Indonesia (Animal Husbandry Research Institute) |
| <b>SCT</b>      | Spatial Characterization Tool                                                       |
| <b>SE</b>       | Socio-Economic                                                                      |
| <b>SEAD</b>     | Servicios de Apoyo al Desarrollo                                                    |
| <b>SECOFI</b>   | Secretria de Comercio                                                               |
| <b>SEMARNAP</b> | Servicio Nacional del Medio Ambiente, Recursos Naturales y Pesca                    |
| <b>SES</b>      | Socio-economic Status                                                               |
| <b>SICA</b>     | Proyecto Censo Agropecuario y Sistema de Informacion                                |
| <b>SNIM</b>     | Servicio Nacional de Informacion de Mercados                                        |
| <b>SR-CRSP</b>  | Small Ruminant Collaborative Research Support Program                               |
| <b>SRNET</b>    | Pan-African Small Ruminant Research Network                                         |
| <b>SRUPNA</b>   | Small Ruminant Production Systems Network for Asia                                  |
| <b>T</b>        | Temperature                                                                         |
| <b>TA</b>       | Technological Alternatives                                                          |
| <b>TACIS</b>    | Technical Assistance to the Commonwealth of Independent States                      |
| <b>Tair</b>     | Air Temperature                                                                     |
| <b>TANAPA</b>   | Tanzania National Parks                                                             |
| <b>TAMU</b>     | Texas A&M University                                                                |
| <b>TDN</b>      | Total digestible nutrients                                                          |
| <b>TE</b>       | Terraneuva                                                                          |
| <b>Techpac</b>  | Technology Package                                                                  |
| <b>Tsoil</b>    | Soil Temperature                                                                    |
| <b>TT</b>       | Technology Transfer                                                                 |
| <b>UACH</b>     | Autonomous University of Chapingo                                                   |
| <b>UCD</b>      | University of California, Davis                                                     |
| <b>UCR</b>      | University of Costa Rica                                                            |
| <b>UCV</b>      | Universidad Central de Venezuela, Maracay                                           |



|                |                                                                                                              |
|----------------|--------------------------------------------------------------------------------------------------------------|
| <b>UMC</b>     | University of Missouri-Columbia                                                                              |
| <b>UN</b>      | University of Nairobi                                                                                        |
| <b>UNALM</b>   | Universidad Nacional Agraria La Molina                                                                       |
| <b>UNAM</b>    | Universidad Nacional Autonoma de Mexico                                                                      |
| <b>UNDOS</b>   | United Nations Development Office for Somalia                                                                |
| <b>UNDP</b>    | United Nations Development Program                                                                           |
| <b>UNICEF</b>  | United Nations Children's Fund                                                                               |
| <b>UNMSM</b>   | Universidad Nacional Mayor de San Marcos                                                                     |
| <b>USAID</b>   | United States Agency for International Development                                                           |
| <b>USAMRID</b> | United States Army Medical Research Inst. of Infectious Disease                                              |
| <b>USDA</b>    | United States Department of Agriculture                                                                      |
| <b>USGS</b>    | United States Geological Survey                                                                              |
| <b>USU</b>     | Utah State University                                                                                        |
| <b>UW</b>      | University of Wisconsin                                                                                      |
| <b>UWI</b>     | University of West Indies                                                                                    |
| <b>VOCA</b>    | Volunteers in Overseas Cooperative Assistance                                                                |
| <b>WAN</b>     | Wide Area Network                                                                                            |
| <b>WHO</b>     | World Health Organization                                                                                    |
| <b>WMO</b>     | World Meteorological Organization                                                                            |
| <b>WSU</b>     | Washington State University                                                                                  |
| <b>WI</b>      | Winrock International Institute for Agricultural Development                                                 |
| <b>WILD</b>    | Women in Livestock Development                                                                               |
| <b>WINS</b>    | Women Infant Nutrition Support                                                                               |
| <b>Wsoil</b>   | Soil Moisture                                                                                                |
| <b>WTO</b>     | World Trade Organization                                                                                     |
| <b>WWF</b>     | World Wildlife Fund                                                                                          |
| <b>ZONISIG</b> | Proyecto Zonification Agro-ecologica y Establecimientos de una Base de Datos y Red de Sistema de Informacion |

