Global Livestock CRSP
Annual Report 1998

Edited and Designed by Susan L. Johnson
Cover Photo by Emilio Laca

Cover Photo: *With a variety of expressions that probably reflect the gamut of experiences and challenges they face, children from a village in Almaty Oblast, Southern Kazakstan, share a limited resource and help with daily chores. During our visit to this village in late summer, we had a glimpse into the daily lives of rural people who struggle to make a living under very difficult conditions. Villagers were open, gentle, and generous with their time. They told us about how they meet serious challenges with hard work and resourcefulness. Teenagers and young adults were busy cutting and storing meadow hay for the winter by hand. Very young girls, probably under six, took care of babies and fetched water from the stream. Herders tended to their flocks as they grazed in the riparian areas near the village. Like most children of Kazakstan, these "three amigos" face a high risk of anemia and an uncertain future, as Central Asia emerges from the soviet times they never knew. Photo Courtesy of Emilio Laca.*

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The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development.

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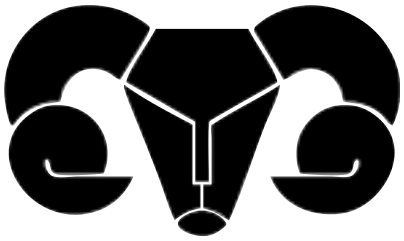

PREFACE

Each year, the Global Livestock Collaborative Research Support Program (formerly the Small Ruminant CRSP) publishes an annual report in compliance with grant requirements. The 1998 annual report covers the initial year of the Global Livestock CRSP program following a period of transition and restructuring. This annual report includes the first year of work for the projects that came out of the assessment team process in Central Asia, Latin America and East Africa. The process by which these projects were selected is outlined in the Overview section. The report also includes small grant projects conducted in Russia and Indonesia during the year.

This annual report documents work completed during the fiscal year, October 1997 - September 1998. 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 Katherine Lui who has been of invaluable assistance in the production of this document.

Susan L. Johnson
Annual Report Coordinator

FOREWORD

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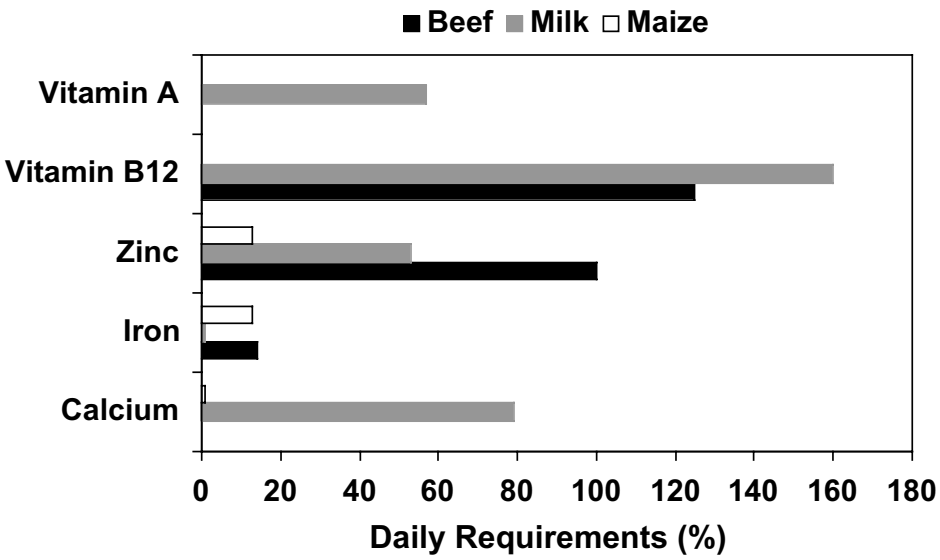
Although agriculture's primary focus is the production of food, there exists a considerable disconnect between human nutrition and agricultural production systems. Present advancements and understanding of the nutritional needs of populations suggests that the integration of agriculture and human nutrition will be a major focus of future development strategies. One of the primary reasons for this lack of integration was the emphasis in international development on the quantity of food as the sole criterion for satisfactory nutritional status. The emphasis has been on survival. The increasing understanding of the role of micronutrients has been critical to the development of a more sophisticated concept of nutritional status.

THE MICRONUTRIENT PERSPECTIVE

The micronutrient story advanced on several fronts in the last decade but the Nutrition CRSP is an excellent example. Their findings were important and surprising. First, they found that, in general, shortages of calories and protein were not as severe as generally expected. While in time of extreme food shortages they clearly are critical, they were not a major chronic problem, especially in children. Second, they found that a suite of micronutrients (especially iron, zinc and vitamin A) were deficient early in life, stunting growth, retarding intelligence and causing behavioral problems. Third, diets high in cereals often have a negative effect on the bioavailability of iron and zinc, hence exacerbating the problem. Secondary compounds in cereals called phytates bind the iron and zinc so it can not be absorbed. The tortilla and posho become the classic empty calorie. Fourth, previous work indicates that micronutrient deficiencies in children have dramatic effects on the development of cognitive capacity. They also indicate that if these deficiencies occur in the first two years of life they are likely to be irrevocable. Fifth, a large proportion of the population of the world's children suffers from these deficiencies. In sub-Saharan Africa the estimates are as high as 60%. These

Micronutrient composition of beef, milk and maize as a percent of the average daily requirements for children.



deficiencies originate in the lactating mothers who are chronically anemic and whose deficient milk transfers the shortage to the nursing child. Sixth, animal products are one of the most effective sources of these micronutrients. Not only do they have a high concentration of these nutrients but also they are very bio-available and appear to actually increase the bioavailability of these micronutrients in other foods consumed simultaneously. The World Health Organization has concluded that children who do not receive supplementation or fortification for micronutrients cannot meet their normal requirements without animal products.

The Global Livestock CRSP Perspective

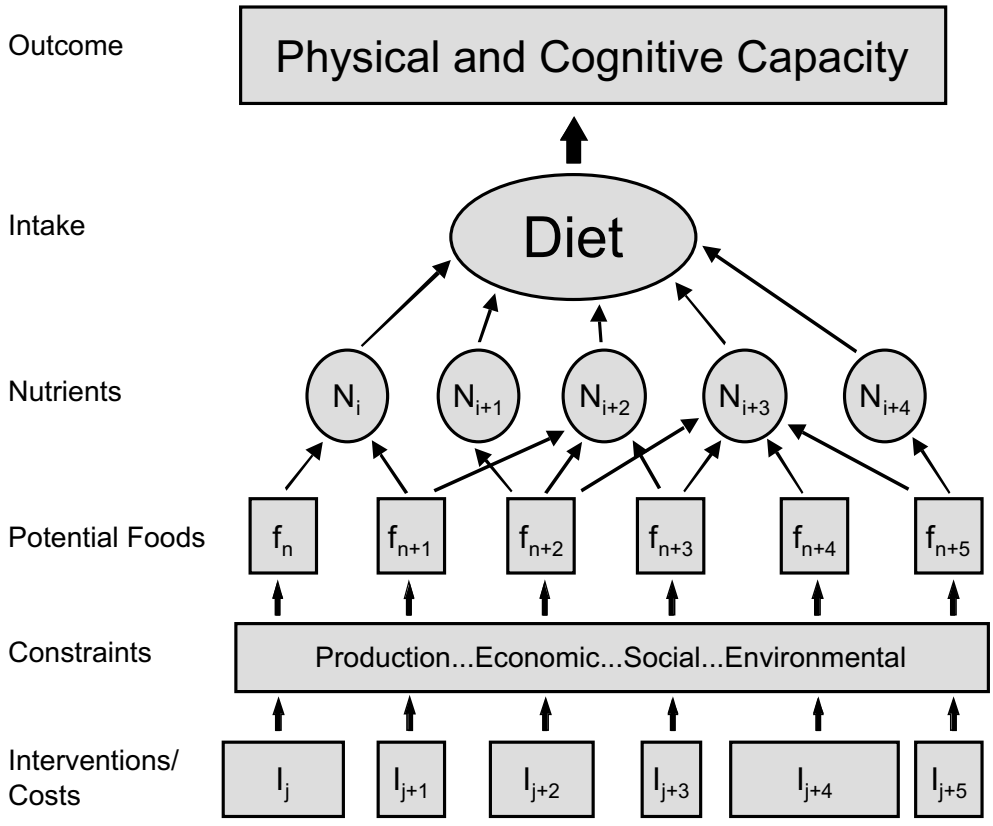
For many human nutritionists this topic is now well established but for most of the development community it is just being recognized as a major issue. The Global Livestock (GL-CRSP) has established micronutrients as one of three focal issues for our new projects. In an era where donors are placing emphasis on sustainability, attacking "the root causes of despair" and investing in "human capital," no problem is more fundamental that the micronutrient issue.

A Conceptual Model of Development with a Nutrition Focus

The challenge is to deliver a suite of nutrients at appropriate levels to populations that allow normal cognitive and physical development, and the maintenance and performance of mature individuals. One could think of this as an optimization problem where the objective (function) is to maximize the nutritional status of a population (call this grossly "human capital"), subject to a set of constraints (economic, ecological, agricultural, structural, cultural, infrasturctural, health etc) by the judicious selection of a set of

potential interventions. The interventions change the availability of foods, each of which would supply a subset of nutrients to the diet.

Assume that for each nutrient we can describe, with varying levels of accuracy, the relationship between the level of that nutrient in the diet and some measure of human capital (a simpler model might just use minimum levels or daily requirements of the nutrient). We have finite resources at our disposal: how should we allocate them to get the greatest increase in human capital? What set of interventions is optimal? On one hand we might intervene with increasing the efficiency and sustainability of cereal marketing, distribution and production systems to supply needed calories and on the other, increase household income and knowledge to allow the purchase of animal products to supply critical micronutrients. Supplementation and fortification programs could be bridges to future sustainable food systems. Interventions could include policy analysis to make foods more available, disease interventions, improved sanitation, and better food processing. In sum, the objective of development becomes development of healthy people who can be productive because they express their full capacity to work and to be creative, and to develop themselves. The approach is a broad based, unified approach to the supply of the optimal nutrient levels given the local constraints.



Conceptual Model of Nutrition Interventions.

Global Livestock CRSP Programs in Nutrition

The GL-CRSP has four projects with specific nutritional components imbedded in an overall agricultural framework. In East Africa one of our projects, is completely built around human nutrition. Led by Dr. Charlotte Neumann from UCLA, her team is testing the affect of different animal source foods on the cognitive and physical development of Kenyan children. While there has been considerable amount of circumstantial evidence of the positive role of animal foods relative to child development (for example, the Nutrition CRSP work), there have been no direct tests of this linkage. The results of this study will be essential to highlight the role of livestock as a critical component of a balanced diet for children in developing countries. Of importance if a strong positive link is established, is how development institutions like HPI and the GL-CRSP will create the resources, information and technologies to bring those micronutrients into the diet of children and adults in the developing world.

Another GL-CRSP team, led by Dr. Michael Coughenour of Colorado State University, is examining how pastoralists can balance their requirements for food from livestock production with the conservation of valuable biodiversity in their communities. This tradeoff is clearly visible in the Maasai who use the Ngorongoro Conservation Area in Tanzania. Surrounded by one of the world's great large mammal resources, Maasai struggle for food security from their livestock. Faced with emerging and multiple new constraints the project addresses the management options that allow proper tradeoffs between conservation and pastoralism. The project invokes a spatial-dynamic model, GIS, remote sensing to bridge the gap between management options and human nutrition to find solutions that provide both conservation of valuable natural resources and household food security.

In Central Asia, a GL-CRSP team led by Dr. Emilio Laca of University of California, Davis is investigating the links between livestock production systems and human nutrition. Recent political and economic changes in the region have had a major impact on all facets of rural life. In Kazakhstan livestock production and livestock number have, as elsewhere in the former Soviet Union, declined precipitously. The decline in rural economies has exacerbated nutritional conditions for women and children particularly in iron intake (49% of women and 68% of children below age three are anemic). The team will directly test the link between the animal production system, consumption of animal products, hemoglobin levels and morphological measures. They will also examine the role of wild edible plants as a complementary source of nutrients and how livestock compete with humans for this nutrient source.

In Latin America, Dr. Timothy Moermond of the University of Wisconsin-Madison leads a project focused on improving the quality of life in households by taking a watershed approach. Within the watersheds of montane forests in Central America resides an ecological unit in which management of the unit has strong implications for the agriculture and environment not only of the resident villagers but also the water supply for most of the urban dwellers at lower elevations. Although not fully funded at the moment, the project has targeted the improvement in nutritional status of families as one of its goals and funding available will measure the impact of watershed management decisions on the nutritional status of households. With additional funding, there are plans for local educational and training programs in nutrition to highlight the role of micronutrients in the nutrition of children and women and test innovative ways to bring animal diets into the diet.

Conclusion

Although the welfare of human populations in developing countries has long been a goal of development efforts, several of the principal components of welfare, child development and nutritional status, have rarely emerged as explicit objectives. Most often the goals are defined in economic terms under the assumption that nutritional status is directly connected to income. The GL-CRSP is advocating a broader more direct approach to human welfare. We accept the premise that the foundation of development is people and that the quality of people is the root of development. One of the major constraints on human development appears to be the impact of loss of human potential, both physical and mental, due to poor childhood nutrition. With limited resources the development community must make wise decisions in the allocation of resources. Only when the cognitive and physical development of people becomes the explicit objective of development can optimal choices be made about how to best supply the nutrients required. A lack of a conceptual model of the program leads to unwise investment that produce short-term solutions at best that have little sustainability beyond the lifetime of the implementation program.

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 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 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_2 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 process.

CENTRAL ASIA

Impacts of Economic Reform on the Livestock Sector of Central Asia

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Narrative Summary

The project has two objectives. First, to provide policy makers with information that will help them facilitate the transition from state-controlled agriculture to new types of ownership, use-rights, institutional organization, and supporting economic and social services that engender a stable, democratic society. Second, to develop technical options that increase the productivity of the livestock sector in environmentally sound ways, specifically, increasing the meat productivity of local sheep.

Under the first objective, fieldwork has begun in three Central Asian countries: Kazakhstan (two teams in the Southern and Western parts of the republic), Kyrgyzstan (in the Chuiskaja oblast), and Uzbekistan (in the Nurata district of the Navoi region). These research sites were selected because of the importance of livestock production in the region after consultations with local scholars and government officials.

In this initial year, data were collected by use of a detailed survey questionnaire, which is supplemented by open-ended interviews. Most members of the research teams are local scholars, who possess the necessary language and cultural skills to win the trust of informants, and thus increase the reliability of the data received. In addition, legislation was collected concerning privatization of land and other resources in the Kazakh agricultural sector.

Results of the surveys are now being analyzed. Papers will be presented at our conference in Almaty, Kazakhstan January 9-10, 1999. Preliminary reports from the field teams underscore the diversity of new forms of organization that are emerging. They also document the large, rapid changes that are occurring in the rural sector. The field teams' preliminary reports also confirm that the three countries studied display a continuum in the change process from Uzbekistan, where Soviet forms of organization still predominate to Kyrgyzstan which has changed the most, with Kazakhstan occupying an intermediate position.

With regard to the second objective, focusing on increased lamb production

from Kazakh Finewool flocks, in this initial year, the research focused on three areas, including (1) improving the genetics of lamb production, (2) improving lamb survival and (3) improving diluents for the freezing of ram sperm.

With regard to improving genetics for lamb production, semen was collected in Madison from Rambouillet and Polypay rams, frozen in pellets and shipped to Kazakhstan. From November 19 to December 2, 1997, 602 Kazakh Finewool ewes at the Aksengerskoe experimental farm in Almaty oblast were inseminated with the frozen-thawed semen from Wisconsin and with fresh semen from Kazakh Finewool and Kazakh Prolific rams. Forty-five percent of ewes inseminated conceived. However, due to a very harsh winter and poor condition of ewes, only 31% (184 ewes) of inseminated ewes produced lambs.

A total of 232 lambs were produced, of which 104 were ewe lambs. If mortality and culling of individuals for defects results in a loss of 20%, there will be 80 to 85 ewe lambs to be retained for a comparison of Kazakh Finewool, Kazakh Prolific, Rambouillet (FecB+), and Polypay breeding for lamb production under Kazakhstan conditions. The matings will be repeated again in October-November 1998 and, if needed, in 1999. The goal is to have at least 50 ewes in production sired by each of the four breeds of rams.

With regard to improving lamb survival, M. E. Gessert, DVM, visited Kazakhstan in April 1998 during the lambing season to assess the level and cause of lamb mortality in non-research flocks, to advise on health and management practices to improve lamb survival, and to train Kazakh veterinary staff in lamb necropsy techniques, so they could assess the levels of lamb loss in the research flocks.

Estimates of lamb mortality in the non-research flocks were 15 to 30%, which was higher than normal and attributed to the poor nutritional status of the ewes. In the research flocks, the lamb mortality rate was lower (12%). Necropsies of dead lambs revealed that the major causes of lamb deaths were navel ill and starvation/hypothermia. In Dr. Gessert's opinion, incidence of both conditions could be lessened with better feeding of pregnant ewes. The incidence of navel ill could be further reduced through treatment of navels of newborn lambs with 7% tincture of iodine. While iodine is available in Kazakhstan and was used by the shepherds at Aksengerskoe, the cost, which is 2 to 3 times that in the U.S., limited their supply.

In August 1998, Steven Sharrow, Professor of Range Management from Oregon State University, and David Thomas of the University of Wisconsin-Madison visited Kazakhstan with the main purpose of viewing the research sheep on the summer mountain pastures to determine the quantity and quality of of lambs that are expected to result from the crossbred ewes. They found striking similarities between the desert steppes

and mountain plant communities of Kazakhstan and the western US. The structure of the communities is similar and they share a large number of the same plant species. Technology transfer between the two should be relatively straight forward. In fact, USDA plant breeders have used many plants from Kazakhstan in their search for improved species suitable for our cold desert steppe areas in the Intermountain West. However, the flow of improved hybrids and exotic species back to Kazakhstan appears to be relatively small.

With regard to improving semen diluents, a study was conducted in Kazakhstan to evaluate the effect of adding amino acids to a standard diluent on motility of frozen-thawed sperm. The four amino acids added were arginine, betaine, glutamine, and proline. Each amino acid was found to improve the motility of frozen-thawed semen. Work will continue to determine the optimum amount of amino acid to be added to the diluent, and promising diluents may be used in an A.I. trial to determine conception rates.

Research

Activity One: *New Forms of Economic Organization*

Problem Statement

For centuries, extensive livestock breeding played a very important role in Central Asian economies. In Kazakhstan, Kyrgyzstan, and Turkmenistan, the majority of the population was involved in nomadic or semi-nomadic pastoralism. The decay of this branch of agriculture had started with the imposition of Russian colonial rule, which deprived the pastoralists of part of their rangelands for the needs of Russian peasant colonization. In a different form this process continued in the Soviet period, when the pastoralists were forced to sedentarize and become sovkhozniki and kolkhozniki, i.e., laborers on the collective and state-owned farms. Excessive cotton-growing and grain production on the so-called virgin lands, dubious from environmental and economic points of view, further contributed to the deterioration of livestock breeding. It is true that by the early 1980s the Soviets, for a short time, succeeded in maintaining a rather large number of livestock in Central Asia, but this number was not based on sound economic considerations and did not take into account the costs of production. It was achieved by providing huge state subsidies and by a complete neglect of environmental factors, which resulted in serious deterioration and desertification of natural pasturelands. Significant damage has also been done to the biodiversity, ecosystem, and habitat in the especially vulnerable semi-and arid zones. Thus, livestock production in Central Asia has never been organized on the principles of capitalist-type private ownership and market economy.

In the Soviet period, significant attention was paid to the selection of new species of livestock. However, the deficiencies of the Soviet economy to a large extent

divorced the selection work from practical demands and prevented it from really improving livestock production. The introduction of new breeds had a very limited effect on the livestock sector; this work had been done mainly for its own sake. If one adds to these problems the specific, essentially pre-modern, sociopolitical, demographic, and occupational structures of Central Asian societies, in which more than half of the population still lives in rural areas and is involved in agriculture, one may conclude that nowhere in the former Soviet Union is the transition to a market economy as difficult as in this region.

The post-Soviet development in the livestock sector of Central Asia is contradictory. One witnesses a deterioration of animal agriculture, especially a serious decrease in the number of stock, which in many countries of the region continues to spiral downwards. This situation has aggravated the human nutrition problem and endangered the preservation of wild ungulates (because of the weakening of state preservation agencies and the increase in poaching).

Our preliminary findings have identified several factors that have caused the decline in livestock production in the region. To put it bluntly, with regard to agriculture the Central Asian
states are strong where they should be weak, and are weak where they should be strong. Although agricultural policy in the different Central Asian countries varies significantly, it remains in every one an essentially top-down business in which immediate producers have little, if any, voice. As a result, their problems and interests are far from always taken into account by the policy makers. At the same time, the Central Asian states prematurely retreated from their former roles as providers of subsidies, credits, services, and input-supply systems (such as fuel, equipment, veterinary service, feed, et cetera), and in Kazakhstan and Kyrgyzstan as purchasers of agricultural production. The states still remain the main owners of food-processing enterprises, however, many of these enterprises are in debt or have gone bankrupt. In Uzbekistan, the state still controls or even dictates the purchasing price on the most important agricultural products. In Kazakhstan and Kyrgyzstan, marketing suffers from significant mafia penetration and by the rampant corruption of many local administrators.

It is no wonder that so far only a small percentage of primary producers have opted for, or have been provided with, the opportunity to start their own small farms. The rest, especially in Uzbekistan, remain dependent on the former kolkhoz and sovkhoz (collective and state-owned farms), which underwent only quasi-privatization, and which continue to operate under different names (e.g. cooperatives, joint stock companies, and others) in essentially unreconstructed forms. Although the amount of services and payments that, at present, are provided to primary producers has drastically decreased in comparison with the Soviet period, the power of their managers has increased

in the post-Soviet period. Thus, there is a danger of repeasantization of the former kolkhozniks and sovkhozniks. Instead of becoming small-scale but efficient market-oriented producers, these people, not habituated to economic choice and wary of taking it for granted, may be locked into the role of subsistence-oriented, non-capitalist small holders, or even worse, to that of laborers in large agricultural enterprises that have been captured by the former kolkhoz and sovkhoz managers and other entrepreneurs.

In spite of this grim picture there are some positive elements in the most recent developments, which indicate possibilities for serious reconstruction of the livestock sector. First, a growing number of policy makers in Central Asia are coming to the conclusion that the only way to improve the situation is to proceed further and more consistently with market-oriented reforms. Thus, various blueprints for these reforms and the ways of their implementation are currently under discussion.

Second, despite all obstacles and around the edges of inertia, new forms of organization are beginning to emerge within, among, and outside the former collective farms; some of them hold the seeds of a more promising future for the region's livestock economy. These new, voluntary, decentralized and horizontal forms of organization and cooperation may become a substitute for the old forms based on a pyramid-shaped chain of command.

Third, a decrease in the numbers of livestock, however deplorable it is, allows the pastures to regenerate and to restore their carrying capacity. This is not an insignificant factor in conditions when primary producers do not have access to an affordable feed supply and must rely upon traditional, extensive methods of grazing.

Numerous interviews with government officials, experts, managers, and primary producers, as well as our personal observations made during repeated visits to the region, have persuaded us to focus on the following priorities: (1) the need to understand the great diversity of new types of collective, cooperative, and individual farms that are emerging in the region and the many different processes that produced them; (2) the underdevelopment of marketing and credit services for the livestock sector and the slow emergence of new providers; (3) the interface between national laws on privatization of land ownership and the administration of the privatization process at the local level; and (4) the transformation of the critically important sheep sub-sector toward much greater reliance on meat as the key to profitability.

Progress

This section deals with the first three goals stated above. The fourth is elaborated and discussed in the section entitled Activity Two. To pursue the first three goals of the project in this initial year we have paid particular attention to data collection, mainly through field

surveys based on the use of a detailed and structured questionnaire and supplemented by open-ended interviews. Our purpose was to identify emerging new forms of farm organization and to define the sociopolitical, economic, cultural, and psychological factors obstructing, or, on the contrary, facilitating development of an independent farm economy in the livestock sector. In addition, our project assistant, John Loncle, visited Kazakhstan in August 1998 to collect copies of relevant land laws and to interview local officials about the implementation of those laws (copies of land title grants have also been collected during field surveys).

Professor Masanov (Kazakhstan) completed the first draft of the questionnaire by May 1997. It was further elaborated upon in October 1997 during Masanov's meeting at Madison with the U.S. researchers. Key questions on sheep production were developed with Thomas during the October 1997 meetings. During the next few months Shapiro and Khazanov continued to work on elaborating the questionnaire. The final draft of the core questionnaire was agreed upon in January 1998 during Khazanov's visit to Kazakhstan. Later on in the same month, the three team leaders for the field research in Kazakhstan and Kyrgyzstan met with Khazanov to adapt the core questionnaire for each country and region. Adaptations for the Uzbek survey were made in Spring, 1998 in meetings with Zanca.

The prolonged work on the questionnaire, in which the American investigators collaborated with Central Asian participants in the project, was inspired by the necessity to develop optimal ways of collecting comprehensive and reliable information in a relatively short period of time while taking into account local cultural and social realities. The American investigators and their local collaborators have tested the feasibility of some questions during their preliminary visits to the regions of future research. The research areas and field sites were selected because of the importance of livestock production there after consultations with local scholars and government officials.

The first surveys in southeastern Kazakhstan were from April through July in the Almaty and Chimkent oblasts (administrative provinces) located in the steppe and semi-desert zones. Altogether 140 questionnaires were completed. The surveys in Kyrgyzstan were conducted in June and July in the plains and high mountain regions of the Chuisk oblast (seventy questionnaires have been completed). In Uzbekistan, the surveys were conducted in July and August in the Nurata district of Navoi oblast, located in the steppe zone. Eighty-two questionnaires were completed. The surveys in the West Kazakhstan oblast located in the dry steppe zone in northwestern Kazakhstan were conducted in August and September. Ninety-two questionnaires were completed. (See Figure 1).

The Central Asian scholars, with extensive experience in sociocultural research, have conducted the bulk of the field research. They possess the necessary language and cultural skills to win the trust of informants and thus increase the reliability of the data received. For the same reasons, many interviews were conducted not in Russian but in the native languages. The relevant research experience of our co-investigators and their understanding of local culture has allowed them to gather considerable information on the emerging new forms of farm organization. As planned, this will be the main focus of our analysis of this first year's data.

Even though our collaborators have considerable experience with social science research and an understanding of local cultures, it was evident to them (in part, because of their experience) that farmers were under reporting key data such as livestock numbers and income. Thus, while analysis of the different forms of farm organization can proceed with some confidence, we do not intend to go beyond our original plan of providing only a general, indicative picture of physical and economic production relationships. The data would not support detailed input/output analysis, and that has never been our objective.

Immediately after their field research, the leaders of the field teams were asked to submit a brief preliminary note documenting their accomplishments and offering general observations. (Their

Figure 1: Central Asia: Project research sites.

first detailed papers analyzing the survey results will be presented at our conference in January, 1999.) Extracts from the preliminary notes are presented below to provide the reader with first hand accounts of two key aspects of the Central Asian livestock sector: (a) diversity and (b) disequilibrium.

(A) Diversity. — Numerous new forms of farm organization are emerging. Most of them do not fit common definitions of "firms," "economic units," or "farm households;" not only as those definitions are used in developed countries but even as they have been adapted for use among, for example, African farmers and pastoralists. Considerable study is needed to understand such key dimensions of Central Asian farms as the following: (1) the nature of the control that these units have over resources; (2) the kinds of decisions that can be made at different levels by different actors; (3) the social, kinship, and economic relationships among farm personnel (in the same farm and across farms) and the impacts these have on production and marketing decisions; (4) the farm's access to and relationships with input and output marketing channels; (5) cooperation across farming units; and (6) the role of local and national governments in controlling the farm's resource allocations, production decisions, and marketing opportunities. Understanding these issues will help us understand the future evolution of Central Asian farming and the factors that will promote different kinds of change. Furthermore, until we understand these dimensions of Central Asian farming, we cannot predict with precision how farmers will respond to changes in the biological and economic contexts in which they operate.

(B) Disequilibrium. — It is almost trite to say that Central Asian agriculture is in transition, and the term "in transition" seriously understates the kinds of change that are occurring. Thus, our analysis of the above dimensions of farming must be cast in a dynamic mode. We are not attempting to describe a static situation, but rather to understand the above dimensions of farm organization as they are manifest in farms that are still very much in the process of changing. Our understanding of the current situation will help us understand the change process; and our return to the same farms over time will expand that understanding. In addition to major changes in the farms themselves, there are also changes, of perhaps greater magnitude, in the external forces affecting farmers and the decisions they make. Farmers face extreme uncertainty, not only about the prices they will face, but more basically about their ability to sell their produce or to buy inputs. Furthermore, since the legislative and administrative bases of property rights are also in considerable flux, farmers even face uncertainty about their future rights to control land and animals. The word "uncertainty" is used advisedly instead of "risk" since the farmers are facing situations in which it is impossible to assign probabilities to different outcomes.

Extracts of the field researchers' notes follow. Some are presented in rough translation from the Russian, but they still provide useful illustrations of the above points.

• *From Olga Naumova's Notes on her Research in Western Kazakhstan Region (Formerly West Kazakhstan Oblast)*

The research team, which included Olga Naumova (Moscow), Saniya Sagnaeva, Yank Lukpanova and Ayan Kospanov (West Kazakhstan), worked from August 4 to September 4, 1998 in the Zapadno-Kazakstanskaya Oblast' (Western Kazakhstan Region, formerly West Kazakhstan Region; hereafter referred to as: ZK Region) of Kazakhstan.. The team visited 14 settlements and 10 "points" (i.e., separated farms) in 5 districts: Kaztalovka, Urda, Akjaik, Jangala and Terektinskii. In total, 92 questionnaires were completed on the following types of farms: 56 on peasant farms; 16 on agricultural production cooperatives (SPKs); 8 on personal farms; 4 on production cooperatives (PKs); 4 on private-owner farms; 3 on limited partnerships associations (TOOs); and l on a sovkhoz (state farm). This division is not very exact. For example, about 8 farms among those classified as peasant and personal ones are in reality private-owner farms. We also gathered statistical data from the regional and district statistical boards.

Types of Contemporary Farms. During the last two years, the organization of rural husbandry [livestock raising] in the ZK Region has been undergoing change. Up to 1997, there had been large agricultural farms (i.e., SPKs, TOOs, AOs (Joint-stock companies) and so on), which were the successors of the kolkhozes (collective farms) and sovkhozes (state farms). In addition, some kolkhozes and sovkhozes have been preserved. The majority of the rural population has belonged to these large farms. But, at the same time, people have had their own livestock and plots of land. Thus, this system has reproduced the organization of the Soviet rural economy, which combined common husbandry and personal husbandry.

In addition, in 1990-1991, so-called farmers began to separate from the then existing kolkhozes and sovkhozes. They received their land and livestock shares and became independent owners. Their number was very small - 1 or 2 per district. We refer to these types of farms as "private-owner farms" in this report.

Beginning in 1997, SPKs, TOOs and AOs began to break up distributing livestock, land and agricultural machinery shares among those members wishing to separate. In comparison with 1990, the number of livestock in the ZK Region presently has declined: sheep and cattle by 2 times, and horses by 10 times. The quantity and quality of equipment also have deteriorated. In connection with this decline, the present shares are so small that the peasants are forced to unite: 5, 10 or 20 shareholders form one krest'yanskoe khozyaistvo (peasant farm, PF). The number of PFs has grown

abruptly. For example, in Urda district there were 5 PFs in 1990, 81 PFs by the beginning of 1998, and 181 PFs by August 1, 1998.

The disbanding of SPKs, TOOs and other large farms has been carried out according to the authority's instructions. Yet, this does not mean that this action was conducted contrary to the SPK members' wishes. Some of our respondents wished to leave the state farms even in the beginning of the 1990s, but they succeeded in separating only in 1997-1998.

Thus, today there are the following types of farms: (1) kolkhozes (collective farms) and sovkhozes (state farms); (2) SPKs, TOOs, AOs and others (non-state organizations, successors of the state farms); (3) private-owner farms; (4) PFs; and (5) personal farms.

Currently, the share of livestock held on private-owner personal and peasant farms is the largest and still growing. In the opinion of the chief of the Regional Agricultural Board, there are practically no "common" cattle in the ZK Region. All livestock are passing into private hands.

Peasant Farm. The organization/ structure of PF leaves the impression that the system of "common personal" husbandry is broken, although the principles of this system are preserved. The members of PFs combine the livestock, which was received as a share from SPKs or TOOs [into a common herd], but they do not combine their own personal livestock. A large number of PFs are unprofitable. During the short period of their existence (1-2 years), the number of their livestock has declined appreciably. Some PF probably are formed only to support their members' personal livestock raising. As a rule, the "common" livestock are used for buying fuel, for laying-in of fodder and for spare parts for equipment. Sometimes, PF members take back a part of their livestock share for urgent large expenses. One more problem for PFs is the labor discipline of their members, who do not consider themselves to be masters of PFs. Many of the PF leaders suppose that in 2 or 3 years the PF will fall to pieces because they will not have any livestock. We heard the same opinion from the chief of the Regional Agricultural Board. He considers PFs to be a transitional type of farm: little by little the real farmers will appear on PFs, the others will become hired workers or leave for the cities.

A small number of strong PFs (1 or 2 for each settlement we visited) stand out against this background. Their leaders are energetic and educated persons (former managers, bookkeepers and those who have business relations with suppliers, purchasers and so on). Many of them failed to separate from state farms in 1990-1991. Today, they do not have enough livestock or agricultural machinery to manage their own farms, and they are forced to unite with rural people. They manage not to sell off livestock, because of involvement in other economic sectors, mainly commercial activity, as well as their

ability as good salespeople. In contrast to unprofitable PF leaders, these individuals make plans for further development, including leasing land for grain farming, opening produce processing shops and so on. For these PFs, many things depend on the [near] impossibility of getting credit.

A Few Notes on Private-Owner Farms. As a rule, large-scale farmers created their large farms not by livestock-breeding. They make a profit on the resale of goods, cultivating grains, meal [feed] production and so on. For them, livestock are a kind of capital, some part of which can be sold to buy goods, which are in great demand, and make a profit.

Mid-size farmers cannot secure large-scale reproduction [of livestock]. They manage only to maintain the number of their livestock and to provide for the moderate needs of their families.

Personal farmers (those having l-3 cows, [and/or] 10-20 sheep) can provide for the minimum needs of their families. In the absence of other sources of income, such a family could find itself living in poverty.

• *From Sergei Kliashtornyi's Notes on his Research in Chuiskaja Oblast in Northern Kyrgyzstan*

Sites of Fieldwork. All work in the first year took place, as planned, in two regions of Chuiskaja oblast' (in North Kyrgyzstan): Chui-Tokmokskii and Keminskii regions. Chui-Tokmokskii is a foothill region with well-developed agriculture and vast pastures. Near Bishkek in Tokmok (65 km away) there is a traditional livestock market, one of the largest in North Kyrgyzstan; a relative advantage in the management of trade of rural farms in the region. The research base was established in the village of AAAA, which is close to the rest of the foothill pastures adjacent to four small villages, at no time (since 1993) entered into the state farm AAAA, and also near to Tokmok, rural Zhany-Zhol and Ak-Beshim. In Keminskii region, the high mountain valley area of Chon-Kemin (1800 meters above sea level at the central part of the valley) was selected for research, an area bordering the Tian'-Shania glacier. Vegetation here appears a month later than in Chui-Tokmoskii region, and natural and climatic conditions (a combination of valley and alpine pastures and an abundance of natural springs) assist in the management of stock raising with seasonal vertical migration. In summer, herds from all parts of North Kyrgyzstan are driven to the outstanding pastures of the adjoining Chon-Keminskii Valley (50-60 km from the center of the valley). The team's research took place in the Chon-Keminskii Valley, on both riverbanks and in proximity to one or another of eight villages.

Work in AAAA Aul (Rural district, formerly called a village soviet). The liquidation of state farms and the start of new agricultural enterprises took place between 1993-1996. At present three types of farms have been established: OKX (Association of Peasant Farms, a type of cooperative farm which

preserves the rights for its members the right of ownership of their land. The rules of OKX "AAAA" have their origin in Kyrgyz tradition and the Russian period (full information will be attached to the final report), agricultural farms, and individual peasant farms. The boundary between the latter two is highly indistinct and theoretical. The exceptions are the not infrequent small family cooperatives, which are not always stable, which follow the relatively marketable peasant-individual farms, which satisfy only family needs in goods, with minimal amounts available for market. It follows to stipulate that existing structures are not definite and are unstable; their long-term future depends on foreign circumstances, mostly in the form of fiscal and credit policies of the government and different forms of foreign support.

OKX "AAAA". OKX "AAAA" appears to be the successor of the fragmented ruins of the extensive and powerful state farms, which consisted of five villages until 1993. Now the OKX is composed of one half of the village of AAAA (1280 people), with each person allotted 0.6 hectares per person, that is, 3-4 hectares per family; composing a general irrigated field of OKX land. Dry agriculture and pastureland is controlled by the village soviet, and is used at far from its total capacity, by all inhabitants of the village. Due to a sharp decrease in the number of head, less than 30% of this land is being utilized. Irrigated fields of the OKX total 769 hectares and hayfields - 442 hectares. At the time of incorporation (February 1996) to the possession of the OKX 224 head of large horned cattle was transferred, but due to winter starvation this was reduced to 127. In absence of cash, cattle were used for payment of debt, and in this year only 43 head remained. All small stock (goats and sheep) was parceled out in 1993. The machinery of OKX consisted of 10 tractors and four combines, all inherited from the state farms and require constant maintenance. OKX inherited 1.5 million in debt.

In the OKX 47 full time workers and mechanics work, the rest of the members of OKX do not take part in production activities and their connection with the farms is limited to the receipt of a share of wheat. In 1997 every family received 126 kg of wheat for every hectare of their land. At the time of urgent seasonal work several rural dwellers or people from far away get jobs in a variety of seasonal work. This is especially practiced in the harvesting of sugar beets and in sugar refineries, and workers are paid not with cash, but with ground sugar. The main part of family income for members of OKX is generated from a) harvesting of personal plots; b) cattle raising; c) seasonal earnings in sugar beet production; d) trade, transport, construction services, hired work, and pension and insurance funds. All members of OKX are not immediate producers for the collective, but are peasant-individual farmers practicing irregular and supplementary farming. Some of these have formed family cooperatives, which combine labor efforts but not ownership.

Farming Homesteads. These are farms on which the general majority of cattle are concentrated and are engaged in reciprocal trade. Some of these farms appear to be family cooperatives under control of heads of families or by members who possess business "know how." In general the heads of families were also directors of the official state farms; they have agrarian, veterinary, zoo technological, and economic education and practical experience, or were mechanics/operators on state farms. The partition of the property of the state farms means that they managed to freely or cheaply acquire technology and cattle. Not one of these created farms appears specialized, however they sometimes appear to be trying. Attempts to create specialized sheep farms were undertaken by the administration of Chui-Tokmokskii region. This service consisted of rendering consultative assistance for farmers who have a specific number of sheep and sheep enclosures. The exception is the planning of veterinary services, reclamation/improvement of pastures and food resources, and improvement of marketing systems for sheep products.

Below are presented 2 examples of farms where stock raising (in one case - sheep herding; in the other - large horned cattle) is predominant. In the first case, it is a family cooperative; the second is an individual farm.

Example 1. Respondent XXXX (survey #18) separated himself along with his 2 brothers from the OKX and created what is called combined arable farming — "stock raising peasant farm," which is composed of 3 families. They own 17 hectares of irrigated fields, with lengthwise distribution of crops and income from the sale of grain. Stock is held in common; two families take care of the harvest while the third raises the livestock. All are producers, and fiscal expenses are shared.

Stock is put on the pasture at a distance of 30 km, where they have yurts (traditional nomadic dwellings) for the stock raising family and enclosures for the animals; there are no other structures. The livestock spend all day on the pasture and are brought into the enclosure for the night. The animals remain here until autumn, when it is time to return to the farm (the home of the respondent). The main stock of the farm is sheep and large horned cattle, which provide livelihood for the third family by means of meat, wool, and milk production for the market and for their own use and for the 2 families which tend the fields. In turn, the crop farmers provide feed for the cattle in winter.

Example 2. Respondent YYYY (survey #19) separated from OKX and created his own farm: 13 hectares of irrigated fields for grain and feed, which he works together with his children. They also have 13 large horned cattle and several sheep. Though part of the production is sold at market, the respondent did not say how much he received for it. Though the respondent is considering the prospects of the raising of large horned cattle and the production of goods for market, he does not have the means for

the expansion of his farm, such as the upkeep of cattle stalls (and pasture enclosures). As with other respondents, he considers it more beneficial to keep livestock on pasturelands for the entire growing period, bringing them into the cattle sheds and sheepfolds in winter. This is hindered by two factors: the multiplication of the number of wolves in recent years and especially by the almost universal theft of livestock, in which entire herds or flocks have been taken.

Virtually none of the respondents are driving their stock for market sale of meat. Stock is sold live due to the necessity for cash currency. Stock that is driven in is primarily for domestic consumption. The types of stock maintained are primarily for meat, which in the opinion of stock raisers are more suited to the current demand than fine-fleeced and semi fine-fleeced sheep. The wool of mutton sheep does not meet the demand of the market because of the domestic demand for felt.

Nevertheless, there are farms which have more than 90% semi fine-fleeced sheep.

Chon-Kemin. Chon-Kemin is a traditional stock-raising region. After the collapse of state farms and the general decline of livestock production, potato farms first appeared, started with materials purchased through an Israeli firm in Holland. As opposed to AAAA, which is 20 km from the major market in Tokmok, Chon-Kemin is 150 km away. The proportion of all stock production in the valley is 40% in the estimates of the economists of AO "Chon-Kemin." Virtually all stock, with the exception of small herds of yak and horses, are found on private farms. Nomadic herding is dominant in the region. Weak utilization of distant pastures is based on these conditions: a) large fields of free pasture in the near country and decreases of state farm stock using it; b) the abundance of wolves; c) theft of entire herds.

Example 1. Respondent ZZZZ (survey 52), formerly of the "BBBB" farm in the village of CCCC, now owns 7.15 hectares of irrigated fields - 5.15 for potatoes (for sale) and 2 hectares for feed. On his farm are 200 fine-fleeced sheep, 100 mutton sheep, 14 large horned cattle, and 27 horses. A hired shepherd and his family tend his stock on year-round pastures (with sheep enclosures), only cattle are driven to the country in winter. Migration is up to 18 km. Problems are the absence of trading establishments, and of artificial insemination centers needed for the support of animal pedigree.

Example 2. Respondent KKKK, along with his family and 2 brothers, has 11 hectares of plowed fields; of these 5.4 hectares are used for wheat and potatoes. They also have 100 hectares of pasture hay growing land. Land and animals (with the exception of personal plots) are owned jointly by the 3 brothers; one of who, along with his family, drives the herds. These consist of 54 fine-fleeced sheep, 46 mutton sheep and goats, 16 large homed cattle, and 10 horses. They intend to increase the number of fine-

fleeced sheep. He and his wife gain additional income by teaching at a school in the village of Tegirment.

• *From Russell Zanca's note on his research in Navoi Province in Uzbekistan*

Contemporary farm organization continues to reflect Soviet patterns of collectivized agriculture. What distinguishes post-l991 collective farm organization (coinciding with Uzbekistan's declaration of political independence) from the Soviet period amounts to a series of reforms designed to make the farms less dependent on state subsidies and more dependent on their own financial accountability, which in turn means that farm leaders and bureaucrats must find buyers or traders for their products. The individual shepherds are permitted to freely buy and sell their own livestock, but not those owned by the farms. In the overwhelming majority of cases, shepherds and their families own a minor proportion of the sheep they care for with ratios rarely going beyond 1:10; 1:15-1:20 ratios are most often the case.

The state leaders, in the interests of reflecting what they think are core cultural values of local agricultural labor and village organization, have broken down the size and administrative apparatuses of the collective and state farms (kolkhozes and sovkhozes, respectively) into cooperatives, known in the Uzbek language as shirkat/s. In theory, these shirkat/s are supposed to encourage private enterprise and capitalist development by making each cooperative more and more independent of state planning, requisitioning, etc. Shirkat leaders and constituents are supposed to negotiate with one another to figure out best how to care for the well-being of the farm as well as to ensure the welfare of the people who make it work—that is, the shepherds and their families. Today, in fact, the only true demand of the state regarding agriculture output, therefore targets, is grain—specifically wheat—production.

The state still provides shepherds and the farms with a number of important subsidies, including veterinary services, water supplies, maintenance of farm buildings and family housing, retirement benefits, education, and triage and primary care medicine. The farm leaders must ensure that feed is stocked for the animals during the winter and early spring and that adequate supplies for pedigree artificial insemination are on hand. In addition, special clothing for severe winter conditions on the pastures are made available to those directly employed by farms.

The Qoraqul primarily serve to supply Uzbekistan with meat. The secondary, and previously very lucrative, aspect of Qoraqul (QQ) rearing is the production of pelts for the creation of luxury garments, such as hats and coats. One of the most serious problems facing all the people involved in this industry today involves not only the terrible decline in official prices paid for these pelts but the general inability to work out any new consumer domestic or export markets for

this highly specialized industry. With the state, primarily through a production plant in Bukhara, continuing to dominate almost all aspects of this industry, there seems to be little development of small-scale privatization in rural areas of direct production.

Decision-making abilities and powers remain a privilege and bastion of the elite, although individual shepherds will certainly attempt to deceive the kolkhoz administrators from time to time by under reporting their own livestock holdings (acquired via purchase, barter, or as part of property descent within a family), or by claiming that a number of the farm's sheep perished when the shepherd themselves either killed and ate them or used the animals for their own economic advancement. Shepherds see such acts as no more criminal or unethical than the methods of deceptions and cheating they believe the state administrators practice upon them.

Overall relations between local farm administrators and the shepherds may hardly be considered harmonious. The administrators claimed inability to pay these people their salaries, their removal of kolkhoz sheep from individual shepherd care (also a part of each shepherd's income), the ability of farm mangers to "fire" shepherds who perform poorly, and the assigning of bad pastures (attar) to particular shepherds are among the reasons for a more or less antagonistic management-worker state of affairs. On this last issue concerning pasture assignment, more must be said. The entire process of deciding who receives the best and worst attars is hardly a matter of chance or impartiality. Sometimes determinations stem from family history (continual lines of descent in a given spot) or the decisions may be based on bribery, other family connections—to members of the local leadership—and similar types of favoritism. Ideally, a more just system would provide for rotation of families living or working on kolkhoz attars. Obviously, the rule of thumb is that the poorer one is the less are his abilities to make decisions or to be treated fairly in terms of this all-important distribution system.

At the kolkhoz administrative offices procedures appear to take place in a very Soviet manner. The working day is started by an endless round of meetings between the director and his chief support staff, including economists, accountants, agronomists, and animal managers, and then lower level meetings between the director and chief support staff with those of lower rank, include tractor and truck drivers, brigade leaders, senior shepherds, etc. Some meetings focus on production figures, potential sale of animals or the working out of barter agreements with other regional enterprises, or the purchase of needed supplies. Many meetings are tense, desperate affairs with administrators chastising or bullying the lowly because of failures, lack of productivity, etc. and the proverbial begging for permission slips to obtain gasoline and repairs for decrepit vehicles and machinery. Despite the number of men engaged in

meetings at these centers, there are almost always twice as many sitting around outside the buildings. Many do nothing day after day until orders come down from the administrators, who in turn wait for orders from Nurota district headquarters, who in turn await orders from Navoi and so on. Life in general is still something that is commanded.

The shirkats do worse, economically, than the kolkhozes, as shirkat leaders simply take sheep away from their shepherds, those sheep owned not individually, of course, but by the cooperative. In the end, the shepherds simply have less sheep to pasture, which greatly harms their livelihood. In terms of the upkeep and improvement of these shirkats, the decision-making input of shepherds is basically nil. It should come as no shock that most shepherds I interviewed and spoke with informally would like the return of the old Soviet system, for reasons that have little to nothing to do with political ideology.

Land privatization is almost a non-issue in Nurota. Some crop lands have been returned with the farm administration taking a percentage of the harvest. We knew of exactly one case of full privatization of land, sold by a farm to an individual, but the said individual told us that farms will not sell good quality land but only useless land. It is his idea to set up some kind of "business enterprise" on this bought land.

• *From Nurbulat Masanov's notes on his research in Almatinskaja Oblast and Chimkentskaaja Oblast in southeastern Kazakhstan*

The following different types of farms were visited: (1) Individual Farms; (2) Production Cooperatives; (3) Agricultural Cooperatives; (4) State Public Agricultural Enterprises; (5) Private Agricultural Cooperative; (6) Member Farms; (7) Joint Stock Companies; (8) Private Peasant Households.

Masanov comments as follows on the problems of data collection:

The main problem of the investigation lay in the fear of the population regarding repression by tax inspectors, tax police, KNB, and other law enforcement organs. Every interviewer received 2-3 refusals, minimum, creating the greatest difficulty for the investigation.

Another problem lies in that the information communicated by informants regarding their income was obviously low. The data on expenditures in virtually all surveys exceeds reported income.

Practically all respondents gave low data on the number of cattle they have. The neighbors of the respondents pointed out that the number of livestock was actually more than the respondents reported. Even in this event, when parents and associates were interviewed, the number of reported livestock was considerably lowered.

Activity Two: *Increased Lamb Production from Kazakh Finewool Flocks*

Problem Statement

The sheep population of Kazakhstan has drastically decreased in recent years from approximately 30 million head in 1990 to approximately 13 million head in 1998. The emphasis on wool sheep and privatization of livestock are both causes for the decrease in sheep numbers. After World War II, the local 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 1950's and 1960's for its wool production. Finewool sheep are superior to the local sheep for wool production but inferior for meat production. Economic collapse in Russia and a glut of wool on the world market has left Kazakhstan with few markets and unprofitable prices for its fine wool. There was little incentive to keep wool sheep since they were unprofitable. When sheep were privatized in the early 1990's, they were the major liquid assets of many farmers and were sold or bartered in order to obtain other agricultural inputs and household necessities. Many sheep were also consumed as food by the farm families.

An increase in the number of lambs raised per ewe in Finewool flocks can result in an increase in both the amount of lamb meat produced per ewe and an increase in the number of replacement females produced in order to help rebuild national flock numbers. 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 kilogram of lamb meat and less pressure on range lands and other feed resources.

In collaboration with Kazakhstan's Center for Sheep Selection and Genetics (CSSG), a study was designed 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 are being inseminated 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, but the Rambouillet crosses should have comparable fleeces to the Kazakh Finewool whereas the Kazakh Prolific and Polypay crosses should have poorer fleeces.

More basic studies aimed at improving

diluents for freezing ram semen were also planned in order to improve conception rates from frozen-thawed semen. Artificial insemination of sheep with fresh 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.

Progress

Improved Genetics for Lamb Production

Semen was collected at the University of Wisconsin-Madison from four Rambouillet rams with a high probability of carrying the FecB gene for high ovulation rate and from two Polypay rams in October-November 1997. Semen was extended, frozen into pellets (enough for approximately 500 breedings), and shipped to Kazakhstan. From November 19 to December 2, 1997, 602 Kazakh Finewool ewes at the experimental farm Aksengerskoe in Almaty oblast were inseminated with the frozen-thawed semen from Wisconsin and with fresh semen from Kazakh Finewool and Kazakh Prolific rams.

Ewes are generally mated in October - November in this region of Kazakhstan. However, since the project did not start until October 1997, it was not possible to get the frozen semen from the U.S. to Kazakhstan until mid-November, 1997. Therefore, the inseminations were conducted under very harsh conditions of extreme cold and heavy snow. However, it was felt that performing the inseminations under less than ideal conditions in 1997 was preferred over waiting until 1998 to perform the first inseminations.

Forty-five percent of ewes inseminated conceived. However, due to a very harsh winter and poor condition of ewes, 7% of pregnant ewes died prior to lambing, and 7% of ewes aborted prior to lambing. Therefore, 31% (184 ewes) of inseminated ewes produced lambs. Results of the insemination are presented in Table 1. The frozen-thawed semen from the U.S. was administered with two methods: placed in the cervix or surgically in the uterus. The intra-uterine method resulted in a greater conception rate than the cervical method for frozen-thawed semen. Fresh semen resulted in a higher conception rate than frozen-thawed semen.

	Kazakh fresh semen	U.S. Rambouillet and Polypay frozen-thawed semen		
Item	Cervical	Cervical	Intra-uterine	Total
No. of ewes inseminated	205	277	120	602
No. of pregnant ewes that died	14	17	11	42
No. of ewes which aborted	19	14	12	45
No. of ewes which lambed to A.I.	92	53	39	184
No. of pregnant ewes to A.I.	125	84	62	271
Conception to A.I., %	61.0	30.3	51.7	45.0

Table 1: Conception rates of artificially inseminated Kazakh Finewool ewes.

Table 2. Lamb production of Kazakh Finewool ewes inseminated with semen from rams of the Kazakh Finewool, Kazakh Prolific, Rambouillet, and Polypay rams

Breed of Sire	No. of ewes	No.lambs born	Lambs/ Ewe	No. of lambs by Sex		Birth wt., kg mean ± s.d. (range)
				Ram	Ewe	
Kazakh Finewool	49	62	1.27	34	28	2.64 + .092 (1.4 - 4.2)
Kazakh prolific	43	56	1.30	30	26	2.64 + .109 (1.2 - 4.5)
Rambouillet	61	78	1.29	44	34	2.84 + .101 (.9 - 5.0)
Polypay	31	36	1.16	20	16	2.85 + .126 (1.5 - 5.5)

The number of lambs produced from each breed of sire and the average birth weight of the lambs are presented in Table 2. Lamb birth weights are 25 to 30% less than normal, reflecting the poor state of the ewes prior to lambing. Lambs sired by U.S. breeds had birth weights that were approximately .2 kg heavier than the birth weights of lambs sired by Kazakh breed rams suggesting greater growth potential of the U.S.-sired lambs. There were 104 ewe lambs born from the four breeds of sire. If mortality and culling of individuals for defects results in a loss of 20%, there will be 80 to 85 ewe lambs to be retained for a comparison of Kazakh Finewool, Kazakh Prolific, Rambouillet (FecB+), and Polypay breeding for lamb production under Kazakhstan conditions.

The matings will be repeated again in October-November 1998 and, if needed, in 1999. The goal is to have at least 50 ewes in production sired by each of the four breeds of rams.

Improved Lamb Survival

Levels of lamb losses were determined at Aksengerskoe by Dr. E. Gessert in non-research flocks during April 7-14, 1998 and by farm and CSSG research personnel in the research flocks from April 15-May 8, 1998.

When Dr. Gessert arrived at Aksengerskoe, lambing had been in progress for approximately two weeks. Estimates of lamb mortality were 15 to 30% which was higher than normal and attributed to the poor nutritional status of the ewes. Necropsies of dead lambs revealed that the major causes of lamb deaths were navel ill and starvation/ hypothermia. In Dr. Gessert's opinion, incidence of both conditions could be lessened with better feeding of pregnant ewes. The incidence of navel ill could be further reduced through treatment of navels of newborn lambs with 7% tincture of iodine. Iodine is available in Kazakhstan and has been used by the shepherds at Aksengerskoe. However, the cost is 2 to 3 times that in the U.S. and there was none available to the shepherd's for financial reasons.

In the two research flocks used for artificial insemination, 285 ewes lambed and gave birth to 355 lambs from April 15 to May 8, 1998. During the lambing period, 42 lambs died (12%); which is a lower mortality percentage than for the non-research ewes which lambed earlier in the season. As in the non-research

flocks, navel ill was the major cause of lamb death.

• *Excerpts from Dr. Gessert's Report*

Data Collection. The location of the study was the Aksengerskoe Farm outside of the village of Aksenger west of Almaty. The farm has six different flocks of approximately 400 ewes each. They are a mixture of purebred and crossbred animals including Kazakh finewool, Kazakh prolific and native fat tail breeds. The mature body weight of the ewes is approximately 55 kg. The shepherds were asked to collect lambs that had died within the previous 24 hours. Necropsies were performed on the lambs and the following data was collected -lamb ID (from ear tags or paint brands), age at death, body weight, litter size and cause of death. Information on age and body condition of individual dams was not available as the ewes were turned out to pasture during the day.

The shepherds were interviewed to determine estimates of lamb mortality rates as well as their impressions of the causes of lamb loss. The two veterinarians who work on the farm were also interviewed about routine disease preventive practices and nutritional management of the flock. Inspections were made of the pastures, lambing facilities and the livestock. Fecal samples were collected for two flocks for parasite examination.

All agreed that the mortality was much higher than normal this year due to a difficult winter and lack of feed for the ewes. There was more snow cover than usual, the spring grass was three to four weeks late and they had difficulty getting supplemental feed. This resulted in the ewes going into lambing in poor body condition and with reduced milk supply. The average body weight of lambs necropsied was 2.0 kg. with a range of 1.0-2.5 kg, for one to ten day old lambs. As a reference, birth weights in the experimental Merino flock kept at the institute were 3.5-4.5 kg. This flock received adequate supplementation all winter. British studies report optimum birth weights for maximum survival to be from 3.7-5.5 kg. Low lamb birth weights are usually due to inadequate nutrition during late gestation. The body condition scores of ewes due to lamb within the next two weeks were in the range of 1.5-2.5 on a five point scale (0=emaciated, 5=obese). Ideal condition at lambing is 3.0-3.5.

Necropsy Results. Causes of lamb deaths were categorized as stillborn (0), starvation/hypothermia (3), pneumonia (2), trauma (0), omphalophlebitis/navel ill (5), enteritis (1), unknown (1). Diagnoses were based on gross findings and were not confirmed by laboratory analysis.

Disease Prevention Programs. Routine vaccination of the ewes includes entero-toxemia given one month before lambing as well as brucellosis and anthrax annually during the summer. However, due to financial constraints, the flocks were not vaccinated for enterotoxemia this year. Other disease prevention measures include post-shearing

treatment for external parasites and an annual treatment using 1% copper sulfate for internal parasites.

Two state run veterinary pharmacies located in Almaty were visited to determine the availability of livestock health supplies. A wide variety of antibiotics, anthelmentics, external parasiticides and other miscellaneous drugs are stocked. Most are imported. Enterotoxemia vaccine was not available the day we visited but we were assured it could be ordered for delivery the following day. Prices were similar to or less than U. S. prices for commonly used products. The exception to this was 7% iodine which was two to three times more expensive.

Lambing Time Procedures. Ewes close to lambing are kept near the barns and give birth either in nearby pastures, in pens or, during bad weather, in the barn. The lambing season starts during the last week of March and lasts about six weeks. After she lambs, the ewe and her lambs are placed in an individual pen (jug), her udder is checked for milk and the lamb's umbilical cord is dipped in strong iodine. The importance of this practice is widely known but few lambs examined had been treated with iodine. They are kept in for about two days before being turned out with the flock of lactating ewes. If the weather becomes cold and wet during this time, the flock is brought into the barn where the lambs are sorted off into group pens and the ewes turned back out to graze. They are brought back to nurse the lambs in the middle of the day and again at night. If the weather is good the lambs go out with the ewes.

Housing and Facilities. Barns were in use primarily for the storage of grain for the ewes as well as for sheltering the young lambs. Lambing jugs were clean and of adequate size, however, no bedding, feed or water were observed in the jugs or in pens where young lambs (1-2 days old) were kept while the ewes were grazing. Floors were of cement or packed dirt. Ventilation was poor and the air damp on wet days when the doors were kept closed. Pens were of adequate size and the flocks were kept outdoors as much as possible.

Recommendations. Overall knowledge of sheep husbandry is very good. The observation of lamb necropsies by farm personnel served to reinforce the importance of disease prevention practices already recommended. The failure to follow good management practices appears to be due to a lack of necessary supplies rather than lack of knowledge.

In my opinion, the major cause of the high lamb mortality is poor nutrition of the ewes during late gestation. It will be essential to insure that emergency feed supplies are available for use at this time. Making trace mineralized salt available would help prevent mineral deficiencies without requiring the use of mixed concentrates. Locally grown grains could then be used for energy supplementation, minimizing the need for processing. Lucerne could be used as a protein supplement as needed depending on the quality of native grass

hay. Forage analysis is not currently performed and would be necessary for the determination of a balanced ration.

The most commonly observed cause of lamb mortality was omphalophlebitis, a septicemia that develops from the migration of bacteria into the umbilical cord at birth. Prevention of this disease is through adequate colostrum consumption within two hours of birth, excellent sanitation in lambing areas and dipping of the umbilical cord in 7% iodine at birth. As was mentioned earlier in the report, iodine is quite expensive in Kazakhstan and the shepherds had already run out of their supply. Finding an economical and dependable source of iodine will allow them to use it on a regular basis to help prevent this problem.

Good colostral management is essential to the prevention of neonatal lamb loss. Colostrum provides energy to prevent starvation and hypothermia as well as antibodies to protect the lamb from infectious disease. Some of the lambs necropsied had never nursed. In these cases it is important that the shepherd provide colostrum to the lamb within the first two hours of life. Demonstrations of tube feeding were done at each flock location and feeding supplies were left with the shepherds. Recommendations were made to tube feed any weak lambs, those whose dams did not have adequate colostrum, underweight lambs (< 3 kg.) and any from litters with more than two lambs. Cow colostrum can be used if ewe colostrum is not available. The amount given is 20 ml./kg, and should be repeated two hours later if the lamb is not nursing on its own.

Separation of lambs and ewes during the first few days of life may lead to poor maternal bonding and eventual lamb starvation. While this practice is necessary when stored feed supplies are limited, I would prefer to see the ewes with newborn lambs fed and watered in the barn during bad weather. This would require the availability of stored feed at lambing time. Ewes in lambing jugs should have feed and water available at all times and bedding should be used to keep the lambs clean and dry.

Summary of recommendations for reducing lamb mortality:

1. Ensure proper nutrition during the last month of gestation by having emergency feed supplies available.
2. Dip each lamb's umbilicus in iodine at birth to prevent infection
3. Provide colostrum to lambs that are too weak or small to nurse at birth as well as to those in large litters (>2).
4. Provide feed and water ad lib to ewes that have recently lambed.
5. Use bedding in pens to improve sanitation and keep the lambs dry.

Supplies were left with Dr. Nurlan Malmakov to continue monitoring of lamb mortality and for use in the project flock during lambing time.

Forage Availability

Dr. Steven Sharrow, Department of Range Science, Oregon State University, accompanied Dave Thomas in Kazakhstan from Aug. 8-15 to assess forage availability in mountain pastures and on semi-arid and arid range lands. In order for the prolific crossbred ewes to be more productive than Kazakh Finewool ewes, there must be sufficient nutrition available to support their increased production. Increased nutrition is necessary during late pregnancy (winter), lactation, (spring), and for lamb growth (summer). We viewed the mountain pastures the experimental ewes and lambs were grazing and found them to have a large amount of forage of great diversity and of high quality. The excellent appearance of the 1998-born lambs was evidence of the high quality of the pastures. The winter and spring pastures where ewes spend their pregnancy and lactation periods are of lower quality and are the major limitations to sheep production. Strategic supplementation of ewes for one month prior to lambing and for two months after lambing while on the semi-arid and arid winter and spring range will be necessary in most years to realize the full potential of the prolific cross ewes.

• *Excerpts from Dr. Sharrow's Report*

The sheep industry in Kazakhstan is predominately forage based. Sheep spend the winter in the desert steppe where their lambs are born. As snow begins to melt in the late spring, herds of livestock are moved up into the mountains to take advantage of green feed. Livestock follow the progression of vegetation up into the mountains, eventually reaching alpine pastures at elevations above 3000 m. This migratory pattern probably mimics traditional grazing strategies present long prior to Soviet times. Similar patterns were common in the Intermountain West of the United States prior to the Taylor Grazing Act of 1934. The migratory sheep bands in the U.S. were also kept predominately for wool. Many of these bands contained a high proportion of weathers.

The similarity of vegetation within the desert steppes and mountain plant commun-ities of Kazakhstan and the Western U.S. is striking. The structure of the commun-ities is similar and they share a large number of the same plant species. Technology transfer between the two regions should be relatively straight forward. USDA plant breeders have used many plants from Kazakhstan in their search for improved plant species suitable for our cold desert steppe areas in the Intermountain West. Introduced *Agropyron* species such as *A. desertorum, A. cristatum, A. sibericum* (collectively called crested wheatgrass) are widely planted in the western U.S. Other past imports, such as *Kochia prostrata*, have quite a bit of unrealized potential. The importation of sagebrush (Artemisia sp.) which are palatable to livestock could also be very useful to U.S. livestock producers. However; the flow of improved hybrids and exotic

species back to Kazakhstan appears to be relatively small.

Past grazing practices have resulted in some over exploitation of vegetation. This is especially true of the desert winter ranges, which are inherently less resilient than the more mesic summer mountain rangelands. Of Kazakhstan's 125 million hectares of arid and semi-arid rangelands, 60 million are degraded. The mountain meadows which we visited in the Raimbek District also showed signs of past overgrazing. Although livestock numbers in general have declined substantially since 1991, those livestock which remain are concentrated on a smaller resource base. In the case of the flock we visited, the sheep do not reach as high an elevation as was previously the practice, now spending more of the grazing season on lower elevation meadows. Lack of adequate roads and vehicles to service encampments high up in the mountains was given as the reason for the abbreviated grazing zone. Since the collapse of the Soviet Union, lack of adequate maintenance of roads and water developments has restricted the distance livestock can be grazed from the farm headquarters.

Although our project is focused upon sheep production, sheep share forage resources in the mountains with cattle and in the desert winter range with both cattle and camels. Range managers in the U.S. calculate forage demand in animal unit months (AUM). The amount of forage consumed by one cow or 5 sheep in a month is one AUM. Although sheep and cattle numbers have dropped precipitously since 1991, cattle numbers have not dropped as drastically as sheep. Therefore, the total numbers of AUMs have not dropped as much as sheep numbers might suggest. There were approximately 168 million sheep+cattle AUMs in 1991 compared to 96 million AUMs in 1997. When one considers the general tendency of sheep to be herded farther from headquarters than cattle, the potential for overgrazing of easily accessible areas is substantial. So, one might expect that the lower livestock populations will result in distant, less accessible areas, and arid areas without water remaining ungrazed while grazing on accessible areas with water, near to towns and villages, will increase. This will produce a large scale landscape pattern of undergrazed and overgrazed areas.

In the case of small ruminants, such as sheep, the forage issue is often one of quality as much as quantity of forage available. Forage on the summer range in the mountains is generally of high quality. However, desert rangeland in the winter has problems of both quality and quantity of forage available. The main source of forage from fall until spring green-up is dry grass and evergreen shrubs. Unfortunately, this is a time when high nutritional demands of late pregnancy must be met by ewes from a diminished stomach volume because of the abdominal space occupied by a rapidly growing fetus. It is especially important that the forage consumed at this time be high in nutrients and rapidly digestible. Dry

grass meets neither of these criteria, making evergreen shrubs very important dietary components of the winter range. *Agropyron* species green up relatively early in the spring and will regrow if grazed prior to their initiating flowering culms. This so called "two crop" grazing system is used in the U.S. to extend the high quality period of crested wheatgrass stands until late spring.

Suggestions. To a large extent, the rangeland resources being used, the general nature of the livestock industry, and land tenure issues in Kazakhstan today strongly parallel the range-livestock situation in the U.S. Intermountain West prior to the Taylor Glazing Act of 1934. It might prove useful to look at this past experience in considering social, political, and economic implications of the changes underway in Central Asia.

It is generally agreed by herders, livestock breeders, and range/pasture managers in Kazakhstan that the single most limiting forage resource for sheep production is the winter range in desert and semi-desert steppes. The Kazakh Forage Production and Range Institute has done some work on improvement and management of the winter range. They assert that the technology now exists to double the carrying capacity of the desert range by establishing and managing for shrubs such as *Kochia prostrata, Ceratoides lanata,* and palatable *Artemisia* species. However, some of the research plots showed signs of significant soil loss. This work should be built upon by establishing reciprocal trials in Oregon and Kazakhstan of improved varieties of these shrubs together with the importation of additional shrubs such as Atriplex species for evaluation in Kazakhstan. Improved desert grass and shrub varieties, which could prove useful in Central Asia, exist in the U.S. and Canada. Work on management of improved desert and semi-desert grass shrub steppe pastures also needs to be expanded so that production systems can be adjusted to do a better job of protecting the soil from erosion.

Although the mountain summer ranges are currently perceived as being adequate to meet current needs, they are a fundamental part of the forage base and should not be neglected. It is on the mountain range, with its abundant high quality forage, that ewes and lambs gain most of their weight for the year. Relatively little work has been done on the subalpine and alpine zone vegetation since the 1930s. At the very least, a quick survey should be undertaken to ascertain their current condition and apparent trend to see if problems are apparent. Overgrazing not only reduces forage quantity, but reduces forage diversity, interfering with the ability of sheep to choose a highly nutritious diet and increasing the possibility of them eating poisonous plants such as *Hypericum perforatum*. Some evidence of photosensitization, probably from consumption of *Hypericum perforatum*, was evident in the flock of sheep grazing in the mountains in the Raimbek District.

A broader geographic and historic overview of Kazakh pasture resources is provided in the paper prepared for this project this year by Leonid Serebryanny and Igo Zamotaev, "The Pastures of Kazakhkstan: Natural Background, History, and Present State." The paper draws on their own earlier work and the literature to provide a valuable context for more detailed field work.

Semen Diluents

A study was conducted at CSSG to evaluate the effect of adding amino acids to a standard diluent on motility of frozen thawed sperm. The four amino acids added were arginine, betaine, glutamine, and proline. Each amino acid was found to improve the motility of frozen-thawed semen. Work will continue to determine optimum amount of amino acid to be added to the diluent, promising diluents may be used in an A.I. trial to determine conception rates.

Gender

Three of our regional collaborators are women, the two who lead the northern Kazakhstan survey team and the regional coordinator. The veterinarian who did the lamb mortality study and conducted related training is a woman. The two survey researchers participate in all the short-term training that the male survey researchers do.

The three UW-funded research assistantships were advertised widely on campus and the three best candidates were awarded the positions. They are all male. One female applied and seemed a strong candidate, but she subsequently received another offer that she found more attractive.

With regard to female producers: 26 of the 114 producer-respondents in the southern Kazakhstan survey were women, 3 of 91 in northern Kazakhstan, 6 of 72 in the Uzbekistan survey, and 4 of 60 in the Kyrgyzstan survey. This a region where female-headed households are not common and where the pattern of male migration to cities has not yet become a widespread phenomenon. One section of the questionnaire deals specifically with male/female decision-making responsibilities.

Policy

Although new forms of agricultural organization in the region are still a matter of ongoing debate and experimentation, most of the decisions on the livestock sector are top down. Not infrequently such decisions are inspired by political considerations more than by sound economic considerations. Besides, we have discovered a discrepancy between decisions made on governmental levels and their implementation by local administrators and managers. Under the situation, various governmental bodies have incomplete and insufficient information of the problems, attitudes and initiatives of immediate producers. However, the continuing deterioration of the livestock sector pushes, at least, some policy-

makers to indicate an interest in our data and recommendations, inasmuch as our field surveys seek to identify viable new forms of agricultural organizations as well as policies and practices that put constraints on their development.

In planning the research, we consulted with the ministries of agriculture in Kazakhstan, Kyrgyzstan, and Uzbekistan. In Kazakhstan, the Minister of Science has taken a special interest in our research.

We are holding a conference in Almaty, Kazakhstan on January 9-10, 1999, to present results from our research and from work by others on related topics. Kazakh policy makers have been invited to the conference. In addition, depending on who can and cannot come to the conference, we may hold individual meetings with policy makers in the new capitol, Astana, after the conference.

Outreach

The outreach target for part of our project is the group of relevant policy makers in each country, as discussed above. In addition, the sheep reproductive efficiency research is aimed at producers. Our collaborating institution, the Kazakh Center for Sheep Selection and Genetics, has well established mechanisms for distributing improved animals throughout the country.

The experimental work is conducted on the cooperative farm Aksengerskoe and favorable results from the study will be incorporated into their sheep management system. If any of the crosses prove successful at Aksengerskoe, breeding stock will be offered to other private and cooperative farms. In addition as we focus our socioeconomic research on a subgroup of farms selected for in-depth study, those farms may also be appropriate sites for on-farm trials.

Developmental Impact

As discussed above, the project attempts to improve understanding of emerging forms of farm organization with the intent to identify factors that promote changes that are favorable to evolution of a livestock sector that contributes to economic development and democracy.

This project also attempts to increase lamb production so Kazakhstan can increase its sheep numbers and increase its lamb meat production at the same time. A flock of prolific sheep requires fewer number of ewes to produce a given amount of lamb meat compared to a flock of less prolific sheep. This reduces forage needs and results in less overgrazing and less degradation of range lands.

Results of this experiment have direct application in the U.S. Much of the sheep industry of the western and southwestern states of the U.S. is based on the production of finewool sheep. Due to low world wool prices and loss of a government subsidy program on

wool in 1995, wool sheep production is unprofitable, and U.S. sheep numbers are falling. U.S. sheep producers in the western range states need to switch their emphasis from wool to lamb production.

Other Contributions

The focus on the organization of livestock farming bears directly on free markets, broad-based economic growth, concern for individuals, and support for democracy. The so-called "nomenclatura privatization" in which the former communist elite grab productive state assets for their private gain is prevalent in agriculture as it is in industry and banking. In many cases this may condemn former kolkhoz and sovkhoz members to lives as poor, landless laborers. To the extent that we can identify mechanisms to help large numbers of families become successful private farmers, the project will contribute to the aforementioned worthy goals.

Leveraged Funds and Linked Projects

The University of Wisconsin contributions nearly doubled the size of the project grant by contributing over $303,000 through matching, leveraged and other UW contributions. The major portions of the contribution were in the form of faculty and staff time devoted to the project. This time was valued at $202,770, of which $114,034 was in addition to the required 25% match. In addition, the Graduate School and the College of Agriculture contributed three half-time Research Assistants (valued at $81,564); the College of Letters and Science contributed $6,250 in travel funds; and the Babcock Institute for International Dairy Research contributed the equivalent of $12,500 in administrative and training support services.

In another related activity, Russell Zanca received a National Council for Eurasian and East European Research grant to produce a study entitled "Uzbeks into Peasants: A Managed Transition Toward A Controlled Market." The $40,000 grant will allow Zanca to build upon his earlier work in Uzbekistan and the research he completed under this project during July and August. Anatoly Khazanov is serving as Zanca's post doctoral advisor and will assist with synthesizing the Uzbekistan findings into the overall project report.

We have maintained communication with ISNAR as they develop their strategy for involvement in Central Asia. Our experience with the Kazakh Center for Sheep Selection and Genetics would be a useful case study for their work. We are also in close communication with the BASIS CRSP as they develop their plans for the region. We have invited a BASIS representative to attend our Almaty conference, and they have indicated that they will use their own funds to do this. Finally, as the UC-Davis project and the UW-Madison project publish the results of their first year's work, the areas of synergy will become more apparent.

Training

Nurlan Malmakov received training at the University of Wisconsin-Madison in transcervical and intrauterine artificial insemination of sheep from Jan. 4-16, 1998.

Dr. Mary Gessert trained veterinary staff from the Aksengerskoe cooperative farm and from the Kazakh Scientific Research Technological Institute of Sheep Breeding in lamb necropsy techniques, and management of preparturient ewes and newborn lambs in Kazakhstan for a week in April 1998.

Our socioeconomic regional collaborators are accomplished senior scholars. However, they have had limited exposure to western research methods. Thus there is an element of ongoing training as we work closely with them on design of the questionnaire and analysis of the data.

Collaborating Personnel

Central Asia

M. Abuseitova, Director, Institute of Oriental Studies, National Academy of Sciences, Kazkahstan, local coordinator for all operations

K. Medeubekov, Kazakh Scientific Research Technological Institute of Sheep Breeding, lead investigator in sheep breeding component

N. Malmakov, Kazakh Scientific Research Technological Institute of Sheep Breeding, co-investigator in sheep breeding component

K. Kasymov, Kazakh Scientific Research Technological Institute of Sheep Breeding, co-investigator in sheep breeding component

N. Masanov, Institute of Oriental Studies, National Academy of Sciences, Kazkahstan, drafted original core questionnaire for all surveys, drafted revisions for second year, drafted structure for in-depth study of successful farmers, leader of the southern Kazakh survey team

A. Kalyshev, Kazakhstan State University, co-investigator with Masanov in southern Kazakhstan.

S. Sagnayeva, Western Kazakhstan University of the Humanities, co-leader of the northern Kazakhstan survey team

K. Kokombaev, Bishkek (Kyrgyzstan) Humanities Institute, member of the Kyrgyz survey team

A. Zhaparov, Department of Ethnography at the Kyrgyzstan Institute of History, member of the Kyrgyz survey team

S. Berdikulov, Department of Sociology and Political Sciences , Oshkii (Kyrgyzstan) State University, member of the Kyrgyz survey team

E. Suleimanov, Department of Kyrgyz History, Oshkii (Kyrgyzstan) State

University, member of the Kyrgyz survey team

N. Babakulov, Samarkand (Uzbekistan) Karakul Sheep Institute, member of the Uzbek survey team (leader was a US postdoc with experience in Uzbekistan)

I. Alimaev, Deputy Director, Kazakh Scientific Research Institute of Fodder Production and Pastures, has written two commissioned papers for us, has provided consultation on rangelands in different ecological zones

Z. Zhambakin, General Director, KazAgro Co-op (Kazakhstan), Institute of Economics and Organization of the Agro-Industrial Complex, has written two commissioned papers, has provided consultation on the privatization process in agriculture, is reviewing reports by survey teams, is scheduled to come to UW this spring.

Russia

O. Naumova, Institute of Ethnology and Anthropology, Russian Academy of Sciences, co-leader of the northern Kazakhstan survey team

S. Kliashtorny, Institute of Oriental Studies, Russian Academy of Sciences, leader of the Kyrgyz survey team

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Yves M. Berger, Spooner Agricultural Research Station, University of Wisconsin-Madison.

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Anatoly Khazanov, Department of Anthropology, University of Wisconsin-Madison.

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Kenneth H. Shapiro, Associate Dean, International Agricultural Programs, University of Wisconsin-Madison.

Steven Sharrow, Oregon State University, Dept. of Rangeland Resources.

David L. Thomas, Department of Animal Sciences, University of Wisconsin-Madison

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PUBLICATIONS

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Khazanov, Anatoly, Vitali Naumkin, and Kenneth Shapiro (editors). 1997. Pastoralism in Central Asia. Moscow: Russian Center for Strategic Research and International Studies.

Livestock Development and Rangeland Conservation Tools for Central Asia

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Narrative Summary

Political and economic changes in Central Asia resulted in an apparent decline of livestock production, rangeland health and rural family welfare. This project's goal is to improve the welfare of herders, and promote livestock development while enhancing sustainability and conservation of rangeland resources. Rural surveys will identify production-limiting factors and will establish the relation between enterprise characteristics and human nutritional and economic welfare. Technologies to address these limitations will be tested on-farm and evaluated in terms of impacts on human welfare, sustainability, global carbon budget and potential for adoption. Characterization and modeling of policy and ecological scenarios will allow identification of policy instruments that will promote our goal.

The project, which focuses on Kazakstan, Uzbekistan and Turkmenistan, was organized in a series of modules. Each module has a leader and produces results that stand alone, whereas the integration of these results will lead to recommendations both at the policy and farm level. The Basic Resources module generates a GIS for integration, modeling, and extrapolation of information. The Forage Production and Carbon Dioxide module studies the role of rangelands on the global C budget, and will produce empirical coefficients to model rangeland forage production under risk. The Animal Production and Technological Alternatives modules will model and test existing and new options for sustainable livestock production. A Human Nutrition component will establish the relation between livestock production system, diet and health. Finally, the Socio-Economic module conceptually integrates all information to model potential impacts of different policies.

During 1997-98 we focused on deployment of research capacity, completion of the GIS for Kazakstan, measurement of CO_2 fluxes in three ecological zones, and rural surveys in Kazakstan. Deployment of research capacity involved the shipping and installation of voluminous field equipment, and training of regional scientists. The basic GIS for Kazakstan

has been completed, including a detailed map of rangeland and the corresponding database. The research capacity and the GIS created by our project were used to prepare maps for and support the National Environmental Action Plan of Kazakstan. Forage productivity, weather and CO_2 flux data for the current growing season were collected successfully at Karrykul in Turkmenistan, Shortandi in Kazakstan, and Karnab in Uzbekistan. A formal survey of rural households and agricultural enterprises was designed, pretested, and conducted in Kazakstan. Besides serving as a baseline to assess future impacts and providing the data for model development, surveys are the basis for two MS thesis and a Ph.D. dissertation, and directly reached 270 rural households in three ecological regions of Kazakstan. In preparation to produce longer-term policy impacts, our team incorporated representatives appointed by the Ministry of Ecology of Kazakstan, Ministry of Nature Use and Environmental Protection of Turkmenistan, and the Association of Livestock Breeding of Turkmenistan. Appointments by the Ministry of Agriculture and the Agency for Central Planning and Reform of Kazakstan are pending.

In the next two years we plan to extend the survey and GIS work to Turkmenistan and Uzbekistan. Concurrently, GIS modeling and on-farm experimentation will start in Kazakstan. Reviews of agricultural policies and technologies will be conducted in all three countries.

RESEARCH

Problem Statement

Recent market changes and privatization caused imbalances and dramatic reductions of agricultural stocks, production and productivity in some 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 affordable, good quality winter forages, temporary collapse of marketing networks, and poor maintenance of livestock water wells appear to have resulted in greater pressure on range plants used for feed and fuel, and greater concentration of livestock around populated areas and active wells. In spite of declining livestock numbers in Kazakstan, rangeland degradation is reportedly accelerating in some areas, whereas remote areas are no longer grazed. 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 land owners, and to prevent further deterioration of rangelands.

Approach

We take an integrated multidisciplinary approach to improve the welfare of herders that involves not only on-farm testing 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. Connections among research and development modules on basic resources, rangeland forages, animal production, technological alternatives, socio-economic integration and policy, and human nutrition, are depicted in Figure 1.

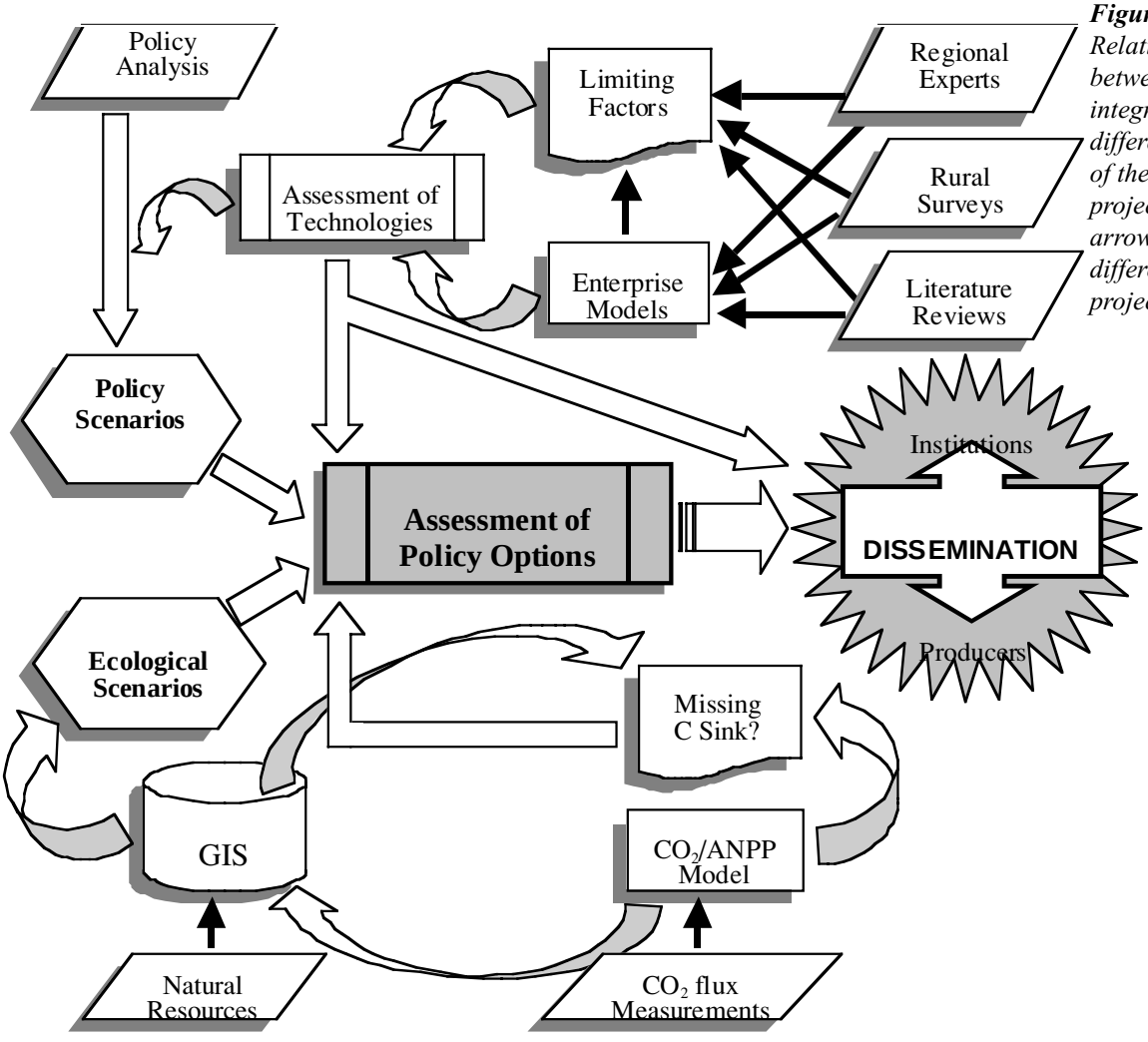


Figure 1. *Relationships between and integration of the different components of the LDRCT project. Different arrows indicate different stages of the project.*

First Year Activities

Main activities proposed for the first year (1997-98) were classified into four categories: deployment of research capacity, completion of GIS for Kazakstan, measurement of carbon dioxide flux in rangelands, and rural surveys of human welfare and production systems in small private farms. As detailed in the following sections of this report, all of these activities were performed with a high level of success.

- Installation of research capacity involved the selection of two new research sites (one in Kazakstan and one in Turkmenistan), in addition to the first one established in the Karnab district of Uzbekistan by ICARDA and ARS-USDA, purchase, shipping and installation of Bowen-ratio equipment and computers in the two sites, and hiring and training of scientist and personnel who will maintain equipment and operate the CO_2 measurements. In addition, the Animal Husbandry Institute of Turkmenistan and the University of Samarkand will be equipped with GIS computers and software, and will be linked to the internet.
- Completion of the GIS for Kazakstan that was started during the assessment year included proofing the layers, translation of the database to English, and preliminary documentation of forage production.
- CO_2 flux data were collected and summarized for the 1998 growing season in Kazakstan, Turkmenistan and Uzbekistan. Data are being used to parameterize empirical range productivity models in conjunction with the GIS.
- A formal rural survey was conducted in Kazakstan. Ninety households were interviewed in each of three regions. Data was collected to describe main features of production systems, including quantification of land, labor and capital. Nutrition and health of humans was assessed in relation to diet quality and quantity. Data was analyzed to determine the link between human nutrition and livestock systems.

Deployment of Research Capacity

Basic Resources and GIS (BR)

A plan of action was developed with the Institute of Desert, Flora and Fauna of Turkmenistan for the development of a GIS for this country. Trained personnel were identified, and a GIS computer system was purchased for this work.

Range Forage Capacity and CO_2 (RF)

Lead investigators from the U.S. traveled to Central Asia during 1997 and 1998 to identify cooperating scientists and evaluate possible research sites. Research sites were established in Uzbekistan (Karnab Site, Dr. Mukhtar Nasyrov), Turkmenistan (Karrykul Site, Drs. Dourikov and Gedemov), and Kazakstan (Shortandy Site, Dr. Kanat Akshalov). Bowen ratio equipment and computers were ordered, cleared through

customs, and delivered to the lead institutions in each of the three countries. Dr. Nasyrov was brought to the U.S. for a two-month training period to become familiar with the Bowen ratio equipment and data processing techniques. Dr. Saliendra traveled to Uzbekistan to install the Bowen ratio equipment at the Karrykul site on 4 March 1998. Drs. Saliendra and Nasyrov subsequently traveled to Shortandy, Kazakstan and Karrykul, Turkmenistan to install the Bowen ratio equipment on 16 May and 26 May 1998, respectively. While in Kazakstan and Turkmenistan, Drs. Saliendra and Nasyrov also provided on-site training in the operation, maintenance, and trouble-shooting of the Bowen ratio equipment and in processing the Bowen ratio data. Work proceeded as planned with no modifications.

Animal Production and Technological Alternatives (AP&TA)

Specific objectives and plans of action have been developed with the Turkmenmallary Association of Livestock Producers of Turkmenistan (former Institute of Animal Husbandry), and the Institute of Pasture and Fodder of Kazakstan. Drs. O. Hodjakov and O. Soyunova are currently preparing the following products: (1) a compilation of agricultural statistics at the raion (district) level for the years 1975-1996, including the following information for each year: numbers of livestock separated by kind; raion name and area; production of livestock in terms of wool, meat, milk, etc.; rainfall; area of land cultivated for grains and forages; incidence of livestock diseases; amount of conserved forages received from other raions; (2) a compilation of agricultural laws and decrees that regulate production of livestock, land tenure and availability of agricultural inputs in Turkmenistan; (3) a description of livestock production systems in Turkmenistan, including a literature review enhanced by opinions of experts, bibliography, descriptions of the current management schemes, grazing methods, types of production (wool, meat, etc.), and annual schedules of livestock management. A computer has been purchased to be used by Drs. Hodjakov and Soyunova for preparing the database that will serve as basis for the reports. A comparable report on forage resources and animal production systems of Kazakstan is being commissioned through ICARDA. A computer system has been purchased for the Institute of Pasture and Fodder of Kazakstan to prepare the necessary database of references and statistics.

GIS for Kazakstan

A computerized geographic information system (GIS) was prepared for Kazakstan in a joint effort by the Institute of Ecology and Sustainable Development (IESD), Kazakstan and the Department of Agronomy and Range Science, University of California at Davis. The GIS consists of a spatial database which currently contains the following information:

Rangeland classification by soil type, vegetation type and productivity

- Elevation
- Precipitation
- Temperature (seasonal maximum and minimum)
- Population of humans and animals
- Location of roads, railways, streams, lakes, cities and oblast boundaries

Information which will be added to the database in the immediate future include the following:

- Solar radiation.
- District (raions) boundaries and location of pertinent villages.
- Remotely sensed data (e.g. NDVI images).

The database currently is in both IDRISI and ArcView formats and can be readily exported into other GIS formats as needed (Figure 2).

Rangeland information was obtained from a map compiled in 1978 by the Complex Prospecting Department of the Institute of Kazgiprozen of the Ministry of Agriculture (within former USSR). This map covered the entire country of Kazakstan at a scale of 1:1,500,000 and was in turn created from several previous mapping sources including materials from Moscow State University. The map was digitized by IESD and is now in digital format. This information will be

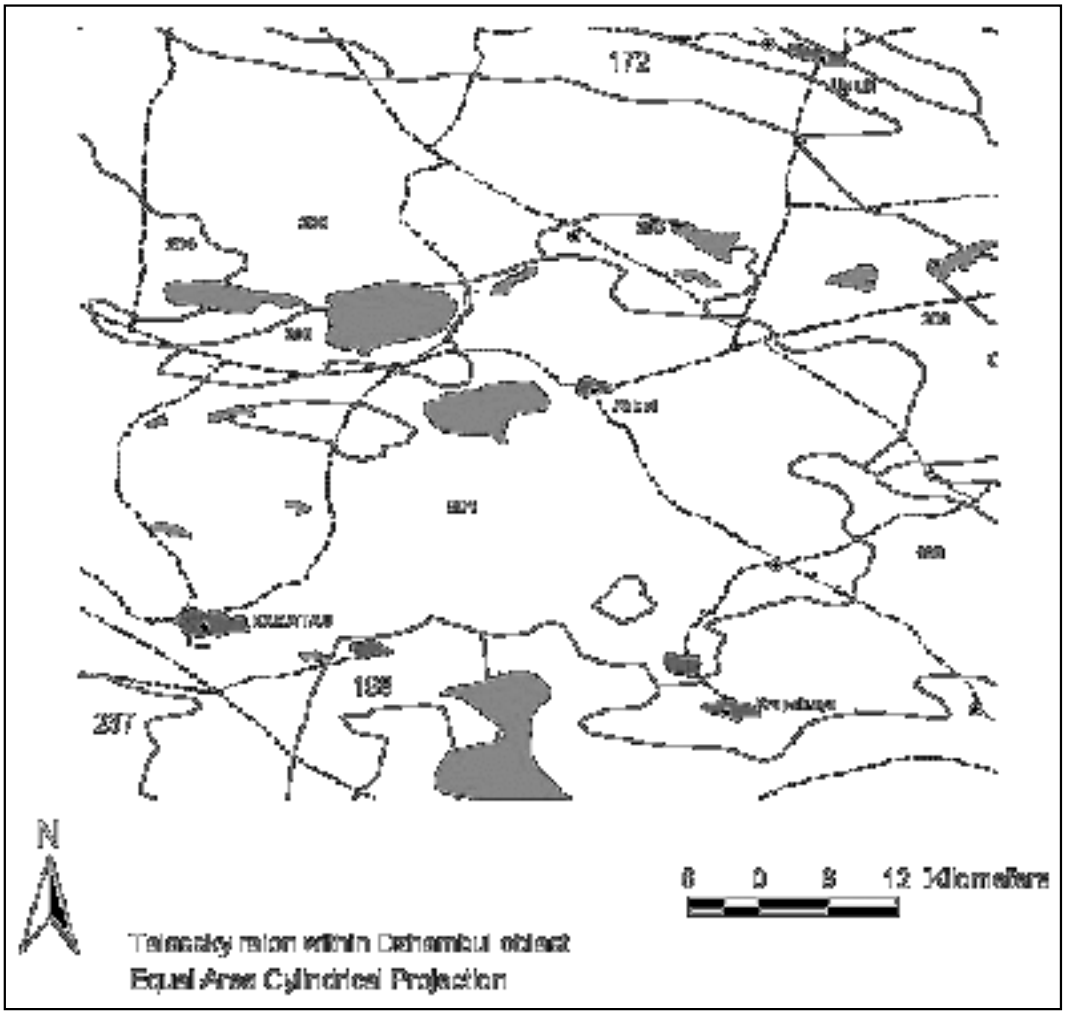


Figure 2: Example of information contained in the GIS. Numbers refer to rangeland types and link each polygon with a database containing detailed descriptions of species, productivity, seasonality, temperatures, rainfall, etc.

updated as needed to reflect current rangeland status.

Elevation information currently in the database was obtained from the Digital Chart of the World (DCW), created in 1992 by Environmental Systems and Research Institute, Inc. The primary source for the information is the Operational Navigation Chart series produced by the former United States Defense Mapping Agency. The DCW is in a 1:1,000,000 scale and has elevation contours at 1,000 feet intervals. In addition, there are paper maps that have contours at 20 and 50-meter intervals that can be digitized and added to the database at a later date if deemed necessary. IESD staff prepared the precipitation and temperature layers. Human and animal population was compiled by IESD staff and is currently organized by oblast. This information is based on statistics published in 1996.

Supplemental information including roads, railways, streams, lakes, city locations and oblast boundaries was compiled both by IESD staff from Russian maps and by UCD from the DCW and Russian maps. This information needs to be reconciled and the information which most accurately represents the current status within Kazakstan will be maintained in the computerized database.

The database is currently being cross checked to verify the accuracy of the information. Sources used within the database exist at several different scales and projection systems. The data will eventually be converted to and stored as latitude/longitude coordinates within the World Geodetic System 1984 (WGS84) which is the current global standard. The information can then be projected at whichever system is best suited to the user.

Once the database is satisfactorily georeferenced, users will be able to select a point anywhere within the borders of Kazakstan, and the computer will then report the rangeland information, temperature, mean annual precipitation, etc., for that location. The layers can also be used in predictive modeling since each informational layer can be treated as a variable in a model equation.

Carbon Dioxide Fluxes on Rangelands in Central Asia

Rangelands provide the main source of forage and pasture that feed livestock in Central Asia. Accurate estimates of annual net primary production (ANPP) from these rangelands will provide important information on carrying capacity to sustain livestock production. The main objective of the RF subproject is to quantify ANPP on representative Central Asian rangelands. A secondary objective of the RF subproject is to assess the role of Central Asian rangelands in the global carbon budget. Three study sites were identified for continuous monitoring of CO_2 fluxes using the Bowen ratio technique. In October 1997, an Artemisia diffusa-dominated rangeland site was selected in Karnab, Uzbekistan; in March 1998,

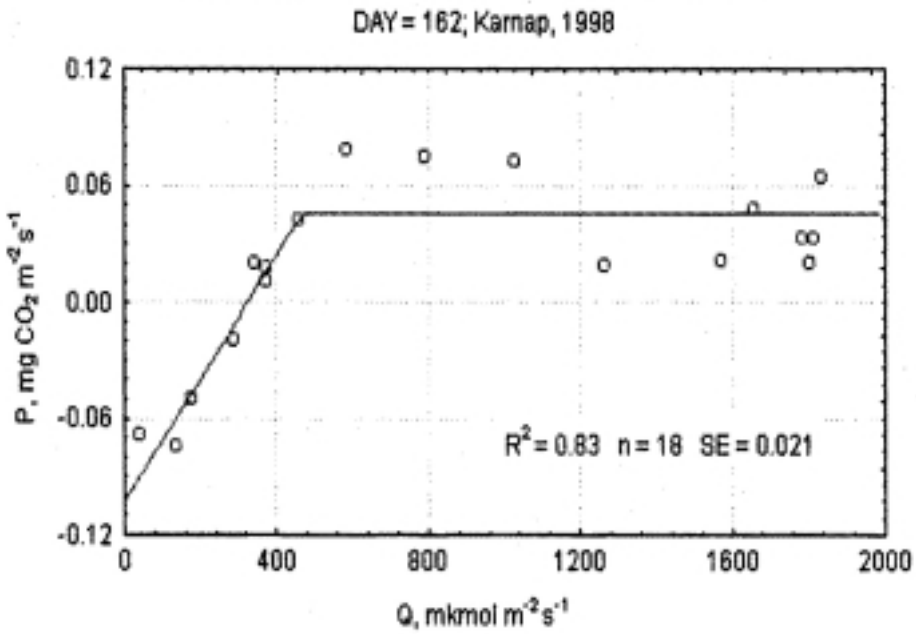
two additional sites were identified in Kazakstan and Turkmenistan. A rangeland site dominated by Stipa capillata was chosen at Shortandy, Kazakstan; this site is part of a 200-ha plot that was protected from wheat cultivation. Similarly, a site representative of sandy desert rangelands was selected on a former USSR agro-ecological research station at Karrykul, Turkmenistan. Drs. Nasyrov (Uzbekistan), Akshalov (Kazakstan), and Dourikov (Turkmenistan) were identified as primary scientific collaborators for the RF subproject.

During February-March 1998, Dr. Saliendra traveled to Uzbekistan to provide technical expertise in the installation, downloading and processing of data, maintenance, and trouble-shooting of the Bowen ratio systems. Drs. Gintzburger and Nasyrov plus technical staff of the Karakul Sheep Research Institute at Samarkand installed the Bowen ratio system at the Karnab site on 4 March 1998. During May-June 1998, Drs. Nasyrov and Saliendra installed Bowen ratio equipment at the sites in Shortandy, Kazakstan and Karrykul, Turkmenistan. They also provided on-site technical support training to cooperating scientists in both Kazakstan and Turkmenistan. During his May-June visit, Dr. Saliendra brought three laptop personal computers for use at each of the CO_2 flux sites; E-mail communications were also established at that time. Data collected with the Bowen ratio system (averaged at 20-minute intervals) include vertical gradients (1 m apart) in temperature, CO_2, and water vapor concentration; ambient relative humidity and temperature; wind speed and direction; net radiation; photosynthetically active radiation; volumetric soil moisture content; soil temperature; soil heat flux; and precipitation. Since installing the three Bowen ratio systems, data have been electronically transferred weekly from each of the three monitoring sites to the USDA-ARS Forage and Range Research Laboratory at Logan, Utah. Weekly Bowen ratio data are routinely evaluated, and collaborators in host countries are immediately advised of any technical problems with the Bowen ratio equipment. These data are processed into five-day periods, and CO_2 fluxes are calculated with a spreadsheet for each 20- minute average, which are subsequently used to obtain daily integrals of CO_2 flux. Monthly Bowen ratio and CO_2 flux data are electronically sent to Dr. Gilmanov at South Dakota State University who develops CO_2 flux models for each site.

Since installation of the Bowen ratio equipment, a wide range of field data have been collected continuously at 20-minute intervals at the three field measurement sites in Central Asia. These data are being routinely transferred electronically to Logan, Utah, where they are processed into five-day segments. Data are evaluated for reliability, and any equipment malfunctions are identified and collaborating scientists notified. The segmented data sets are subsequently used to calculate daily integrals of CO_2 flux. These data are electronically sent

to Dr. Gilmanov at South Dakota State University who evaluates the relationships between environmental characteristics and rates of CO_2 flux (Figure 3). These relationships will be used to develop predictive models of CO_2 flux for each site. Work proceeded as planned with no modifications.

Daytime CO_2 flux in relation to photosynthetically active radiation



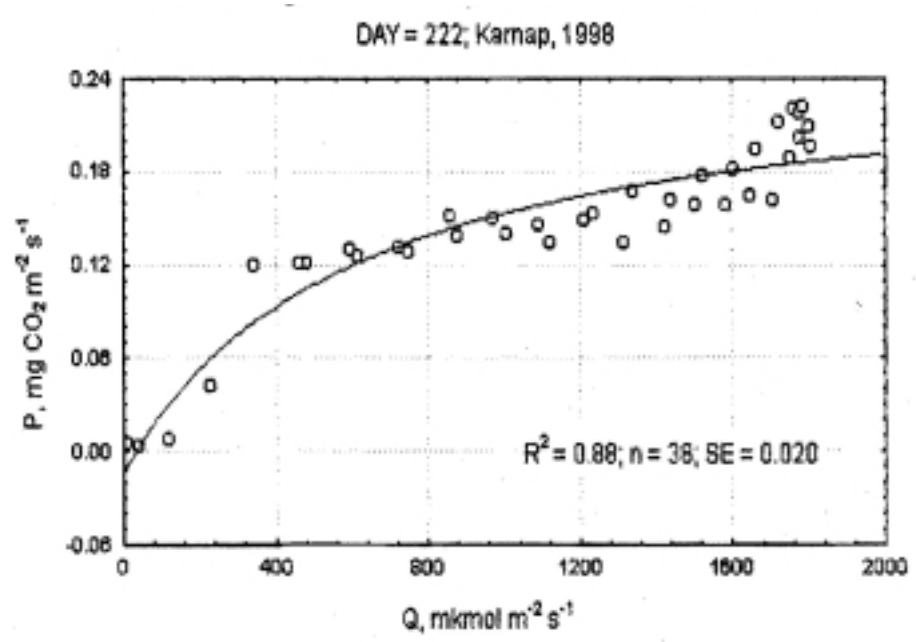


Figure 3: Relationships between net CO_2 fluxes and environmental conditions at the foothills rangeland site.

Rural Surveys in Kazakstan

Surveys of human nutrition and food security (HN surveys), household livestock production systems (AP surveys), and livestock marketing (LM surveys), took place during July-September 1998. Human nutrition, food security and production systems were surveyed concurrently in three large-scale ecological regions along a transect from Akmola to Almaty. Thus, the HN and AP surveys followed a single sampling plan, and data for both surveys was obtained from each of the 270 households reached. The study of livestock marketing was conducted by Dr. C. Kerven along a transect in western Almaty Oblast. Most of the data collected are still being organized and analyzed. We presently report on activities that led to the successful conduction of surveys, methods used, and preliminary results.

Human Nutrition and Livestock Systems

Several team members were directly involved in the planning and conduction of the HN and AP surveys in Kazakstan. Planning meetings took place in UC Davis during the Fall of 1997 and Winter of 1998, with the participation of Jarvis, Howitt, Grivetti, Plant, Breuer, Carpenter, Laca, and Jose Bervejillo. Carpenter, Breuer and Bervejillo drafted survey forms on the basis of examples and suggestions from the other team members, including Tom Nordblom, from ICARDA. Drafts were reviewed and improved over three iterations. An almost final draft was distributed to collaborators during the annual meeting at Ashgabat in March 1998. Comments from Z. Zhambakin, I. Alimaiev and other team members were incorporated. During his trip to the region in March 1998, E. Laca and other team members visited former state farms, collectives, and herders, to conduct informal interviews. These interviews were used as a basis to determine what information was available and how the survey forms should be revised further. M. Carpenter and A. Breuer went to Almaty in May and June to establish the organizational infrastructure for the surveys. Drs. A. Aw-Hassan and E. Thomson joined the survey efforts in mid July, and participated in the training of survey team members, pre-testing of procedures, and sampling design. Survey forms were translated to Russian and were further improved on the basis of pre-testing results. Drs. S. Beniwal and M. Suleimenov provided technical and logistical support throughout the survey period.

Surveys to examine household food security were conducted in 270 households along a wide, 500-mile long transect covering three ecological regions, dry steppe in the north, semi-desert in the central region, and foothills in the south (Figure 4). In the central region, the survey took place in three districts (raions) of Karaganda Oblast (Shetsky, Zhanaarkinsky, and Aktogaysky). In the south, the survey included four districts covering two oblasts: Almaty Oblast (Djambul rayon) and Djambul Oblast (Sariysusky,

Figure 4: Oblasts and rayons of Kazakhstan included in the rural survey of human nutrition and livestock systems. S, D, and F indicate dry steppe (S), semi-desert (D) and foothill (F) areas surveyed.

Sverdlovsky and Talassky rayons). These sites were selected because they represent three major ecological zones where livestock production is of major importance. The unit of sampling was the household. Peasant farmers were the focus of the survey for two reasons. First, according to reports of local experts, they hold about 80% of the livestock in the country. Second, they have a clearer legal framework and simpler ownership structure than the different forms of co-operatives, which are quite complex and are in a state of transition.

Ninety households were selected randomly in each region. Randomization took place at the district level for selection of villages and at the village level for selection of households. Villages with more than 0.06 sheep units/ha and less than 2000 people were eligible for inclusion in the survey (sheep units refers to any combination of livestock that amounts to a sheep equivalent). Within a village, households had to have more than ten sheep units in order to be included in the survey. Four to six households were surveyed per village, and 15 villages were sampled in each region.

Two complete survey forms were filled out for each household, one focusing on human nutrition, and one focusing on the household as an economic and production unit. Data to assess nutritional status and food security of each household was collected through questionnaires about basic demography,

socio-economic status, seasonal food frequency, weaning foods, and home food production and purchases. Hemoglobin levels of women (15-49 years of age) and children (1-7 years) were assessed using a Hemocue and standard finger prick to determine the prevalence of anemia (Hg<120g/L). Height and weight of women and children were measured using a UNICEF mother-child digital scale and standard height board to determine the prevalence of undernutrition, stunting and wasting. Body mass indexes for the women and Z-scores for the children were calculated.

Forms for collecting data on AP included the following sections: (1) labour resources, (2) land and infrastructure, (3) water, (4) agricultural equipment, (5) use of pastures and hay fields, (6) livestock numbers, breeds, health, management calendar, sources and purposes, and marketing (all by species), (7) crop and forage production and transactions. A grazing section in the survey included an assessment of seasonal grazing techniques and requested that villagers describe changes observed in their pastures over time. Coordinates of each household surveyed were determined with hand-held GPS. Thus, village-level evaluations can be matched with information from the GIS, and a comparison of local perspectives and requirements with data on range carrying capacity will be possible. In addition to the survey data, 12 vegetation transects were examined in five villages located within the foothills of the Dzhambul Oblast. In three villages, three 500-m long transects were surveyed. The transects were located 0.8-1.5, 3-5, and 6-7 km from the edge of each village, along the main grazing routes in use. These distances were selected to assess the impacts of heavy to light use in areas grazed continuously. In the remaining two villages, transects near the villages were evaluated, other transects could not be measured due to the proximity of surrounding villages. Soil condition, and species frequency, height, and % cover were recorded along each transect. These data will allow a quantitative assessment of rangeland condition as a function of distance from village and village characteristics. Preliminary results are reported below.

Preliminary results of human nutrition and livestock surveys

Health Indicators

Overall prevalence of anemia among women was 38% (n=239). Prevalence of mild (10-11.9 g hemoglobin/dl), moderate (7-9.9 g hemoglobin/dl), and severe anemia was 28.0, 9.2 and 0.8%.

The prevalence of anemia among children was 47% and there were no significant regional differences (Figure 5). Prevalence of anemia in mothers and prevalence of anemia in children were not related (P>0.20). Whereas our sample detected less than 1% severe anemia in children, mild anemia was found in 32% and moderate anemia in 15% of children.

Body mass indexes (BMI) were

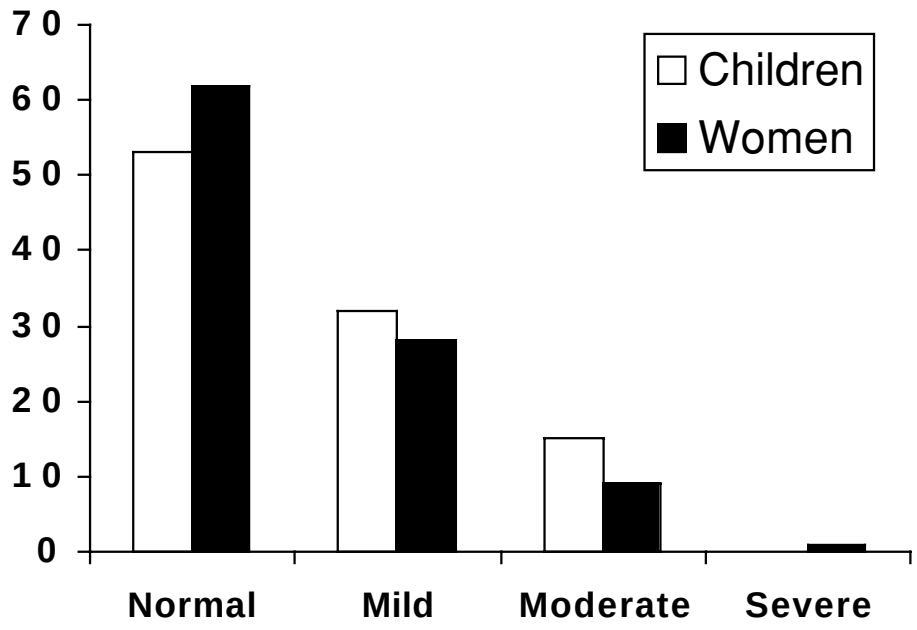


Figure 5: Prevalence of different degrees of anemia in rural children and women of Kazakstan.

calculated by dividing weight (kg) by height squared (m^2). The BMI for women did not differ between regions. Average BMI was 24.2 kg/m^2; 6.2% of women were underweight and 36% were overweight. In contrast, Hill and Ismail (1994) found that only 5.7% of the women were obese and 11.8% were moderately or severely malnourished.

Growth of children was assessed by calculating height for age z-scores. We found that 12% of the children were stunted (z-score< median-2 s.d.), and 5.2% were severely stunted (z-score< median-3 s.d.).

Current nutritional status of children was determined by calculating weight for height z-scores. Approximately 1.4% of our sample population were found to be wasted and 1% exhibited severe wasting. Three percent of children were moderately underweight.

Weight for age z-scores were calculated to indicate the overall nutritional health of the children. We found 7.6% to be moderately underweight, and 1% to be severely underweight for age relative to the reference population.

Overall, our preliminary results indicate that nutritional health of rural women and children in the Central and Southern regions of Kazakstan compare favorably with previous reports. This was unexpected, and it may be due to differences in the populations sampled or actual changes in the overall population. This question will be addressed by the full analysis of our complete data set.

Livestock and Land

Information on the number of household livestock (camels, cows, horses, sheep, goats, pigs, rabbits, and poultry) was collected along with information about

the fate of the products from these animals (milk, meat/eggs, wool/skin/feathers). Southern and Central households did not differ in total number of livestock (P>0.20, X=8±5.4 animal-unit equivalents per household), but small livestock (sheep, goats, pigs, rabbits and poultry) were more abundant in the Southern region.

Access to garden, orchard plots, and other agricultural land was examined. Seventeen percent of the households had no land; 44% had only gardens; 15% had a garden, orchard and fields; 7.8% had a garden and an orchard; and 15% had a garden and a field. There were significant differences in access to agricultural land between the two regions (P<0.001, Table 1). The Central region was characterized by having access to crop fields or vegetable gardens, whereas the Southern region was characterized by access to orchards or garden plots. Furthermore, all households without any type of land were located in the Central region.

Table 1: Access to agricultural land by households in Central and Southern Kazakstan.

LAND ACCESS	REGION	
	Central	**Southern**
None	22.2	0.0
Field and/or garden	75.6	11.1
Orchard and garden	2.2	88.9

Table entries are percentage of all households in each region. Sample size was 90 and 27 for the Central and Southern regions (χ^2=87, df=113, P<0.001).

Households in both regions reported selling meat, and no differences were detected in the amount of meat from large ruminants sold in each region. However, a larger proportion of Southern households reported selling meat from small livestock (P<0.05).

Households were asked about decreases in their livestock from 1990-1996 as well as in the last year. Whereas 57% of Central households reported livestock reductions between 1990 and 1997 due to lack of feed and cash, only 7.4% reported declines in the Southern region. In the last year (97-98), 44.4% of the Central households reported decreases, again because of the need for money and high cost of feed. In contrast with the past 8 years, 59.2% of Southern households reported decreases due to the lack of cash in the past year.

Both regions reported decreases in the amount of vegetables and/or grains grown in the last year. Lack of water and change in climate were the most commonly reported reasons.

Livestock Marketing Survey

(Text in this section was written by C. Kerven and edited for this report by E. Laca)

This study covered a 300 km transect in western Almaty Oblast. The transect incorporates the ecological variation exploited by livestock-keepers moving seasonally with their livestock, and follows a northwest-southeast gradient beginning in the north with sand dune

desert south of Lake Balkhash, through semi-desert and steppe, and ending in the south with the high altitude meadows of the Tien Shan (Ala Tau) mountains.

Interviews were carried out with livestock producers and farm administrators situated within three major ecological zones; semi-desert, semi-steppe and mountain pastures. The sample included 7 different co-operative farms, from which 24 employed shepherds and 20 private farmers were interviewed. A total of 7 staff, including Directors and technical personnel, of 3 cooperative farms were also interviewed, as well as village administrators and their deputies from 2 village centers of cooperative farms. Interviews were also carried out at 3 livestock or fodder markets in Almaty, and the regional administrative center, with a total of 13 buyers or sellers. Finally, several urban-based key informants were interviewed. A total of 71 individuals were interviewed between 13 July and 4 September.

Interviews included examples of most institutional forms of livestock farms now found:

- production cooperatives (3)
- joint stock cooperative (1)
- Institution farm (1)
- state-registered private farmers (8)
- unregistered private farmers (12)
- employed shepherds of cooperatives, joint-stock and institutional farms (24)

Data from a national sample survey of livestock marketing and unpublished official statistics on livestock numbers within the study area were obtained.

A checklist was used for interviews with producers. Not all information in the checklist could be collected in each interview for the following reasons. Respondents were sometimes unwilling to divulge certain information, for example, on how many animals they owned or sold. A few respondents became impatient with answering the questions, and cut short the interview. On other occasions a respondent would have to leave in order to attend to an immediate task, for example, catching up with sheep grazing on the open range. However, any lack of numerical data is counterbalanced by the insights which some respondents offered, for example, on their strategies for marketing livestock, on how livestock markets are controlled, or reasons why prices varied by season. This information is reflected in the analysis of the numerical data.

For interviews with cooperative farm and village administrators, a more open-ended approach was used. General questions were asked on the production and marketing of livestock by the cooperative farm, as well as specific questions on the quantities, prices and seasons of sales. Some administrators were reluctant to reveal their farm marketing strategies, and information obtained is therefore not complete. Field work involved camping at the grazing areas and small villages where livestock producers were situated during the summer months. In this way, it was possible to observe some of the livestock

management and marketing practices, in addition to interviewing people.

Preliminary results of marketing survey

(Text in this section was written by C. Kerven and edited for this report by E. Laca)

In spite of the relatively short time since market liberalization, a small group of commercially-oriented farmers is clearly established. These farmers do not simply sell disposable surpluses but produce to meet specific market demand. Sales are planned, timed to coincide with optimal prices; particular types of animals are selected for the market, and raised in a manner which makes them more marketable. The commercial objective does not prelude dependence on livestock also for meeting family subsistence requirements. Subsistence-oriented producers, by contrast, sell on an ad hoc basis, often under economic pressure. Although production is not geared toward marketing, these producers are forced to sell to maintain an income. The orientation of production depends on the scale of operation. Farmers having more than about 50 sheep can be commercially oriented, but those with very few livestock find this impossible. The largest operations, with hundreds of sheep (or equivalent number of animal units) exhibit characteristics of commercial operations in market economies.

Marketing is also firmly privatized. The state plays very little part in marketing livestock and their products. The state controls and taxes animal movement to market, and is in charge of inspection of animal products for sale. Enforcement is the task of police and veterinary personnel, often involving bribery.

Separate market channels exist for various products - live animals, meat, sheep wool, goat hair, camel hair, karakul pelts, merino-type pelts, etc. Entrepreneurs usually specialize in handling only one of these products. Small- scale buyers purchase the products from rural producers at the farm, and then sell them at wholesale prices to retailers in towns. These middlemen connect producers with consumers and profit from the differences in price between farm and central markets. In another category, farmer-entrepreneurs specialize in buying and fattening young or thin livestock to resell them for a profit at consumer markets. Their presence indicates that a stratified livestock production system is developing.

Thus, there are clear signals that foundations are laid for an integrated modern commercial meat livestock industry; profitable and segmented along specialized lines. Internal demand for meat remains high in Kazakstan, where meat is valued in the culture. Export channels, however, are limited mainly due to veterinary health problems. Nevertheless, the capacity exists for expansion of the meat sector, both to supply domestic and international markets.

The prognosis for livestock products

other than meat is not clear, and the situation for each commodity is different. Demand for wool within Kazakstan is weak, as former state wool-processing and manufacturing industries have collapsed. Most wool is exported to China, but producer prices are low, reflecting the low world price for wool for the past several years. Farmers do not consider income from wool, at US$ 0.60/ kg, as a significant contribution to their incomes. As a result, most private farmers are switching from keeping wool breeds such as the dominant Merino-Kazak cross breed in the study area, to purely meat breeds, in particular, the hardy Kazak fat-tailed sheep. Other animal fibers, including goat and camel hair are sold by some producers. A type of angora goat, with a fine, long fiber, is kept by many farmers, some of whom sell the goat fiber to itinerant entrepreneurs or directly at urban markets. Camels are kept by only a few farmers, and the hair is also sold to middlemen, for resale either to a local small factory in Almaty or for export. The price received for camel hair is very low, by world standards, and farmers do not receive significant income from this product. There is a demand for sheep pelts, for making the warm winter coats used by rural people in winter. A factory in Almaty makes these coats, but most pelts are exported to China, as prices across the border are much higher - up to double. Middlemen buy from Kazak producers and sell onto Chinese businessmen either in Almaty or at the border. Some Kazaks also cross into China to sell directly to Chinese factories.

Strong local demand for milk and diary products has led to some small-scale entrepreneurs, usually women, establishing regular deliveries of cows' milk from villages within a radius of Almaty, to the city. Due to the perishable nature of milk, and lack of refrigeration facilities, this marketing tends to be from villages not further than about 4 hours drive from Almaty. Income from sales of milk is particularly important to very poor farmers who may only have one or two milk cows. Further from urban centers, intra-village sales of milk and home-made butter take place, by women. Camel and horse milk is fermented at home for sale, by some farmers, and is highly prized for medicinal properties. However, urban links are poorly-developed for these commodities, such that little reaches the urban markets. Formerly, state farms collected milk and fermented mares' milk, for sale to institutional canteens during the peak production period over summer, but this service no longer functions. Consumer demand for these products is strong, and investment in small-scale dairy marketing would be justified. At the other end of the scale, some European firms have invested in dairies in Kazakstan, producing packaged milk products.

Thus, the greatest proportion of income from the sale of animal products comes from meat, for all producers, regardless of size, species kept, or whether individual or cooperative farms. Animals are sold either alive, for immediate slaughter at the urban markets, or slaughtered, and the meat transported to

market. A proportion of animals marketed are bought by other producers, either to fatten or to add to their inventory. It is more profitable to sell an animal alive for slaughter, as buyers prefer to see the animal and particularly value animals with more fat. However, poorer farmers cannot afford the transport costs of taking animals to market, and therefore slaughter at home and take only the meat to be sold.

Sales of animals for slaughter take place through the year, but more commercially-oriented producers time their sales to periods when market prices are highest. Small-scale producers sell a few animals frequently, sometimes once a month, whereas commercially-oriented farmers only sell once or perhaps twice a year, in large batches. The best prices occur in early spring (February-March), but only for fattened animals. As is typical of less-developed livestock sectors, fewer animals are offered for sale in winter, as the bulk of smaller producers try to retain their animals over winter until they can be fattened on free, natural pastures in the spring. Those animals which are sold by small-scale producers in winter are thin and underweight, and therefore not attractive to consumers. In March there occurs an important national holiday period of the Kazak New Year (*Naarus)* when families try to slaughter animals for feasting. If producers can sell a fat animal at this lean period, they can obtain a premium price. While most producers are aware of the price differentials by season, only larger-scale farmers have the resources to take advantage of these differentials by marketing fat animals when few are for sale. Larger-scale farmers can obtain the better prices by being able to afford better-quality and quantity of feed over winter. Wether lambs are kept in barns for up to six months before and during winter, and fed on grain and the more nutritious cut grasses. Although most farmers are aware that livestock production depends on good quantity and quality of feed, small-scale farmers have to feed their stock whatever is cheapest, and let the sheep graze in the open as much as possible over winter.

The period when livestock prices are lowest is late summer and autumn (August-October). By then, most animals have reached their best body condition by grazing over the spring and summer. A "buyers' market" prevails, as supply is high and a new winter looms. Flocks and herds are culled to avoid keeping surplus animals during the winter months, when forage is scarce and feed is expensive. Many small-scale and poor farmers try to sell their surplus animals at this time, as they need cash for winter food supplies and necessities for school children. Commercially-oriented farmers, on the contrary, do not sell at this period, but instead buy fodder from the new harvest, and prepare to fatten up their young animals over winter.

Overall there has been a long term trend toward increasing livestock prices, over which typical seasonal trends are superimposed. Prices for livestock and products also vary by distance from the principal markets. The price received by

producers is lower if they sell locally rather than in one of the main markets, and is lower the further away from a main market. For example, the price of an adult male sheep in the summer of 1998 was 3000, 5000, and 8000 tenge (Kazak currency) at a small village 300-400 km form Almaty, at Uzan Agach market, and at the Almaty market, respectively.

Gender

Addressing women and children in multiple ways is a central part of our project. Women were involved directly and intensively as executive administrators, senior and junior scientists, staff, students, end users and foci of the project. Four out of five U.S. students directly involved in our project are female. One woman (Karibayeva) represents the Ministry of Ecology of Kazakstan before our group. Six key scientists (Soyunova, Kerven, Shabanova, Karibayeva, Kurochkina, Abuova) working in fields ranging from human nutrition to GIS are female. During the summer of 1998, 270 women and their children were interviewed, and received a health evaluation and recommendations for the amelioration of nutritional problems. Two women were hired as interpreters and one as liaison staff.

Policy

In preparation to have long-term policy impacts, our team incorporated appointed representatives of the Ministry of Ecology of Kazakstan (K. Karibayeva), Ministry of Nature Use and Environmental Protection of Turkmenistan (A. Babaev), and the Association of Livestock Producers of Turkmenistan (O. Hodjakov). Appointments by the Ministry of Agriculture and the Agency for Central Planning and Reform of Kazakstan were requested and are pending. The main role of the appointed team members will be to maintain their institutions appraised of our activities, and to provide them with the information generated. Additionally, their participation as team members ensured direct inputs from the institutions into our objectives and plans. The aforementioned linkages are described in detail below.

The Institute of Ecology and Sustainable Development (IESD), under the direction of Dr. Ludmila Shabanova and Dr. Kuralay Karibayeva, is one of the main collaborating institutions and our link with the Ministry of Ecology of Kazakstan. The IESD has been in charge of building the GIS for Kazakstan and has provided general assistance to our project in the region. Ludmila and Kuralay work at the Ministry of Ecology of Kazakstan, and they constitute a strong link between our project and the Ministry. During my trip in March 98 I had a meeting with the deputy Minister of Ecology. During this meeting the deputy Minister expressed his interest in our project being linked to the NEAP-SD, and verbally appointed K. Karibayeva as the official representative of the Ministry in our project. We agreed that a symbolic contribution from our

project to the NEAP-SD effort would be in order. The vice Minister delegated the development of this link on K. Karibayeva. We are now working on formalizing this link.

The Institute of Deserts, Flora, and Fauna of Turkmenistan (IDFF), within the Ministry of Nature Use and Environmental Protection, is the main collaboration institution in Turkmenistan. In March 1998, E. Laca and other team members briefed Dr. P. K. Kurbanov. Minister of Nature Use and Environmental Protection of Turkmenistan, on our LDRCT project and requested the nomination of a representative for our team. Minister Kurbanov appointed Dr. Agadjan G. Babaev, director of the IDFF, as representative, and he expressed keen interest in the establishment of a formal link between our project and the Ministry.

A strong linkage with another user institution was established during a meeting with Dr. Deryakuly C. Karadurdiev, Chairman of the "Turkmenmallary" Association of Cattle-Breeding Joint Stock Companies of Turkmenistan. This association functions at a level comparable to a Ministry of Animal Husbandry. Since the abolishment of the Academy of Sciences, the "Turkmenmallary" Association houses the former Institute of Animal Husbandry and Veterinary Science, which is directed by Dr. O. Hodjakov. Chairman Karadurdiev was briefed on our project. He expressed strong support of our objectives, and appointed Dr. Hodjakov as representative of the Association in our team. As described above in the Research section, Dr. Hodjakov has conducted research on agricultural statistics, agricultural policy, and livestock production systems within our LDRCT project. The information and databases that will be created reside in the "Turkmenmallary" Association, and are immediately available to Chairman Karadurdiev.

Dr. Z. Zhambakin, Director General of the National Federation of Private Farmers of Kazakstan has been a team member since the inception of the LDRCT project. Dr. Zhambakin contributed directly to the objectives and planning for the rural surveys through meetings and review of survey forms. He is among the major players who, in collaboration with VOCA, are submitting proposals to shape the new farm policy (e.g. the new law on cooperatives) in Kazakstan. Thus, Dr. Zhambakin provides another direct link between our group and policy in Central Asia.

Finally, by meeting with and briefing the Minister of Agriculture, and the staff of the Agency for Strategic Planning and Reform (ASPR) of Kazakstan, we established the basis for further involvement of policy makers at the highest level. Dr. Khaslan K. Kusainov, Director of the Department of Socio-Economic Reforms within the ASPR, and his staff attended a detailed presentation of our project by E. Laca, D. Johnson, and T. Gilmanov. He expressed support for our plans, and

indicated particular interest in the Basic Resources and CO_2 modules.

Outreach

We targeted and successfully reached multiple level of users, in many cases exceeding our expectations. At the lowest hierarchical level, rural surveys allowed direct involvement of rural families in expressing what their problems and concerns are, as well as in proposing the solutions they feel are necessary and feasible. Women were informed of their and their children's nutritional status as indicated by hemoglobin levels and anthropometry. National research institutes, NGOs and universities participate as mid-level end users and future sources of information for both lower and higher hierarchical levels. Our success in reaching this second target level is documented throughout this report. A large number of institutions and scientists were supported, directly involved in the research, and trained. At the highest hierarchical level of decision-making, we continued and increased collaboration with members of Ministries, farmers associations and NGOs to ensure that information is relevant, and that the project has impacts beyond its term.

Goals, activities and results have been disseminated through popular press articles, presentations at scientific meetings, and publication of technical papers. A large number of people were also reached directly through meetings, workshops and surveys.

The problem of quantifying the magnitude of CO_2 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 Kazakstan, 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_2 flux subproject included: Kazakstan (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_2 flux module will be based upon: (1) informing the target institutions and individuals about the results of the CO_2 flux evaluations at the three monitoring stations; (2) sharing quantitative models to predict CO_2 flux rates as functions of environmental factors and management decisions; and (3) discussing with the target institutions the resultant maps of CO_2 flux rate and estimated carbon sequestration potentials derived from

combining flux models with the GIS of basic ecological resources of the Central Asian states.

Developmental Impact

Basic Resources and GIS

Our LDRCT project is already having a significant environmental impact through its link with the Institute of Ecology and Sustainable Development (IESD), which is directed by Drs. Ludmila Shabanova and Kuralay Karibayeva, and is one of our main collaborating institutions. The IESD has been in charge of building the GIS for Kazakstan and has provided general assistance to our project in the region. Drs. Shabanova and Karibayeva also work for the Ministry of Ecology and Bioresources of Kazakstan in the National Environmental Action Plan (NEAP), and they constitute a strong link between our project and the Ministry. Our project contributes significantly to the long-term strategy for Kazakstan (Plan 2030) set forth by the Ministry of Ecology and Bioresources. At least the following priority areas identified by the NEAP are impacted by our project.

Improvement of rational pasture use system. We have performed rural surveys and field measurements to assess the ecological condition of rangelands as affected by livestock and human use. Data will be used to diagnose problems and suggest management techniques to restore degraded lands and conserve those in good condition. Literature reviews and consultation with experts will generate a set of feasible alternative options that will be tested in commercial farms. These activities involved the training of young scientists and building of research capacity, and in the future will include training of land managers, and demonstration of results with on-farm experimentation. Rangelands and abandoned marginal croplands in the steppe and dry steppes of Akmola oblast are included in our studies. Other activities that will be conducted under our USAID-funded project and that relate directly to this aspect of the NEAP are:

a. Modeling of pasture production and estimation of grazing capacity.
b. Assessment of the role of wells on the degradation and utilization of rangelands.
c. Microeconomic evaluation of grazing technologies.
d. Analysis of effects of different agricultural policy instruments in the adoption of different technological options.

Inventory of environmentally affected non-fertile lands and their transformation. The IESD has been in charge of preparing a GIS for Kazakstan. We have provided them with advice, funds and equipment (a total of about $30,000) to create the GIS. The GIS has already been very helpful for the presentation and planning of the Long-term Strategy within the NEAP

Improvement of arable land fertility. A focal point of our project is to determine the successional processes that take place

in abandoned croplands in the Akmola oblast. A student has been recruited to study cover crops and pasture rotations to restore fertility and conserve land. Basic CO_2 flux information from an almost pristine steppe area was collected for the 1998 growing season and will be used to assess the role of abandoned croplands, cover crops and pasturelands on the absorption of atmospheric carbon dioxide. We hypothesize that restoration of marginal croplands to permanent pasture, and improvement of degrade rangelands can account for significant sequestration of atmospheric carbon.

Rangeland Forage Capacity and CO_2

Obtaining information of the magnitude and distribution of the CO_2 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 Kazakstan conducted at the Barayev Research Institute of Grain Farming (Kazakstan) 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 Kazakstan) into managed pastures constitute a significant reserve of carbon sequestration that could minimize subsequent wind and water erosion. In Uzbekistan, plowing desertified steppes and semidesert rangelands in the foothill zone for wheat production is taking place. Thus, information obtained in Kazakstan will be directly relevant to forecasting the situation in these lands of Uzbekistan under alternative management schemes.

Estimation of the potential effect of these processes on the carbon balance of the affected soils in Uzbekistan (where presumably a substantial loss of soil organic matter will take place through accelerated wind and water erosion of those light-textured, loose 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_2 flux measurements will provide critical information necessary to make good decisions concerning sustainable management of forage resources. The RF subproject has established close links with the USDA-ARS Rangeland CO_2 Flux Network, including the sharing of data processing algorithms. Results of the CO_2 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 has close cooperation with the International Centre for Agricultural Research in Dry Areas (ICARDA), which contributed expertise, equipment, and resources to the establishment of the CO_2 flux station in Uzbekistan. Plans are being considered to establish additional CO_2 flux monitoring stations at several ICARDA research sites in rangelands of

the Middle East and North Africa, which together with the Central Asian sites will form a network of CO_2 flux monitoring sites in arid/semi-arid regions of the African and Asian continents.

Animal Production and Human Nutrition

Based on her survey work, Dr. C. Kerven ("Analysis of livestock marketing by households and cooperatives in western Almaty Oblast, Kazakstan," report in preparation) made the following preliminary recommendations that are of relevance for the development of small-scale livestock farmers and cooperatives.

- Seasonal agricultural credit should be provided to small family groups, for production of winter fodder crops. Credit is needed to buy spare parts, fuel, and seeds.
- Transportation to markets should be facilitated. Cost of transport is a major constraint to small-scale herders in marketing livestock, and it contributes to a steep decline in price from consumer market to farm.
- Local micro-processing of livestock products, including pelts, milk, and meat, should be promoted.
- Specialized wool and pelt production and local processing should be developed. Potentially high-value wool and pelts already exist but currently obtain very low prices. Small-scale producers could be assisted by improvement of breeds, livestock management and processing.
- Development of export markets for specialized accessible to small-scale producers of high-value products would be necessary.

A Memorandum of Understanding was signed between UC Davis LDRCT project and the Institute of Nutrition of Kazakstan to collaborate in the survey and to express interest in future collaboration to further develop the Kazak food composition database.

The following contacts were made by M. Carpenter on behalf of our LDRCT project.

- USAID, Environmental Desk, K. McNamara. Spoke about project, survey implementation.
- Counterpart. Discussed grants made to small farmer organizations, received a list of farmer non-governmental organizations throughout Kazakstan, consulted with regards to "Farmer to Farmer" training, received help of two instructors for training of survey teams.
- WHO, Eastern Europe and CIS Desk. Discussed nutrition research in Central Asia and where efforts would be most fruitful, discussed cooperation on further development of the Food Composition Database, received informational materials.
- UNICEF, CARK office. Met with director of the anemia prevention project, and former office director about future programs, discussed development of food based projects in addition to already planned supplement and

fortification projects, discussed work with the Kazak Nutrition Institute and their current joint projects.

- TACIS, Farm Development Program and AgroInform. Learned about projects in the region, including a radio program on agriculture, small farmer support project, publications, received copies of TACIS reports on the agriculture sector.
- International Red Cross, Almaty Office. Learned about activities in country, their role relative to the national office, and training efforts.
- UNDP Health Office, Almaty. Met to discuss further development of their 1996 nutrition assessment project in Kazakstan, learned that UNDP will be focusing on issues of development policy rather than strict nutrition research.
- ISAR, Central Asia Office. Discussed grants made to small farmer organizations, received a list of farmer non-governmental organizations throughout Kazakstan.
- VOCA, Almaty. Discussed our LDRCT and a BASIS project they are working on. VOCA brings over US specialists to work with local farms or villages on problems of production. They recently changed their focus to food production and processing rather than agricultural production. Consulted on problems and concerns of farmers, as determined by VOCA's work. Received information about farms they provided with volunteers or from whom they received proposals.
- Peace Corps, Kazakstan. Inquired about volunteer placement in villages, and received contact information for volunteers in specific areas.
- HIVOS, Almaty Office. Discussed grants made to small farmer organizations, received a list of farmer non-governmental organizations throughout Kazakstan.
- Soros Foundation Office, Almaty. Consulted director who is an anthropologist expert in the study of nomadic life.
- National Environmental Center. Received oblast level information along with various reports and project proposals issued by the Center (formerly known as the Center for the National Environmental Sustainable Development Program)
- Kazak Red Cross and Red Crescent Office, Almaty. Discussed the vulnerability study implemented by the office in 1997, and their follow-up plans.
- CASDIN, Almaty. Consulted for "Farmer to Farmer" training. CASDIN is one of the forerunning groups trained in participatory rural appraisal work in Central Asia.
- Zhalgas Center, Almaty. Obtained space for meetings and training, use of computers, and an instructor for the "Farmer to Farmer" training.
- Association of Private Farmers, Almaty. Consulted with director about survey and sample development, and site selection, learned about the projects they are working on, including a micro-credit program.

- Association of Private Farmers, Astana. Discussed farms and problems in the Akmola oblast, their goals, current projects.
- Karaganda Ecological Center, Karaganda (local NGO). Discussed analysis of plants from rangelands located on former nuclear testing sites.

Other Contributions

Team members of our LDRCT project met with Tom Hensleigh, director of Mercy Corps International, and Chuck Moffat of VOCA, both of whom run programs to give small and medium loans to farmers and agricultural enterprises. Both expressed interest in the surveys as a means for their organizations to have current information about the clientele they serve. Because these organizations have to rely in government statistics, they feel that they don't know much about the people they are supposed to be helping. As a result of this meeting, Mercy Corps International and VOCA will receive a complete report on our findings.

Field surveys served effectively as a means to bring heath and nutrition information to the rural population. Nutritionists in the survey team counseled all people interviewed, especially those with low hemoglobin scores. Information was also distributed to emphasize the importance of animal food sources for growing children and women of child bearing age, lag times between meals and tea consumption, and inclusion of leafy green vegetables in the diet. These recommendations were based on materials developed by UNICEF-CARK to fight anemia in Central Asia. Several participants expressed an active interest in their health and queried surveyors about proper nutrition. One of the survey teams included a pediatrician, who was frequently approached for diagnosis and advice. Parents and grandparents alike were very active in taking advantage of this resource, as most villages have at most a medical nurse, clinician, or a health technician. Parents were given recommendations for proper child health care, and were informed of potential growth and health problems. Several parents asked for an initial diagnosis with questions such as "Why is my child sluggish?" "Why isn't my child speaking yet, at age 2.5 years?" "Why isn't my child growing?" "My son is 12 years old and he's shorter than his 8 year old sister; what can I do?" "Is this the proper medicine to give my child?" Participants appreciated the information on their height, weight and hemoglobin level. Heights and weights were measured on all family members.

The survey activity also provided a chance for the distribution of vitamin C supplements and some basic first aid supplies. Candy supplemented with vitamin C was left at each household in an effort to enforce the idea that vitamin C is important with regards to anemia status. Extra medical gloves, band-aids, and alcohol swabs were left with the medical doctor in the last towns surveyed.

A few mayors expressed interest in the initial results of the surveys in their town. They asked if we found that "their" people were healthy, and asked for comments about the village. The mayor of one village asked why there was so much more Artemisia in the rangelands this year, and inquired about the ecology of rangelands. People in another village felt that the survey provided a great service by prompting the mayor to turn the water back on after three days of having no tap water. After the water was turned on, villagers wanted to know if the survey team would ask about electricity.

Leveraged Funds and Linked Projects

Scientists with USDA-ARS at Logan, UT (Drs. Douglas Johnson and Nicanor Saliendra) and Dubois, ID (Drs. Harvey Blackburn and Wolfgang Pitroff) are participating in a joint sheep/range project in Central Asia with scientists from ICARDA (Drs. Gus Gintzburger and Euan Thompson). The RF subproject has benefited considerably by significant in-kind support from the USDA-ICARDA project. This includes support to purchase and install a Bowen ratio system at the Karnab Site in Uzbekistan, fencing and security guards to secure the CO_2 monitoring site, a vehicle for travel to and from the research site, and a portable shelter at Karnab. Salary support for two Uzbeki field scientists is being provided through the USDA-ICARDA project. In addition, significant travel expenses were paid by the USDA-ICARDA project to select the two other field research sites and identify cooperating scientists in Turkmenistan and Kazakstan as well as to install the Bowen ratio equipment and train cooperating scientists at the three monitoring sites. Support from the USDA-ICARDA project for CRSP-related research in Central Asia is estimated to be about $60,000. In addition, USDA salary support for Saliendra (50% time) and Johnson (10% time) on CRSP-related activities is estimated to be another $34,000. Thus, a total of about $94,000 has been leveraged through interaction with the USDA-ICARDA project.

M. Carpenter obtained the following funding to conduct the human nutrition research:$3000, Jastro Shields Research Grant, UC Davis; $500, Hemocue, Co. (donation of equipment); $1000, Institute of Nutrition, Kazakstan (donation of equipment).

This project is closely linked to the activities of ICARDA in Central Asia through common team members (E. Thomson, A. Aw-Hassan, M. Suleimenov). ICARDA provided approximately $4500 for E. Laca to travel to Aleppo to plan joint research and extension activities in Central Asia. In addition, ICARDA provided $24,000 of in-kind matching funds. A subcontract was signed with ICARDA to regulate the collaboration during 97-98 and the bases for further collaboration were discussed. E. Laca, T. Nordblom, and M. Demment were involved in the original development of the ideas for a proposal from ICARDA to IFAD for a linked

project. Dr. Nordblom developed an initial concept paper that was later modified and submitted by ICARDA to IFAD. Although no formal agreements have been made yet, there is an understanding that if funded, the IFAD project will support the extension aspects of our project. In specific, ICARDA scientists expressed interest in supporting our on-farm research and demonstration activities.

Our LDRCT project is linked to the project entitled "Impacts of privatization on range and livestock management in semi-arid Central Asia," funded by Department for International Development, British Government and managed by the Overseas Development Institute, London. The PI of this project is Dr. Carol Kerven, who is also a member of our team and who conducted field work with funding from our GL-CRSP project. Dr. Kerven's project is in collaboration with:, Macaulay Land Use Research, Kazak Pasture and Fodder Institute, and Institute of Animal Husbandry and Pastures, Turkmenistan. Total cost of her project is $384,000 over 2 years from 1998-99.

Through common members (L. Shabanova and K. Karibayeva), our project is formally linked to the implementation of the National Environmental Action Plan (NEAP)led by the Ministry of Ecology of Kazakstan. The deputy Minister expressed his interest in our project being linked to the National Environmental Action Plan (NEAP), and verbally appointed K. Karibayeva as the official representative of the Ministry in our project. We agreed that a symbolic contribution from our project to the NEAP effort would be in order. The vice Minister delegated the development of this link on Dr. Karibayeva. The GIS that was built with USAID SR-CRSP by the Institute of Ecology and Sustainable Development funding, an NGO headed by Dr. Shabanova, has already been used for the purposes of the NEAP. The link between LDRCT and NEAP is described in greater detail in the section on Developmental Impacts above.

Training

Degree Training

Abigail Breuer, MS, 1999, Agronomy and Range Science, Grazing and conservation of rangeland resources, University of California, Davis.

Mary Carpenter, MS, 1999, International Agricultural Development, Linking human nutrition to livestock systems, University of California, Davis.

Karen Olmstead, MS, 1999, Biological and Agricultural Engineering, Remotely sensed trends of rangeland condition in Kazakstan, University of California, Davis.

Adam Wolf, MS, 2001, International Agricultural Development, Cover crops to restore soil carbon, University of California, Davis.

Kevin Gonzago, University of California, Davis.

Short-term Training

Workshop: Participatory rural survey methods. NACAR, Almaty, Kazakstan, 23-31 July 1998. Sixteen scientists and students from Kazakstan and UC Davis participated in the workshop and received instruction from ICARDA and UC Davis scientists.

Workshop: Human nutrition surveys. NACAR, Almaty, Kazakstan, 23-31 July 1998. Six staff members of the Institute of Nutrition of Kazakstan were trained in interviewing techniques, and use of hemoglobin equipment, mother-child UNICEF scales, and height boards.

Farmer to Farmer communication: NACAR, Almaty, Kazakstan, 22 July 1998. Sixteen scientists from various institutes of Kazakstan participated in the training organized by UC Davis, ICARDA and Zhulgas Center.

Range condition assessment: Institute of Pasture and Fodder of Kazakstan, Almaty, 31 July 1998. Three members of the survey teams learned how to conduct vegetation measurements from I. Alimaiev.

Workshop: Introduction to Global Positioning Systems. NACAR, Almaty, Kazakstan, 31July 1998. Sixteen scientists and students from Kazakstan and UC Davis participated in the workshop and received instruction from E. A. Laca.

Special training: In April-May 1997, Dr. Nasyrov from Uzbekistan was brought to the U.S. and trained to install, operate, maintain, and trouble-shoot the Bowen ratio equipment at the USDA-ARS Forage and Range Research Laboratory in Logan, Utah and the U.S. Sheep Experiment Station in Dubois, Idaho. During 7 May to 6 June 1998, Drs. Saliendra and Nasyrov traveled to Kazakstan and Turkmenistan and provided similar on-site training to collaborating scientists (Drs. Dourikov, Gedemov, and Akshalov) in the operation of Bowen ratio systems and subsequent data processing.

Collaborating Personnel

United States

Douglas A. Johnson, ARS-USDA, Utah State University.

Tagir Gilmanov, South Dakota State University.

Nicanor Z. Saliendra, Research Assistant ARS-USDA, Utah State University.

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Publications[1]

Mary F. Carpenter, Emilio A. Laca, and Louis E. Grivetti. In press. Linking livestock production to human nutrition in Kazakstan. Proceeding of the Symposium on Human Nutrition and Livestock in the Developing World, organized by Heifer Project International, Little Rock, Arkansas, 14 October 1998.

Carol Kerven and Ilya Alimaiev. In press. Mobility and the Market: Economic and Environmental Impacts of Privatization on Pastoralists in Kazakstan. Paper presented at Conference on Strategic Considerations on the Development of Central Asia, Council for Development of Central Asia and Chinese Academy of Science, Urumchi, China, Sept. 1998.

Carol Kerven and Christopher Lunch. 1998. Routes to privatization for livestock collectives in Kazakstan and Turkmenistan. Dryland Forage, Pasture and Range Network, ICARDA, Issue no. 14, 1998. Aleppo, Syria.

Carol Kerven. "Review of extensive livestock development in Central Asia" in Dryland Forage, Pasture and Range Network ICARDA, Issue no. 12, 1998. Aleppo, Syria.

Abstracts and Presentations[2]

Mary F. Carpenter, Emilio a. Laca, and Louis E. Grivetti. 1998. Linking livestock production to human nutrition in Kazakstan. Proceeding of the Symposium on Human Nutrition and Livestock in the Developing World, organized by Heifer Project International, Little Rock, Arkansas, 14 October 1998.

C. Kerven. 1998. Objectives and findings of field work in winter 1998, Kazakstan and Turkmenistan. Workshop on Integrated Tools for Livestock Development and Rangeland Conservation in Central Asia, Institute of Deserts, Flora, and Fauna, Ashgabat, March 1998.

Carol Kerven. 1998. Prospects for Extensive Pastoralism in Central Asia: Spontaneous commercialization and extensification of production. Presentation to Conference on Conditions and perspectives of the development of animal husbandry in Central Asia, University of Wisconsin, St. Petersburg, Russia, June 1998.

Carol Kerven and Ilya Alimaiev. 1998. Mobility and the Market: Economic and Environmental Impacts of Privatization on Pastoralists in Kazakstan. Paper presented at Conference on Strategic Considerations on the Development of

Central Asia, Council for Development of Central Asia and Chinese Academy of Science, Urumchi, China, Sept. 1998.

Emilio A. Laca and Mekhlis Suleimenov. 1998. Changing patterns of rangeland tenure and management in Central Asia. Symposium on the privatization of the world's rangelands, 51st Annual meeting of the Society for Range Management, Guadalajara, Mexico, 8-12 February, 1998.

Chris Lunch and Carol Kerven. 1998. Bibliography on livestock, rangelands and socio-economic conditions in Central Asia. Overseas Development Institute, London.

Tom Nordblom, Gus Gintzburger, Eddy DePauw, Wolfgang Goebel, Mustafa Darwich, Emilio Laca, and Jonathan Rae. 1997. GIS and natural resource economics in North Africa and West and Central Asia. Conference on "Transformations of Middle Eastern Natural Environments: Legacies and Lessons", October 30-November 1, 1997, Yale University, New Haven, Connecticut.

[1] (Note that the exact amount of credit, if any, due to our LDRCT project for the publications by C. Kerven is not yet determined. We list them here tentatively, with the kind approval of C. Kerven).

[2] (Note that the exact amount of credit, if any, due to our LDRCT project for the abstracts and presentations by C. Kerven is not yet determined. We list them here tentatively, with the kind approval of C. Kerven).

References

Allen-Diaz, B. et al., 1996. Rangelands in a changing climate: Impacts, adaptations and mitigation, Climate change 1995. Impacts, adaptations and mitigation of climate change. Scientific-Technical Analyses. Contribution of Working group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge et al., pp. 131-158.

Ash, A.J., Howden, S.M., McIvor, J.G. 1996. Improved rangeland management and its implications for carbon sequestration, p.19-20. In: Rangelands in a sustainable biosphere. Proceedings of the Fifth International Rangeland Congress, Vol. 1. Ed. by. N.E. West. Salt Lake City, July 23-28, 1995. Society for Rangeland Management, Denver, Colorado.

Fisher, M.J. et al., 1994. Carbon storage by introduced deep-rooted grasses in the South American savannas. Nature, 371: 236-238.

Gilmanov T.G. 1997. Ecology of rangelands of Central Asia and modeling of their primary productivity. In: Proceedings of the SR-CRSP/ICARDA Regional Assessment Workshop on Central Asian Animal Production, Tashkent, Uzbekistan, February 27-March 1 1996. 28 pp. (In press, to be published by Small Ruminant CRSP, US AID).

Gorshkova, A. A. 1983. Osnovnye cherty pastbishchnoi digressii v stepnykh soobshchestvakh Sibiri. Sibirskii Vestnik Sel'skokhoziaistvennoi Nauki, No. 4: 51-54.

Gorshkova, A. A. 1986. Stepnye pastbishcha Sibiri i ikh ratsional'noe ispol'zovanie, p. 123-127. In: A. A. Titlyanova (ed.), Produktivnost' senokosov i pastbishch. Novosibirsk: Nauka.

Gorshkova, A. A., Shushueva, M.G. 1981. Izmenenie struktury stepnykh fitotsenozov Tuvy pod vliyaniem antropogennykh faktorov, p. 59-76. In: L. I. Malyshev (ed.), Okhrana rastitel'nogo mira Sibiri. Novosibirsk: Nauka.

Gorshkova, A. A., Zhuravleva, N.A., Grineva, N.F., et al. 1977. Ekologiia i pastbishchnaya digressiia stepnykh soobshchestv Zabaikal'ya . Novosibirsk: Nauka.

IPCC, 1996. Climate change 1995. Impacts, adaptations and mitigation of climate change. Scientific-Technical Analyses. Contribution of Working group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge et al.

Karibaeva, K.N. and Kurochkina, L.Y., 1991. Vegetation changes and their regulation under rangeland use. Gylym, Almaty, 168 pp.

Kerr, R. A. 1995. Studies say - tentatively - that greenhouse warming is here. Science, 268: 1567-1568.

Kurochkina, L.Ya. 1995. Trends and effects of desertification in Central Asia. Paper presented ad: International Conference on Desertification. 14-16 June. Almaty, Kazakstan: United Nations Environment Program and Ministry of Ecology and Bioresoruces of Kazakstan. Manuscript, 8 pp.

Momotov I.F., and Faiziev K.T. 1973. Opyt sozdaniia iskusstvennykh fitomeliorantov po fonu vlagonakopitel'nykh borozd, p. 118-140. In: teoreticheskie osnovy i metody fitomelioratsii pustynnykh pastbishch Yugo-zapadnogo Kyzylkuma. Tashkent: FAN.

Nechaeva N.T. (ed.) 1985. Improvement of desert ranges in Soviet Central Asia. Chur, Switzerland ; New York : Harwood Academic Publishers.

Nechaeva N.T., Antonova K.G., Karshenas .S.D. et. al. 1979. .Produktivnost' rastitel'nosti TSentral'nykh Karakumov v sviazi s razlichnym rezhimom ispol'zovaniia. Moskva : Nauka, 1979.

Nikolaev, V. N., Amangel'dyev, A.A., and Smetankina, V.A. 1977. Pustynnye pastbishcha, ikh kormovaya otsenka i bonitirovka . Moskva: Nauka.

Saidov D.K., Momotov I.F., Padunina M.V., and Alimzhanov A.G. 1986. Pastbishcha Yugo-Zapadnogo Kyzylkuma i ikh uluchshenie, p. 118-123. In: A.A. Titlyanova (ed.). Produktivnost' senokosov i pastbishch. Novosibirsk: Nauka.

Shamsutdinov, Z.S., 1991. Adaptive system of arid fodder production. Problems of desert development(4): 1-8.

Volkova, A. V., Kochurov, B.I., Khakimzianova, F.I. et al. 1979. Sovremennoe sostoyanie stepei Minusinskoi kotloviny. Novosibirsk: Nauka.

Watson, R.T., Rodhe, H., Oeschger, H. and Siegenthaler, U., 1990. Greenhouse gases and aerosols. In: J.T. Houghton, G.J. Jenkins and J.J. Ephraums (Editors), Climate Change: The IPCC Scientific Assessment. Intergovernmental Panel on Climate Change. Cambridge Univ. Press, Cambridge, U.K., pp. 7-40.

Zhambakin, Z.A., 1995. The rangelands of Kazakstan (In Russian). Kainar, Almaty, 208 pp.

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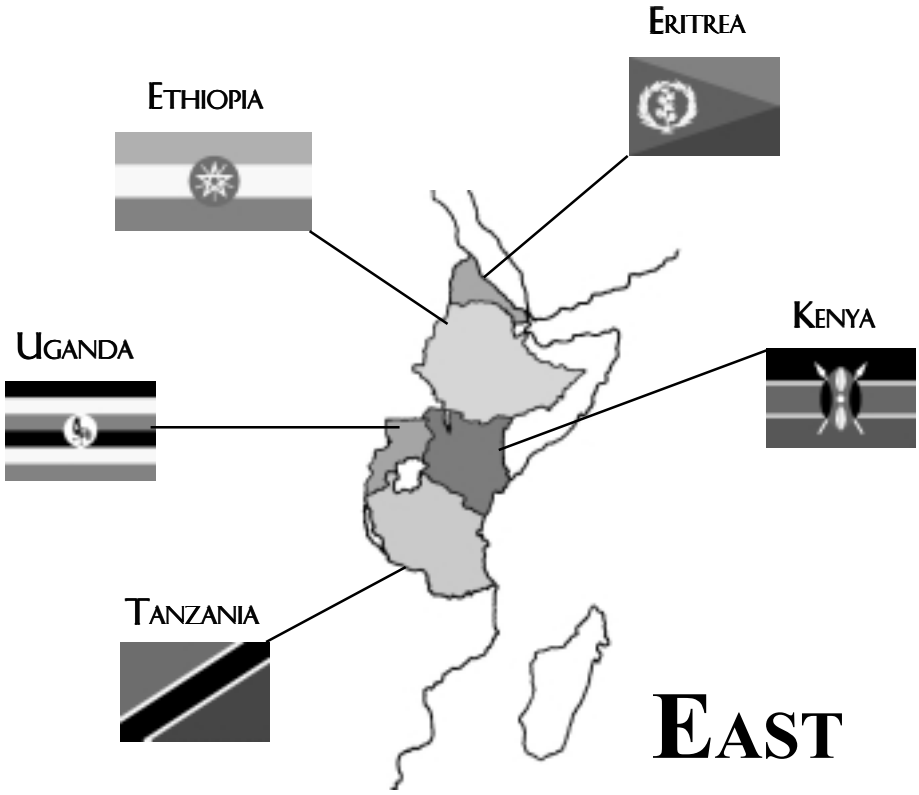

EAST AFRICA

Improving Pastoral Risk Management on East African Rangelands

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Narrative Summary

Year 19 of the SR/GL-CRSP was the first year of work for this project. We began by establishing administrative links among primary collaborating institutions [i.e., Utah State University (USU), Egerton University (EU), University of Kentucky (UK), the World Council of Credit Unions (WOCCU), and the International Livestock Research Institute (ILRI)]. We also hired a post-doctoral associate, Dr. Kevin Smith, and prepared Smith for a year in the field with a two-week workshop held during February at Logan, Utah. Research began by wrapping-up a long-term field assignment by Solomon Desta in southern Ethiopia in October funded by USU, GL-CRSP, ILRI, and the Rockefeller Foundation. New field work began in March in both Ethiopia and Kenya with key roles played by Smith, Abraham Ndofor of WOCCU, and Dr. Jon Moris of USU. Smith began a broad reconnaissance of our study region to create a participatory risk map and study the status of support services. Ndofor did a two-week consultancy to evaluate rural finance in southern Ethiopia, while Moris performed a four-month survey of relevant policy issues in Kenya and Ethiopia. A research planning workshop chaired by Abdilahi Aboud et al. was held at EU in June where a review of research and training activities occurred. Two outreach workshops, variously chaired by Layne Coppock and Solomon Desta, were subsequently held in Addis Ababa and Nairobi to begin a process of organizing a strong group of development agents who could work with the project in setting outreach priorities for risk-management interventions and conceive collaborative pilot projects. Color brochures that describe the project have been widely distributed in Kenya and Ethiopia. Electronic communication has been set up with outreach participants via e-mail and a project web page. Two master's students, one Ethiopian and one Finnish and affiliated with Norwegian Agricultural University, received strategic support from the SR/GL-CRSP and began field work among the Gugi people in southern Ethiopia in August. Five other Kenyan and Ethiopian master's candidates were matriculated at EU under the tutelage of Aboud and Frank Lusenaka, and these students are envisioned as field assistants in the next

research phase of the project. A Kenyan Ph.D. candidate was recruited to begin studies at UK, and prior to departure for the USA in August he conducted a survey of trader networks in the study area under the supervision of Peter Little. Other efforts in East Africa and the USA included completion of a literature review on pastoral natural-resource management and field data collection pertaining to property rights and production risks in southern Ethiopia led by Brent Swallow et al. at ILRI, a detailed literature review on pastoral economic diversification by Peter Little et al. at UK, and a review of livestock marketing literature and statistical analysis of thousands of records of livestock prices in northern Kenya led by Deevon Bailey and Christopher Barrett at USU. Development of a GIS template for the study area was begun by Paul Box et al. at USU, which is also linked to the on-going risk mapping activity.

We believe our first year has been a success. We were able to meet 28 of 30 targets for administration, research, and outreach despite potentially destabilizing events in both Kenya and Ethiopia. We were even able to address three additional targets that were not explicit in the workplan. All research results are preliminary and are reviewed in the following pages. Research results aside, our key achievements include: (1) Creation of an effective and dynamic outreach capability involving 52 organizations— with all indications being that we can play a very important role in improving communication and coordination among outreach participants, and consequently positively affect lives of project beneficiaries; (2) recruitment and/or support to 14 research trainees in a variety of master's, Ph.D., and special studies projects; and (3) creation of a strong team culture of research, intellectual freedom, and collegiality.

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 and Simeon Ehui.*

Problem Statement and Approach

Observations in the semi-arid Borana pastoral system have been interpreted to suggest that the cattle population dynamics exhibit a "boom and bust" pattern of rapid growth followed by precipitous crashes. It has also been contended that death losses of cattle due to starvation are very high and induced by equilibrial interactions between stocking rates and rainfall. Such losses have also been thought to constitute a large economic loss for the society overall, and the degree to which they are (or are not) predictable is important. The objectives of this activity are to confirm phenomena posed above as well as to quantify the risks and returns to cattle rearing. Once risks and returns to cattle rearing are identified, the features of complementary alternative (non-pastoral) investments can be known in

terms of their maximum risk and minimum return characteristics. One subsequent goal is to prescribe a more risk-tolerant combination of assets that can help pastoralists mitigate economic losses and result in poverty alleviation. We also anticipated, however, that the Boran were not very diversified at present and had few economic links to towns other than occasional trips to market. Our approach involved survey of 336 Boran households within 35 km of the towns of Yabelo, Mega, Arero and Negele. History of cattle dynamics at the household level over the past 17 years was reconstructed based on 56 group interviews. Data were to be analyzed using descriptive statistics, factorial ANOVA (Analysis of Variance), and quadratic programming.

Highlights of Preliminary Results

About 11,590 households— distributed among 222 villages or encampments— occurred in the sampling regions. A stratified random sample of 336 was selected for study. Of these 336 households 7% were classified as wealthy, 39% as middle class, and 54% as poor. Women headed 15% of all households. The vast majority of respondents perceived that their production system was in a downward spiral in terms of standards of living and human support capacity. Needs for grain for human consumption, and money to purchase food, were increasing. Ninety-one percent of respondents indicated that traditional pastoralism could no longer support the society. There is a strong desire among the population to diversify into non-pastoral economic activities, but the poor felt they had insufficient livestock assets to diversify while the middle class and wealthy felt that a lack of information on options was their major constraint. Few households had any business interests in town. Most of the major forms of diversification focused on cultivation and petty trade. About 82% of respondents knew about local banks and 30% had used banks at least once. The Boran were interested in using banking services if they were more accessible. Informal financial institutions— outside of family loaning of livestock— were virtually non-existent. The rate of illiteracy among household helds was about 82%.

The average household lost 147 head of cattle over 17 years. The overall pattern resembled a cycle of "boom and bust" as the major cattle losses occurred during 1983-5 and 1990-1. The period 1983-5, in particular, was a time of severe drought. Cattle holdings per household appeared to ratchet downwards over the 17 years. A net downward trend was evident, from about 125 head of cattle per household in 1980 to 90 head per household in 1997. The total asset loss over 17 years totaled about USD 9,000 per household and USD 380,000,000 for Boran society at large, which was comprised of about 42,465 households. This confirmed that the economic losses due to cattle wastage and deaths has been extremely high for this society.

Factorial ANOVA were conducted to analyze eight cases of cattle herd dynamics— involving four study areas

(i.e., Yabelo, Mega, Negele, and Arero) and two classes of cattle (mature and immature). Two sets of eight ANOVA were conducted. One set dealt with the occurrence of mortality (i.e., yes or no cattle mortality happened in that year for that household) and the second set dealing with the magnitude of mortality once it occurred (i.e., if cattle mortality occurred, how great was it?). Data had to be analyzed in this fashion because there were many instances of zero mortality for households over the years and large numbers of zeros violated ANOVA assumptions. The data base for each of the eight ANOVA consisted of 14 households per study area. Results indicated that main effects of both stocking rate and rainfall significantly influenced ($P<0.05$) occurrence of cattle mortality for immatures in all four study areas, and significantly influenced ($P<0.05$) occurrence of mortality for matures in two of the four study areas. In the other two cases for matures (i.e., Negelle and Mega) only rainfall had a significant effect ($P<0.05$) on occurrence of mortality. In contrast to results on occurrence of mortality, rainfall deficits alone affected ($P<0.05$) the magnitude of mortality in seven of eight ANOVA. Significant interactions between stocking rate and rainfall on cattle mortality were only observed in one of sixteen ANOVA.

This lack of statistically significant interactions between stocking rate and rainfall, contrary to our expectations, was attributed to the great variability among households in cattle mortality year to year, imprecision with recall data, and our contention that 17 years is actually a relatively short period of time to observe some types of important, yet rare, interactions. It is also possible that other factors such as disease epidemics and periodic animal losses to insecurity complicated cattle herd dynamics and made interpretation of results more difficult.

Nonetheless, it is clear that high stocking rates and low rainfall predispose the system to an increased occurrence and magnitude of cattle mortality. This quite simply implies that high stocking rates of cattle have an economic cost in terms of the risk they pose for contributing to crashes in cattle numbers. Stocking rate is a community management factor that could conceivably be managed to diversify assets, reduce grazing pressure, and mitigate losses of livestock capital in a comprehensive risk management approach. Rainfall operates more as an uncertainty factor that influences the magnitude of animal losses. Work continues on the risk and return aspects of cattle asset management, including simulation modeling. We are also pursuing the goal of prescribing viable investment alternatives that complement livestock, and these together with livestock could yield a more risk-tolerant portfolio for wealthy, middle-class, and poorer households.

Activity 2: *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 the livestock commodities they sell. It is important to get a broad understanding of the patterns of risks. We undertook this research as an efficient and inexpensive means to canvass an exceedingly large and diverse region. Results help us to confirm or refine hypotheses and stratify sites for future, more-intensive research at the community and household levels. Our approach was to have our post-doctoral associate crisscross the study region repeatedly and solicit views of people encountered regarding identifying and ranking the sources of risk they routinely face. Although certainly subjective and non-random, the method can result in establishing the behavioral or welfare effects of risk exposure and providing reasonable information per unit effort. Data are then geo-referenced with a hand-held GPS unit. Data can then be processed as a GIS layer easily depicted on maps and incorporated into other spatial databases. Data can be analyzed for spatial patterns of risk occurrence and degree of severity.

Highlights of Preliminary Results

This work is in progress. The 82 interviews conducted by August, 1998, have yielded 219 total ranking points for 13 risk factors as volunteered by pastoralists. The ranking points reflect the number of times particular risk factors were mentioned as well as their ranking. Here data for men and women are combined, but we will segregate data by locale and gender for the final analysis. Trends in the data are interpreted to suggest that the dominant problem in the study region is food security (45 ranking points or 20% of the total), followed by poor livestock markets (39 ranking points or 18% of the total), water shortages (35 points or 16%), and animal disease (22 points or 10%). Other risks mentioned have included crop failures, conflicts and insecurity, wildlife damage to crops, and poor forage resources. It is hoped to double or triple the data base by early 1999 in year 2.

Activity 3: *Status of formal rural financial institutions serving the southern Ethiopian rangelands, led by Abraham Ndofor (consultant) with key participants including Christopher Barrett and Layne Coppock.*

Problem Statement and Approach

One basic tenet of our project is the idea that pastoralists need local opportunities to save and invest money, and that this can create a virtuous cycle of economic growth in the region. Grass-roots community credit unions are one way to

try to achieve this, because branches of national banks are often limited in accessibility. Credit unions also offer the means for communities to control the processes of savings mobilization and loans to help retain funds locally. We commissioned a short-term study by A. Ndofor, a regional expert with the World Council of Credit Unions (WOCCU), to examine the situation in the southern Ethiopian rangelands with respect to possibilities for credit union formation. The approach Ndofor used was interviewing a wide variety of pastoralists, development agents, and finance professionals over a period of two weeks. The terms of reference for Ndofor included evaluation of rural finance policy, assessment of local demand for rural financial services, and determination of whether there were social or economic features of the Boran that could mitigate against credit union formation.

Highlights of Results

With regards to finance policy the situation in Ethiopia is dynamic. Ethiopia has some credit unions already, but these are employer-based and located in major cities. There were, however, no federal laws to permit formation of community credit unions when Ndofor visited in March. Legislation was thus still required to allow formation of appropriate regulatory bodies that could oversee community credit union formation in rural areas. Ndofor noted, however, that some entities in-country were already pushing for the relevant federal legislation to be approved. Relatively few pastoralists in the south use formal financial services at present—a general ignorance on this topic prevails. Opinions were mixed concerning the utility of informal financial systems in the area. Despite these obstacles, Ndofor reported that there was a genuine interest among pastoralists and local administrators towards savings mobilization. There was also the realization that the pastoral world was changing rapidly in the south and need for financial services would arise in the near future. Although the vast majority of the local population is illiterate (see above), Ndofor concluded that there was enough of a critical mass of educated people who could manage credit unions. In addition, the Boran culture was deemed as a very positive attribute in that it gives rise to the types of cohesive community values important for successful credit union formation. Finally, Ndofor proposed a highly decentralized structure for a community credit union network that reflects the spatially dispersed nature of pastoralism. He concluded that the basic elements were favorable for community credit union formation, assuming that relevant legislation was passed. A pilot approach was recommended whereby different forms of credit union implementation could be tested and evaluated. A major initial step would also include a broad-scaled community education program regarding financial services and their uses. Constraints in livestock marketing would also need to be overcome. Periodic bottlenecks for selling livestock routinely occur in the southern rangelands, and this in turn constrains

monetization, economic security, and use of financial services provided by credit unions.

Addendum

In August it was revealed that the appropriate legislation already exists to permit community credit union formation in the State of Oromia, irrespective of federal legislation. In addition, local experts in Addis Ababa predicted that federal legislation endorsing formation of community credit unions throughout the nation would be approved during 1999.

Activity 4: *Preliminary Assessment of Policy Environments for Pastoralists in Ethiopia and Kenya, led by Jon Moris.*

Problem Statement and Approach

Understanding the policy environment for pastoralism is important because policy affects opportunities and constraints for development processes. Our approach involved interviews with decision makers and review of appropriate documentation in Kenya and Ethiopia during March to June.

Highlights of Results

General similarities between the two countries: Compared to highlanders, pastoral lowlanders in both countries have been marginalized in terms of development. They occupy borderlands which are often politically sensitive. Despite social and ecological stresses, human population growth in the rangelands has been significant. During the past 20 years a network of settlements has emerged based on continual distribution of food relief and has contributed to a "desert urbanization of the poor." General differences between the two countries: Both countries have attempted (Kenya) or are attempting (Ethiopia) to transfer more power of governance to local levels, but this has taken different forms— Kenya began with a "District-level focus" in 1984 and Ethiopia is now implementing a federal system. The Kenya effort at decentralization has waned somewhat over time, however, and most power is still found in Nairobi. Kenya has an advantage over Ethiopia in that pastoralists in Kenya have been more exposed to rural education— in some cases for over 20 years— and Kenyan pastoralists appear more aware of the commercial economy. Ethiopia is more pre-occupied with building schools and getting pastoralists to send their children to school, while Kenya's problem appears more to be finding a sustainable way to finance the existing educational operations and infrastructure and getting better performance out of pastoral children who attend school. More provision of pastoral services is provided by NGOs in Kenya compared to that for Ethiopia. Kenya has encouraged and used NGOs to help capture more external funding for development, while Ethiopia has recently been more strict with NGOs and has compelled NGOs to conform and contribute more to governmental

priorities for development. In Kenya there is somewhat less diversity in official languages used by government (i.e., Kiswahili, English) compared to that for Ethiopia (i.e., Amhariña, Oromigña, Tigrigña, English). Government in Ethiopia has been subjected to huge upheavals and change during the past 30 years, while Kenya government has been relatively stable, especially at the district level where continuity has been maintained in some rural areas for up to 70 years.

In terms of past policy interventions, there are many similarities between the two countries including: A commonly unsatisfactory experience with technical interventions in pastoral regions, which has contributed to disillusionment among pastoralists and agency personnel; overly optimistic development projections by planners; and unhappy donors. From the 1950s to 1980s development programs in both countries have commonly included grazing blocks, veterinary campaigns, range planning, water development, marketing infrastructure improvements, breeding ranches, and various forms of pastoral associations. Ethiopia has continued with large-scale range projects under the auspices of World Bank and African Development Bank financing, while Kenya has tended to refrain from such continued involvement on a broad scale, except for the Arid Lands Resource Management Project financed by World Bank. In the 1990s more typical interventions are localized, small-scale, and participatory including drought mitigation, re-stocking, women's programs, improvement of goats and camels, etc.

There is variation between Kenya and Ethiopia in the process of how policies are forwarded, debated, processed, and approved. Major policies in Ethiopia appear to be crafted in general and idealistic forms, while those in Kenya appear to be more detailed and technocratic. In Ethiopia policies appear to be used more for mobilizing a population that is still trying to learn about policy implications. In Kenya, proclamations are often highly specific about investment commitments to various sectors. Investments may not always be delivered, but the Kenyan population appears generally better informed and knowledgeable about policy implications. Ethiopia at present is more sensitive to intrusion by donors or other outsiders in debates over key policy issues, while in Kenya many draft policies and background papers are viewed as not particularly sensitive and are even prepared with donor assistance. Government structure in Ethiopia is dynamic at state and federal levels—given the massive changes in Ethiopia over the past 30 years this is not surprising. Government structure in Kenya, however, is relatively stable and even outlined in the Nairobi phone book.

Other features of Ethiopia include: A national early warning system is run by the federal Disaster Prevention and Preparedness Commission (DPPC); agricultural field bureaus, run by the various states tend to be weak and have insufficient resources; NGOs are

experimenting with local paravets, but drug supplies are a problem; the status of livestock marketing infrastructure is unclear— some resources are in the process of privatization; revenue generation occurs through annual taxation at the household level as administered through peasant associations; pastoral lands are still held by the state, but can be leased to commercial operators; government allows pastoralists the freedom to own guns; bush encroachment is a threat to carrying capacity for range livestock, and privatization is an issue commonly manifested at a local level.

Other features of Kenya include: District-based, early warning systems are coordinated from the Office of the President; the Ministry of Agriculture and Livestock Development still carries out a reduced set of technical and participatory activities at the District level; NGOs are also experimenting with paravets; status of marketing infrastructure is unclear— much has deteriorated and is no longer used; revenue generation solely by fees raised by County Councils on commercial activity; pastoral lands are still held by the state, with some group ranch legislation still in effect— uncertainty for the future of land tenure in some areas prevails; government only officially condones that pastoralists have guns if they reside near an international border; bush encroachment is a threat to carrying capacity for range livestock; and privatization is an issue more at the national level.

The lengthy process of forming new policies in Ethiopia is caused by several factors, and a "policy gap" can be problematic if it allows poorly thought-out initiatives to be approved in the interim. The lack of policy and relevant technical interventions is particularly evident for the rangelands in Ethiopia. For example, a new move towards forced sedentarization of pastoral populations or initiation of irrigation schemes may be poor choices that could be pursued in the absence of a well thought-out policy framework. In the absence of new policies, old policies of previous Ethiopian regimes would remain as defacto rules and regulations, even if they are not appropriate today. Despite a "policy gap" and a lack of operating resources, the federal and state governments in Ethiopia appear committed to redressing problems in the rangeland areas by virtue of their commitments to creating new development agency offices in the south and paying attention to problems of infrastructure and supporting institutions. Kenya's problem, in contrast to Ethiopia, is a rather poor record of policy implementation in the rangelands despite having more governmental stability and a generally greater access to operating resources and well-trained agency manpower. The few larger range projects that remain in Kenya may still not be making the most effective use of a vast amount of technical information at their disposal. Problems with banditry, infrastructural damage from El Niño, and a decline in tourist revenues have recently hurt Kenya and have probably contributed to more isolation and

poverty stress in the northern rangelands. The once impressive governmental services in the range sector still appear well-staffed, but operating resources to make good use of trained manpower are increasingly scarce.

Some issues that merit more attention as avenues for new initiatives in both southern Ethiopia and northern Kenya include consideration of how to sustain and strengthen local-level, decentralized development agencies, user associations for water supplies, other forms of grass-roots community mobilization, locally supported paravets, and alternative approaches to existing disaster early-warning systems. One fruitful area of applied research could involve study of how economic policies influence pastoral behavior at international borders, especially when those borders are like the one between southern Ethiopia and northern Kenya that bisects a functioning market space. How government can best achieve its goals and improve the welfare of locals with instruments such as exchange rates, duties, taxes, etc, could be illuminating.

Major unresolved policy issues for Ethiopia may include: (1) How to improve food security in the lowlands; (2) how to mitigate resource degradation in semi-arid range sites, especially in the form of bush encroachment; (3) how to train and retain more talented personnel in the public sector, and encourage more talent to reside in rural locations to better serve the rural population; (4) how to engage more pastoralists in obtaining formal education and making rural education sustainable; and (5) consider other equitable forms of revenue generation for rangeland areas. For Kenya, major unresolved policy issues may include: (1) dealing with how to improved the security of land claims, rural people, and rural commerce; (2) rehabilitation of infrastructure; (3) reconsidering how formal education can best meet changing needs of pastoralists; (4) how to limit and redress environmental degradation and growing poverty associated with rangeland towns and settlements; (5) how to retain talented public sector personnel, as above; and (6) consider other forms of revenue generation, as above.

Activity 5: *Marketing Perspectives for Pastoral East Africa— Price Dynamics and Trader Networks, led by Deevon Bailey, Peter Little, and Christopher Barrett with key participants including Francis Chabari, Hussein Mahmoud, and Sheila Nkonge.*

Problem Statement and Approach— Price Dynamics

The ability of pastoralists to market their livestock products in a timely fashion and at a fair price is essential for improving risk management at the household level, permitting an economic climate that fosters monetization, savings, and 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

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. We have initially addressed this component by commencing on a literature review of livestock and grain marketing for pastoral regions of East Africa. This review will identify areas where additional research is needed to answer questions about how price discovery occurs and the role of infrastructural constraints in market function. Another result of the review will be determination of revised theoretical frameworks and novel modeling applications. We have also embarked on an empirical analysis of livestock price dynamics and rainfall patterns 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.

Preliminary Results—Price Dynamics

The data base for northern Kenya consists of over 63,000 records. Records include price data for cattle, camels, sheep, goats, donkeys and poultry collected at four markets (i.e., Dagoretti, Kariobangi, Marsabit, and Moyale) during the period 1993-7. We also have monthly rainfall data for Moyale and Marsabit for the period 1991-7 and quarantine records since 1990. We will examine relationships among market throughput, prices, rainfall, and quarantine restrictions.

Our initial analyses indicate a high degree of week-to-week price variation for livestock in these markets. This means that pastoralists face considerable price risk when they take their animals to market. Price differences among markets on similar dates are also extremely variable, indicating that there are additional price risks involved when livestock are moved over long distances. Such levels of price risk almost certainly affect marketing decisions in the study region.

Problem Statement and Approach—Trader Networks

Virtually no detailed studies have been conducted concerning livestock marketing chains linking northern Kenya and southern Ethiopia with a terminal market in Nairobi. A preliminary survey was therefore conducted by Hussein Mahmoud under the supervision of Peter Little during August, 1998, to clarify trader networks, market through-puts, and marketing risks. Mr. Mahmoud visited markets in Nairobi, Isiolo, Marsabit, and Moyale and conducted 20 structured interviews with traders as well as visits with government officials and various NGOs. He also collected secondary data on livestock and grain marketing, veterinary services and quarantines.

Preliminary Results— Trader Networks

Livestock trade is a very important aspect of the economy of northern Kenya and southern Ethiopia. Moyale is a key livestock and agricultural market that serves as an important daily outlet for both agricultural products and livestock from Ethiopia. In 1996, 33,500 cattle and 15,700 goats were exported (with veterinary permit) from Moyale to Nairobi— perhaps another 5,000 head of each were trekked to Isiolo avoiding veterinary requirements. In 1997, the various influences of El Niño served to reduce cattle and goat exports from Moyale by 60% and 39%, respectively, compared to the previous year. Conversely, however, the prolonged rains of 1997 appeared to boost crop production in the vicinity of Moyale, Sololo, and Marsabit. Most cattle for the Nairobi market come from southern Ethiopia, while most of the goats come from northern Kenya. Isiolo may not play a critical role in the regional livestock trade as once thought. Rather, livestock for Isiolo markets tend to be procured locally (including from lowland Samburu) and then re-distributed to Nanyuki, Nyeri, and Nairobi. Livestock originating in Moyale and Marsabit tend to by-pass Isiolo and head straight for Nairobi markets. Transport costs for livestock from Moyale to Nairobi are very high, and represent up to 15% of the original purchase price. For example, it can cost Ksh 40,000 to transport 18 head of cattle. Profitability is also reportedly threatened by excessive County Council fees, bribery, and unpredictable prices in Nairobi. Animals which are trucked or trekked long distances are at risk of morbidity or death. Market bans due to foot-and-mouth disease quarantines persisted up to six months in a few cases during the period 1992-8, which further contributes to marketing risks. In total Baringo and Samburu may export only 14,000 cattle per year, but export of smallstock may exceed 45,000 head per year. Nairobi is an important market for smallstock, while Nakuru and Laikipia are important outlets for cattle. Trading networks are often defined by ethnicity. Boran procure cattle in southern Ethiopia and get them to Moyale, while Burji traders (numbering 50 to 70), Garre, and a few Gabra are more involved in the livestock trade between Moyale and Nairobi. Many Burji traders have also diversified into trucking and wholesale operations, but most are also illiterate, know little of formal financial services, carry lots of cash when transporting animals, and thus are susceptible to robbery. The Isiolo trader network is dominated by Boran, Garre, and Issaq. The Boran tend to procure livestock locally for market, while the Garre can operate far to the north and northeast. The Issaq are the wealthiest traders who have worked in the area for the longest time. The Issaq are also diversified into other endeavors, including hotels, farming, wholesaler enterprises, and ranch fattening of beef cattle. Some Boran and Meru traders are involved in moving livestock from Isiolo to Nairobi.

Activity 6: *Economic Diversification and Risk Management among East African Herders— A Preliminary Assessment, led by Peter Little with key participants including Barbara Cellarius.*

Problem Statement and Approach

The general social and economic literature postulates that economic diversification is a key component of risk management. We wanted to further explore this critical concept by conducting a thorough review of pastoral literature and secondary data for East Africa. Specifically, it was of interest to evaluate the influence of a number of key variables on the extent to which economic diversification occurs among pastoralists. These variables included: annual rainfall, ethnicity, ratio of pastoral to non-pastoral income sources, type of non-pastoral enterprises, income source by herder wealth category, gender, "other" indicators of income flows (i.e., food aid transfers), human population density, per capita livestock holdings, distance to urban centers, and effects of time.

Preliminary Results

Our review resulted in the following conclusions: (1) Cultivation generally allows herders to better manage risk in more favorable agricultural areas, but in less favorable (i.e., lower rainfall) areas cultivation can actually increase risks and result in localized environmental degradation; (2) per capita livestock holdings are a good predictor of pastoral diversification— the lower the holdings the greater the degree of diversification; (3) human population density is also a good predictor of pastoral diversification— the higher the density the greater the diversification; (4) agroclimatic data can help determine certain patterns of diversification, but spatial relations (i.e., distance to markets and urban pastoralists via trading also seems to be an important element of diversification since the 1980s. Rapid growth (i.e., >10% per annum) of market towns such as Marsabit, Isiolo, and Maralal reflects the increased importance of trading in the study region.

We also found several gaps in our understanding of economic diversification among East African pastoralists. First, there is a lack of detailed information on intra-household resource allocation and how women are influenced by opportunities in the non-pastoral sector. Second, there needs to be more work on the risks and returns of non-pastoral investments, particularly education. Third, the literature raises a series of questions attempting to link economic diversification and risk management with spatial proximity to things like urban centers and roads, but provides little analytical treatment. The GL-CRSP can address all of these gaps in subsequent research.

Activity 7: *Spatially Explicit Archive (Atlas) of the Study Region, led by Paul Box with key participants including Chet Olson, Akiko Ogawa, and Kevin Smith.*

Problem Statement and Approach

Assessment of risk management needs and options is greatly facilitated using a broad, spatial perspective. Recent advances in Geographic Information Systems (GIS) technology allows us to effectively incorporate spatial display and analysis in our project. We first wanted to begin to create a GIS template for the study region and incorporate a spatially explicit, simulation modeling environment that will operate on the GIS template. The idea is to use the GIS template 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 previously. Lastly, the GIS template can serve as means to conduct macro-level spatial and economic analysis. Mechanistic models depicting pastoral herd dynamics over space and time can operate on the GIS template.

Preliminary Results

A series of GIS files have been located and compiled from standard public locations. The GIS layers compiled for a base map include: (1) country boundaries; (2) water bodies (lakes and oceans); (3) rivers; (4) major cities; (5) roads and railways; and (6) elevation (for shaded relief). Coding requirements are currently underway for the multi-agent simulation environment— the system should be ready for pilot exercises by November. The geo-referenced risk mapping data is being added as a layer to the GIS template as an ongoing exercise.

Activity 8 and 9: *Land Use, Land Management, Risks, and Property Rights in Southern Ethiopia, variously led by Brent Swallow, Nancy McCarthy, Winnie Luseno, and Michael Kirk with key participants including A.B. Kamara.*

Problem Statement and Approach

Property rights— the rules that determine who can use resources and how they can be used— help shape the way that people use land and livestock. Currently, in much of sub-Saharan Africa grazing lands are primarily governed by common property regimes which allow people to pool and reduce risks associated with variable forage production. The specific aims of this activity are to: (1) better understand grazing management under different property rights regimes and with different environmental and production risks; (2) identify conditions under which different development pathways are followed; and (3) identify how policy and other external interventions can assist communities to achieve preferred development pathways. The approach includes: (1) literature review; (2) development of a conceptual framework

to analyze the relationships among property rights regimes, risk, land allocation, and livestock production; (3) development of simulation models that depict short- and long-term consequences of alternative policies; and (4) conducting field research in southern Ethiopia to examine relationships and test hypotheses. This report focuses on a review of land-tenure policy in Ethiopia, predictions of analytical models, and some initial field results.

Some clarification on field procedures is warranted. Forty ardas (communities) were selected in the Borana region to field test predictions from the analytical modeling. These were selected from the six districts of Yabello, Mega, Arero, Negelle, Teltele, and Moyale. The main criteria for sample stratification were the average and distribution (CV) of annual rainfall (in mm) for data collected from 1992-7. Mean rainfall varied from 873 mm (Arero) to 353 mm (Demballa Wachu). Coefficients of variation (CVs) were not necessarily correlated with mean rainfall, as is commonly the case elsewhere— CVs ranged from 67% to 23%. They wanted to distribute the 40 sites evenly among four cells. The cells would vary in terms of mean rainfall (high or low) and variability (high or low). A 12-page questionnaire was used as the community level survey using participatory rural appraisal (PRA) methods. A GIS Spatial Characterization Tool and field surveys were used to characterize ecological resources and prepare community maps. Each community consisted of two or more encampments (e.g., ollas). Marketing and price data were collected from six markets on the Borana Plateau.

Preliminary Results

A review of land-use and property rights for Ethiopia is most easily broken-out into three periods: (1) The time of the Monarchy (until 1974; referred to here as Pre Derg); (2) the time of the socialist regime (1974-91; referred to as Derg); and (3) the time of the transitional government (1991- present; referred to as Post Derg). Each of these regimes has introduced different land policies. In Pre Derg times a few, large landowners controlled a massive peasantry through tithing, verbal lease arrangements, and sharecropping. In Derg times rural land was nationalized and programs involving creation of a socialist agrarian society prevailed— individual transfer of land was prohibited. The current regime has moved relatively slowly on changing land tenurial regimes. At present there is a policy mix— it is generally proclaimed that land remains under national ownership, but some inheritance rights are now respected and commercial privatization is encouraged in some cases. To a large extent pastoral land use in the south has remained unchanged over many generations, and relatively unaffected by change of government in Addis Ababa. One exception has been the creation of Peasant Associations (PAs) in the 1970s, which sometimes complimented, or conflicted, with traditional decision-making processes. In some cases private access to land can be granted through

PAs, which circumvents more conservative judgements by traditional pastoral leaders. It is contended that there is a growing trend of privatization on the Borana Plateau— annexation of communal land for cropping and pastures is the main form this trend takes, and some attempt to examine this issue— and the threats it could pose to the pastoral way of life— needs to occur.

A conceptual framework of how climate risk is related to land use patterns and enterprise choices under alternative social structures and tenurial regimes was established using analytical and simulation modeling. This effort yielded some predictions which could be field tested. Two of these predictions, for example, include: (1) in the absence of perfect social cooperation, a decreased climate risk (i.e., reduced annual variability in rainfall) should lead to higher stocking rates and lower profits per household with a specter of overstocking; and (2) conversely, in the presence of perfect social cooperation, a decreased climate risk should lead to lower stocking rates and higher profits per household. There are seven other hypotheses from this work that examine interactions among other socio-economic and environmental variables and their expected outcomes in terms of livestock management and property rights regimes.

Field data documented ecological and production characteristics for each of the 40 ardha. There were 199 olla comprised of 3,141 households. About 74% of households were headed by males, and 12, 21, and 66% of households, respectively, were characterized as wealthy, middle-class or poor. Cattle added to over 64,000 head and comprised 91% of the livestock biomass. Communal land overall added to 75% of the areas surveyed, while privatized land made up the remainder. Most (nearly 17 percentage points) of the privatized land was used for cultivation. Thirty-two of the 40 communities were involved in cultivation. Cultivation has increased from 1.4% of the land area to 17% in some cases by 1997. These data are currently being used to parameterize econometric models to test relationships among stocking rates, land use, property rights, and management institutions as mentioned above.

Gender

We recognize the key role that women can play in carrying out applied research and outreach. We also recognize the importance of women and youths in our target population of beneficiaries when designing our field investigations. Gender dimensions of our project are thus reflected in terms of : (1) how our team is organized; (2) the research questions and issues being pursued in the field; (3) how training benefits are allocated; and (4) the types of people who are participating in our outreach activity. Examples follow below.

First, we have two female scientists on our team, namely Dr. Cheryl Doss of Williams College and Dr. Nancy McCarthy of ILRI. Both are economists.

We are studying risk at various hierarchical levels. These include the regional, subregional, community, household, and individual levels of resolution. There can be important variability in risk exposure at each of these levels. Issues of gender and age can influence variability in risk exposure, particularly at the levels of the individual, household, and community. Females and youths may be unduly exposed to risks by virtue of their relative lack of social and economic power in these societies. Females and youths can be among the first casualties of severe socioeconomic or ecological perturbations. For example, it is well known that perturbations involving drought or insecurity in our study region often result in female-headed households being established nearer to towns and settlements. These are often the poorest households with few, if any, assets. Women from such households are commonly those who are initially forced to diversify their income-generating activities to survive, including marketing of dairy products, incense, firewood, etc. They and their families are especially vulnerable and will receive special attention during the course of our project. In the household economics study by Desta, women were found to be the heads of almost 14% of Boran households (i.e., 1,583 households out of 11,562 censused within a 30-km radius of four towns), and 83% of these female-headed households were found to be relatively "poor" on the basis of livestock holdings. In the risk mapping study by Smith, risks as identified and ranked by women are held separate from those of men to see if varied patterns ultimately emerge.

We have given support to two female trainees in year one, both of whom are working on master's degrees associated with the Agricultural University of Norway. Their thesis topics are described in a following section under training. These women are Tihut Yirgu Asfaw (Ethiopian) and Kirsi Saaristo (Finnish). We are always on the lookout to recruit women for training opportunities.

For our outreach network we have included 25 organizations from Ethiopia and 27 from Kenya. Senior women represent five of these organizations in Ethiopia and four in Kenya.

Policy

We have several goals for involving policy makers in our project. The first goal is to build a general awareness that we exist. A second goal is to "go on the offensive" regarding a few key issues and bring policy makers into that loop. A third goal is to actively involve some key policy makers in the decision-making process for our project.

We have identified policy makers either via the survey by Moris (above) or through an iterative process in our outreach activities.

For the first goal, we made a couple thousand copies of a color brochure that described the project, and have liberally distributed these to a wide variety of

decision makers at local, national, and regional levels. Also for the first goal, we have included key decision makers as "information participants" in our outreach activity. Information participants receive hard copies of outreach workshop deliberations and are always invited to attend.

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. This gets them involved at the beginning. A good example is inviting leaders of the Oromia State Bureaus for Research Coordination and Cooperative Promotion to co-chair outreach workshops in Addis Ababa.

Outreach

Our outreach targets are gradually evolving. Overall, we currently have two main outreach goals: (1) empowering pastoralists and agropastoralists within our study area to better manage the risks they face 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 started to address the first goal through outreach activities. We currently have a network of 25 organizations in Ethiopia and 27 in Kenya. 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, in Ethiopia the workshop participants agreed that out of a broad spectrum of choices, the risk management priorities should be: (1) conflict mitigation; (2) public education; and (3) benefits-oriented, cooperative formation. Improved focus on these topics is what will be striven for by workshop participants at their specific localities. A similar effort will be conducted for Kenya before the end of 1998. The next step in year 2 is to create an outreach component on the GL-CRSP that is independent of core funding for the applied research, and acts regionally to unite outreach across southern Ethiopia and northern Kenya. This outreach component will be a coordination arm to harmonize efforts of outreach participants at each locale to

achieve improved risk management capability across the region.

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. This has been identified through field reconnaissance and analysis of livestock marketing data. If this road were to be up-graded, numerous benefits would accrue to livestock markets, security, rural investment, etc. Another issue identified this 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. Other issues are pending for year 2. These 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.

To complete outreach for year 1 we also established a web page that outlines activities of the project and provides trip reports, training announcements, and other documentation for members of our outreach group in both Kenya and Ethiopia.

Developmental Impact

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 agropastoralists. 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 agropastoral households. Mitigating poverty would then reduce the specter of poor people being engaged in destructive activities such as charcoal making, harvesting of green fuelwood, 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 agropastoral 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 agropastoralists to save and invest outside of their traditional sphere, the resulting investment surge for education and entrepreneurial activity in towns and settlements should 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 US 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-emminent 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 specter 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 some nine host-country nationals during year 1 (described below). Outreach will primarily have impact on project beneficiaries— pastoralists and agropastoralists— but it will also have impact on development professionals and their organizations that link to us directly. In the training sphere our contributions have also included computers, books, and other technical materials to our main academic partner in Kenya, Egerton University.

Collaboration with IARCs and Other CRSPs

We collaborate extensively with the International Livestock Research Institute (ILRI) in both Ethiopia and Kenya. We hold our workshops at ILRI conference facilities. Some administrative and logistical support 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. We also have links to the BASIS CRSP. Dr. Peter Little, a Co-PI on the GL-CRSP, is a PI on the BASIS CRSP. The GL-CRSP and BASIS CRSP share an interest in policy and economic issues that deal with border relations.

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 a recent outreach workshop in Addis Ababa, one conclusion was that the GL-CRSP should help outreach partners find a means to help pastoralists form their own cooperative associations to spur development processes— the idea being that a local association would 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 handle their own 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 agri-business, 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 incipient, but good, 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 Ph.D. 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 outreach as well as research. Research will therefore will 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 4,000 this year to our project in accommodation costs. Egerton University has contributed about USD 7,231. This includes one month of salary support for both Aboud and Lusenaka (total = USD 1,631) and 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 starting in September. Our grand total leveraging in-region is thus USD 11,231. A new project at Utah State University led by Dr. Paul Box entitled "A GIS-Based Cellular Automata and Individual-Based Model Simulation

Environment" is briefly described below. This provides leveraging of another USD 19,200. Another older project at Utah State led by Dr. Layne Coppock funded by the USDA Sustainable Agriculture Research & Extension (SARE) program is entitled "Public Land Grazing Permittees Under Pressure: Sustainability of Coping Strategies on Private Lands" is briefly described below. It has been funded at USD 20,000 per year for three years. The grand total leveraging is thus USD 50,431 for year 1, equivalent to 16% of our core funds from the GL-CRSP.

Our project is linked to other projects 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 393 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 Training

(Note: The list below includes graduate students and post-doctoral associates who are receiving full financial support from the GL-CRSP, as well as those who receive various forms of partial support. The list also includes graduates and undergraduates who have assisted with literature reviews, data analysis, and related tasks in the form of special projects).

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

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

Kirsi Saaristo. MA. Graduation in 1999. Rural economic developement. Norwegian Agricultural University, Norway.

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

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

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

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

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

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

Sheila Nkonge. BA. Graduation in 2003. Business Administration. Utah State University, Logan, Utah, USA

Chet Olson. BA. Graduation in 1999. Geography & Earth Resources. Utah State University, Logan, Utah, USA

Akiko Ogawa. MA. Graduation in 2000. Geography & Earth Resources. Utah State University, Logan, USA.

Barbara Cellarius. PhD. Graduation in 2002. Anthropology. University of Kentucky, Lexington, Kentucky, USA.

Kevin Smith. Post-doctoral associate. Finishing in 1999. Economic Anthropology. Department of Rangeland Resources, Utah State University, Logan, Utah, USA.

Short-Term Training (research and outreach workshops)

Preliminary Research Planning Workshop on Risk Mapping and Associated Field Topics, held at Utah State University, Logan, UT, February 16-26, 1998. The purpose of this was to provide a framework for the field work to be undertaken by Dr. Kevin Smith, a newly hired post-doctoral associate. Attendees were primarily GL-CRSP team members including Coppock, Smith, Barrett, Little, Box, Bailey, Desta, and Moris and advisory board member Adams.

First Project Planning Workshop, held at Egerton University, Njoro, Kenya, June 18-22, 1998. The purpose of this was to review initial progress in field research, review the proposed master's-level training program in the Department of Natural Resources at Egerton (that would supply students for our field work), and do a review of possible field sites in Baringo District. There were about 27 people in attendance at the workshop sessions held at the Egerton campus. The Kenyans were mostly represented by key administrators and faculty, staff, and prospective graduate

students from the Department of Natural Resources. Team members of the GL-CRSP in attendance included Coppock, Barrett, Little, Smith, Moris and McCarthy.

First Outreach Workshop for Ethiopia, held at ILRI, Addis Ababa, Ethiopia, August 18, 1998. The purpose of this was to review progress in field research and have the outreach group set risk management priorities for intervention in southern Ethiopia. There were 21 people in attendance. Team members, students, and field assistants of the GL-CRSP in attendance included Coppock, Smith, Tihut Yirgu, Kirsii Saaristo, and Shanu Godana.

First Outreach Workshop for Kenya, to be held at ILRI, Nairobi, Kenya, December 01, 1998. The purpose of this meeting is the same as the one immediately above for Ethiopia. It was postponed from late August because of travel restrictions imposed for Kenya due to the embassy bombings. About 25 people are expected to attend. Team members of the GL-CRSP who will be in attendance for this meeting include Coppock and Desta.

Collaborating Personnel

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, Department of Economics, Williams College.

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

Mr. Abdillahi Aboud, Professor, Department of Natural Resources, Egerton University.

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

Dr. Brent Swallow, research scientist, Livestock Policy Analysis Program, International Livestock Research Institute.

Collaborating Institutions

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Fax: 254-2-631-481

Publications

We have no peer-reviewed publications ready for submission by the end of year 1. Several are in preparation, however. We have published two popular articles in Ruminations, the newsletter of the SR/GL-CRSP, during year 1. One dealt with preliminary results of the field research by Desta, while another dealt with a consultancy conducted by Ndofor of the World Council of Credit Unions.

Abstracts and Presentations

Desta, S., and D.L. Coppock. 1998. Banking livestock capital: A strategy for pastoral asset diversification in southern Ethiopia. Abstract published in the proceedings of the 51st Annual Meeting of the Society for Range Management, held February 8-12, Guadalajara, Mexico.

Integrated Modeling and Assessment for Balancing Food Security, Conservation and Ecosystem Integrity in East Africa

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Narrative Summary

This project is 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 is based upon an existing spatial-dynamic ecosystem model called SAVANNA. 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 is being implemented at Ngorongoro Conservation Area, Tanzania; Kajiado District, Kenya; and the Lake Mburo National Park in Uganda; Regional analyses are being conducted to identify areas of high and low conflicts between pastoralists and wildlife, the economic costs of conflicts and the benefits of their solutions, and appropriate policies for mitigating and preventing unfavorable pastoral-wildlife interactions in an era of rapid land use changes, human population growth, and modernization.

Ngorongoro Conservation Area (NCA) is a multiple use area where wildlife , Maasai pastoralists and their livestock herds reside under the conservation and land use policies of the Ngorongoro Conservation Area Authority. In Loliondo, Maasai, livestock and wildlife co-inhabit an area where land use is not restricted by local land use policies. The most important factors affecting land use include an increasing human population, conservation policies and disease interactions. The IMAS is being adapted to simulate historic and current patterns of land use by the Maasai and by the NCA, to represent the degree of competition between livestock and wildlife for forage and usable habitat. Long-term changes in livestock and wildlife abundances, fire, and human wood utilization will be simulated, along with their combined impacts on the vegetation and soil.

The implementation of the IMAS for the

NCA is proceeding well, through field studies, data syntheses, and modeling. We are establishing working relationships with the Ngorongoro Conservation Area Authority (NCAA), as well as NCA pastoralists. Meetings have been held with NCAA and several local authorities, numerous local Maasai herdsmen, NGO representatives and other interested stakeholders.

Reconnaissance surveys of the NCA and Loliondo District were carried out to meet stakeholders and to get a general idea of the contrast in land use patterns and land use strategies between the two areas. We are collecting socioeconomic, health and nutritional data on Maasai pastoralists.

Research

Problem Statement and Approach

Pastoralism or extensive livestock herding is the most prevalent form of land use in East Africa in terms of land area utilized. These pastoral regions also support some of the largest and most viable wildlife populations in Africa. Traditional pastoral livestock production has been highly compatible with wildlife conservation, but this compatible interaction is showing signs of disintegration in many parts of East Africa. Livestock and wildlife are viewed as competitors for limiting forage. Livestock are seen as spreading disease into wildlife, and wildlife are seen as spreading disease into livestock. Spatial components of pastoral ecosystems have been disrupted by competing forms of land use, with negative implications for ecosystem persistence.

Our first of three intensive study sites is the Ngorongoro Conservation Area, Tanzania where land use pressures have been growing rapidly. Pastoralists in the NCA share grazing areas with Serengeti migratory wildebeest and zebra. Pastoral population densities in the NCA nearly tripled 1966-1988. Many have settled, and are cultivating small plots. Increases in agro-pastoral populations have led to increased poaching, unplanned fires, and illegal. There is increasing conversion of pastoral rangelands and associated wildlife grazing areas to large-scale cultivation. Massive increases in wildebeest numbers 1960-1980 diminished NCA Maasai grazing lands. Maasai herders state that the traditional migratory herding pattern of moving down to the Serengeti plains for the wet season has been disrupted by the wildebeest expansion. Maasai cattle are now unable to take advantage of the nutritious grazing resources of the lowlands, resulting in lowered production and weakened animals which are more prone to other livestock diseases. Wildebeest transmit the fatal malignant catarrhal fever (MCF) to cattle, and other diseases such as Rinderpest, canine distemper, and rift valley fever, pose additional problems for pastoral-wildlife coexistence.

This project is addressing the different facets of the problem through the development and implementation of an integrated modeling and assessment

system (IMAS). The IMAS will be used to improve prospects for establishing an appropriate and sustainable balance between food security and natural resource conservation in the pastoral regions of East Africa. The assessment system will integrate computer modeling, geographic information systems, remote sensing, and field studies. The core of the IMAS is a spatial ecosystems model called SAVANNA. The system will enable alternative policy and management strategies to be objectively explored, debated, implemented, and reassessed. The IMAS will include empirical and data-based assessment procedures, linked to computer-based procedures, and land-use analyses. Assessments will be made based upon modeling, and participatory involvement from stakeholders at the community level. The results of the assessment will then be used by land managers and policy analysts to develop environmentally and economically sustainable plans of resource utilization.

The results of ecological changes or developmental innovations are felt primarily and most directly at the household level, in terms of changes in income, food security and nutritional status. Impacts also have to be assessed at the community and regional levels, because land-use and other decisions are often made at these levels as well as at the individual household level. A human ecology and economics component of the IMAS is being developed to address processes at the household level.

A GIS-based disease submodel is being developed and will ultimately be linked to SAVANNA. Employing a linked disease-SAVANNA model, we will predict the health consequences of alternative livestock and wildlife management strategies and disease control measures, and the relative trade-offs in terms of disease risk vs. loss of forage and animal productivity. Existing information for each disease will be evaluated to identify parameters for which data exist and those for which assumptions and estimates must be made.

Site-level studies are being conducted to assess changes in vegetation composition and abundance, and to develop a response database for ecological responses to resource utilization. Changes in herbaceous layer production and species composition are being studied in response to climate, grazing, fire, and soils.

A regional level component of the IMAS will be based upon GIS analyses. Cross-site comparisons are to be conducted among the study sites in 3 or 4 countries. More immediately, we are scaling-up to the region based upon our understanding of the varied situations in different countries and physical environments, and the distributions of such environments across the region. We are developing a regional-scale modeling initiative which will be designed to address broad-scale gradients and differences. Regional-scale GIS modeling will be used to identify areas of high and low conflicts between pastoralists and wildlife, in relation to

policies which may be causes of, or which aim to resolve such conflicts.

Studies are being conducted to determine the policy environment at both the local and regional levels, to determine how the IMAS approach might be most effectively used to effect change.

Progress

The project includes modeling, GIS analysis, remote-sensing and field-based research in three east African countries: Tanzania, Kenya, Uganda. During 1998 we emphasized research in Tanzania but also carried out some preparatory studies and networking in Kenya and Uganda which will be the research foci in 1999 and 2000, respectively.

Tanzania

Modeling, GIS, remote-sensing

A vegetation map for the NCA was created by unsupervised classification of Landsat Thematic Mapper data. Preliminary vegetation types were assigned based upon existing maps. Several additional vegetation maps were acquired from cooperators, the US Geological Survey, and from digitizing published maps. These existing maps (n = 6) of the region were plotted at the same resolution and with similar color schemes for comparison and refinement. In October, an expert in the vegetation of the region reviewed the maps. We are now finalizing the vegetation map to be used in our study.

A long term remote-sensed NDVI data are being used to trace the dynamics of vegetation in the NCA, over a decadenal time period. We have developed a spatial-dynamic visualization tool to examine this data, which produces images and animations of vegetation greenness over time and space.

Compiling geographic data layers for use in modeling the Ngorongoro Conservation Area ecosystem is progressing well. Other geographic layers (e.g., boundaries, elevation, NDVI ratios, soils, roads, bomas, water sources) were acquired from published sources or cooperators, and merged into the information system. Climatic data are in place for Ngorongoro. We continue to refine the characteristics of the SAVANNA model for the NCA. Our plans are to model seven vegetation functional groups, tracking both palatable and unpalatable grasses and shrubs. Eight herbivore functional groups will be modeled, including grazers (e.g., cattle, wildebeest) and grazer-browsers (e.g., goats, giraffe). A ninth animal functional group – predators – may be modeled as well, removing a portion of their prey in a density dependent fashion. Finally, an early version of a user-friendly interface for SAVANNA has been created. Although creating the interface and ancillary programs is complex, our experience suggests that using Microsoft Visual Basic and ESRI's MapObjects to create the integrated management system is most efficient. In the coming weeks we will be continue estimation of the values of the parameters used in

SAVANNA. Parameters controlling biomass accumulation, herbivore foraging behaviors, and soil nutrient transfer must be set, for example.

Socio-economic submodel and linkages

This submodel will address the economic outcomes of management scenarios on the pastoral population. The design of the model is rule-based which is flexible enough to incorporate various levels of market activity. For the NCA we have chosen nine strata based on three wealth groups and three elevational groups for which distinct rules may be required in the building of different household models. The model will be run at two levels: the household and at the regional scale where we can assess courser-level processes such as ecotourism. We hypothesize that there is a quantity, T, of total livestock units per person that characterizes pastoral systems. It is not clear what this value of T is, but the idea is that this increases to levels at which the operator becomes a commercial beef rancher and it decreases to the point where agropastoralism commences. The rules in the household model reflect the management decisions that are taken to aim at the target TLU per person, which may vary with wealth levels. If there are excess animals, these can be sold for cash. If there is a deficit, then animals can be bought, if there are resources to do so.

We also hypothesize a hierarchy of goals at the household level. Food requirement is first met. If there is a shortfall, then this is made up by recourse to various options, including the selling of an animal. Second, the household is assumed to manage for investment and disinvestment decisions regarding livestock. Third, there is discretionary consumption.

Human ecological field research

Research was conducted in the Ngorongoro Conservation Area (NCA), northern Tanzania and in adjacent parts of Loliondo District. A total of ten US, three Tanzanian and two Kenyan scientists and graduate students carried out field research during 1998. Some of these scientists were supported by other leveraged research programs but all contributed to the objectives of the IMAS-CRSP. Research topics included pastoralist nutrition and welfare; pastoral demography and health; land use patterns of Maasai pastoralists; livestock holdings and involvement in crop cultivation; laws, policies and customary relations that determine land use in the NCA; vegetation production and range condition; livestock condition and sales; and a survey of livestock disease patterns and prevalence. We can say that the field research program went as planned and we were able to address all objectives. However, some of our Tanzanian colleagues had difficulties getting into the field and therefore had less time in the field than we had hoped.

The majority of the field research continued into August or September of

1998 and as of October 1st, two researchers remain in northern Tanzania, completing their work. Results from the summer's research are now being compiled, so specific results are not addressed in this report.

Some preliminary results from this year's fieldwork suggests that this El Nino year had a major impact on land use and livestock condition and wildlife movements. The El Nino rains detrimentally affected livestock and crop production of the Maasai. However, relative to the previous drought year of 1996-97, the 1997-98 El Nino impact was not so severe. This year there was a high incidence of livestock disease, especially East Coast fever and calf mortality was estimated as being between 60 and 90 percent. Wildlife, especially wildebeest lingered in the NCA much longer than "usual" due to good forage conditions. Crops rotted and were washed, but last year they never sprouted. Measures of nutritional status however were similar to those which we found during more "normal" years of the mid 1990s. This suggests that the Maasai are able to ameliorate climate variability on their food supply, at least in the short run. This does not suggest however, that the Maasai are in good nutritional condition; on the contrary we have found them to be chronically undernourished. The question for the IMAS is under what management conditions can the Maasai maintain a modicum of well-being while maintaining their environment and the wildlife who live there.

Range ecological research in the NCA

Vegetation and range reconnaissance, sampling, and data synthesis were conducted in the NCA. Range conditions were deemed good to excellent partly due to the El Nino year. Data from the Ngorongoro Ecological Monitoring Program are being synthesized, to characterize biomass, species composition over time in response to climate and grazing. The biomass data will be related to satellite greenness (NDVI) data for broader extrapolation.

Disease research and modeling

An investigative survey was conducted in the NCA to determine the primary livestock and wildlife disease problems, and their potential solutions. Numerous authorities and pastoralists were interviewed. Data were gathered which will be necessary for parameterization of the disease model. A report is being prepared.

Good progress has been made on the development of a disease submodel. The model is based upon a model that was developed earlier to simulate brucellosis in American bison. Preliminary model runs have been conducted. A survey instrument has been designed to provide better information to parameterize this model.

Kenya

Field Research

Field research in Kenya was limited to one graduate student project (U. of

Nairobi) on vegetation dynamics in 1998 (J. Mworia, under J. Kinyamario).

The major objectives of this study are:

1) Study differences in vegetation structure, composition, production and associated soil physical and hydrologic status as influenced by the management approach, grazing pressure and cultivation,

2) Characterize the main factors critical to the spatial distribution and standing crop of the key forage species in the study area and the influence of land management options, and

3) Assess the potential for integrated production of livestock and wildlife under various managerial and land use conditions. The study is based in and around the National Range Research Centre (NRRC) in Kiboko.

The expected outputs of this study are:

1) Quantification of the effects of three land management strategies namely; group ranch, small scale ranch/farm and a reserve, in a semi-arid area of Kajiado on:

a. Vegetation structure, composition and population; biomass production and spatial distribution, animal feed diversity, and some soil physical and hydrologic aspects critical for sustained productivity.

2) The potential of the three management approaches to support sustained integrated wildlife and livestock production. That is, the classes and numbers of livestock and wildlife herbivores that can be best supported under the prevailing vegetation and soil status.

Modeling, GIS, remote-sensing

Major efforts were conducted at ILRI to develop a comprehensive GIS data base for Kajiado District, the main area of research in 1998-99, and for the east African region in anticipation of more regional scale research in the future. This included digitization of thematic maps and portions of the atlas of Kajiado District. A GIS technician was hired and two computers acquired to facilitate these efforts. Also at ILRI, we have undertaken the development of a socio-economics sub-model for SAVANNA. The model will be a modification of a dynamic land use model, developed by P. Thornton, to meet IMAS objectives. Thornton traveled to NREL CSU in March to coordinate his efforts with those of the SAVANNA modeling team.

Other Activities

Planning meetings were held at ILRI among US, ILRI and Kenyan scientists from the University of Nairobi and DRSRS, (Department of Remote Sensing and Resource Surveys) to specify research objectives and methods for year II CRSP research. Several reconnaissance trips were made to Kajiado District, led by M. Rainy to familiarize project scientists with the region, to gain a perspective on local problems, to identify research sites and

to make contacts with local stakeholders. In addition, Rainy has been very active in publicizing the research program with local stakeholder organizations and with individual land holders, Maasai group ranches and with the Kenya Wildlife Service, the Dutch ASAL program and with other local stakeholders.

Uganda

No research was actually conducted in Uganda during 1998 although a lot was accomplished in terms of developing local contacts and local interest in the CRSP project. This is in preparation for initiation of limited activities in 1999 and a major field effort in 2000. Dr. Jim Else, Ms. Joyce Acen and Mr. Arthur Mugishu, all of the Uganda Wildlife Authority, worked hard to get the CRSP project well integrated with other ongoing NGO research efforts (conducted by AWF and GTZ, among others) in the Lake M'buro region. They also conducted reconnaissance visits for US-based CRSP scientists to the Lake M'buro area. During these visits by J. Ellis, R. Reid (ILRI) and K. Galvin, a workshop was held with local stakeholders, including ranchers, civic leaders, research and extension agency personnel, NGO representatives and Lake M'buro National Park staff. Objectives of the CRSP project and an introduction to the SAVANNA model were provided by the CRSP scientists. Local participants reviewed problems and perspectives on wildlife-livestock conflicts in the area. In addition to the workshop, CRSP scientists participated in site visits to the Kanyaryeru Resettlement Scheme (a section of land de-gazetted from Lake M'buro National Park for agricultural settlement); local Ranches including private ranches and a government Ankole cattle breeding ranch and local farms where wildlife conflicts recently occurred. Finally, the team visited staff at Lake M'buro National Park to see firsthand the situation in the park and to get staff perspectives on conflicts between wildlife and the surrounding communities.

Gender

The end users of the IMAS include pastoralists, both male and female, 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 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. For example, if policy or management decisions are

contemplated that suggest an increase or decrease in 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 a woman and there are two other US-based women researchers involved in the project. In addition, we have a woman team member who is working in Kenya and another who is our site-coordinator for Tanzania. (Our graduate students funded on other projects, but working in Tanzania are all female). And finally, a team member and future Ph.D. graduate student from Uganda is a woman.

Policy

Work done on policy in 1998 included an assessment of the laws, policies and customary relations that determine the use of land and wildlife resources in the NCA. Interviews were conducted in Arusha and Dar es Salaam; pertinent documents were collected and reviewed. We are considering holding a one-day workshop to review policy issues impinging on east African pastoralists. This workshop will involve personnel from the CSU and Utah State CRSP projects. It will most likely take place in early 1999.

Outreach

Our outreach target for our first site, the NCA, are all the stakeholders we have previously identified. We intend to have a workshop which will demonstrate the model, show results of model output based on stakeholder problems and how to use a version of a user-friendly model. Computers and the model will be left in Tanzania for stakeholder use. The stakeholders include Ngorongoro Conservation Area Authority staff such as A. Kijasi, V. Runyoro and E. Chausi, K. Hirji and F. ole Kashe; representatives from NGOs such as AWF, WWF, and Maasai NGOs such as Inyuaat Maa and the Sanjan Development Association. Other stakeholders from the University of Dar es Salaam include I. Kikula and A. Nikundiwe. USAID officer R. Ruybal and other AID mission folks are interested in this process for possible work in other areas of Tanzania. Tanzania National Park people and Serengeti Wildlife Research Institute are other potential endusers.

Development Impact

Environmental Impact & Relevance

We are developing an integrated modeling and assessment system (IMAS) that will integrate 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. Livestock based agriculture cannot be developed in East Africa without careful consideration of environmental impacts. Since

ecotourism is a primary source of revenue for the region, and ecotourism depends on the continued viability of savanna ecosystems and the wildlife they harbor, any threat to savanna ecosystem viability would constitute a grave threat to the economic viability of the region.

Agricultural Sustainability

Livestock based agriculture, including extensive and intensive pastoralism, is highly dependent upon the natural ecosystem processes. East African rangelands are largely native ecosystems, and they have coevolved with ungulate herbivores for millennia, and with pastoral man for centuries. The continued viability of livestock based agriculture depends upon the continued sustenance of these well-adapted ecosystems over the long-term. The requisite ecological characteristics of intact pastoral ecosystems, such as ability to move over large areas and access key seasonal grazing areas must be fully recognized, and either conserved or emulated for successful combined use. Pastoralism was a sustainable land use under free access to grazing lands, but the reality is that now, land use is constrained.

The IMAS which we are developing will explicitly consider the ecosystem processes which are vital for livestock based agriculture, as well as wildlife. The IMAS is aimed at the identification of effective strategies for conserving the natural resource base that is the core of livestock-based agricultural sustainability.

Contributions to US 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 SAVANNA modeling projects of Coughenour, funded by USGS BRD and NPS 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 Grand Teton N.P., the National Elk Refuge, and 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.

Contributions to Host Country

The results of this project have the potential to have a large impact on wildlife-pastoral interactions in that judicious and sustainable management decisions for pastoral ecosystems could be made with use of the IMAS. In Tanzania, for instance, the Ngorongoro Conservation Area Authority is very interested in using the IMAS as an integral part of their management planning. Serengeti Wildlife Research Institute director sees the IMAS as

having great potential for their domain of interest. This project, should it be successfully used by stakeholders in the NCA, could be used by several other protected areas in Tanzania such as Tarangire National Park where USAID-Tanzania has management interest. In Kenya, we established an MOU with the Kenya Wildlife Service, who is interested in collaborating on the use of the SAVANNA model to improve ecosystem management and the viability of savanna ecosystems.

Linkages and Networking

This project is linked to other projects as described below. We are networking with a wide array of institutions, projects, and initiatives as evidenced elsewhere in this report.

Collaboration with IARCS and other CRSPs

The International Livestock Research Institute is a full partner in this research.

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.

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.

Leveraged funds and linked projects

Several other research projects have direct or indirect linkages to the GL-CRSP/IMAS. These fall into two categories. Some projects provide direct inputs of information and/or methodological advances to the GL-CRSP/IMAS; others are spin-offs or applications of the GL-CRSP/IMAS methodology, adapted to other ecosystems and/or other problems of a similar nature.

Projects Providing Inputs to GL-CRSP/IMAS

•1996-1998. Integrated Assessment of the Effects of Climate and Land Use Change on Ecosystem Dynamics, Stability and Resilience on the Mongolian Steppe. U.S. National Science Foundation. $400,000 for 3 years. J. Ellis, M.B. Coughenour, K. Galvin, K. Price, Principal Investigators.

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

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

Applications of the GL-CRSP/IMAS Methodology (Indirect Contributions)

•1998-2001. 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. $336,000 for 3 years. K. Galvin, J. Ellis and C. Vogel, Principal Investigators.

•1999. Integrated Modeling and Assessment for Balancing Food Security and Ecosystem Integrity in the Mara-Serengeti Ecosystem: Transboundary Ecosystem Management. $250,000 for three years. USAID/REDSO (Nairobi Office) M. Coughenour, J. Ellis, K. Galvin, R.Reid et al., Principal Investigators.

•1999-2000. Living with Uncertainty: Northern Great Plains Agroecosystems in the 21st Century. USDA. $120,000

for one year. D.Watt, J. Dodd, J. Ellis, and K. Galvin, Principal Investigators.

•1995-1999. Large Mammalian Herbivores, Plant Interactions and Ecosystem Processes in Five National Parks. U.S.G.S. Biological Resources Division. Francis Singer, P.I. $683,000.

•1995-1999. Landscape-Scale Gap Analysis: A Complementary Geographic Approach for Land Managers. U.S.G.S. Biological Resources Division. T.J. Stohlgren, P.I. $765,000.

•1995-1998. Integrated Assessment of the Effects of Climate and Land Use Change on Ecosystem Dynamics, Stability and Resilience on the Mongolian Steppe. National Science Foundation. J.E. Ellis, PI. $400,000.

•1998-2202. Spatial Modeling of Yellowstone Bison and their Environments. U.S.G.S. B.R.D. $113,000. M.B. Coughenour, P.I.

•1998-2001. Ecological Studies of the Jackson Bison and Elk Herds. U.S.G.S. B.R.D. $293,500. F. Singer and M.B. Coughenour, P.I.s

•1998. Assessing Carrying Capacity for Elk and Other Native Ungulates, and Cattle in the Owl Mountain Habitat Partnership Program Area of Northern Colorado. $50,000. N.T. Hobbs, M. Coughenour, J. Ellis P.I.s

Training

In progress

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

Jeff Worden, Ph.D. candidate 1, Colorado State University - full support.

John Mworia, under Prof. Kinyamario, M.Sc. candidate 2, University of Nairobi, Botany - support for field studies.

Yusufu A. Ndyamkama, under Prof. Nikundiwe, M.Sc. candidate 2, University of Dar es Salaam, Architecture and Lands - support for field studies.

M.S. Maskini, under Prof. Kindunda, M.Sc. candidate 3, Sokoine University, Animal Sciences - support for field studies.

Mr. Onyango, GIS/modeling trainee 2, ILRI - salary.

Peter Weisberg, Postdoctoral Research Associate, CSU - partial support.

Beginning in 1998

Joyce Acen, Ph.D. candidate 2, Ugandan, at Colorado State University, Ecology - full support.

Frank Atieno, under Prof. Njoka, M.Sc. candidate 5. University of Nariobi, Range Science - partial support.

A. Kijazi from NCAA to attend, Shortcourse on GIS and ecological modeling - ILRI.

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

Comments

We believe there is widespread interest in furthering the objectives of this approach, and we have seen it expressed by government agencies, donors, and various branches of USAID. We are encouraged also by the potential synergism that exists with other research and development efforts, and the high level of willingness of other parties to collaborate. We are hopeful that the initiative will grow through increased collaboration with other agencies, particularly with other branches of USAID. We will need a broader base of funding and other support for this effort to be ultimately successful. Early signs indicate that the collaborative approach is working, towards providing the necessary base.

Most of us, including the PI, other senior investigators, and researchers at ILRI, are full or part-time soft money research scientists, or faculty with 4.5-9 month appointments. The current limitation of a maximum of 10% of budget to be spent on PI salaries is, at best, marginally workable. This project is subsidized by other research projects or by personal time if the actual time we put into this project exceeds our income from it. We will require a significant increase in salary support in order to expand our efforts any further, into additional linked projects. The other grave problem is the large matching contribution that is expected of our university. We are likely at our maximum possible contribution, meaning we cannot take on additional funding from AID at the same matching rate. In all likelihood we will simply be unable to take responsibility for additional projects without increased salary support and a waiver of further matching fund contributions from AID. This seems unfortunate, and ironic, given the potential demand for our services.

Collaborating Personnel

United States

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

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

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

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

James Ellis, Senior Research Scientist, Associate Professor (Affiliate), Advising Faculty, Colorado State Univ., Natural

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

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

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

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

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Kenya

Dr. H.K. Cheruiyot, Assistant Director, Range Research. Kenya Agricultural Research Institute.

Jan Grootenhuis, Veterinarian Consultant.

Jenesio Kinyamario, University of Nairobi, Dept. of Botany.

Russell Kruska, International Livestock Research Institute.

Stephen Mbogoh, Univ. of Nairobi, Agricultural Economics Dept.

Michael Rainy, Explore Mara Ltd., Consultant. Representative, Ololepo Hills Grazing Assoc.

Robin Reid, Senior Ecologist. International Livestock Research Institute.

Paul Rwambo, Veterinarian.

Mohammed Said, Department of Resources, Surveys and Remote Sensing.

Philip Thornton, Agricultural Systems, International Livestock Research Institute.

David Western, Former Director, Kenya Wildlife Service.

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

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James Else, Veterinarian, Institutional Development Advisor, Uganda Ministry of Tourism, Wildlife and Antiquities.

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Publications

Thornton P K and Jones P G (1998). A conceptual approach to dynamic agricultural land-use modelling. Agricultural Systems (in press).

Abstracts and Presentations

Coughenour, M.B., J. Ellis, K. Galvin, R. Reid. 1998. Integrated modeling and assessment for balancing pastoral food security, wildlife conservation, and ecosystem integrity in East Africa. Abstract accepted by International Rangelands Congress.

Galvin, KA. 1998. Compatibility of pastoralism and conservation? How to assess management strategies in the Ngorongoro Conservation Area, Tanzania. Paper presented at the International Congress of Anthropological and Ethnological Sciences, Williamsburg, VA. July 1998

Galvin, K.A., M.B. Coughenour and J.E. Ellis. 1998. Ecology and economy of pastoral nutrition. A test case using integrated assessment in the Ngorongoro Conservation Area, Tanzania. Poster presented at Heifer Project International. 1998 Symposium on Human Nutrition and Livestock. October.

Galvin, K.A. 1998. Issues of sustainability of pastoralism in East Africa. Talk presented at the International Connections Seminar Series, Colorado State University, October.

Ellis, J. START/NAFCOM/CARPE Workshop on Land Use and Land Cover Change (LUCC) in West and Central Africa, in Accra, Ghana Nov.3-5, 1997 and presented the keynote lecture entitled "Exploring the science-policy interface: Assessing and affecting land use and land cover change".

Ellis, J. Invited Address: Pastoral Ecosystems: Human -Ecosystem Linkages. At the NREL 30th Anniversary Symposium. October 1998.

Ellis, J., R. Reid, P. Thornton, and R. Kruska. Population growth and land use change among pastoral people: local processes and continental patterns. Abstract accepted by International Rangelands Congress.

Reid, R.S., Kruska, R.L, Wilson, C.J. and Thornton, P.K. (1998) Conservation crises of the 21st century: Tension zones among wildlife, people and livestock across Africa in 2040. Paper presented at the International Congress of Ecology, Florence, Italy, 19-26 July, 1998.

Reid, R.S., Kruska, R.L, Wilson, C.J. and Thornton, P.K. (1998) Conservation crises of the 21st century: Tension zones among wildlife, people and livestock across Africa in 2040. Paper presented at the Annual meeting of the Ecological Society of America, Baltimore, Maryland, 2-6 August, 1998.

Role of Animal Source Foods in Improvement of Diet Quality and Growth and Cognitive Development in East African Children

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Narrative Summary

During the first year of the project, we initiated a controlled intervention study of school children in Embu District schools in order to verify our observational findings that animal products play a key role in the growth and cognitive development of children. In order to clarify the effects of micronutrient intake we initiated a set of nutritional interventions through daily school feedings with three types of recipes: meat, milk, or increased calories (oil) added to a basic local dish, githeri.

This first year's accomplishments included setting up a field operation in Embu District, establishment of a data management system, staff recruitment and training, pilot studies of the feeding interventions and study measurements, and baseline studies of the study sample. These activities have gone fairly smoothly, with the exception of several notable problems including a shortage of adequate transportation and a brief national teachers strike in July, which just resumed in October. The teachers were promised increased pay two years ago which has not been forthcoming.

Field Operation

An office site has been established in Embu, with three small field offices and a food preparation building donated by the rural health center in the study area. The major project supplies and equipment have been delivered to the project site and a new project vehicle was purchased a month ago.

Recruitment

Recruitment and training of field personnel and professional and scientific staff have been extensive. Field personnel are local residents, some of whom previously worked in the former Nutrition CRSP (NCRSP) study. Two nutritionists with MSc. degrees were recruited, and the Embu District Nutritionist as well as a community nutritionist were secunded to the project by the Ministry of Health, which has been extremely supportive. A Kenyan Field Coordinator has been hired, and we have also recruited and trained a field psychologist, a programmer/data manager, a data entry clerk, an

administrator, about fifty field workers covering all measurements, and the crucial food preparation staff for the daily school feeding.

Field Activities

The definitive sample of twelve schools and over 500 Standard I students and their households have been enrolled. The schools were assigned to four groups: three each assigned to a specific intervention, and one control group. The following validation studies were undertaken:

- Comparison of three food intake measurement methods;
- Pilot studies of videotaping children classroom behavior, attention and classroom quality, and activity;
- Activity of the children in the schoolyard during free play was observed;
- Pilot studies of cognitive testing and measures of attention;
- Setting up and testing of the data entry system by computer scanning of field research forms;
- Recipe development and determination of nutrient composition, as well as recipe acceptance by the children (the recipe was the local dish, githeri, consisting of maize, beans, greens and onions, with the addition of meat, oil, or milk);
- A feasibility study of large-scale food preparation, where ingredients were obtained and cooked, measured into individual bowls, transported to the schools and fed to the children, with a measurement of leftovers;
- Baseline studies included a food intake study, cognitive performance, physical activity, classroom behavior, teacher ratings of children, literacy testing, and a socio-economic survey and census of each household, along with a monthly illness (morbidity) survey. Data analysis is in progress;
- Baseline health measurements included physical examinations and health histories, stool examinations for ova and parasites, hemoglobin, smears for red cell morphology and malaria. Blood samples have been obtained for micronutrient studies (zinc, ferritin, B12, Vitamin A) to be analyzed at a later date. Urine samples were obtained for iodine determinations as Iodine Deficiency Disease (IDD), albeit mild, is present in Embu and could be an important confounder for cognitive function.

Research

Problem Statement and Approach

The original problem statement was described in two phases. In phase I we planned to implement a controlled feeding intervention study of school children to test if animal source foods, particularly meat, eaten at school each day by Standard I children (ages 6 to 9 years) improves their micronutrient status, rate of growth, school performance, attention, and physical activity and health compared to these parameters in children who receive either added milk or extra calories (oil). All feeding groups receive the local dish

githeri, a mixture of maize, beans and greens. A comparison group receives no school feeding and serves as a control group. This latter group will receive school feeding a year later. Thus between-child and inter-child comparisons will be possible.

This controlled intervention study research is of utmost importance, as the original observations of the beneficial effects of animal source foods on cognitive and school performance, activity and growth were based on non-intervention observational studies. Causality could not be ascertained, even with careful multi variate analyses, which controlled for relevant intervening and confounding variables.

In Phase II, years 3-4, we had planned to carry out a three country community-household intervention, working with livestock NGOs on an East African regional level. The approach would be to increase availability of a variety of small animal (rabbits, chickens, goats, etc.) to households in order to enhance the ability of families to increase the amount of meat in their diet and also to derive some income generation activities from the sale of some of the animals. The main targets are children and women of reproductive age, the most vulnerable groups. The NGOs would be responsible for the organization of groups of women into small credit groups to obtain the animals and to train the women in the care, feeding, management, and breeding of these animals. Our team's responsibility would be to increase the utilization of these animals for diet improvement by intensive, practical, hands-on participatory nutrition education on how to slaughter, process, prepare and cook the meat for consumption by the family. Preservation of the meat through solar drying would also be included. The NGOs would be instrumental in training community volunteers as "paravets" or community health workers for animal care and to help with the marketing of any extra meat produced after satisfying household nutritional need. We plan to collaborate with Heifer Project International and with Farm Africa as a start and would develop close ties with such groups as KARI, ILRI, and the NARS. Intervention sites would be in Ethiopia, Kenya, and Uganda.

A related project has been initiated in collaboration with the Child Health and Development Center (CHDC) of Makerere University. Our team was funded by the Thrasher Research Fund for a small two-year community intervention project in rural Uganda to increase consumption of animal source foods by rural subsistence families. We are working with an NGO called VEDCO that supplies the expertise in community organization, rabbit care, rearing, breeding, and marketing. Their focus has been on marketing of rabbit meat and income generation. The input of our team is to work in the communities with women's groups who are raising the rabbits and increase household consumption of rabbit meat through intensive, hands on participatory nutrition education. The women would develop recipes and try these out. The

CHDC has highly trained community nutrition educators. A doctoral student from Pennsylvania State University (student of Dr. Audrey Maretzki) will also work with the project to set up solar drying of rabbit meat to produce a powdered form of a weaning food supplement and meat sticks as snacks for older children. Households could store reserves and this product could possibly generate income. Testing the feasibility and acceptance of these products and their marketability will comprise the basis of a doctoral dissertation. Our team would also monitor food intake and child nutrition status - mainly growth and anemia.

In summary, the project currently involves the implementation of the controlled feeding intervention study of school children in Embu, Kenya. However, the small Thrasher funded project in Uganda retains some of the original approaches and is guided by the problem model.

Progress

The year's accomplishments include setting up a field operation in Embu District, establishment of data management systems, staff recruitment and training, pilot studies of the feeding interventions and study measurements, and a baseline survey among the study sample.

Recruitment of field personnel and professional and scientific staff has been extensive. Two nutritionists with MSc. Degrees were recruited in Kenya from the University of Nairobi, both of whom intend to use project data to obtain doctorates in Nutrition. A third Nutritionist, the Embu District Nutritionist was secunded to the project by the Ministry of Health, Government of Kenya.

We also recruited the following Kenyans: a part-time field psychologist with an MA, also interested in a doctorate; a part-time computer programmer and data manager who is from the Applied Nutrition Program of the University of Nairobi, a data entry clerk, and an administrator. Fifty Kenyan field workers covering all needed baseline and ongoing measurements (food intake, anthropometry, cognitive measures and behavioral and activity measures, socio-economic status and morbidity), and a critical food preparation staff for the daily school feeding of over 500 individuals were also hired and trained. We recently recruited a Field Coordinator in September 1998 after a long search. She is a Kenyan national with a recent doctorate from the State University of New York (SUNY) at Buffalo, New York.

A project office has been established in Embu Town, some 18-20 km from the research site, with three small field offices scattered throughout the study area and a food preparation house donated to our project by the Rural Health Center. There is electricity, running water, and outdoor and indoor cooking facilities at the "cook house".

The definitive sample comprising twelve schools and over 500 Standard I students and their households have been enrolled. The schools were randomly assigned to four groups: three each for a specific type of feeding intervention, and one as a control or comparison group. Each school has 1 to 2 Standard I classrooms per school with about 110-125 children per group.

Special attention has been given to pilot testing of the data entry system by computer scanning of field research forms rather than manual computer data entry. The data is then electronically transmitted to the USA and the University of Nairobi.

Recipe development for the feeding interventions and determination of nutrient composition has been labor intensive. The recipe comprises the local Embu dish Githeri (maize, beans, greens, and onions) with the addition of meat, oil, or milk. Taste tests in the pilot test area have been successfully carried out and the children and teachers liked the food and readily ate it.

A feasibility study of large-scale centralized food preparation was carried out. The ingredients were obtained, cooked, and portions were measured into individual bowls, pre-numbered with each child's study number, transported to the schools, and fed to the children; then, measurements of leftovers were made. This was successfully carried out for 80 children. Actual full-scale feeding of over 500 children began on August 31 with the start of the new term. The food preparation group works under the strict supervision of two nutritionists and their assistants who work from evening to 7 am in order to have the food cooked and ready for delivery for a morning feeding. To ensure quality control, exact nutrient composition, and strict sanitation and food safety, the cooking, serving and feeding are carried out under strict supervision. All food handlers have been checked at the health center for intestinal parasites and other sources of obvious infection. Hand washing with soap is required before food or utensils are handled. A refrigerator and freezer are available for food storage. Two vehicles are required to cover the food delivery to the nine feeding schools. A project feeding assistant accompanies each driver to ensure food is properly delivered and schools supplied and project feeding assistants (one per classroom) ensure that food is properly distributed and the pre-numbered bowls are retrieved and leftovers measured. Milk is served and leftovers are measured at the schools.

Unfortunately, we could not carry out the school feeding for the definitive study on half of the schools in the month of July as planned for several reasons. The project statistician felt strongly that either all of the designated feeding schools receive food at the same start date or the feeding be delayed until all the feeding intervention schools could be fed. If half were to be fed, this would upset the design of the study with some bias being introduced. Also, all of the baseline studies were not completed in all of the schools because of the brief

teacher's strike in July, which closed the schools for almost a week. Lastly, there needed to be a feeding and food delivery feasibility trial from start to finish in two pilot schools before full-fledged feeding on over 400 children was initiated. This feasibility study proved to be invaluable. Lessons learned from the report made the feeding in the main study run smoothly.

Progress Relevant to the Criteria for Evaluation

We have largely accomplished what we set out to do in the first year. Baseline studies have been completed for food intake, anthropometry, socio-economic status, health evaluations and physical examinations (see below). Blood samples were obtained for hemoglobin determinations, and blood was collected, processed, and frozen for micronutrient determinations now begun at the University of Nairobi and at the University of California at Davis. Stool examinations for intestinal parasites and blood smears were examined for red blood cell morphology and malaria in Embu. Urine samples were collected for iodine determinations at Kenyatta University Hospital. Hemoglobins were measured in Embu using the Hemacue portable hemoglobinometer.

The final study sample has been selected, and the schools have been randomly assigned to intervention groups and a control group, three schools per group. The staff has been recruited on all levels, the field psychologist, the Field Coordinator, the administrator and others, and all groups of enumerators have been trained. The total staff now numbers about seventy total, with sixty local Embu district residents and the others from Nairobi.

Under the current Memorandum of Understanding with the Kenyan Government, all project supplies and equipment such as a refrigerator/freezer, have been allowed into Kenya and a new right-hand drive vehicle purchased duty free in Kenya. Dr. Bwibo has been an excellent colleague moving activities forward, problem solving and keeping the project afloat after its first launching through his personal management of staff and funds and frequent trips to Embu to provide leadership and supervision to the field staff and field scientists. Dr. Patterson Semenye has provided invaluable part-time assistance from time to time in expediting many essential administrative and logistic details.

A Steering Committee for policy consideration and evaluation is being constituted and will be multidisciplinary with broad representation – nutrition and food security, health and health planning, and education and agriculture (livestock). The steering committee will serve in a policy advisory capacity and will consider new policy issues as brought forward by the research findings and their implications. The group will assume increasing importance as more research findings are forthcoming. We hope to convene the steering committee this coming December around the time

of the Annual Review meeting in Kenya and Tanzania.

Baseline studies took place from late May to the end of August prior to the start of school feeding. Very limited analysis of data has taken place thus far and is mainly descriptive. Baseline data were collected on the following:

- Food Intake – Twenty-four hour recall of food intake on three non-consecutive days and a one-week food frequency was carried out on each study child.
- Anthropometry - height, weight, arm and head circumference, and fatfolds (subscapular and triceps);
- Cognitive testing;
- Physical activity- observations during free play;
- Classroom organization and quality- by videotaping;
- Child classroom attention - by videotaping and observation;
- Parental literacy (tested);
- Socio-economic status of the household;
- Household census;
- Health- Physical examinations, health histories, stool examinations for ova and parasites, hemoglobin, smears for red cell morphology and malaria, serum ferritin and urine iodine determinations are in progress, and plasma samples are being stored for future analysis of zinc and Vitamins B12 and A. The above were carried out by J. Siekmann, a UC Davis doctoral student, and by Kenyan physicians, nurses, and laboratory technologists hired short-term and supervised by Drs. Bwibo and Neumann in July and early August. The above micronutrients are apt to be low when intake of animal source foods is low. An ongoing monthly illness (morbidity) survey will be carried out during the main study as illness can effect both nutritional status, food intake and school performance.

Descriptive findings from baseline studies

Selected Baseline Findings: In August and September, 1998, 535 Standard I children in the sample had health assessments. This included a health history and physical examination performed with the parent present and included past medical history obtained by a nurse, a physical examination conducted by three Ministry of Health Physicians and Clinical Officers working with Drs. Bwibo and Neumann who trained and oriented the and supervised the group. Blood samples were obtained for red cell morphology, presence of malaria parasites and hemoglobin. Blood was processed and frozen into plasma and sera for biochemical analysis, some of which has started. Urine was collected for urinary iodine levels and stool specimens were examined within a few hours for ova and parasites.This was an extremely labor intensive and very ambitious undertaking in a relatively short time. Mrs. R. Ngaruro, the District nutritionist working with us, and the provincial clinical officer were of great assistance in selecting the physicians and lab technicians from Embu Provincial Hospital, as was the clinical Officer in Charge of the Karurumo Health Center

who gave us space and staff to assist us. Although this was an expensive undertaking it is essential that we know the main confounders present which can have an adverse impact on child growth and function as well as micronutrient deficiencies. Also it is essential to know if the different experimental groups are similar in their health status prior to starting the feeding interventions.

Some Common Clinical Findings

Health Status: From health examinations, over 50% of children had enlargement of their spleen. Normally, the spleen should not be palpable below the left costal margin. In this study, over 50% had spleens palpable over 1cm below the right costal margin. This is indicative of endemic malaria. This high spleen rate was corroborated by >50% of the children having malarial parasites present in their red blood cells.

Anemia: Using the Hemacue, a highly accurate portable method to determine hemoglobin, over 30% were found to be anemic. The WHO reference for children 6-10 years old is <12gm/dl indicates anemia. With increasing altitude 1 gm is added per 1000 ft of elevation. If 11gm/dl is taken as the cut-off for anemia, then 37.2% are anemic. Below 9gm/dl and particularly below 7gm/dl is severe anemia with 7.3% suffering from severe anemia (see Chart 1).

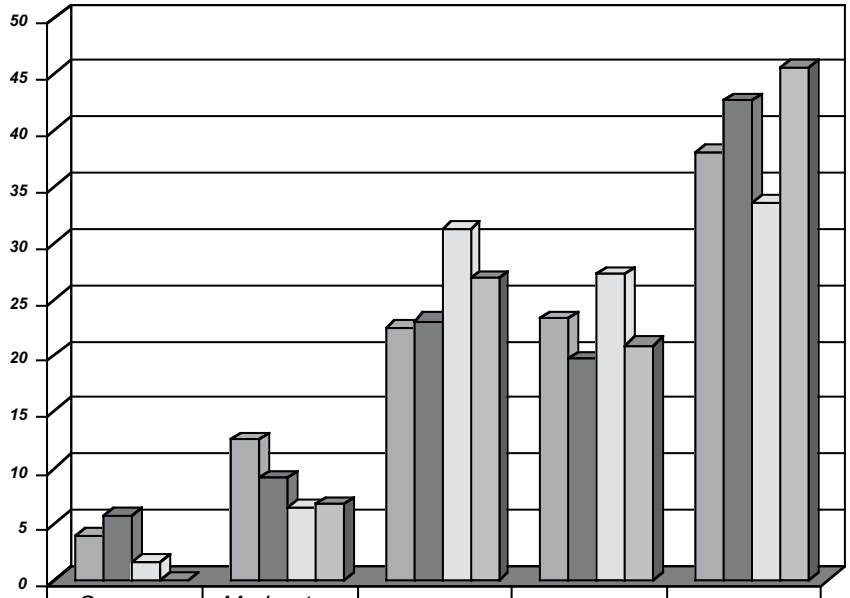


Chart 1: Anemia (by School Group)

	Severe Anemia	Moderate Anemia	Mild Anemia	Low Normal	Normal
I (n=129)	3.9	12.4	22.5	23.3	38
II (n=122)	5.7	9	23	19.7	42.6
III (n=125)	1.6	6.4	31.2	27.2	33.6
IV (n=134)	0	6.7	26.9	20.9	45.5

Based on WHO reference for children 6 - 10 years old: <12gm/dl indicates anemia when 1 gm is added per 1000 ft of elevation. **Severe anemia:** <7gm/dl; **Moderate anemia:** 7-8.9 gm/dl; **Mild anemia:** 9-10.9 gm/dl; **Low normal:** 11-11.9 gm/dl; **Normal:** 12+ gm/dl.

Malaria Parasites: Examination of stained blood smears showed that malaria parasites were seen in over 50% of children, consistent with the splenomegaly and high anemia rate.

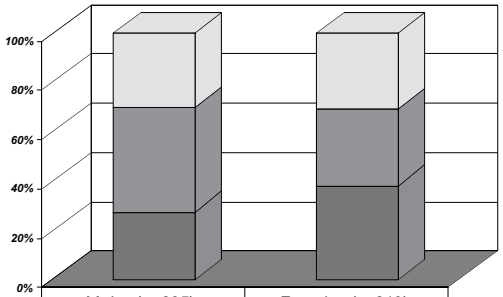
Intestinal Parasites: Examinations of stools for intestinal parasites were carried out in preparation for generalized deworming with mebendizole. Parasites were present in nearly half of the children, with the following distribution:

Hookworm	35%
Ascaris	30%
Trichioris Trichura	20%
Protozoa Omebioses (End. Histolytica)	23%
Giardia H.	20%

The hookworm contribute to iron deficiency through blood loss.

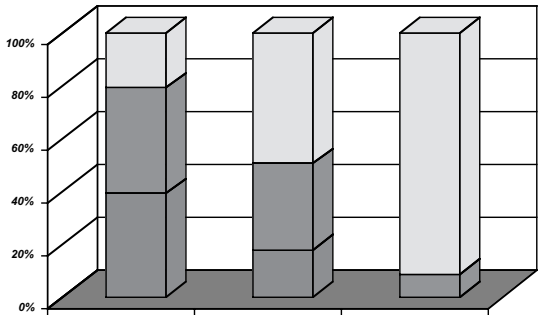
Anthropometry: Baseline height, weight, head and arm circumference (MUAC) and fatfolds-triceps and subscapular were obtained.These were analyzed by age, sex,and intervention and control group (see Charts 2-5).

Chart 2: Nutritional status (by sex) based on weight/age measurements.



	Males (n=235)	Females (n=219)
Malnourished	30.2	30.6
Mildly malnourished	42.1	31.1
Normal	27.7	38.3

Chart 3: Nutritional status (by age) based on weight/age measurements.



	6-7 Years	8-9 Years	10-11 Years
Malnourished	20.8	49.5	91.3
Mild Malnutrition	39.9	32.6	8.7
Normal	39.3	17.9	0

Malnourished:
<80% of WHO/NCHS median weight for age - moderate to severe PEM.

Mildly malnourished:
80-89% of WHO/NCHS median weight for age - mild PEM.

Normal:
> 90% of WHO/NCHS median weight for age - no PEM

*** PEM = Protein-Energy Malnutrition.*

Specific Nutrient Deficiencies Noted on Physical Exams:

- Pallor of conjunctivae and nailbeds indicative of anemia.
- Enlargement of thyroid gland (goiter) 2/500.
- Mouth angular scars - indicator of vitamin B deficiency.
- No clinical signs of vitamin A deficiency were noted.
- The majority of children appeared underweight.

Problems Encountered

One unforseen problem is the very high cost of photocopying forms for data collection. Expenditures to date now total

several thousand dollars. We are looking into purchasing our own photocopier should funds become available. Another major problem has been a shortage of transportation, now somewhat alleviated with the purchase of a new vehicle. To this end, the Ministries of Health and Agriculture of Embu District have assisted us greatly by allowing us considerable use of their vehicles; nevertheless, this has been costly as we pay for gas and repairs. Because of constant malfunction and the need for repeated expensive repairs of the former SRCRSP Subaru, we hope to replace this vehicle in 1999.

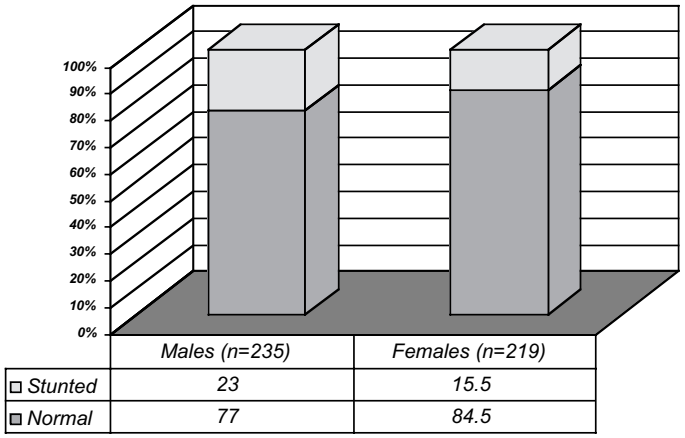


Chart 4: Height for age (by sex).

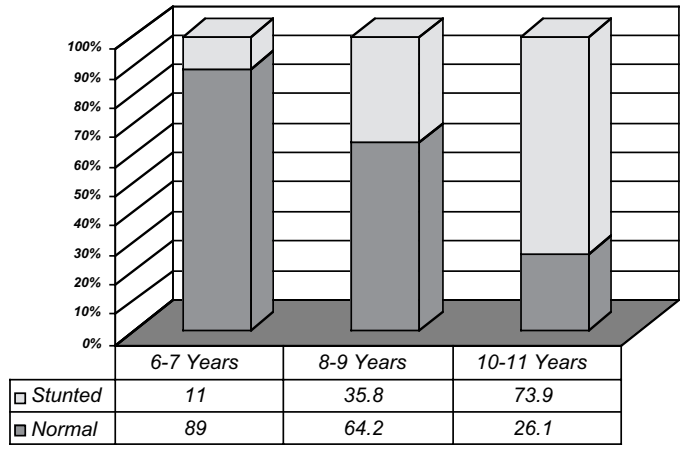


Chart 5: Height for age (by age).

Stunted: <90% WHO/NCHS median height for age

A current problem is the possiblity of a recurring nation-wide Kenyan teacher's strike. After an initial strike in May, there was a recurrance this October which lasted for over two weeks. Our team, with Dr. Bwibo, met with school administrators, head teachers, and classroom teachers, and worked out an excellent contingency plan. The team was extremely cautious so as to not appear to be "strike-breaking". The schools allowed the feeding of the Standard I children to continue at schools daily despite the strike and allowed the children to have their anthropometric measurements carried out and to have their hearing and vision checked. Also they allowed the children to play in the school yard for an hour so that activity observations can take place as usual. All other measurements (food intake, morbidity, and cognitive testing) were carried out in their homes. The only observations missing were the classroom observations and videotaping of classes in session.

Gender Analysis

The project staff positions, at all levels, are held predominantly by women. This is in large part due to the fact that most

nutritionists and child development specialists are women. Many of the women were trained in the previous CRSP study and wished to be working once again to earn income of their own. Women also enjoy working with the young school children, and are more comfortable with the home visiting aspects, wherein they obtain information on food intake and illness. The following personnel are women:

Senior level: Principal and Co-Principal Investigators (Neumann, Murphy, Sigman); Co-Investigator (Allen). These are all senior level faculty at the University of California.

The newly appointed field coordinator, Dr. Edith Mukudi, is a young Kenyan woman who just received her Ph.D. from SUNY at Buffalo in Education Development with a minor in Nutrition. Her dissertation research dealt with the interrelationship of "Education Achievement and Nutrition in Rural Kenyan Children". She holds a teaching appointment of Lecturer at Kenyatta University in the Department of Education. She has done extensive fieldwork in Embu District. She is also appointed as a Post-doctoral Scholar at UCLA.

The senior field staff resident in Embu are all women, and with one exception are all Kenyan. Three hold Masters and one a Bachelor's degree. Three are nutritionists and one is a psychologist/ educator and all but one were educated in Kenya. The nutritionists are C. Gewa, R. Ngaruro, M. Grillenberger (Germany) and M. Kamore. One of the Kenyan Nutritionists who is the Embu District Nutritionist (R. Ngaruro) was secunded to the project for its duration by the Ministry of Health. A Community Field Nutritionist was secunded to us as well to act as a supervisor for the Food Intake measurements.

The Master's level nutritionists and the psychologist plan to get Ph.D. degrees using the project to collect their dissertation data. Two hope to study at the University of Nairobi and one in Holland. The Bachelor's level nutritionist would like to obtain a Master's degree. We felt it important to recruit as many Kenyan women as possible who would assume senior positions of leadership in the University or the Government of Kenya as part of infrastructure building. The field coordinator and senior investigators also provide excellent role models and mentoring for the younger scientists who wish to carry out doctoral studies. We also have a University of California at Davis student doing her doctoral research in the project (S. Bunch) and a postdoctoral scholar from UCLA (S. Whaley) who divides her time between UCLA and Embu. These young women also serve as role models and mentors for the Kenyan staff.

In regards to the proposed policy advisory committee, Dr. Charity Kabutha, well known in gender issues, especially in Women in Leadership in Agriculture, has been a consultant and will serve in an advisory role on the steering committee. She will play an

important role when we get to a community and household intervention phase.

The field workers are village women and are learning to bank and save their salary money aside from receiving training and carrying out highly responsible work. The schoolteachers and many head teachers (principals) at the study school are predominantly women as well.

Contributions to Policy

The study that we are undertaking has, even at its early stage, already stimulated policy considerations by the GLCRSP. By studying human health, growth, and cognitive development in relation to diet quality improvement through increased intake of animal source foods, the livestock community has begun to consider a linkage of livestock production with improvement of human well-being and nutrition as one of the outcomes or impacts of improved livestock production. Increasingly NGO's, the other livestock CRSPs, and International Livestock Research Institute (ILRI) are viewing human health and nutrition improvement as a desired positive outcome. Groups such as Heifer Project International (HPI), ILRI, and some of the other SR/GL CRSPs have invited our group to speak about such linkages and the evidence for the role of animal products in improving diet quality and human function at their meetings.

By working closely with the school administrators, physicians, parents and community leaders, there has been an awareness-raising of the need for school feeding, particularly of young school children. Children often come long distances to school without having eaten, and teachers and administrators are becoming very concerned about this. As children make it through their fifth year of life, 90% survive now compared to 50% less than a decade ago, and many more children are now enrolled in primary school. Lack of food, poor nutritional status, and poor health interfere with the children's ability to benefit from their educational experience, albeit relatively brief and of limited quality.

The health assessment activities of the children have a high visibility, with parents accompanying their children and watching a health professional examining their children. They get feedback and see their children being checked for anemia, malaria and intestinal parasites, and receiving de-worming medication in conjunction with a school program. These activities introduce the community to the concept of the role for schools in health and nutrition services.

Lastly, a food-based, rather than pharmaceutical approach, is being used to improve the micronutrient content of the diet. Foods available in the community are being used for the school feeding. In the words of a speaker at a workshop on "Food-Based Approaches to Control of Micronutrient Deficiencies through Food-based Solutions" sponsored by the Thrasher Foundation

in 1997, participants were advised to "...look at their farms and not at their pharmacies..."

It is anticipated that the study will raise and call attention to the following policy issues:

- Food-based solutions to micronutrient deficiencies; particularly for zinc, iron, vitamins B12 and A, and calcium through the use animal source foods.

- The role of nutrition in learning and cognitive function: If the large investment in primary education is to realize a return, the children must be in the best condition to learn. Successful students go on to higher education and become future leaders contributing to social and economic development.

- The prevention of anemia through school-based feeding (and de-worming) will make increased physical work possible and increase the activity and learning of the children.

- Serious policy constraints that must be addressed include a lack of resources for any sustained school feeding programs, and the nationwide discontent among the organized teachers groups (Kenya Teacher's Union).

Outreach

Outreach will not receive direct attention until the third year of the study. Once the research has been completed and there are research results, then outreach will begin in earnest. An immediate goal of any outreach activity will be to make school feeding both affordable and sustainable by the community itself. There will need to be a major collaboration involving the parents, teachers, school administration and communities, women's groups, NGOs, and agricultural, home economics, and nutrition extension services. The health sector also plays a role, and the families of the children will be major players as they have already been.

Already, in the course of explaining the purpose and details of our research study, the interest and awareness for the need of school feeding has been stimulated among parents, teachers, school officials and the Ministry of Agriculture and of Health and some local NGOs. Increasing emphasis will be placed on increasing the intake of animal source foods, both meat and milk in the diet of children. The office of Nutrition and Health within the Ministry of Education are very interested in the research study.

Our vision for future outreach and extension is to emphasize community and school partnership in procuring or producing food for the feeding of toddlers and school children. Should the research findings support the advantages and "added value" of meat or other animal source foods in the diet, there would be ample opportunity for NGOs involved with livestock and other small animals to become involved in micro-enterprises involving particularly, but not exclusively, women. They would assist

households in obtaining and maintaining animals for household consumption, particularly by the children and for preservation for future use and for income generation. Parents, children and even schools could be involved on the production side through 4H-like efforts. Intensive and practical health and nutrition education of a participatory and practical nature would be needed through extension services of the Ministries of Health (Nutrition) and Agriculture. The latter would have a critical role to play in making school feeding of high quality feasible, affordable and sustainable.

Contributions to Development

Developmental Impact

The main developmental impact of this research project lies in the enhancement and fostering of human capital and future leadership potential of young school-aged children. Increased food intake and diet quality improvement, through increased intake of animal source foods, will promote better nutritional status, health, growth, and cognitive development of children and their ability to learn and be more productive adults.

The quality of life as children will also be improved so that they will be in a better condition to learn and benefit from their school experience. Record numbers of children are attending primary school in many developing countries. Governments like Kenya are investing a third of their budget (the third largest budget expenditure) in education and for the Government of Kenya and taxpayers to maximize and realize a return on their investment, children must be in a position to learn. School feeding with high quality food will also bolster school enrollment and attendance, the latter being essential for success in school. The World Bank states that "health and nutrition are equitable and cost effective interventions that contribute to human capital and social capital development".

As school feeding becomes more prevalent and the demand increases, sustainable community-based programs may evolve. School feeding will create an increase in demand for locally produced foodstuffs. Should animal source foods prove to be more effective than only cereal/legume/starchy feeds, then the demand and challenge for affordable production of animal source foods on a community basis will increase considerably, thus stimulating local production and markets.

Contributions to Agriculture

Iron deficiency and, to a lesser extent, zinc deficiency and vitamin B12 deficiencies are problems in the USA, particularly among poorer families in inner cities and in rural areas and among strict vegetarians and groups who have drastically reduced meat in their children's diets. The less severe cognitive deficits associated with iron deficiency, poor linear growth associated with zinc deficiency, and neurologic development problems associated with

vitamin B12 need to be addressed in American children as well.

Contributions to Host Country

The development target is to improve the ability of children to learn, to benefit from their school experience and to enjoy better health. This will enhance their ability to contribute to leadership roles and social and economic development of their community and nation. Kenya spends over a third of its budget on education. Better-nourished children who are not iron deficient or suffer other micronutrient deficiencies will learn better, be more physically active and in better position to learn and increase the returns on Kenya's heavy investment in education. In addition to cognitive and school performance we anticipate improvements in physical growth and reduction of anemia which will increase ability to perform physical work and therefore contribute to economic development.

Socio-economic development of a community and nation will be well served through improving the health, growth and development of its children and enhancing their ability to learn. Should the study results of the controlled intervention study establish a causal relationship between intake of animal foods and the child's cognitive function and growth, this would contribute immeasurably to policy in multiple areas - education, nutrition and health, agriculture, and economics.

Linkages and Networking

Community

This year, we employed over fifty members of the community. Community resources have been made available to the project, i.e. use of community halls, meeting rooms, and classrooms. We are "sponsored" and supported by the zonal education administration. On the provincial level, the Provincial Health Officer and the Provincial Education Officer have supported us with space, transport and office and work space at the local Health Center in the study area, and classroom work space in the schools.

Regional/National

We have full support and formal collaboration with the Ministries of Health, of Education, and the University of Nairobi School of Medicine and Applied Nutrition Program. Personnel have been secunded to us in nutrition and education.

Global

Due to the presence of this child nutrition project, livestock organizations, both governmental and non-governmental, have already started to consciously consider and even incorporate human nutrition linkages with livestock production. This has already occurred in the other GL-CRSP funded projects, which are now examining human nutrition impacts of their activities and finding a common thread of interest in looking at these impacts. This project has

been and continues to be happy to consult with the other projects in helping to select nutrition outcome indicators. In addition, an ancillary project in rural Uganda is bringing together agriculture, human nutrition, health, and education, in a child nutrition project involving household rabbit production and consumption.

Collaboration

Interaction is occuring with other SR/GL CRSP projects not only in East Africa but also in Latin America and Central Asia. The improvement in human health and nutrition through enhanced livestock production is a shared theme.

Other Contributions

Support for Free Markets and Broad-based Economic Growth

Stimulation of small animal production, production of milk and local foodstuffs for school feeding, and family diet improvement support income generation and the marketing and sale of the above foodstuffs.

Contribution and Compliance with Mission Objectives

Our project is promotive of and consistant with the revised strategic framework of USAID Agency Goal #4: "World Population Stabilized and Human Health Protected", and specifically REDSO/ESA Strategic Objective #4, that of "Improved Child and Reproductive Health Systems in East and Southern Africa".

In the context of improving diet quantity-quality and growth and cognitive development and health of children, our project will strengthen the following areas:

Intermediate Result (IR) 4.1
Strengthening of information networks and improved policy

IR4.2 Improving technical capacity of partners in nutrition assessment and promotion.

IR4.3 Improving policy in the area of food based micronutrient approaches. Importance of school feeding in relation to enhancement of cognitive function and learning.

IR4.5 Improving family diet quality through incorporation of animal source foods, particularly for your children, schoolers and women of reproductive age.

Concern for Individuals

Children who have severe anemia or any other serious condition will be referred for medical evaluation and treatment. All children will receive anti-helminthics as the prevalence of hookworm and ascaris is high. Children have all had physical examinations and health histories taken and those with problems referred for further evaluation and care. All children are having vision and hearing tested.

Support for Democracy

This project promotes democracy in several ways:

- Through membership in animal credit groups, women will obtain experience in leadership skills and be given hands-on experience in the processes of electing leaders and representatives and use the concept of majority rule. They will experience democracy in action. Also, through involvement in credit, savings, and investing they will be introduced into private enterprise.
- Improved food security, nutrition, and income generation allow community members to obtain better health and to become more active and creative participants in their communities. This leads to increased political stability, which fosters participation in community governance.
- The highly interactive and participatory style of operation of the Assessment Team has set the tone for the project teams. Decisions have been mainly by majority vote or by consensus and this will continue.

Humanitarian Assistance

Many school children in the study appear to come to school hungry. The school feeding is most welcome and is the only substantial food some children receive prior to or during the school hours. Also see the section entitle "Concern for Individuals".

Leveraged Funding and Linked Projects

A Thrasher Foundation grant for $25,000 was received for 1998-2000 for a community intervention in Uganda entitled "Community Intervention to Improve Diet Quality for Children through Household Rabbit Production and Consumption in Rural Uganda: Food-based Approaches to Preventing Micronutrient Malnutrition". The project entails a community-based approach to increase animal source food intake by households through rabbit raising. This project targets women and children in Uganda, and is a collaboration with Dr. Jitta of Makerere University's Child Health Development Center and College of Agriculture, and a Ugandan NGO, VEDCO. This NGO has already introduced rabbits into communities in Lowero District through women's credit groups, with a focus on income generation. We will introduce the nutrition education components with hands on, participatory education, demonstrations and recipe development to increase meat intake of the households, particularly of women and children. This project will address diet quality improvement through increased meat in the diet, food security, and income generation by and for women. Impact will be evaluated by nutritional food intake and economic indicators.

In addition, applications are being prepared for IDRC's micronutrient initiative, the World Bank, the Cattlemen's Association of America, the Thrasher Research Fund, and the

Foundation of Conservation, Food and Health. Visits in Nairobi are being arranged with representatives of the World Food Program, UNICEF, the Ford Foundation, SIDA, DANIDA, and REDSO/ESA.

Travel funding in the amount of $3,000 was received from the James S. Coleman African Studies Center and International Studies and Overseas Programs (ISOP) at UCLA for travel to East Africa (Kenya, Uganda) in 1998-99.

Training

All of the trainees will carry out or use project data for their dissertations. A great deal of training and retraining has gone on of the field enumerators and supervisors. Over fifty have been trained in various areas of food intake, anthropometry, cognitive testing and observations, censuses, morbidity, socioeconomic status, literacy testing, computer and data entry. These are marketable skills for future research or evaluation positions or in relevant ministries.

Degree Training

S. Bunch, Ph.D., Nutrition, University of California, Davis. Expected completion 2001-2.

C. Gewa, Ph.D., Nutrition, University of Nairobi or University of California, Davis. Expected completion 2002-3.*

M. Grillenberger, Ph.D., Nutrition, Wageningen University. Expected completion 2002-3.*

M. Kamore, Ph.D., Psychology, University of Nairobi. Expected completion 2002-3.*

J. Siekmann, Ph.D., Nutrition, University of California, Davis. Expected completion, 2001-2.

*Proposed - not yet admited

Comments

Provincial level and district level Ministries of Education, Health and Agriculture are wholly supportive of our project in Embu District and Eastern Province. They have helped with extensive use of vehicles, secundment of personnel (District Nutritionist, Community Nutritionist), use of laboratory and clinic facilities, as well as use of two houses at the Rural Health Center at Karurumo. Also physicians, nurses, clerical officers have worked short term with the project as needed. Without this assistance, the project would not have been implemented according to schedule. In addition, ILRI has been of assistance in loaning our project a vehicle for 3 weeks.

Collaborating Personnel

United States

Lindsay B. Allen, Professor, Nutrition Department, University of California, Davis.

Suzanne P. Murphy, Professor, Nutrition Department, University of Hawaii.

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Robert Mwadime, PhD, Lecturer and Researcher, Applied Nutrition Program, University of Nairobi.

Hellen Ommeh, Lecturer and Researcher, Animal Economics Department, University of Nairobi.

James O'Mararo, Chief Economist, Kenyan Ministry of Health, Nutrition, Planning and Economics

Patterson Semenye, PhD, Animal Scientist, formerly of KARI/SRCRSP

E. Shako, Kenyan Ministry of Health, Division of primary health care, Nutrition office.

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Jessica Jitta, Director and Senior Lecturer, Child Health and Development Center, Makerere University.

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Applied Nutrition Program
College of Agriculture
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Ministry of Agriculture
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Presentations and Abstracts

Dr. Charlotte Neumann has made the following presentations on "The Role of Animal Source Foods in Child Growth and Development":

- World Federation of Public Health Associations, October 1997
- ILRI workshop on Agricultural Ecosystems Health and Livestock, May 15-19, 1998, Addis Ababa, Ethiopia.
- Heifer Project International Nutrition Symposium, October 14, 1998, Little Rock, Arkansas.

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

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Narrative Summary

An innovative livestock evaluation tool designed to enhance early warning systems is being developed for East Africa. It will provide the capability of detecting changes in the well-being of free-ranging livestock six to eight weeks before they are currently being detected by the pastoralist or livestock advisor. This tool, or sub-system with respect to the Greater Horn of Africa Famine Early Warning System, involves the integration of near infra-red spectroscopy (NIRS) fecal profiling technology with advanced grazingland and crop models. Texas A&M Agricultural Experiment Station (TAES) scientists developed this technique and, to date, it is being deployed in the USA for the prediction of dietary protein/energy status of cattle, sheep and goats on grazinglands.

The foundational technology is comprised of the African 5 km^2 gridded Geographical Information System (GIS) dataset used by the Spatial Characterization Tool (SCT) which provides spatial analysis of weather, soils, terrain conditions and human and livestock populations. A network of effective environments has been established in Eritrea, Ethiopia, Uganda, Kenya and Tanzania. Sampling locations (zones) and household units have been selected within effective environments to establish a route system for collecting fecal samples and critical herd/household information. Through a consortium of scientists in Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and the International Livestock Research Institute (ILRI), university professors, NGO staff and local pastoral organizations, six validation sites were established in four of the five countries to ascertain predictive capacity of the fecal NIRS profiles for determining animal performance and model validation forage and crop production. The NUTBAL nutritional decision support tool along with simulation-modeled forage and crop production from the PHYGROW, APEX and EPIC spatially explicit modeling systems will offer a mechanism to project likely responses of animals and forage balance with 6-8 weeks advanced notice of the current

warning systems. The spatially explicit analyses will be tempered by probability analyses using an updated ENSO index for East Africa. A NIRS laboratory has been established at ILRI - Debre Zeit, Ethiopia.

A pastoral coping mechanism survey is currently underway with expected completion date of November 30, 1998. The survey is for the purpose of collecting livestock population inventories and household coping mechanisms, for the environmentally stressed periods of the 1995-97 drought and 1997-98 floods. Seven hundred (100 per site) household surveys were stratified by pastoral ecoclimatic zones, climatic clusters within zones and cattle density within climatic clusters in the arid, semi-arid and savanna zones of Ethiopia, Kenya, Tanzania and Uganda. The data, with respect to household coping mechanisms include strategies for minimizing risk and managing loss, the effects of the coping mechanisms, types of assistance provided to mitigate the effects of drought and flood and household demographics. Results from the survey will be used in the Livestock Early Warning System (LEWS) project to enhance the strategic planning of effective and timely responses to these environmental stresses imposed upon the pastoralists.

The resulting information on emerging problems will be provided to in-country policy makers, international monitoring network allowing for multi-directional flow of critical information. Timely spatial information on trends of livestock well-being allows for greater learning among pastoralists and policy makers leading to more rational decision making and reduced land degradation risk.

Research

Problem Statement

The recurrent drought and famine, followed by floods are regular features that induce limitations within the natural environment in East Africa. The chances of drought occurring in parts of the Greater Horn have increased from a probability of one in six years to one in three years for areas affected. Repeated occurrences of drought and high variability in precipitation have reduced the ability of many smallholders, such as pastoralists, to maintain their assets or respond when conditions are good. The phenomenon reduces livestock productivity and threatens food security of pastoral communities in the regions. Other natural disasters, such as pest infestations and periodic flooding, destroy area-specific production levels. Migration, as a coping mechanism, causes conflict/ethnic strife over available resources, such as grazingland and water. Crisis prevention involves the ability to foresee and the means to prevent, prepare for and mitigate, or resolve, crisis and conflict. Effective prevention requires monitoring and analytical capacity at the regional, national and local levels, as well as the ability and desire to respond to warning signs of all kinds. The current set of weather and remote sensing information generated by donor-based monitoring

programs offers information on locations of "initiating conditions" while the on-ground monitoring programs of markets, human conditions and animal herd situations reflect, mainly, a "post-effect" appraisal system. However, many of the problems besetting livestock (e.g., weight and body condition loss) have already occurred before the human eye can detect the response. Other human indicators are further down the food chain within the pastoral ecosystem and offer even more delayed post-effect monitoring of emerging crisis. Analysis of these factors supports arguments for a more effective early warning system in the region, especially as it affects livestock throughout the pastoral and mixed farming region of East Africa.

The proposed monitoring and analysis system, based on NIRS livestock fecal profiling technology and spatially referenced modeling of emerging forage/crop conditions, can add a new dimension to the existing monitoring programs in East Africa. The ability to predict responses, such as impending livestock mortality by kind and class of animal, losses in forage supply and decline in milk production allows more flexibility in decision making from the household level to the policy maker. A more timely destocking strategy will allow pastoralists to maintain their assets through crisis. It will also aid in the assurance of greater ecosystem integrity by allowing more rapid response after droughts have run their cycle. When properly implemented, the system will provide an additional 6-8 weeks advanced notice on the current early warning systems in East Africa. When linked with the suite of simulation models on animal nutrition, developed by the Center for Natural Resource Information Technology at TAMU (i.e., grazingland forage growth/hydrology and mixed farming crop models), analytical capacity of existing early warning infrastructures will fill a much needed niche. This niche can bridge distant monitoring and on-ground surveys of emerging effects of drought and other stress conditions associated with pastoralists in East Africa; thus, providing a valuable missing link-type enhancement to the mitigation process.

The challenge is to demonstrate the usefulness of these technologies, in East Africa, while organizing a critical mass of personnel and institutions for the mitigation of nutritional crises among livestock and humans and the resultant social conflicts, in a manner that provides timely and high quality information on trends in the well-being of livestock. Also, it will be demonstrated that this information can reach all levels of decision making, including the pastoralists, national policy makers and international assistance/monitoring organizations.

Approach

With respect to the LEWS project, warning signs refer to livestock nutritional well-being and forage imbalance, in a timely and appropriate

manner. A number of nutritional crises among humans and their livestock and the resultant social conflicts can be mitigated if empirical relationships between weather, livestock feed resource base and animal performance and productivity are established. One of the most innovative methods, to date, involves the systems approach being taken in this LEWS project - a supplemental monitoring mechanism that will be readily incorporated with already instituted monitoring programs. The sustainability of the system requires simple monitoring and decision support tools and active participation of pastoral communities.

The major goal, reflected in the project's approaches, is to mitigate nutritional and social crises for humans in pastoral areas, who are dependent on livestock for the majority of their livelihood. The approaches to this goal involve the development of tools and institutional capacity to predict impending crisis in livestock nutrition, in East Africa. These approaches are designed with the intent to add 6-8 weeks advanced notice on the current early warning systems in East Africa.

To establish empirical relationships between weather, vegetation and regrowth potentials, soil and climate dynamics and nutritional status and livestock productivity, tools for monitoring these components have been implemented. These same tools are also being used to establish an inventory of indicators for impending nutritional and livestock health crises. The tools include: (1) the Spatial Characterization Tool (SCT) used to assist in the characterization of the selected zones, (2) the Nutritional Management System (NIRS/NUTBAL) for monitoring feed quality from feces of the ruminant livestock and (3) Plant Growth/Yield/ Hydrology Simulation Models (PHYGROW and APEX) for monitoring herbage and crop production. For a complete description of these tools see the 1997 Global Livestock CRSP – Annual Report for the LEWS project: "Early Warning System for Monitoring Livestock Nutrition and Health for Food Security of Humans in East Africa."

Modifications

The problem approach modifications included (1) a survey to evaluate existing indigenous knowledge and coping mechanisms used by pastoral communities in mitigating drought and flood crises for the purpose of enhancing the LEWS project's strategic planning of effective and timely responses to these environmental stresses imposed upon pastoralists and (2) the participation of the Eritrean team in the project.

Pastoral Coping Mechanisms Survey

In the planning process of the LEWS project, it was recognized that a socio-economic survey at the beginning of the project would reveal critical issues and/ or constraints on technological development. Mitigating crises and optimizing early warning systems, in East Africa, requires an understanding

of the pastoralists' complex livestock production systems and inter-relationships between livestock and people, as well. Historically, livestock and household inventories had not been documented for the overall spectrum of drought, nondrought (normal) and/or flood phases.

In seven sites in the pastoral ecosystems of East Africa, community-based field enumerators are conducting the survey by personal interview with pastoralist households. The purpose of the survey is to investigate the responses of pastoralists to the environmental stresses affiliated with the 1995-97 drought and the 1997-98 floods. This survey is also setting the baseline information for the pastoral fecal profiling routes that will be designed in next year's work tasks. The survey addresses (1) the effects of the environmental phases, drought and flood; (2) pastoralists' coping mechanisms to the stresses associated with the phases; and (3) the efficacy of the coping mechanisms as perceived by the pastoralists. Livestock population inventories and household coping mechanisms in the arid, semi-arid and savanna zones of Kenya, Tanzania, Uganda, and Ethiopia are the overall categories of the survey. The data concerning livestock populations include (1) livestock herd size; (2) livestock herd situation (e.g., births, deaths); (3) livestock sales and purchases; (4) livestock nutrition; and (5) livestock diseases, conditions and treatments. The data with respect to household coping mechanisms include (1) strategies for minimizing risk and managing loss (e.g., herding, transhumant movement, and supplementary feeding); (2) the positive (e.g., survival) and negative (e.g., increased vulnerability to hunger) effects of the coping mechanisms upon the household; (3) types of assistance provided to mitigate the effects of drought and flood; and (4) demographics with respect to household (e.g., number, age, sex of the people within the household).

LEWS will contribute to a set of plans (designed to complement a variety of regional drought preparedness programs in livestock systems in the Greater Horn of Africa) for the monitoring, intervention and activities aimed at mitigating the crises of drought and flood. Results from the survey will provide the pastoralists' views, about their situation, that will be used in the LEWS project to enhance the strategic planning of effective and timely responses to these environmental stresses imposed upon the pastoralists. To assess the overall situation, two timeframes of inquiry are being used for the drought phase and three (one overlapping the drought phase – end of drought and onset of rains) for the flood phase. The timeframes are (1) prior to the drought; (2) during the peak of the drought; (3) at the onset of rains; (4) during the peak of the floods; and (5) recovery from the floods. The following locations and responsible persons have conducted 100 household surveys in each location using the SCT system to proportionally allocate the samples according to effective environments and livestock density distributions:

- Mwanza, Tanzania - Mr. S. Kaganda and Mr. A. Mwilawa
- Arusha, Tanzania - Mrs. S. Bitende and M. Kingamkono
- Mpwapwa, Tanzani - Mr. A. Mwilawa
- Kajiado District, Southern Kenya - Mr.W. Mnene and Dr. P. Wandera; Kiboko landrover renovated
- Northern Kenya - Mr. P. Kamau, Dr. R. Shavulimo and Mr. Mnene
- Mbarara, Ngaramanga, Uganda - Dr. C. Ebong and S. Beyenkeya
- Adami Tulu, Borana Region, Ethiopia - Dr. Sileshi and Abule Ebro

The coping mechanism survey, sponsored by ASARECA and funded by USAID, was designed by TAMU-LEWS team members and has been initiated with expected completion in November. A survey form with enumerator instructions has been distributed to all the LEWS in-country NAR/University team members, in East Africa. The ASARECA Crisis Mitigation Office at ILRI –Nairobi is currently entering the data into a database management application (i.e., Microsoft ACCESS) and has assigned Roger Kamidi, a statistician, to assist the TAMU-LEWS in data analysis and in the compilation of the final report.

The map below (figure 1) is a sample of the clusters where the survey scheme is being implemented in Southern Ethiopia.

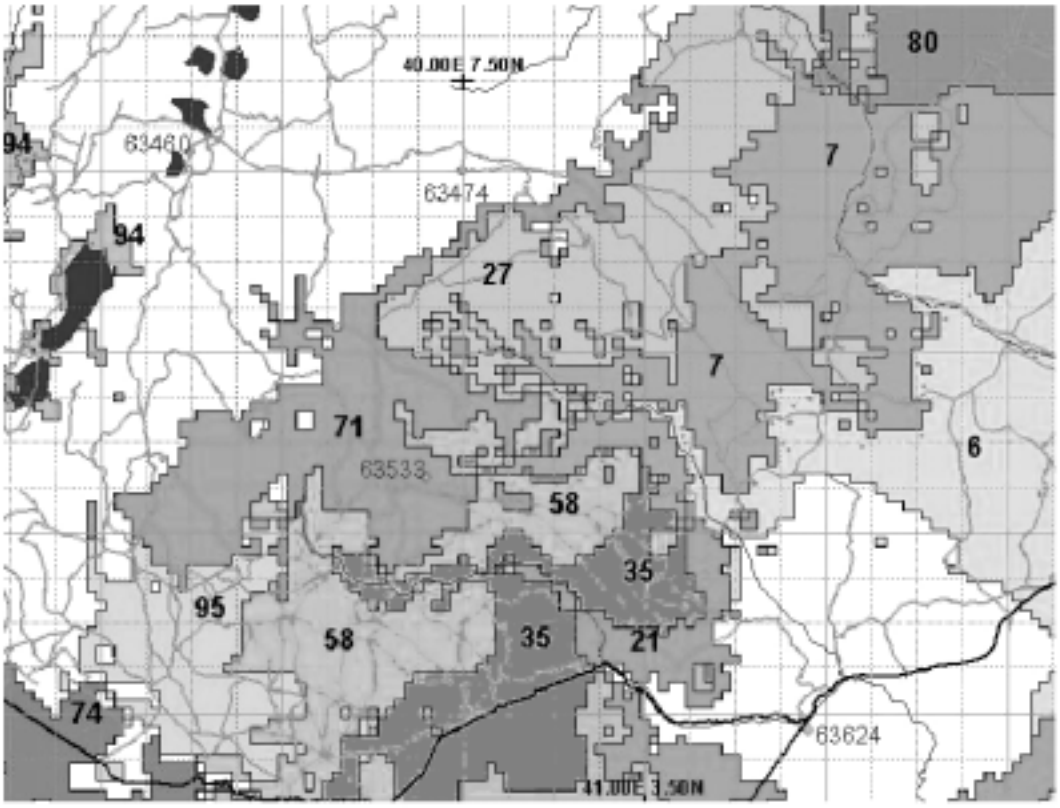

Figure 1: Climatic clusters with roads, Southern Ethiopia

Eritrea participation in the project

Contacts, institutional links, in-country representation on the LEWS team, and validation sites were established in Eritrea, as well as some dispersion of funds. However, Eritrea participation has been temporarily halted due to loss of all contact during the period of war between Eritrea and Ethiopia. Attempts have been made to contact the in-country team leaders of Eritrea as recent as October 12, 1998, from TAMU, USA and ASARECA – the Kenya team has made attempts, as well, to no avail. Thus, reluctantly, Eritrea has been excluded from the 1998-99 budget with expectations of their reentry into the program and budget in 1999-2000.

Progress

The first year of the LEWS project was dedicated to linking the parts of the program and validating the technologies and the development of diet:fecal pairs. Validation sites were established within the 5 countries of East Africa – Eritrea, Ethiopia, Kenya, Uganda and Tanzania. These sites were based on the location and the availability of personnel, facilities and livestock to allow the pursuit of the validation tasks. The purpose of the validation is to be able to measure plant growth and animal performance. Therefore, we needed to have an active plant growing period, as well as a slow growth and nearly no growth period, within the trial. Thus, all validation trials were scheduled to start at the latter part of the growing season and extend into the dry season. Most of the countries in the study experienced unusually heavy rains in 1997/98, which delayed the start of the trials as planned. Data from the validation studies will be used to test predictions from various models. The validation sites are:

Halhale, Eritrea
: Semi-arid pastoral ecosystem

Adami Tulu, Ethiopia
: Grassland Savanna pastoral ecosystem

Chemeron, North Kenya
: Arid/Semi-arid pastoral ecosystem

Kiboko, Southern Kenya
: Grassland Savanna pastoral ecosystem

Mbarara, Uganda
: Grassland Savanna pastoral ecosystem

Mpwapwa, Tanzania
: Grassland Savanna pastoral ecosystem

Site validation and paired fecal sampling trials have recently been completed or are in their final stages in all countries, except Eritrea due to a border conflict and war that erupted between Ethiopia and Eritrea. Some of the sites have already sent the data to Texas A&M University, while others are still entering their data in computers provided by the LEWS subproject. The activities in these sites included the characterization of the plant communities, livestock profile and grazing trials and diet:fecal pairs development.

For all sites, every month, measurements were completed for herbaceous plant

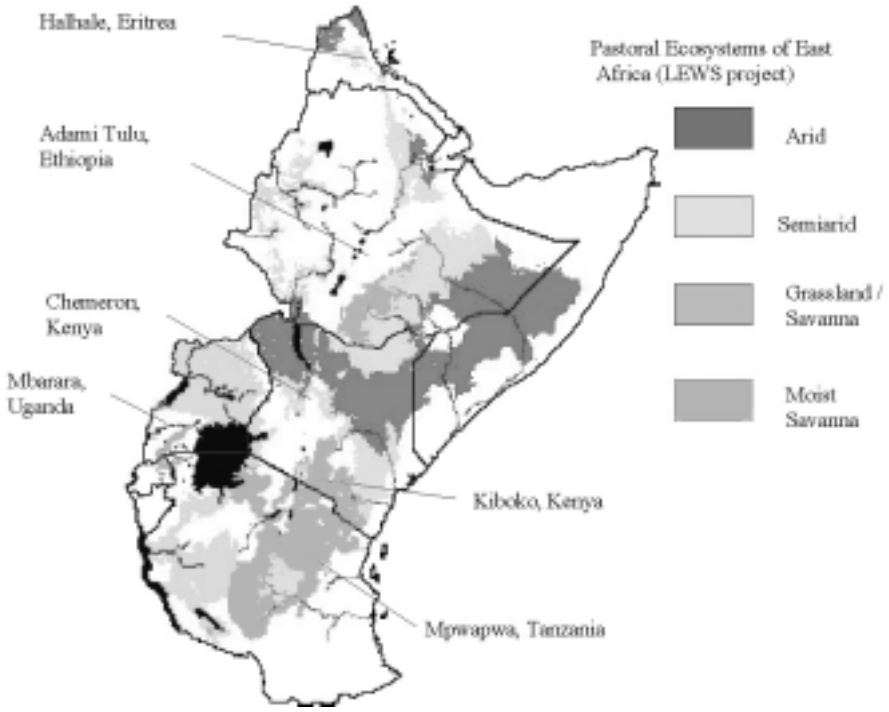

Figure 2: Validation sites and pastoral ecosystems of East Africa.

standing crop, density, cover, woody plant allometry, browse volume weights, and water adhesion coefficients for each plant species (to improve water balance component of model), and assigning preference status to the plants by growth stage and livestock species.

Characterization of plant communities

Kenya

There are two validation sites in Kenya. They are Kiboko, in southern Kenya, and Chemeron, in northern Kenya.

Kiboko

The validation site, KARI-National Range Research Station, at Kiboko, in south-central Kenya, covers about 31.5 ha (Lat. 502° 15, 212. Long. E 037° 44.092). It is dominated by Commiphora woody species and an assortment of grasses and forbs. The site was deferred from utilization for the month of December, 1997, to allow for full expression of the vegetation.

Total herbage standing crop of 15,990 kg DM (slightly over 500 kg DM/ha) recorded was believed to be enough to support the experimental animals for the planned five month study. Because there was plenty of browse and forbs, goats and sheep had more than adequate dietary nutrients. There were over 16,000 woody plants/ha with the majority (> 80%) of the canopy cover being shrubs. In 1998, abnormally high precipitation resulted in a large annual forb population.

Two structures were identified near the research center: a night holding pen (boma/Kraal) and a roofed and partitioned shed. The former is used by the validation grazing animals, while the latter is used for the diet:fecal pairsing. Both facilities were renovated. Cattle, sheep and goats were fed hand-gathered native diet mixtures and generated feces was collected. These diet:fecal pairs were sent to the GL-CRSP NIRS lab, at ILRI-Debre Zeit, Ethiopia, for processing and scanning. Each sample was split and half was sent to TAMU's GAN Lab for further analyses.

Chemeron

A validation range site (N 00° 29.297', E 035° 55.315) was identified at Egerton University's Chemeron Field Station, in the Baringo District, about 13 km west of Marigat Township, toward Kabarnet. The station is approximately 113 km north of Nakuru. The area of the site is approximately 38 ha and consists of multi-aspect slopes. This hilly terrain is mostly dominated by Acacia shrubs, with some forbs and less grasses. The dominant woody vegetation species is comprised of Acacia mellifera, A.. senegal, A.. hockii, Balamites aegyptiaca and Commiphora spp. Other vegetation species include shrubs, such as Acacia brevispica, Hibiscus micranthus, Penthas spp, Combretum spp and Acalypha fruticosa. Forbs include Hypoestis spp, Justicia spp, Aeva pinnata and Elargia spp.

Since grasses contributed less than 1% of the total canopy cover (i.e., trees, bushes, shrubs and forbs), only sheep and goats were allocated to this site for validation purposes. There were about 2,346 woody plants (mainly, trees) per hectare in the sampling site.

The GL-CRSP team from Utah State University is working in the same area with Dr. Abule, at Egerton University. Our Egerton team members are coordinating efforts with Dr. Abule to assure inter-team cooperation.

Uganda

There are two validation sites in Uganda. They are Nshara and Mbarara. These sites are located in the central part of the Ankole ranching region, which is currently undergoing restructuring of land holdings among pastoralists. The GL-CRSP/IMAS team, from Colorado State University, has co-located personnel and research with us in this region.

Nshara

The grazing validation study, for cattle, was conducted at Nshara Ranch near the Lake Mbuiro game park. The site is a 50-ha paddock on the ranch. We had to modify security for the livestock to reduce leopard predation of the calves, given the site's proximity to the game park.

Nshara Ranch is located in an Acacia Grassland Savanna zone between Masaka and Mbarara in South Western Uganda. Major tree species include: Acacia hockii, Acacia gerrandii, Acacia

seyal and Acacia siberiana. Dominant grasses include: Bracheria spp, Chloris guyana, Hyparrehnia spp, Cymbopogon afronandrus, Sporobolus spp, Cynodon spp and Cenchrus ciliaris. Legume species include: Crotolaria spp, Indigofera spp, and Stylosanthes spp. Cymbopogon afronandrus is the dominant grass species. It is unpalatable at advanced stages of growth. Bracheria spp were the dominant pasture species of nutritional significance. Others, such as Hyparrehnia spp, Cenchrus spp and Sporobolus spp are important feed resources in the dry seasons.

Mbarara

For the small ruminants, the validation study is located at Mbarara Stock Farm (MSF), near the town of Mbarara. The vegetation is similar to the Nshara site.

Dr. Ebong, Uganda's in-country coordinator, is designing a science project with the local grade schools to create the woody biomass allometry equations for the project. This science project will make contribution to the fecal profiling project, next year. Dr. Ebong has agreed to report the outcome to the entire team and suggest approaches for the other LEWS team members.

Tanzania

Mpwapwa

The LEWS team, at Mpwapwa, selected an area of 15 ha (300m x 500m) on the Ilolo farm, at the Livestock Research Institute, Mpwapwa. The institute is situated in the semi-arid zone at 900m above sea level. The average rainfall ranges from 400-650mm and varies greatly in distribution and amount from year to year. Drought years, with low erratic rainfall, are frequently experienced. About 90% of the rain occurs between December and April, with a dry spell in February, for most years. The average minimum temperature is 15.5 C, with August being the coolest month (13.8 C). The average maximum temperature is 27.5 C, with November being the warmest month (30.2 C). Generally, soils in the region are sandy loam on the slopes and clay loam along valley bottoms. Soils are low in nitrogen and phosphorus, but adequate in potassium. The topsoil pH ranges between 5.6 and 7.7, while that of the subsoil is between 5.3 and 8.6. The main tree and shrub species are: Adansonia digitata, Acacia tortilis, Acacia nilotica, other Acacia spp, Lannea spp, Sena siame, Faidhebia albida, Markamia spp, Delonix elata, Albizia spp and Combretum spp. Grass species include: Cynodon plectostachyus, Cenchrus ciliaris, Panicum maximum, Chloris gayana and Heteropogon contortus. Given the high level of rainfall during 1998, the site had a high population of large annual forbs.

SOIL PROFILE

Location:	Ilolo farm, Mpwapwa, Tanzania (06° 21¢S., 036° 28¢E)
Landform:	Alluvial plains
Parental material:	Alluvial deposits of red brown soils
Topography:	Almost flat.
Slope:	0-2%, straight
Altitude:	915 m
Soil:	Very deep, well-drained, dark red, loamy sand topsoil, over dark red and red sandy clay and sand clay loam subsoil. The site experienced a moderately rapid run-off during early rains.
A 0-10cm	Dark red (2.5YR 3/6, dry) and dark reddish brown (2.5YR 3/3 moist); loamy sand; weak to moderate, fine and very fine subangular blocky; slightly hard to hard when dry, very friable to friable when moist, slightly sticky and slightly plastic when wet; many, fine and medium pores; many, fine and medium roots; clear and smooth boundary.
Bt1 10-21cm	Dark red (10R 3/6, dry) and dusky reddish brown (10R 3/4, moist); sandy clay; moderate to strong, fine and very fine angular and subangular blocky; slightly hard to hard when dry, friable to firm when moist, sticky to very sticky and very plastic when wet; many, fine and medium pores; common, fine and medium roots; few, faint clay cutans/pressure faces; few, fine soft rounded clay nodules; few, fine and medium rounded weathered gravel (0.2 - 2.0 cm); clear and smooth boundary.
Bt2 21-58cm	Dark red (10R 3/6, dry) and dusky red (10R 3/4, moist); sandy clay loam; moderate to strong, fine to medium angular blocky; hard when dry, friable to firm when moist, sticky to very sticky and plastic to very plastic when wet; many, fine and medium pores; common, very fine and fine roots; common, distinct clay cutans; common, medium soft rounded clay nodules; few fine and medium subrounded weathered gravel (0.6 - 6.0 cm); clear and smooth boundary.
Bt3 58-96cm	Red (10R 4/8, dry) and dark red (10R 3/6, moist); sandy clay loam; moderate to strong, angular blocky; hard when dry, friable when moist, sticky and plastic to very plastic when wet; many, fine and medium pores; few, very fine and fine roots; many, distinct clay cutans; many, medium both hard and soft rounded clay nodules; very few, fine and medium subrounded weathered gravel (0.2 - 2.0 cm); clear and smooth boundary.
Bt4 96-129cm	Red (10R 4/8, dry) and dark red (10R 3/6, moist); sandy clay loam; moderate to strong, angular blocky; slightly hard to hard when dry, friable when moist, slightly sticky to sticky and plastic when wet; many, very fine and fine pores; very few, very fine and fine roots; many, distinct clay cutans; common, fine both hard and soft rounded clay nodules; very few, fine subrounded weathered gravel (0.2 cm); clear and smooth boundary.
Bt5 129-164cm	Red (10R 4/8, dry) and dark red (10R 3/6, moist); sandy clay loam; weak to moderate, angular and subangular blocky; slightly hard when dry, very friable to friable when moist, slightly sticky to sticky and slightly plastic to plastic when wet; many, very fine and fine pores; very few, very fine and fine roots; many, distinct clay cutans; many, medium both hard and soft rounded clay nodules; very few, fine subrounded weathered gravel (0.2 cm); clear and smooth boundary.

Horizon	Au	Bt1	Bt2	Btw1	Btw2	Btw3
Depth (cm)	0-10	10--21	21-58	58-96	96-129	129-164+
Clay %	16	38	36	32	36	32
Silt %	6	8	6	8	10	10
Sand %	76	54	58	60	54	58
Textural Class	LS	SC	SCL	SCL	SCL	SCL
pH(water)	6.2	6.1	6.8	6.9	7.2	6.2
pH(KCl)	5.1	4.9	5.1	5.1	5.4	4.8
EC (dS/m)	0.07	0.08	0.04	0.03	0.04	0.04
Organic C %	0.65	0.85	0.36	0.23	0.19	0.49
Total N %	0.04	0.05	0.02	0.02	0.01	0.04
C/N	16	17	18	12	19	12
Available P (mg/kg)	11.95	8.37	5.36	3.49	1.70	0.78
CEC Cmol(+)/kg soil	2.01	8.62	8.82	7.18	8.50	8.36
Exch. Ca Cmol(+)/kg soil	0.4	2.7	3.8	3.2	4.5	3.7
Exch. Mg Cmol(+)/kg soil	0.3	2.1	3.2	3.1	3.9	2.2
Exch. K Cmol(+)/kg soil	0.72	1.10	0.89	0.46	0.40	0.14
Exch.Na Cmol(+)/kg soil	0.05	0.05	0.05	0.06	0.10	0.05
BS %	73	69	92	95	100	74
TEB Cmol(+)/kg soil	1.47	5.95	7.94	6.82	8.90	6.09
CEC Cmol(+)/kg clay	12.56	22.68	24.50	22.44	23.61	26.13
BD Mg/m*3			1.60	1.54		
0 kPa %			30.6	32.8		
33 kPa %			21.1	24.7		
1500 kPa %			8.7	8.8		
AWCu%			19.8	24.5		

Table 1: Soil classification and profile, Ilolo Farm, Mpwapwa, Tanzania.

Soil classification (FAO-UNESCO, 1988): Haplic Lixisols

Ethiopia

Ethiopia has one validation site located at the Ethiopian Agricultural Research Organization Research Center at Adami Tulu .

Adami Tulu

Adami Tulu Research Center has provided 20 ha of grazing pasture for the validation study and other activities of the LEWS project. This validation site is in a Rift Valley sandy loam-ash soil, gray in color, and shallow with poor water holding capacity location. The site was fenced and deferred from grazing December, 1997, to May 21, 1998. Currently, a separate area of 16.47 ha is being grazed for the validation trial. The site is located in a grassland savanna, dominated by *Acacia tortilis*. Dominant tree species include: *Acacia tortilis (the most dominant species), Acacia seyal, Acacia mellifera, Acacia senegal, Dichrostachys cinerea, Balanites aegyptica, Opuntia spp, Acacia siberiana, Capparis tomentosa, Commiphora*

Table 2: Mean monthly and total annual rainfall (mm) for Adami Tulu validation site from 1981-1998

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1998	35.5	103.2	115.0	78.0	122.1	70.6	177.1	152.6					
1997	15.5	0.0	41.1	172.8	12.9	83.6	198.3	83.4	35.3	84.7	0.0	0.0	727.6
1996	34.3	0.4	46.4	76.1	107.3	96.7	137.3	123.3	102.6	0.0	4.5	0.0	728.9
1995	0.0	16.6	47.1	117.6	69.0	39.8	74.3	145.7	32.4	5.2	0.0	7.0	554.7
1994	0.0	0.0	15.4	16.5	38.7	209.2	111.1	439.5	118.1	0.0	25.3	0.0	973.8
1993	92.9	160.2	0.0	97.2	124.5	87.2	184.9	149.3	44.5	82.3	0.0	0.0	1023.0
1992	35.6	49.1	8.1	45.1	41.7	139.5	179.4	188.0	24.4	107.7	4.7	2.3	825.6
1991	8.8	109.1	136.8	4.3	51.2	46.6	199.6	184.9	45.5	40.0	2.0	0.0	828.8
1990	0.0	166.8	44.8	91.8	73.8	49.1	173.9	160.9	113.2	0.0	0.0	0.0	874.3
1989	18.8	49.6	228.1	93.4	0.0	140.7	142.5	137.0	134.2	15.8	0.0	33.5	993.6
1988	5.0	18.2	5.1	26.3	8.8	57.1	112.6	127.9	121.3	73.7	0.0	0.8	556.8
1987	0.0	19.1	110.4	97.4	190.0	64.6	44.9	87.4	33.3	9.9	0.0	0.0	657.0
1986	0.0	48.3	23.7	86.1	124.3	79.3	82.2	76.3	69.1	31.0	0.0	3.3	623.6
1985	0.0	0.0	21.6	126.1	56.3	44.4	115.5	137.0	57.8	0.0	0.0	0.0	558.7
1984	0.0	0.0	11.8	0.0	135	57.6	126.5	157.5	77.5	0.5	0.0	0.0	566.4
1983	1.9	80.2	59.4	124.4	127.0	16.8	164.4	105.6	95.6	35.8	0.0	0.0	811.1
1982	74.4	13.3	23.1	116.6	78.2	74.6	144.7	173.8	97.7	180.6	5.4	0.2	982.6
1981	0.0	52.2	193.5	68.2	21.2	7.5	263.4	95.5	172.9	3.4	0.0	0.0	877.8
Mean	18.0	46.1	59.8	80.0	74.1	76.1	144.4	151.4	80.9	39.4	2.5	2.8	775.5

habessenica, Solanum incanum, Acacia nilotica, Combritum spp, Comberatum spp, Euphorbia candelabrum and Euphorbia abyssinica. Dominant grass species are: *Heteropogon contortus, Cenchrus setigerus, Pennisetum straminum, Pennisetum ezianum, Eleusine multiflorum, Harpachne schimperi, Cynodon dactylon, Sporobolus spp and Aristida adoenis.*

Samples were taken to estimate standing crop biomass for the determination of the stocking rate and productivity of the validation site, in terms of its carrying capacity. A double sampling method was employed for the calculation of the standing crop for the herbaceous component using a 1m x 0.5m quadrat. Four quadrats were systematically sampled from each 50m x 1m along predetermined line transects within the site. Standing biomass was estimated in each of three quadrats and the fourth one was estimated and clipped. Plant species in those quadrats were also identified.

A soil profile pit of 2.6 m deep was dug

Table 3: Percent cover (%) for the herbaceous plant species at Adami Tulu validation site

Species	13/04/98	21/05/98	18/06/98	16/7/98	13/8/98
Pennisetum	35.7	19.6	18.5	23.67	39.08
Elucine	8.4	10.7	10.58	12	8.17
Sporobolus	7.5	2.9	5.33	5.08	1.73
Digitaria milinjana	1.4	0.0	0.0	0.0	0.0
Cynodon	5.5	7.2	0.42	2.33	4.93
Aristida	0.2	1.7	0.25	1.33	5.08
Crotolaria	1.3	0.8	1.25	3.17	3.45
Sida ovata	1.2	1.0	1.33	1.42	3.13
Tribulis teristeris	0.8	0.0	0.0	0.0	0.0
Cenchrus		9.2	5.58	5.0	3.08
Brachiaria		0.7	0.33	3.67	2.75
Dactyloctenium		0.5	0.0	0.0	0.0
Heteropogan		0.3			1.92
Broad leaf weeds		1.9	0.17	3.25	5.42
Bare ground	38	43.7	56.17	39	17.42
Chloris	0.0	0.0	0.08	0.0	0.0
Chloris ychnotrics	0.0		0.0	0.08	0.0
Eragrostis	0.0	0.0	0.0	0.0	2.58
Microchola unthii	0.0	0.0	0.0	0.0	1.25

and soil samples were taken from the horizons. Characterization of the horizon thickness was made and the soil samples were submitted to Holetta Research Center for detailed laboratory chemical analysis. Prior to this study, soils at Adami Tulu center had never been analyzed.

A detailed topographic survey of site boundaries and elevation was conducted at 30m intervals to construct a contour map for the site. The boundary of the site was surveyed to determine its exact area. The elevation of the compound (measured with an altimeter) was about 1670 m above sea level, at benchmark.

Pedon Description

Location	Adami Tulu Research Center, Ziway, Ethiopia
Coordinates	N 07^0 51" 354' S 38^0 43" 2173'
Physiography	On nearly flat area
Relief	Almost a level of topography of about 0-0.5% slope
Drainage	Better
Parent material	Natural pasture, mainly for grazing of goats and cattle
Water table	None was detected at sampling time to a depth of 2.60 m
Date of sampling	1 April 1998

Depth of the horizon(cm)	Description of the profile
0 - 20	Ashy, many fine roots, big tree roots, dry, abrupt wavy boundary to horizon below
20 - 45	Ashy, silt, very fine roots, dry, big tree roots, indistinct boundary, shells of snails
45 - 75	Dry, silt, fine roots, very fine coarse sand, shells of snail, distinct layer, Ca particles
75 - 120	Dry blocky angular very fine grain size particles, very few fine roots, stones, coarses and ashy
120 - 190	Fine coarse sand, dry, granular grain size Ca particles, very fine roots, dry to moist
190 - 220	Blocky angular fine grain size particles, no roots, no clear demarcation, gray, dry to moist
220 - 260	Blocky angular, no roots, stony, coarse sand, gray, dry to moist

Table 4: An example of soil profiling at the Adami Tulu validation site.

The soil profile (Table 4) has an abrupt wavy boundary to the horizon below. The H_2O pH (1:1) is alkaline. There was a strong pH increase with depth in the profile and the increase is explained by the Ca distribution down the profile, which was observed during the sampling. Available P (Olsen) was higher in the surface layers, showing a sharp decrease at the middle of the profile, and an increase below the root zone from 120 to 260 cm. The P amounts and distribution patterns are not uniform.

Percent total surface nitrogen (N) is low. Total N distribution pattern decreased with depth. This is linked with low organic matter of the soil. Organic carbon also decreases with depth. In general, the inherent fertility status of this soil is poor. The amount of exchangeable cation is a good indicator of the fertility status of the soil. The CEC is higher in the surface soils than at the lower horizons. The CEC of this soil is to the lower side. The texture is

Table 5: Physical and chemical characteristics for the soil profile.

Depth cm	pH (1:1) H_2O	Available P (ppm)	Total N %	OC %	CEC (meq/100g)	Sand %	Silt %	Clay %
0-20	7.32	3.00	0.22	2.22	23.95	30.00	55.00	15.00
20-45	8.00	1.20	0.16	1.60	23.05	32.50	57.50	10.00
45-75	8.25	1.60	0.10	0.68	13.45	50.00	42.50	7.50
75-120	8.61	0.80	0.08	0.62	18.80	37.50	52.50	10.00
120-190	10.09	2.80	0.06	0.18	24.40	41.25	57.75	10.00
190-220	10.16	3.40	0.06	0.10	19.75	48.75	38.75	12.50
220-260	10.10	7.40	0.05	0.06	19.15	55.00	40.00	5.00

Table 6: Physical and chemical characteristics for representative soil samples.

Depth cm	pH (1:1) H2O	Available P (ppm)	Total N %	OC %	CEC (meq/100 g)	Sand %	Silt %	Clay %
0-20	6.81	1.81	0.20	2.00	23.95	42.50	40.00	17.50
20-40	7.43	0.80	0.14	1.60	24.35	45.00	42.50	11.25
Sample 2	0.61							
0-20	7.77	2.80	0.18	1.77	24.65	42.50	47.50	10.00
20-40	7.53	3.40	0.14	1.36	23.45	42.50	50.00	7.50

dominated by silt particles. In the lower parts, toward the parent material sand, is the dominant fractions. On the average, clay particles are about 10 per cent and their distribution is almost uniform. Large particles, such as sand and silt, provide better transmission pathways for water and air. Fertility management will be the major management challenge of this soil. The texture class is silty loam.

Livestock profile for grazing trials

Kenya

Kiboko

Six groups of cattle and one, each, for sheep and goats representing different classes, physiological stages and/or breed types were selected for the validation grazing trial. Three kinds of livestock were used in the grazing and pairing validation trials. East African Shorthorn Zebu cattle, East African goats and Red Masai sheep were selected for the trial. These breed types, of the three kinds of livestock being used in the trial, are dominant in the Kenyan arid and semi-arid areas, as well as indigenous to these areas.

Lactating Boran x Sahiwal cows had an average initial liveweight of 272 kg, Zebu weighed 210.8 kg and Boran 261.4 kg. Zebu heifers averaged 173 kg while Boran and Boran x Sahiwal heifers averaged 116 kg and 182 kg, respectively. Boran x Sahiwal steers had an average initial liveweight of 96.4 kg. All the cows were over five years of age, while the steers and heifers were from recently weaned stock. There were no sufficient lactating sheep to select from, so one group of lactating goats was used. Lactating small East African goats averaged 23.5 kg, while female weanlings of Red Masai sheep averaged 18.6 kg and female small East African weanling goats averaged 14.9 kg.

Grazing began March 11, 1998. Animals were grazed for about eight hours a day (between 8.00 a.m. and 4.00 p.m.). They were handled as a mixed herd of cattle,

sheep and goats. There was no water in the paddocks, except some rain puddles, occasionally. Water was only available outside their night-holding pens. So, the animals were allowed access to water for one hour before being penned. Sheep and goats were penned separate from cattle.

Weighing was done using a stationery scale for large stock (cattle) and suspension spring balance for small stock. All animals were weighed on an empty-body basis every week, on Wednesday. At the time of weighing, body condition scoring was done and pictures (slide) of individual animals were taken. Body condition scales for cattle, sheep and goats were 1-9, 1-5 and 1-3, respectively. Almost all cattle scored 4 to 5, sheep scored 3 and goats were about 2. Height, at withers, loin and heart girth, was measured on each animal and repeated monthly.

Lactating animals were milked once a week, on Monday. The dam and offspring were separated overnight. The weigh-suckle technique was attempted for one week, but proved too difficult, since available scales could not accurately weigh 100-250 gm. Therefore, starting from the second week of the study, the half-udder stripping technique was used. This technique involved the calf/kid being allowed one side of the udder, as milking continued. Every time, the right side of the udder was milked, while the left was for the young one to suckle.

Fecal sampling was done every Saturday morning. This was the third day after weighing of the animals. The samples are composited by group of animals, generating 10 fecal samples per week. The dry samples were packed and air-mailed to Debre Zeit, Ethiopia, beginning May, 1998. Rectal grub technique was used for the sheep and goats, while fresh fecal piles from cattle were collected.

The health program, for the animals, has

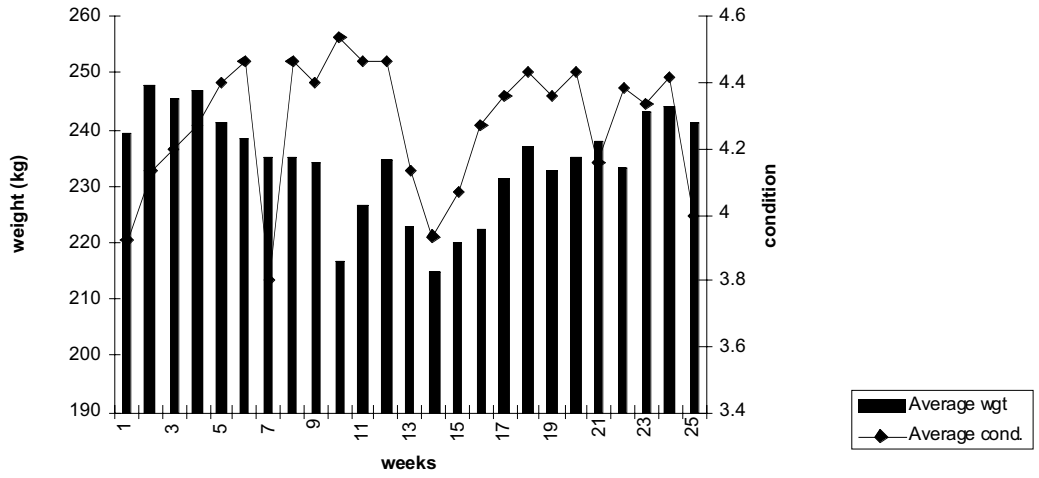

Figure 3: Body condition vs. livestock weight for mature cows at Kiboko site, 1998.

included the initial de-worming and routine dipping/spraying with acaricide and inoculation with trypanocide. Mature cattle were dipped, while small stock were hand-sprayed. However, since several clinical cases of tick-borne diseases were observed and later confirmed through examination of blood smears, it was decided that hand-spraying would be used for all animals. It was suspected that the validation site center plunge-dipwash was under-strength (e.g., too low concentration of caricide). Some of the major diseases included Anaplasmosis and Trypanosomiasis. Some of the test animals experienced wounds caused by photosensitization dermatitis resulting from the consumption of Cassia mimosoide. Drugs of choice were tetracycline injectable, veriben and vetracycline aerosol. Due to exceptionally wet conditions, some biting flies (larger than tsetse) became prevalent. They not only sucked blood and caused great irritation, but they also caused intensive worry for the animals.

Livestock handling facilities have been renovated. Old equipment was also repaired, including squeeze chutes, scales and chaff cutter to allow monitoring of animal performance.

Chemeron

Given the limited amount of grasses in the region, the study focused only on sheep and goats for the trials. The site for the boma/kraal was identified and constructed. Twenty head of sheep were purchased from the local pastoralists. More photographs of the vegetation and animals in the sampling sites were taken. A weighing scale was purchased and delivered to the site. The general health of the experimental animals was continually evaluated. All the animals were weighed and herdsmen were employed to look after these animals.

Progress at Chemeron seemed behind the other groups. Primary concerns were on developing allometry equations for the major woody species and the browse volume weight measurements. After a visit by the TAMU-LEWS team to the site, it was agreed to discard the initial measurements and start over, given the dramatic change in the availability of browse from essentially no leaves to full expression of leaves.

Uganda

Grazing trials were set up in two sites in Uganda, about 50 km apart. One validation site is located at Nshara Government Ranch stocked with cattle and the other site is at Mbarara stockfarm with goats. Both sites are located in Mbarara district, at the center of the Ankole ranching region, which is currently undergoing restructuring of land holdings among pastoralists. The GL-CRSP IMAS team from Colorado State University has co-located personnel and research with us in this region.

Nshara Ranch

The grazing validation study for cattle was conducted at Nshara Ranch, near the

Lake Mbuiro Game Park. A 50-ha land area was identified at the ranch and fenced off. Thirty lactating Ankole (Sanga) cattle, with their calves (product of crossing with Friesian bulls) were selected from the government ranch and placed in the grazing area on 11 May 1998. All the calvings were born within the months of April and early May. Initial weights of the dams were taken on 15 May 1998. Calf weights and milk production, determined by weigh – suckle method, were initially determined on 16 May 1998. The weights of the dams varied from 286 to 426 kg with the majority being between 300 – 400 kg. Liveweight and milk production were, thereafter, determined after every 2 weeks for 3 consecutive days. Fecal samples were also taken on the same days. The last determinations were done on 22 Aug 1998. Animals that lost their calves or developed serious sickness were removed from the trial. By the end of the trial, there were 21 dams and their calves. Being near Lake Mburo National Park, we were discouraged from putting goats in this trial due to the presence of many predators. The goats were therefore placed at Mbarara Stock Farm about 50 km away.

Nshara Ranch is located in an Acacia Grassland Savanna zone between Masaka and Mbarara in South Western Uganda.. Major tree species include: Acacia hockii, Acacia gerrandii, Acacia seyal and Acacia siberiana. Dominant grasses include: Bracheria spp, Chloris guyana, Hyparrehnia spp, Cymbopogon afronandrus, Sporobolus spp, Cynodon spp and Cenchrus ciliaris. Legume species include: Crotolaria spp, Indigofera spp, and Stylosanthes spp. Cymbopogon afronandrus is the dominant grass species. It is unpalatable at advanced stages of growth. Bracheria spp were the dominant pasture species of nutritional significance. Others, such as Hyparrehnia spp, Cenchrus spp and Sporobolus spp are important feed resources in the dry seasons.

Mbarara Stock Farm

For the small ruminants, the grazing study was conducted at Mbarara Stock Farm (MSF), near the town of Mbarara. MSF is also the study site for diet:fecal pairsing development. About 1.5 ha of land was fenced off at Mbarara Stock Farm. The site was stocked with 25 male Small East African (SEA) goats (about one year old) on 25 April 1998. Due to unavailability of a good weighing balance, the first most reliable weights of the goats were taken on 18 May 1998. Weights varied from 10.2 to 17.8 kg. Most goats weighed between 14 – 16 kg. Weights, condition scores, hip heights, hipbone width, heart girths and crown to tail lengths were, thereafter, taken monthly with the last measurement being on 8 September 1998. Fecal samples were collected weekly.

Dr. Ebong, Uganda's in-country coordinator, is designing a science project with the local grade schools to create the woody biomass allometry equations for the project as a technique to be implemented, next year, for the fecal profiling project. Dr. Ebong has agreed to report the outcome to the entire

team and suggest approaches for the other LEWS team members.

Tanzania

Mpwapwa

The grazing experiment started on April 1, 1998. Prior to grazing on the validation site, the initial weights, for each animal, were determined in the morning. Animals selected for this trial were as follows: cows were Tanzania Short Horn Zebu (5), Boran (5) and Mpwapwa (5); goats were blended (5), Indigenous -Central Zone (5) and Indigenous-Lake Zone (5); and sheep were Black Head Persian (5), Red Masai (5) and indigenous (5).

The decision for the selection of the type of animals was based on their wide representation in semi-arid areas of Tanzania. All of the animals were similar to those kept by the pastoralists (e.g., Masai and Barbaig) and agropastoralists (e.g. Sukuma and Gogo), in the region. Mpwapwa cattle and blended goats are popular composites among the agropastoralists of Central Tanzania. All experimental animals were given numbers, in addition to their identification numbers, at the farm for easy identification. The additional numbers were especially important during fecal collection and/or monitoring phases. Animals were weighed every 28 days. Preliminary results indicated an increase in weight, with the exception of the few animals that birthed young. The increase in weight was probably due to good pastures that were deferred until the grazing phase started, in April. Various photos of these animals were taken at different times. Other measurements recorded included body length, height at withers, heart girth and hip height. Also, body condition scores of animals were recorded during weighing. Body condition of livestock was assessed during weighing, using a scale of 1 to 9 for cattle as per ILCA manual, and 1 to 5 for sheep and goats (Australian system).

Animals were taken for grazing between 8:00 a.m. – 4:00 p.m., everyday, and were taken to water around 1:30 p.m. Fecal samples were collected every Wednesday and taken to the laboratory for further processing. All the samples were shipped to NIRS Lab at ILRI-Debre Zeit, Ethiopia, for scanning.

Prior to initiation of the trial, all animals were drenched with Albendazole and Milson to control digestive tract worms and vaccinated against Blackquarter. The animals were dipped, using Stelladone, every Friday to control ticks. One case of death occurred among the goats, due to injury by the cows. The goat sustained injuries that caused internal bleeding of the spleen and liver. A replacement was brought into the study.

Ethiopia

Adami Tulu

Seven goats were allocated from the Center's main herd. Seven sheep and seven cattle were purchased from local

surrounding markets. The age of cattle was estimated to be about 5-6 years, while sheep were two years old. All animals used in this study were male. Purchased sheep and cattle were kept in quarantine. All animals were drenched, de-wormed, sprayed and vaccinated against major diseases. After a period of quarantine, animals were kept in the barn, overnight, and the necessary management was provided.

The animals were allowed into the grazing trial on May 5, 1998. A day before entering into the validation site, the animals were fasted and their weights were taken on May 5, 1998, in the morning. The animals were condition scored. The nine-point condition scoring method of Nicholson and Butterworth (1986) was used for cattle and a 5-point scale for sheep and goats. Moreover, heart girth, height and loin height were measured. Slide pictures of each animal was also measured. The animals were moved to the grazing site at 8 a.m. daily and they were returned from the field at 5:00 p.m., for nine hours.

The animals were treated with anti-helmintics before being allowed to graze the pasture. They were watered once a day, in the evenings. Once a week, Friday morning, fecal samples were taken. A composite sample for each species was put in a plastic bag. The samples were labeled and kept in a deep freeze until they were dried for analysis. Every 28 days, all animals were weighed and condition scored and body measurements were taken (i.e., heart girth, length and loin height). The day before these measurements, the animals were not allowed to drink water for the accuracy of the body weight measurement.

A training session on body condition scoring, heart girth and hoof height measurement was conducted. A technical staff, from Holetta Research Center, trained Adami Tulu research technicians and enumerators that were hired for the project. The training lasted for three days, using 20 steers and 20 goats for practical application.

A total of 31 animals (i.e., 7 cattle, 7 goats and 17 sheep) were presented to the veterinary clinic, at the center, within a 4 month period. Three sheep were treated. One of them was treated for copper deficiency, one for GIT disorder and another for meningitis. The one with copper deficiency died. One goat was treated for opthalmitis.

Sample Date	CATTLE					SHEEP					GOATS				
	Body score	Heart girth (cm)	B.wt (kg)	Height (cm)	Loin length (cm)	Body score	Heart girth (cm)	B.wt (kg)	Height (cm)	Loin length (cm)	Body score	Heart girth (cm)	B.wt (kg)	Height (cm)	Loin length (cm)
5/22/98	4.7	139.4	206.0	112.3	62.4	2.9	-	25.6	-	-	3.1	-	23.1	-	-
6/19/98	5.4	141.1	225.5	-	63.6	3.5	72.9	28.0	62.9	40.7	3.3	71.7	26.2	66.6	37
7/17/98	5.9	147.7	239.9	112.4	66.6	3.7	73.6	29.6	65.4	43.0	3.8	72.1	28.4	68.9	41
8/13/98	6.2	150.4	253.9	112.9	67.6	3.8	74.0	31.8	66.4	43.0	3.7	72.9	30.1	69.0	41.1
9/10/98	6.6	151.6	271.6	112.9	68.0	3.9	75.3	32.3	66.6	43.9	3.9	73.1	30.9	69.6	41.3

Table 7: Body weight (B, wt), condition score, height and loin length of livestock used for the validation trials.

Diet:fecal pairs development

We only had diet:fecal pairs from the subtropics of Texas, USA, and the samples from Debre Zeit, Ethiopia, at the beginning of the LEWS project. Even though these seemed to be sufficient at that stage, the first year was used to expand these pairs to help increase the robustness of the NIRS equations for East Africa. Each of the 4-5 sites has established animal feeding protocols to generate expanded diet:fecal pairs and, in some sites, the animals were fed with fresh forage (or mixed hays) each day for a period of 21 days. Each site selected about 20 diet pairs, based on the dominant plant communities in their respective location, so that the diets would be representative of the various growing conditions. The key was to get diet:fecal pairs across most of the East African region. Some of the countries, in the project, may be more appropriate for the site validation study, while others may be more appropriate for the diet:fecal pairs development. The material consumed will be analyzed for crude protein (CP) and CP fractions. An in vivo digestible organic matter (DOM) protocol will be used to determine DOM value of the forage source, through the measure of intake and fecal output.

These results from the diet:fecal pairs, developed at each of the validation sites in the first year, will be used to verify that the NIRS fecal profiles are predicting correctly. About 80-100 rations are tested for a wide array of forages on cattle, sheep and goats. Moreover, approximately 30 rations have been tested at 3 sites and a comprehensive validation trial was completed at ILRI-Debre Zeit, by a Ugandan Ph.D. student from TAMU supported by Rockefeller Foundation.

Kenya

Kiboko

The renovation of the study shed was completed. Therefore, all the animals were on a concrete floor. Wooden feed troughs were made and water was supplied using buckets.

Four of each cattle, sheep and goats, were selected for this study so as to intensify the coverage of the range of diets. Young growing animals were preferred. The Kiboko LEWS team has completed 10 diet:fecal pairs for

Table 8: Composition of the various diets and ratios fed in the fecal diet pairing experiment.

Diet no.	Feed type	Ratio
1.	Grass:legume	2:1
2.	Grass:legume (flowering stage)	9:1
3.	Grass:legume	3:1
4.	Grass:browse	3:1
5.	Grass mix:legume:browse	2:1:1
6.	Gay:Acacia tortilis pods	7:3
7.	Grass:legume (podding stage)	9:1
8.	Grass:legume (podding stage)	3:1
9.	Maize stover:bean straw	9:1
10.	Grass:legume yellow leaf stage	3:1
11.	Maize stover:Acacia tortilis pods	3:1
12.	Grass:legume (pods shatter stage)	9:1
13.	Hay : Acacia tortilis pods	9:1
14.	Maize stover : beans straw	3:1
15.	Grass mix:maize stover:Acacia tortilis pods	2:1:1
16.	Maize stover:Acacia tortilis pods	9:1
17.	Grass mix:legume:browse	9:1:1
18.	Grass mix:maize stover:Acacia tortilis pods	9:1:1

cattle, sheep and goats, and are planning to do 10 more. The diets used included various combinations of natural forage (e.g., grasses, forbs and browse), as well as crop residues and Acacia tortillis pods. The composition of the various diets and ratios fed in the fecal diet pairing experiment is presented in Table 8.

The unique aspect of this trial was that the same 20 rations were fed across species and we will be able to ascertain spectral differences between species with the NIRS system, for the first time. The diet:fecal pairs study was completed and fecal samples were sent to the NIRS lab at Debre-Zeit, ILRI Ethiopia.

Chemeron

New facilities (e.g., feeding pens) were constructed the for diet:fecal pairs, at Chemeron, for sheep and goats. The team selected 20 head of sheep and goats. They accumulated a large quantity of annual forbs that represent the flush of growth with recent rains. They also accumulated various Acacia leaves, small stems and pods for the feeding trials. Diets were composed of 50-100% browse. The use of high amounts of grass was avoided, given the heavier grass content of the pairs developed at Kiboko. Sixteen diet:fecal pairs were constructed to do 8 animals per species (i.e., goats and sheep) at a time. The site focused on heavy browse content diets, which were more typical of the arid zone. The diet:fecal pairs studies were completed.

Uganda

Diet:fecal pairs were established at two sites, Mbarara Stock Farm and Namulonge Agricultural and Animal Production Research Institute.

Mbarara Stock Farm

Five Friesian cross cattle (yearlings – heifers and steers), averaging 150kg were used in this trial. Diets consisted of fresh local forage species both grasses and leguminous cut and collected from around the farm each day. The grass species included: Bracharia sp., Chloris gayana, Cynodon dactylon, Hyparrhenia sp. and Digitaria scalarum. Leguminous species both herbaceous and shrubs included: Lablab purpureus, Desmodium uncinatum, Macroptilium artropurpureum, Gliricidia sepium, Sesbania sesban, and Leuceana leucocephala. Each animal consumed a different diet. Different combinations of the forage species and quantities were made. The trial was initiated on 23 April 1998 and by the end of it on 30 July 1998, 24 diets had been offered. On each day, the forage feed was harvested in the morning, chopped up and thoroughly mixed. A sample was removed for quality and dry matter determinations. The rest was weighed and then placed in the feed trough. At the end of each feeding day, the refusal was also weighed and a sub-sample taken for dry matter calculations and later laboratory analysis. All the feces for the day were collected and weighed and a sub-sample taken for oven drying.

NARO veterinary research officer to Mbarara station, Dr. Julius Tuhumwire, was assigned as the administrative head. He provided animal health care to the project and also assisted Mr. Stephen Beyenkya, the LEWS program coordinator, at the site with sampling activities. The diet:fecal pairs studies were completed and the fecal samples were sent to the NIRS Lab, at ILRI-Debre Zeit, Ethiopia.

Namulonge

Diet:fecal pairs trial here started on 17 April 1998 and ended on 30 July 1998. 24 diet:fecal pairs were collected at this site during the trial period. Twelve (12) Small East African goats (all males, about one year old) were used at this site.

The diets consisted of leguminous fodder shrubs in combination with grasses i.e Pennisetum purpureum (elephant grass) and Bracharia sp. All species were offered in fresh and dry form. The leguminous fodder shrubs included: Calliandra calothysus, Gliricidia sepium, Leuceana diversifolia, Albizia chinensis, and Sesbania sesban. Two goats were offered the same diet daily. The grass and the legume were offered separately.

The feed both the offered and refusal was weighed and sub-samples taken for oven drying. All the feces were collected on a daily basis, weighed, and sub-samples taken for oven drying. Total urine was also collected at this site and sub-samples kept awaiting laboratory analysis.

Tanzania

Mpwapwa

The diet:fecal pairs study was done in feeding pens, at the main farm of the Livestock Research Institute, Mpwapwa, with minimum repairs, especially for cow pens. A total of 23 diet-rations were used in this study, which included Cenchrus ciliaris, Panicum maximum, Cynodon plectostachyus, mixture of annuals, Heteropogon contortus, Chloris gayana, browse (leaves/pods), maize and sorghum stovers and a grass mixture. The rations from the grass species formed the basal diet and the tree leaves/ pods were used as supplements.

The proportions of the rations implemented were as follows:

R1 = 50%CC + 50%PM;
R2 = 50%CC + 50%CP;
R3 = 50%CC + 50%AA;
R4 = 50%PM + 50%CP;
R5 = 50%PM + 50%AA;
R6 = 50%CP + 50%AA;
R7 = 75%R1 + 25%CG;
R8 = 75%R2 + 25%CG;
R9 = 75%R3 + 25%CG;
R10 = 75%R4 + 25%CG;
R11 = 75%R5 + 25%CG;
R12 = 75%R6 + 25%CG;
R13 = 75%R1 + 25%HC;
R14 = 75%R2 + 25%HC;
R15 = 75%R3 + 25%HC;
R16 = 75%R4 + 25%HC;
R17 = 75%R5 + 25%HC;
R18 = 75%R6 + 25%HC;
R19 = 13%R1 + 25%R2 33%AA + 12%PM + 5%CG + 7%HC;

R20 = 14%CC + 14%CP + 20%AA + 10%PM + 5%CG + 7%HC + 30% Browse (Leaves/pods).

NOTE:
Cenchrus ciliaris (CC);
Cynodon plectostachyus (CP);
Heteropogon contortus (HC);
Browse (Leaves/pods) (BR);
Sorghum stovers (SS) ;
Panicum maximum (PM);

Mix of Annuals (AA):
Chloris gayana (CG)
Maize stovers (MS)
Grass mixture (GM)

Concerted efforts were made to make sure that each ration was properly composed and that the ration was used throughout the 12 days of the trial period. The first seven days were used for familiarization to the diet and fecal samples were collected in the last five days of the trial. All of the 23 rations have been fed to cows, i.e., each ration per cow for 12 days. The rations were also fed to goats, with additional browse material, where the rations formed the basal diet and the tree leaves/pods were used as supplements.

Almost all of the feed rations were in the form of chopped hay, initially baled according to species. Fecal samples were shipped to the NIRS lab, at ILRI-Debre Zeit, Ethiopia.

Ethiopia

Adami Tulu

Diet:fecal pairs were conducted for goats, donkeys, cattle and sheep. All diet:fecal pairs collections for cattle (10), goats (12), sheep (12), and donkey (19) were completed. Fecal samples were sent to ILRI-Debre Zeit, Ethiopia.

A batch digestibility trial was conducted, for each species, in such a way that each animal was assigned to one ration. Each animal was weighed, after an over-night fast, during the morning hours prior to feeding and watering. Then, they were randomly allocated to the dietary treatments. The supplements were calculated based on live- weight. Basal feeds were chopped using a chopper to minimize selection. All animals, of each species, were adapted to the test diet for 14 days to adjust to the rations. The actual collection period lasted 7 days. The basal diets were given ad libitum. Water and mineral licks were available at all times.

Donkeys and cattle were placed in individual feeding pens with concrete flooring. Water was provided using a metal bucket. The sheep and goats were placed in a house, where individual partitions were made of wood. Water was provided using small plastic buckets. Feces for sheep and goats were collected in fecal bags. The concentrate mixture for cattle and sheep contained wheat, bran, wheat middling, noug cake and salt. For donkeys, mixtures were composed of wheat bran, wheat

middling, noug cake and salt. Most of the supplemental feeds for goats consisted of leaves and twigs of different browse plants collected from the grazing field and sun-dried.

Feed intake of the basal diets and the supplements were measured on a daily basis. The feeds were measured using a sensitive balance. Supplements were offered to the animals at 8 a.m., daily. At the same time, the animals in the control groups were given their respective basal diets. In most of the cases the animals finished their supplements within an hour (in case of concentrate feeds as in donkey diets). It has taken a longer time in case of browse supplements. After finishing their supplements, the respective basal diets were offered. Refusal of the basal diets and the supplements (usually most supplements were eaten easily) was weighed at 7 a.m., the following morning. Sub-samples of offered feed (basal and supplements) were taken daily from the mixed bulk, whereas refusals were taken daily for each animal.

The daily fecal output was collected in plastic buckets. Daily, the total quantity of feces collected was weighed, thoroughly mixed and 10% of the daily fecal output was sub-sampled; then, the sub-sample was placed into a plastic bag and frozen. Plastic buckets and metal scrapers were cleaned daily to be ready for the following day, i.e., each animal was provided with two plastic buckets throughout the experimental period. After the end of the collection period, the animals were weighed. Then, the frozen fecal samples for each animal were thawed over-night and sub-sampled. Duplicate samples of 100-150 gm, per animal, were oven-dried at 60 C for 48 hours. Finally, oven-dried samples were put in paper bags and sent to ILRI-Debre Zeit, Ethiopia, for analysis.

Gender and Child Issues

There are two categories of women that the LEWS project is having an impact upon. They are the in-country women team scientists and in-country women within the targeted pastoralists' families.

In-country Women Team Scientists

The program has seven women scientists/technicians directly involved in the Livestock Early Warning System project. One of the female scientists is the country coordinator for LEWS in Ethiopia. Three of the women are zone coordinators, another woman is a science advisor and the other two women are site managers. The following are their specific responsibilities, by country.

Ethiopia

Zinash Sileshi, Animal Scientist, is the in-country coordinator. A NIRS lab is scheduled to be functioning at the research station where she is located, by year four of the project. The time in which her project duties will include the coordination of that laboratory. She was recently appointed as the director for the National Livestock Research Program

under the newly re-organized Ethiopian Agricultural Research Organization (EARO).

Tanzania

Stella Bitende, Forage Scientist, is the Arusha Zone coordinator. She has relocated to Arusha and holds the position as Zone Coordinator for Northern Tanzania. Margaret Kingankono is Site Assistant to Stella Bitende.

Uganda

Sarah Ossiya is a PhD student as part of a NARO training program, funded by the World Bank and Rockefeller Foundation, and studying at Texas A&M. She is conducting diet:fecal pairs analysis at ILRI-Debre Zeit, Ethiopia. Sarah is designated to setup and operate the NIRS lab in Uganda, in 1999. Grace Ebiyau is a Site Assistant/Technician. She has been a member of the LEWS team from its beginning. Grace collected and processed a major portion of the original samples and data from Uganda. Dr. Emily Twinamasiko coordinates a sampling zone in Uganda. She is the National Research Coordinator for veterinary medicine and animal health.

In-country Women as Target of Project

The LEWS program is designed to be sensitive to types of livestock and sources of feed. In many of the geographic areas encompassed by the program, livestock ownership and management is a gender issue with women owning and having access to income from small livestock and chickens, while the males control the larger animals. The program will address gender issues as they relate to these and other socioeconomic practices.

Policy

It is important that the governments develop flexible contingency policies, or storage plans, that they can implement as needed. The LEWS team views this issue important because certain population segments (e.g., pastoral communities) may be more vulnerable than others to small variations in conditions. Thus, researchers and policy makers must be conscious of how pastoralists (as well as other socioeconomic groups) respond to climatic shocks.

Contributions to Policy

This project will contribute to policy that relates to food security of pastoral and mixed farming populations in East Africa. It will help reduce risk of loss of livestock populations and human life in the arid, semi-arid and savanna regions of East Africa. Timely analysis of livestock and human security in the pastoral regions of East Africa are critical for famine and drought mitigation policy within national governments and international donors/food relief organizations. This state-of-the-art technology will help address a critical component of the necessary infrastructure to address this identified

policy need. The project is designed to provide national and international policy makers with innovative decision support information systems, tools and methodologies for an increased early warning capacity for the pastoral communities in East Africa.

Steps taken to insure policy makers involvement

The crisis mitigation program in ASARECA will be the primary mechanism used to establish critical communications between the on-site monitoring program and in-country policy decision-makers. The main step is the inter-regional coordination of key NAR personnel involved in the livestock early warning system program and the establishment of the needed NIRS laboratories and analytical capacity of each country's team members. The LEWS team will work intensively with the ASARECA organization infrastructure to foster interregional coordination as part of their crisis mitigation program. As far as establishing NIRS labs and analytical centers throughout the region, the LEWS team will work with ASARECA to coordinate the needed dialogue to insure NAR organizational cooperation across regions in setting up the labs, assigning key personnel and maintaining the necessary equipment.

Each in-country team has determined an action plan to work with the appropriate decision making bodies in their respective country. In-country teams, individuals involved in policy making in their governments, and local community leaders within each explored option for the best linkages with the project activities.

A National Workshop on "Early Warning System For Monitoring Livestock Nutrition and Health in Ethiopia", was held in February 4, 1998 at Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia. National, regional government and non-government organizations attended the workshop. Drs. John Corbett and Jerry Stuth of LEWS-TAMU group presented papers. One of the resolutions of the workshop was the establishment of a technical committee to work on Livestock Early Warning System in Ethiopia. The committee will work under the overall auspices of the National Disaster Prevention and Preparedness Commission.

Preparations are underway for an early warning workshop for policy makers in East Africa to enlist their support and to work with our various in-country teams. The workshop is intended to make stronger linkages with the people in the project's household monitoring systems and the key government policy makers in each country. Participants from the targeted countries, NARS researchers within these countries and staff in ILRI and Texas A&M University are expected to participate. It is believed that discussions among national decision-makers, policy advisors and the collaborating NARS researchers should be initiated at the outset of the research. The reason is that this will ensure that

the research is influenced by policy needs and that, in turn, the technical results and recommendations have an impact on innovative development policies for pastoral communities. The workshop will, therefore, focus on an agreement of mechanisms for a two-way information flow between researchers and decision-makers in the region.

Outreach

Involvement of local extension officers were an integral part of the pastoral monitoring network. To establish the pilot collection routes, local extension officers were contacted and met with the in-country NAR, university or ILRI coordinator to help locate high impact sampling sites (e.g., water points, routing concentration points), identify herders and introduce the samplers to the herders to facilitate fecal collections and herd profiling interviews. In some instances, extension officers identified villages where the livestock were corralled at night and interviewed the families for in-depth characterization of the herds sampled. The optimum organizational structure is still being finalized for the rural monitoring networks. The strongest probability for people to handle the logistics are extension, NAR and NGOs to be integrated to cover the geography of the monitoring system. People within rural schools and clinics are, eventually, likely to be involved along with NGO and PVO on-site personnel.

Development Impact

In the section of development impact are the environmental impact and relevance, agricultural sustainability, contributions to U.S. and host countries agriculture, linkages and networking and collaboration with international research centers.

Environmental Impact & Relevance

Some environmental impact will be realized in the decrease of land degradation by notifying pastoralists of the changes (decreased nutrient composition) occurring to the range 6-8 weeks earlier than the current information provides; thereby, leading to the rotating (migrating) off the affected range before an irreversibly detrimental trend intensifies.

Agricultural Sustainability

The rangeland will become more sustainable for the pastoral way-of-life with timely livestock movement and destocking 6-8 weeks advanced notice of forage defoliation and significant weight loss in livestock, from the affected rangelands and resultant decreased land degradation. The rangelands will become more capable of sustaining long-term quality grazing from livestock, because with the livestock being removed from the affected range 6-8 weeks prior to detectable poor conditions, the higher quality forages will not be selected to the

point of no return. Also, there will be less erosion since the soils will be more stable due to higher forage cover.

Contributions to U.S. Agriculture

The establishment of improved NIRS predictions of diet quality of livestock will have significant impact on the quality of predictions provided to ranchers throughout the USA via the national service lab at the Grazingland Animal Nutrition Lab, at Texas A&M University. Currently, this lab provides nutritional advisories to over 1300 ranchers throughout the USA via the NIRS/NUTBAL nutritional management system. The linking of the incoming weather data on a near-real time basis for both the PHYGROW and APEX models will help build the foundation for regional drought and stocking advisory systems currently being proposed for the USA. Development of the methodology for the classification of effective environments through the use of the SCT tool will lead to more robust impact assessment of technologies in a more spatially explicit manner in the USA.

The technologies assembled and used in this project will be directly transferable to USA grazinglands. The new emerging Grazing Lands Conservation Initiative (GLCI) will be a direct beneficiary since the technology can be directly adopted by NRCS for application nationwide. This should reduce drought and market induced risk to USA livestock producers and improve production efficiencies, all objectives of the new Farm Bill and the Funds for Rural America program.

The LEWS team believes that the technology package designed for East Africa will help address rangeland health issues in the USA and help establish regional stocking advisory systems. It will also provide a framework for remote client monitoring system for technical advisors (public, private, corporate) and enhance development of science education programs for rural America.

Furthermore, stable societies in Africa are both a direct and indirect benefit to the USA in terms of direct aid costs and costs of political instability. This project is expected to provide US policy organizations with more timely information to allow a more precisely measured response to developing conditions.

A series of USA-based corporations will provide the technical equipment needed in the project, including NIR spectrophotometers, computers, GPS units, etc. When fully implemented, the system established in East Africa will likely be repeated in many other regions of the world, increasing international sales of these USA-based companies.

Contributions to Host Country

The contributions to the East African nations involved in the LEWS project include the ability to foresee and prevent, prepare for and mitigate or resolve crisis and conflict in a more timely manner

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

Also, during this first year, the LEWS project has focused on the formation of human capital through a network of scientists and organizations across the East Africa region, which is founded on a common purpose and protocol to establish an advanced livestock early warning system that is regionally cohesive. Educational and technical contributions include one NIRSystem laboratory established in ILRI – Debre Zeit, Ethiopia, and technicians trained to use the instrumentation and various workshops designed to establish validation sites and protocols. Other equipment (e.g., GPS units, computers, software, etc.) has been provided to the in-country team leaders and zone coordinators.

Linkages and Networking

The LEWS project is co-located in an office in the ASARECA office, at ILRI, Nairobi, Kenya, as part of the Crisis Mitigation Program. A portion of a program manager's time has been allocated from ASARECA crisis mitigation funds to serve as an ASARECA-CRSP-LEWS coordinator. This person works under the supervision of Dr. Jean Ndikumana, executive secretary for ASARECA.

FEWS and GIEWS have identified key contact people to work with the national data center. Sampling zones have been established and key on-site personnel for both organizations have been identified. A visit to Djibouti established linkage with IGAD as it relates to the Greater Horn of Africa Program and ASARECA's role in crisis mitigation.

We established contact with USAID mission in Kampala, Uganda. We met with Ron Stryker, Chief-Agriculture and Private Sector Office, USAID, Gaudensia Kenyangi, USAID liaison with Heifer International, and David Mutazinawa in June 1998. Mr. Mutazinawa was designated as our primary contact person at Kampala for the LEWS program given his connection with the FEWS program. Ms. Kenyangi was provided as our contact for potential

training opportunities within the Heifer International program. The entire LEWS-Uganda team attended the meeting at USAID as a show of solidarity within the project. Ron Stryker provided us names of critical contacts at the mission including Rob Rose (FEWS Contact) and Mike Foster (Global 2000 contact).

Computer systems were sent to East Africa and were established to foster electronic mail capacity at validation sites. The search is in progress to locate other organizations in the proximity of the sampling zones that could be linked for e-mail capacity.

Some specific international donor organizations were targeted to develop collaborative efforts. Some of the organizations were ILRI, Rockefeller Foundation, Danish International Development Agency (DANIDA) and International Center for Research in Agroforestry (ICRAF) in the region, as well as NGOs such as FARM AFRICA, PENHA and World Vision. Linkages with the various international research organizations are critical to provide the nucleus of infrastructure for the more advanced technologies in the early phases of the project and assist with building robust sampling routes within each country.

Collaboration with IARCS and Other CRSP's

The LEWS project has integrated its activities with ILRI in the development of the ASARECA crisis mitigation. Other collaborations include chronic under-nutrition studies in livestock and enhanced NIRS fecal profiling.

Other Contributions

Support for Free Markets and Broad-based Economic Growth

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

Contributions to and Compliance with Mission Objectives

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

Concern for Individuals

The project is designed to secure working relationships with households and individual pastoralists. The project staff is sensitive to the fact that the pastoralists, whose livelihood depends on livestock, are the keys to the success of the project. To a large extent, the outcome of the project will depend upon the participation and the commitment of the local people and the ability of the project personnel to empower, motivate and involve them.

Support for Democracy

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

Humanitarian Assistance

The need for humanitarian assistance usually emanates from poverty-related degradation of natural resources. An early warning system for livestock is essential both for food security by protecting the natural resource base and disaster preparedness. A proactive early warning system will help in making people in the region less vulnerable to disasters by alerting them of impending crisis and provoking a humanitarian assistance response from local and international relief systems (e.g., governments, donor and NGOs).

Leveraged Funds and Linked Projects

Leveraging of funds is an approach that is essential to the success of this project. Corporate entities are involved that have a vested interest in LEWS. Particularly, it was thought that the manufacturer, Foss NIRSystems (formerly Perstrop Corp), would be a key player in equipping the proposed 5 national NIRS laboratories to handle the fecal profiling system. The plan was to obtain letters of commitment from Foss to allow purchase of the machines at much reduced prices. Also, Dell Computers Inc. was targeted to help provide computing capacity to the sampling locations throughout East Africa, including placement in extension offices, clinics and schools. Dell has targeted East Africa as a market development area for its line of personal computers. To help reduce transportation costs for sampling the regions, we planned to ask major motorcycle manufacturers to help donate or provide motorcycles at low cost to the program. Currently, Dell and motorcycle companies have not responded.

US support for the project was critical, as well. There were plans to work with

the Grazinglands Technology Institute, within the USDA-Natural Resource Conservation Service, to help establish a mirror program in the USA, through their agency, to assure that technology developed within LEWS would be directly transferable back to the USA. This would assure that the technologies developed in East Africa would help build an infrastructure, which directly benefited US livestock producers.

Training

Long-Term Training

LEWS has funded academic fees for a Ph.D. program for Mr. Stephen Byenkya in the Animal Science Department at Makerere University under the joint supervision of Dr. Felix Bareeba and Dr. Jerry Stuth. NARO has agreed to pay his salary and provide him the necessary equipment and facilities as well as relief time to pursue research and academic studies. Mr. Byenkya is a critical member of the LEWS team in charge of the coordination of all the field work, monitoring and validation studies. A NARO vehicle was repaired for his use via USAID/ASARECA crisis mitigation funds. A preliminary title for his research would be "Impact of Changing Land Use on Traditional Ankole Pastoralist Systems." The TAMU-LEWS team agreed to prepare a document of understanding outlining the general thrust of the training program for the concurrence of NARO and Makerere University.

Discussions are under way for Angello Mwilawa to get sponsorship for a Ph.D. study under Dr. Jerry Stuth at Texas A&M University through the Tanzanian Agricultural Research Program II funded by the World bank /IDA. A likely scenario will be for Angello to come to Texas A&M for his course work and return to Tanzania for his field work in an area that fits within the LEWS subproject. The topic of his research will be developed jointly the Department of Rangeland Ecology and Management at Texas A&M and the Department of Animal Science at Sokoine University at Morogoro, Tanzania.

A joint proposal by the Animal Nutrition Group of ILRI Debre Zeit and LEWS subproject has been approved and funded by USAID/ILRI/Span. The study will focus on the use of NIRS for estimating condensed tannins, NDF and intake prediction. There is also a possibility this project will be merged with another one by the ruminant Nutrition Group at the University of Florida. Our counterparts at ILRI have indicated to us that they would like to fund a graduate training (MS) for Dawit Negassa at Texas A&M University under the Joint supervision of Dr. Jerry Stuth and Dr. Victor Ummuna (ILRI Debre Zeit). Dawit was already trained on the use of NIRS machines at GAN lab, Texas A&M and is currently running the LEWS NIR lab at ILRI Debre Zeit, Ethiopia.

Short-Term Training

Training in Design and Implementation of Early Warning and Crisis Mitigation for Livestock in East Africa, November 17-21, 1997. The LEWS project workshop was funded by a grant provided to ILRI as part of the USAID CGIAR-University Collaboration program on training. This training was attended a team of 25 scientists from five countries in East Africa.

A workshop and hands-on training on Almanac Characterization Tool (ACT) Uganda, a packaged set of spatial data and query tools targeted for use in agricultural and natural resource management activities, was held September 15-19, 1998, Uganda. LEWS – Uganda team members, national Research organizations and NGOs attended the meeting.

A similar *workshop and hands-on training on Almanac Characterization Tool (ACT) was held for the Ethiopian team on September 20-26, 1998 in Addis Ababa, Ethiopia.*

Ad Hoc GIS Working Group. April 5-6, 1996. Fort Collins, Colorado. The following key individuals, working with GIS applications in their respective subprojects in the SR/GL CRSP program, attended the April 5-6, 1998, meeting:

Texas A&M University: Paul Dyke, Jerry Stuth, John Corbett, Abdi Jama.

Utah State University: Paul Box

Colorado State University: Mike Coughenour, Jim Ellis

University of California –Davis: Emilio Laca

University of Wisconsin – Madison: Robert Langstroth

A National Workshop on Early Warning Systems For Monitoring Livestock Nutrition and Health in Ethiopia, February 4, 1998, Addis Ababa, Ethiopia. Sponsored by SR/GL-CRSP and Ethiopian Agricultural Research Organization. Regional and national government and non-government organizations attended the workshop.

Comments

This was a busy year where we concentrated on establishing organizational and communication infrastructure for the teams and setting up the validation studies across the region. A network of core in-country LEWS teams in East Africa were put in place and communication infrastructure to facilitate contacts and exchange of views and information flow was initiated among the LEWS teams in the region and TAMU. Each team initiated contact and worked with the appropriate decision making bodies in their country to enlist their support and to set the stage for a workshop to bring in the full team and those individuals in government (policy makers, decision makers) and local community leaders. We are seeking external funds and have

submitted a proposal to USAID/ILRI-SPAN. We believe that it is critical that we bring national decision-makers and policy advisors into discussions with the involved NARS researchers right from the outset of the research. This will ensure that the research is influenced by policy needs and that, in turn, the technical results and recommendations have an impact on new development policies for pastoral communities. The workshop will, therefore, focus on the present objectives of the LEWS project, and on an agreement for mechanisms for a two-way information flow between researchers and decision-makers in the region. We also initiated dialogue and contacts with USAID missions in Uganda and Kenya, IGAD and NGOs in several of the host countries to explore areas of collaboration and information sharing which could assist our common objective of developing solutions to the regional issues regarding early warning and food security.

Site validation and paired fecal sampling trials went well in all countries except Eritrea despite delays due to extended rainfall in most countries. The group at Eritrea had difficulties getting clearance from their ministry to use the research facilities they proposed and the border conflict with Ethiopia exacerbated the situation. Recent contacts indicated that the situation is stabilizing and our team is returning back to their positions to restart the activities of the LEWS project.

Collaborating Personnel

United States of America

Abdi A. Jama, Assist. Research Scientist, Texas A&M University.

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

Jimmy R. Williams, Crop Systems Modeler, Texas A&M University.

John Corbett, Research Scientist, Texas A&M University.

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

Ethiopia

Ato Tesfaye Kumsa, Researcher, Institute of Agricultural Research.

Azage Tegegne, Animal Scientist, International Livestock Research Institute.

Gebre Berhane, Professor, Makelle University.

Paschal Osuji, Coordinator/Animal Nutritionist, International Livestock Research Institute.

Victor Umunna, Animal Scientist, International Livestock Research Institute.

Zinash Sileshi, Animal Production

Researcher, Ethiopian Agricultural Research Organization.

Eritrea

Berhane Kiflewahid, Dean of Ag Sciences, University of Asmara.

Negusse Fessehaye, Livestock Scientist, University of Asmara.

Kenya

Henry Cheruiyot, Assistant Director for Range Research. Kenya Agricultural Research Institute.

Jean Ndikumana, ASARECA-AARNET Coordinator, International Livestock Research Institute.

Peter Kamau, Range Animal Scientist, Egerton University.

Peter Wandera, Animal Prod. Scientist, Kenya Agricultural Research Institute.

Robert Shavulimo, Veterinary Professor, Egerton University.

Russell Kruska, GIS Researcher, International Livestock Research Institute.

William Mnene, Rangeland Management, Kenya Agricultural Research Institute .

Tanzania

Angelo Mwilawa, Range Scientist, Mpwapwa Livestock Research Institute.

Margret Kingamkono, Animal Scientist, Selian Agricultural Research Institute.

Ndelilo Urio, Tanzania Coordinator, Animal Scientist, Sokoine University.

Rashid Kidunda, Range Ecologist, Sokoine University of Agriculture.

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

Suleiman Kaganda, Animal Scientist, Ag. Research & Training Institute.

Uganda

Cyprian Ebong, Livestock Production, National Agricultural Research Organization.

Emily Twinamasiko, Veterinary Medicine/Animal Health, National Agricultural Research Organization.

Felix Bareeba, Professor, Makerere University.

Sarah Ossiya, Range Scientist, Currently a PhD student at TAMU, USA.

Stephen Byenkya, Animal Scientist, NARO.

Collaborating Institutions

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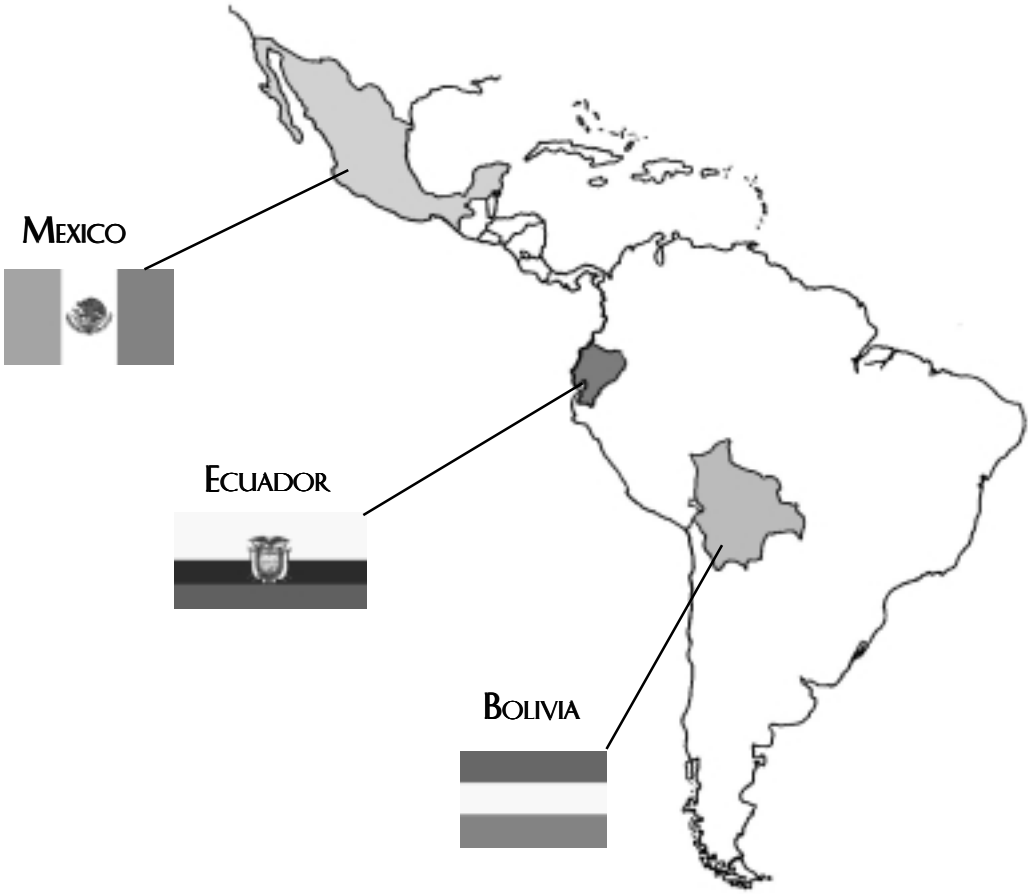
Abstracts and Presentations

Jerry W. Stuth, Paul Dyke, Abdi A. Jama and John D. Corbett (1998). The Use of NIR/NUTBAL, PHYGROW, and APEX in a Meta-Modeling Environment for an Early Warning System to Monitor Livestock Nutrition and Health. National Workshop On Early Warning System for Monitoring Livestock Nutrition and Health, Addis Ababa, Ethiopia, February 4, 1998. Sponsored by the Small Ruminant Collaborative Research Support Program (SR-GL/CRSP) in collaboration with the Ethiopian Agricultural Research Organization (EARO)

John D. Corbett, Jerry Stuth, Paul Dyke, and Abdi Jama (1998). New Tools for the Characterization of Agricultural (crop and livestock) Environments: the identification of pastoral ecosystems as a preliminary structure for use in sample site identification. National Workshop On Early Warning System for Monitoring Livestock Nutrition and Health, Addis Ababa, Ethiopia, February 4, 1998. Sponsored by the Small Ruminant Collaborative Research Support Program (SR-GL/CRSP) in collaboration with the Ethiopian Agricultural Research Organization (EARO)

Latin America



Livestock-Natural Resource Interfaces at the Internal Frontier

Spanish title: "Planificacion Local Agropecuaria y de la Naturaleza"(PLAN)

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Narrative Summary

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 are using livestock as a principal focus to find solutions to environmental problems in these regions. 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) Evaluate current practices of livestock and natural resource management and experiment with alternatives. 3) Generate local participation in planning, implementing, and monitoring current and alternative practices. 4) Establish long-term, on-going, local community-planning for natural resource and livestock management. Our first year the project has accomplished several actions needed to achieve our goals:

Implementation of community autodiagnostics. The community self-assessments (autodiagnostics) of their situation and livelihood and use of land and natural resources is a critical first step needed to involve and understand the target communities. The information from the autodiagnostics is needed to design the data collection and studies to follow as well as to build an effective participatory plan of work with the community members themselves.

Characterization of effects of livestock on production and on landscapes. The Mexican team implemented and established the first set of grazing plots and grazing exclosures to be used to assess and demonstrate impact of livestock on pastures and natural vegetation. The vegetation within the exclosures already show clear responses to the removal of grazing pressure. The exclosures serve as a method that can be simultaneously observed and assessed by the researchers and the local farmers. The results of the vegetation changes will be used as the means to introduce other studies and alternative livestock management practices.

Experiments with alternatives to improve livestock production and reduce impacts. In Mexico, an initiative to improve the quality of local pastures through use of local forage species is now in progress. Local community members are engaged in the collection of seeds of native forages and the creation of nurseries of seedlings to plant in local pastures to improve forage and create more stable ecological plant associations. In Ecuador, a local farmer experimenting with rotational grazing with dairy cattle more than doubled milk production in the first year without using his forested land for browsing. This farmer's example will be used to enroll other local farmers to work with this and related alternatives. An adaptation of pasture rotation inserted into the local annual pasture/forest grazing/browsing cycle is being developed in Mexico.

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 are 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 potentials and limitations 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.

The problem model and vision that we had developed gave us a goal that appealed strongly to our Latin American partners. The appeal was 1) in the recognition of a problem that was already very apparent to our partners and 2) in the goal of community-based planning vision and the step-wise approach as the way to achieve it. The structure and open nature of the collaboration and interactions with our partners built a strong, committed team.

Progress

The start of the first year required a major restructuring of the work plan given a reduction in funding from a requested $377,000 to $100,000 (a later addition of $20,000 was critical). The continued strong support of the University of

Wisconsin-Madison made possible the participation of key researchers. Coordination within and among the three host country teams also required rethinking and reworking to achieve effective and efficient coordination within each country's team and to promote better, more effective coordination among all partners. All three teams have shown unprecedented levels of cooperation among their members and member groups. One early significant product of this project has been the development of this increased level of exchange with has served already to strengthen the capacities of all three groups to undertake interdisciplinary, integrated projects such as this one. The recent development of an email network has facilitated an open exchange of information among all participants to increase overall awareness of project activity and to enhance the interchange of ideas. The participation by a representative of each host country team in the annual SR/GL-CRSP meeting at Davis was an important element to facilitate and strengthen collaboration by each team. This equal participation will be continued at the second annual SR/GL-CRSP meeting in Africa with representatives from each team attending. An exchange of researchers with visits to other sites is serving well to increase mutual awareness among the host country teams, to build stronger linkages among these teams, and to favor the application of similar methodologies and approaches to data collection.

The plan for the first year will be to implement the following objectives of the Proposal.

Objective 1.1. *Implement a community autodiagnostics in all three sites: Mexico, Ecuador, and Bolivia.*
Objective 1.2 *Collection of secondary and scientific data.*
Objective 1.3. *Store information in GIS databases.*

Targets

Due to the limitations of funding for the first year, we set limited targets for each of these objectives: 1) Design autodiagnostics for all three sites and synthesize the two approaches of all three groups. 2) Implement the first round of the autodiagnostics in Mexico, Ecuador and Bolivia. 3) Collection of sufficient data to characterize the situation to support Objectives 2.1, 2.2, and 2.3. 4) Plan a database to store and retrieve the information to be collected (primary and secondary). 5) Set up a GIS database for a) Mexico, b) Ecuador, and c) Bolivia.

Progress

Autodiagnostics have been designed in all three sites. Lastarria visited Ecuador and Mexico and has worked with collaborators from all three sites to coordinate approaches and information to be collected within the constraints and needs of each site. Lastarria, Wattiaux, and Moermond all participated in this process.

The first phase of an autodiagnostic was completed in Ecuador in fall 1997.

Follow-ups and subsequent phases were planned in July 1998 in Ecuador and have been continued to the present. The first phase of an autodiagnostic was undertaken in Bolivia in summer 1998. Subsequent phases will continue during the coming year. Mexico has not yet been able to undertake the autodiagnostic at the target site due to local problems that need to be resolved first.

The collection of known and new information is allowing the building of a more complete picture and history of the situations at all three sites.

On overall database has yet to be completed. Digitizing thematic maps for the study areas at each site have been in progress. The work here is not complete, but moving ahead well within the constraints of the limited funding.

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

Targets

2.1: 1) Achieve a preliminary assessment of the socio-economic-cultural practices sufficient to guide the design of a more detailed assessment for Year 2. 2) Identify additional "candidate alternatives" to add to Objective 2.5 in Year 2.

2.2: Based on autodiagnostics and selected interviews, begin a preliminary assessment of the production and management systems to guide the designs of assessments under Objectives 2.1, 2.3, and 2.4.

Progress

All three sites have accumulated more information for an preliminary assessment of socio-economic-cultural practices and have developed detailed questions for further investigation in year 2. While some potential "candidate alternatives" have been suggested, the understanding of differences in the basis and nature of local communities has raised the importance of designing "alternatives" that are "community specific." In particular, "sustainable use of ecosystems" will need to be reformulated in terms of local constraints and options and the development of attractive and tractable sustainable options. This direction is likely to be productive but will need more information and study and will need to be built upon a better understanding of local knowledge and perspectives. The framework of approach applied by Terranueva and HPI in Ecuador provides a particularly interesting model that can be shared and applied to the other sites.

One important area for assessment of alternative resources is that of non-timber forest products. The CDC has already made 120 collections of plant species with known or potential value. They are creating a database of species

name, structure, habitat, distribution, and use of each species including details on the part of plant used and the form of use.

Objective 2.3 *Scientific evaluation of ecological processes and productivity of ecosystems.*

Targets

1) Achieve a preliminary assessment of ecological processes sufficient to guide the design of a more detailed assessment for Year 2. 2) Begin remote sensing and mapping to assess vegetation cover, land use, and setup of GIS in a) Mexico, b) Ecuador, and c) Bolivia. 3) Soils: Design of set of diagnostic tools for assessment of soils and watershed health. 4) Biodiversity: a) Assess preliminary native biodiversity, b) Identify keystone species candidates, c) identify and assess avian indicators of vegetation change: a) Mexico, b) Ecuador, c) Bolivia.

Progress

We have made selective progress in several of these targets.
2) Mapping of vegetation cover and land use are well underway at all three sites. For example, in Ecuador, the CDC generated a basic map of vegetation cover and land use and then digitized five other thematic maps:

- Vegetation cover and current land use,
- Conflicts of land use,
- Land use capacity,
- Soils and geo-morphology,
- Forest's functions,
- Zones of life

In Mexico, a UW M.S. student from IMECBIO, Cardenas, is carrying out an assessment of change in land use and land cover between 1971 and 1998 in the Ejido Zenzontla (the principal site of our project). His analysis provides one of the first quantified studies of land use change; his doctoral dissertation will focus on the factors that influenced the change in land use and current land uses in this area.

3) Polly Ericksen completed the design (and testing in Honduras) of a set of diagnostic tools to evaluate sustainability of agroecosystems in hillside agroecosystems. Her methodology will be useful in using to assess and monitor land use and livestock management practices in all our sites.

4) Preliminary assessments of avian diversity and identification of candidate keystone species for seed dispersal and indicator species for vegetation quality were carried out by Moermond, Bleiweiss, and two students, Erdmann and Hernandez, in Mexico and Ecuador.

Objective 2.4. *Characterization of effects of livestock on production and on landscapes.*
Objective 2.5. *Experiments with alternatives to improve livestock production and reduce impacts.*

Targets

1) Design and implement paired sets of grazing plots and exclosures in a) Mexico, b) Ecuador, and c) Bolivia. 2) Preliminary study of cattle follows to

assess utility for Objectives 2.4 and 2.5.: Mexico.

Progress

1) Ten paired sets of grazing plots and exclosures were established in Mexico in August 1997 and have been monitored monthly since. Moermond, Wattiaux, and Langstroth all visited these plots over the past year. Sanchez and his team have already reported obvious and interesting results from these plots. In June 1998, Langstroth and Sanchez (the lead scientist on the plots in Mexico), visited Ecuador to guide the selection and establishment of a similar series in the Cosanga area. Three sets have already been established there and the remainder are expected to follow soon. The establishment of these plots in Bolivia is expected to occur during the second year. Analysis of livestock impact in the Mexican plots which contain 20 shrub species and 18 tree species is underway.

2) The cattle follows, being carried out by a CUCSUR student, Juan Pablo Esparza, for an undergraduate thesis has been very useful with the following preliminary results:

- Establishment of the study area covering four types of habitat: Dense tropical deciduous forest, open tropical deciduous forest, riparian vegetation, and perennial tropical forest.
- Identification of the main routes followed by cattle and the areas for resting.
- Quantification of the number of animals located in the site.
- Collection of 36 species of foliage and 15 of other plants. Observations on abundance for both groups, and records of frequency of consumption for the foliage species.
- Preliminary recordings for characterization of 110 micro-sites (2 m in diameter).
- Training in the use of the radio-telemetry technique.

The success of this mini-project will be used to replicate it with appropriate students in the other sites.

3) In addition in Mexico, an additional approach was applied to describe vegetation units used by livestock and the effects of their grazing. Local farmers identified forest vegetation used in wet and dry season. 50 point-quadrants were established in four sites to assess tree species diversity: the richest site provided 43 tree species in the sample emphasizing the high biodiversity of these grazed forests. Native forage plants are identified and assessed in terms of nutritive value, distribution, and abundance in the management unit to evaluate the potential grazing productivity in different vegetation types.

Objective 2.5a. *Optimal mix of forage species.*

Targets

Set up a participatory project of native forage selection and propagation as step

one to improve production value of pastures and biodiversity health of pastures: a) Mexico

This project, led by Sanchez and Louette in Mexico, was a participatory search for agroforestry options for the enhancement of pasturage and improvement of soils. The required the determination of appropriate native plant species and associated agroforestry techniques for their use in pastures in order to reduce the negative effects of cattle grazing and to provide additional options for feeding domestic animals. Nurseries and pilot experiments were carried out in collaboration with local farmer/ community members. The preliminary results are very promising:

a) Propagation of arboreal species for multiple use selected with the help of local inhabitants through informal talks. Seeds of several species were collected, including "mezquite" (Prosopis laevigata), "guazuma" (Guazuma ulmifolia), "guamuchil" (Pithecelobium dulce), "capiri" (Sideroxilum capiri), and "parota" (Enterolobium cyclocarpon). Statistical analyses of the treatments were also carried out. At these time, there are three pre-germinating treatments for species with potential to feed cattle and to build "living fences."

b) Production of trees for multiple-use and pasturage enhancement. This activity consists on two phases: Production of plants in a greenhouse, and through extension. In the first phase, local farmer/livestock producers continue collecting seeds. 8000 "mezquites", 1200 "guamuchil", 2000 "guazimas", and 5 "capiris" have been produced. Approximately 8000 trees already have been distributed among the Ejidos Zenzontla, Mezquites, Ahuacapan and some privates land-holding. Trees are being planted in parcels as "living fences" and are utilized also as forage.

Objective 2.5b. Rotational Grazing

Targets

1) Identify and begin preliminary assessment of local farmers who are using rotational grazing: a) Ecuador, b) Mexico. 2) Establish participatory support for implementation of rotation experiments as a "candidate alternative" in a) Mexico, b) Ecuador, and c) Bolivia.

Progress

In all three countries, there are possible alternative grazing patterns that will reduce ecological damage AND enhance cattle production. One example reported by FUNAN in Ecuador was of one dairy farmer who initiated rotational grazing on his pasture instead of cycling through his forests. He reported that the rotational grazing resulted in more than double his milk production in one year. If study of this farmer's success is confirmed, the next step is to work with him and his neighbor's to improve and spread the adoption of this practice. The problem is not in identifying technological improvements; the problem is to find practices that are appealing and practical to local farmers to meet their needs.

In Mexico, Louette and Sanchez have

developed a plan to enroll livestock producers into experiments to determine modifications of grazing cycles that will improve their cattle production and reduce the degradation of the environment in terms that are clearly visible to the producer. This plan has been adopted to be put into action by the Regional Program for Sustainable Development carried out by the Ministry of the Environment in the same area.

Objective 2.5d. *To improve the genetic stock of local livestock.*

Targets: Ecuador

1) Assess the situation for feasibility of embryo transfer experiments.
2) Determine available facilities, participating people and agencies.
3) Set up initial facilities, procedures and training.
4) Begin initial experiment.

Progress

Appropriate and feasible communities and producers have been identified as potential sites for a pilot project. Laboratory work in preparation for this has been proceeding at the UW. Limited funding has greatly slowed this initiative. Nevertheless, the techniques necessary to apply this approach successfully continue to be refined.

Objective 2.8. *Preparation of educational and training materials.*

Targets

Although the detailed preparation of education materials will not take place until year 2, a strategy and preliminary plan for this preparation and implementation will be made in year 1.

Progress

CIEC, the lead group in developing the education strategy was unable to begin on this strategy until funding and priorities were worked out. Since that time CIEC organized a three-day workshop at our site in Tarija in Bolivia with participation of CER-DET, PROMETA, AND ZONISIG and with additional attendance of delegates from communities in the area of the project. This workshop took into account the following aspects to develop an educative strategy to be applied to all three country sites:

- 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.

A similar workshop is now being organized in Ecuador for November, 1998. A Mexico workshop has yet to be set up.

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

Targets

We 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. The first conference will be at the beginning of the second year; however, arrangements for the visits by farmers will be make through Heifer Project International's U.S. and Canada Program.

Progress

The limited funding for both year 1 and year 2 have forced us to delay this planned "farmer to farmer" exchange. Nevertheless, we still find this idea exciting and worthwhile; we will attempt to look for additional funds for a possible exchange toward the end of year 2.

Additional Objective A1.1. *To develop evaluation criteria and procedures appropriate to 1) the workplan objectives, 2) host country organizations, and 3) university researchers.*

Targets

1) To agree upon criteria for self-assessment of progress and success of the project using criteria appropriate to the project and its participants. 2) To implement the evaluation and apply the selected criteria at the end of the first year.

Progress

We have not yet set up a self-assessment of progress of the project itself. We had hoped to work through this as part of our first annual meeting. We now do not have funds for an annual meeting. We have moved this item to the agenda for year 2.

Gender

Gender, as targets and participants. Our project is aimed at community-planning with an emphasis on local producers and the family level. In this, our final goals is to include families in their entirety, including all men, women and children. We have begun to work with local community structures and farmers' organizations which are typically dominated by men in these Latin American countries. Nevertheless, our auto-diagnostics are done in cooperation with representative samples

of local communities to take into account critical factors such as gender, age, ethnicity, and income. The auto-diagnostics, which are critical stages for understanding local communities and for beginning the process to achieve subsequent objectives, must include women explicitly to be able to understand and include their perspectives in the assessments and planning of the four main objectives.

Gender, as project team leaders and collaborators. Within our teams, a number of women are included at several levels: At UW-Madison, 3 women scientists are included within the local team of 15. In Mexico, one of the two co-coordinators is a women and 2 women are included in the team of 10. In Ecuador, women are directors of three of our four partner organizations and 4 women are in the team of 11. In Bolivia, no women lead any of our four partner organizations; however, 2 women are included in the 12 team members. Overall, among the 50 participants, 12 are women. We hope to increase the training and participation of women in the future. Note that 3 of the 7 students whose research was supported through this project are women.

Policy

Local community area leaders have been informed and brought into the process at the earliest stages in seeking authorization, cooperation, and support in initiating and developing the project in target communities in all three countries. Their positions of influence and responsibility will be respected and incorporated so that the project develops in step with the interests and timetable of local communities. We are far from the policy contributions that are expected to arise out of local community planning, which is scheduled for beyond year 3.

Outreach

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. 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, CIEC and Pilar Lizarraga worked closely together to arrange the first workshop to delineate an explicit educative strategy for the Bolivia site. This workshop, held in Tarija, Bolivia on October 13-15,

included not only participants from our three partner organizations (CER-DET, PROMETA, and ZONISIG) but also delegates from the communities found in the area of influence of the project. This educative strategy 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 the 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. The planning for a second workshop with CIEC and our Ecuador partner organizations is now underway.

Communities and 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 beginning of the second year. With even less funds for year 2, we are now in search of funds to hold an annual meeting. 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.

Developmental Impact

Environmental Impact and Relevance

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 contribute to conservation of biodiversity of the sites themselves, thereby enhancing the prospects of conservation of valuable biological resources on a regional scale.

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.

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 provides 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 will reduce 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 the section entitled 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 participating were intended to be communicated among the 40 groups of farmers in the Heifer Project's U.S. and Canada program.

Contributions to Host Country

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 year one, 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.

Linkages and Networking

This project has already fostered and strengthened linkages among the partner organizations in Ecuador and Bolivia. Two of the local environment/ development NGO's in Tarija—CER-DET and PROMETA—which had never worked together before this project are now collaborating closely and effectively.

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 a 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 they have also chosen who will represent the group at conferences and workshops. CRSP. We also have established valuable linkages among the four main teams in Wisconsin, Mexico, Ecuador and Bolivia. We have already had an exchange of a researcher between Mexico and Ecuador and have others planned including exchanges between Mexico and Bolivia and Bolivia and Ecuador. 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.

Other Contributions

Compliance with Mission Objectives

At the USAID 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 for 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 is direct assistance to these farmers and their communities. Our goal of participatory community-based planning is an activity that will directly enhance decision-making abilities of the local people at the scale of their communities. This is promoting and effecting democratization.

Leveraged Funds and Linked Projects

We have obtained substantial funds from the University of Wisconsin-Madison well beyond the matching funds. In addition, we have been actively applying for other grants as well as applying resources from other grants when possible. Three examples are detailed below. In addition, our target country partners have been able to accomplish some of their objectives with funds for other projects with overlapping, compatible objectives.

•USIA "NAFTA" Grant for a U.S., Canada, Mexico exchange
P.I.s: Thomas Yuill (UW-Madison), Eduardo Santana C. (CUCSUR, U. de Guadalajara), and Michael Moss (U. of Guelph).
Title: "Partnership for Environmental Stewardship"
Amount of Award: ~$5,000 allocated for work on this project (visits of Lastarria and Wattiaux to Mexico) as well as additional trips in the second year to be covered. (The concept of the livestock-natural resource project was originated under this "environmental partnership" in 1995.)

•UC MEXUS- CONOCYT Collaborative Grant
P.I. John W. Menke, Agronomy and Range Science, UC-Davis
Co-P.I. Lazaro Sanchez, IMECBIO, CUCSUR, Universidad de Guadalajara
Title: "Sustainable livestock management in forest ecosystems in the Sierra de Manantlan Biosphere Reserve."
Amount awarded: $14,999
Time of award: 1 October 1998—30 September 1999

•Babcock Institute for International Dairy Research and Development, University of Wisconsin-Madison
P.I. Jack Rutledge
Title: "Cross-breeding to improve dairy cow genetics in Ecuador"
Amount of Award: $15,000

Training

The following students have been funded or partially supported by our project for thesis studies useful to the objectives of the project. The first to complete her degree, Polly Ericksen, did her field work in Honduras; however, her methodology for evaluating sustainability in agroecosystems will be directly applicable to this project.

Juan Pablo Esparza, Ecology and Natural Resources: Habitat use for livestock in Zenzontla, Sierra de Manantlan Biosphere Reserve, Mexico , IMECBIO, CUCSUR, University of Guadalajara.

Oscar Cardenas-Hernandez, Conservation Biology and Sustainable Development: Land use changes in a protected area in western Mexico., Institute for Environmental Studies, University of Wisconsin-Madison.

Sarahy Contreras-Martinez, Conservation Biology and Sustainable Development: Conservation of birds in the Sierra de Manantlan Biosphere Reserve, Mexico—Gap analysis, Institute for Environmental Studies, University of Wisconsin-Madison.

Yoyi Hernandez, 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.

Polly J. Ericksen, Soil Science: Evaluating sustainability in hillside agroecosystems., Dept. of Soil Science, University of Wisconsin-Madison

Hong Hseng Men, Animal Science: Control of maturation of oozytes in cattle, and cryopreservation of oozytes in cattle., Dept. of Animal Science, University of Wisconsin-Madison.

Joshua Erdmann, Zoology: Ecological interactions of keystone fruit-eating bird species and fruiting plants in Ecuador., Dept. of Zoology, University of Wisconsin-Madison.

Collaborating Personnel

Ecuador

Baez, Sara, Terranueva, Director of Terranueva. Lawyer, Anthropologist.

Ballesteros, Hector, HPI—Heifer Project International-Ecuador, Veterinarian. Animal Science. Will assist in implementation of livestock genetic improvement with J. Rutledge of UW-Madison.

Castillo, Marco, Terranueva, Agronomist. Assist farmers in development and implementation of crop management systems.

Castillo, Mauricio, FUNAN—Fundacion Antisana, Agronomist. Will coordinate project implementation in agricultural management area.

Chancusig, Edwin, HPI, Agroecologist/ Technical Assistant. Will characterize existing production systems and develop models of sustainable use of available resources.

Guevara, Marcelo, CDC—Centro de Datos para la Conservacion, Geographer. Geography, remote sensing, GIS, GPS. Mapping and creation of GIS database for study sites.

Hernandez, Kattya, HPI, Sociologist.

Working with community auto-diagnostics and environmental perspectives.

Josse, Carmen, CDC, Director of CDC. Plant ecologist. Conduct monitoring of vegetation dynamics and forest regeneration. Manage data collection.

Larrea, Fernando, HPI, Coordinator. Director of HPI-Ecuador. Anthropologist. Will conduct analyses of community production strategies and impacts of social and cultural aspects on sustainability. Will aid in developing community diagnostic methods.

Mosquera, Gustavo, FUNAN, Technical Director. Biologist. Will direct projects related to resource management around the Reserva Antisana.

Penafiel, Marcia, CDC, Botanist. Monitoring of plant populations and database management.

Bolivia

Arnold, Ivan, PROMETA—Proteccion del Medio Ambiente Tarija, Biologist, Park Director.

Castro, Miguel, CER-DET—Centro de Estudios Regionales para el Desarrollo de Tarija, Director of CER-DET. Lawyer. Legal aspects on land tenancy.

Chavez, Freddy, PROMETA, Social psychologist. Community organization and autodiagnostics.

Erazo, Orlando, CER-DET, Forester. Assisted in design of project proposal. Forest resources, non-timber forest products.

Espinoza, Linder, ZONISIG— Proyecto Zonificacion Agro-ecologica y Establecimiento de una Base de Datos y Red de Sistema de Informacion Geographica en Bolivia, Forester. Forest resources, non-timber forest products. Land use evaluation.

Jung, Jorge Eduardo, CIEC— Centro Interdisciplinario de Estudios Comunitarios, Environmental Education. Conduct environmental education programs and group management. Evaluation and follow-up of education programs.

Lizarraga, Pilar, CER-DET, Anthropologist. Design and conduct community auto-diagnostics.

Montano, Blanca, CER-DET, Psychologist. Will assist in autodiagnostics and community planning.

Roth, Erick, CIEC, Director of CIEC. Environmental Education. Will design and plan education strategy, educational materials and audiovisuals for all three countries.

Ruiz, Jorge, ZONISIG, Director of ZONISIG. Agronomist, GIS Specialist: Will direct and coordinate GIS applications and cartography of the Tarija site. Will be coordinator for Year Three.

Vacaflores, Carlos, PROMETA, Agronomist, Research Coordinator-Tarija. Direct research on forest-community-cattle relationships. Will be Coordinator for year 2.

Valdez, Alipio, CER-DET, Anthropologist. Will work with community auto-diagnostics.

Mexico

Carranza, Arturo, IMECBIO—Instituto Manantlan de Ecologia y Conservacionde la Biodiversidad, Agronomist. Will study the impact of livestock in the watershed.

Carranza, Mario, IMECBIO, Agronomist. Will study the effect of livestock on vegetation and management alternatives.

Cuevas, Ramon, IMECBIO, Botanist. will work with plant taxonomy, livestock forage and vegetation change.

Dario, Ruben, IMECBIO, Soil scientist. Will work conservation of soils and watersheds.

Iniguez, Luis, IMECBIO, Zoologist. Radio-telemetry. Will study feeding habits and movement of livestock and roles of key species in seed dispersal.

Jardel, Enrique, IMECBIO, Ecologist. Management of natural resources. Will study dynamics of vegetation change, landscape ecology, land use changes, GIS applications.

Louette, Dominique, IMECBIO, Agronomist. Coordinator. Community development, autodiagnostics, livestock farming system management.

Martinez, Luis Manuel, IMECBIO, Soil scientist. Will work conservation of soils and watersheds.

Pineda, Maria del Rosario, IMECBIO, Ecologist. Will study effect of livestock on vegetation in dry forest and cloud forest.

Sanchez, Lazaro, IMECBIO, Botanist. Co-coordinator. Will study vegetation dynamics and impact of livestock on vegetation change.

United States

Bleiweiss, Robert, University of Wisconsin-Madison Department of Zoology, Zoologist. Will conduct research and investigate potential for community production of medicinal plants.

Cooperband, Leslie, University of Wisconsin-Madison Department of Soil Science, Soil scientist. Will study affect of livestock management on soil quality, manure management in grazed vs. confined systems.

Fristrup, Kurt, Cornell Laboratory of Ornithology Bioacoustics Research Program 159, Biophysicist, Ethologist. Will provide technical support for radio-tracking of livestock and acoustic censuring of birds.

Hester, Alison, MacCaulay Land Use Research Institute, Craigbuckler, Aberdeen, UK, Agronomist, Range Scientist. Will advise on methodology of forest grazing systems.

Kelley, Gene, Colorado State University, Professor of Soil Science, Department of Soil and Crop Sciences. Will work on modeling the terrestrial carbon cycle.

Langstroth, Robert, Wisconsin Division of Safety and Buildings, Geographer/ Botanist. Environmental Analysis and Review Specialist: Will design, conduct, and supervise research on vegetation dynamics and range/pasture management problems in collaboration with local investigators.

Lastarria, Susana, University of Wisconsin-Madison , Land Tenure Center, Land Tenure Specialist. Will participate in community autodiagnostics and assess land tenure related constraints to sustainable production.

McSweeney, Kevin, University of Wisconsin-Madison Department of Soil Science
Director, School of Natural Resources, Soil scientist. Will direct research on soil-landscape-hydrological modeling.

Menke, John, University of California-Davis, Department of Agronomy and Range Science, Range ecologist. Will advise on design of field range vegetation.

Moermond, Timothy, University of Wisconsin-Madison, Department of Zoology. Chair, Conservation Biology Sustainable Development Program, Principal Investigator and Principal Coordinator. Zoologist. Will coordinate the overall project. Will direct studies of livestock foraging and changes in vegetation and biodiversity.

Moen, Ronald, University of Minnesota-Duluth. Professor of Biology Natural Resources Research Institute, Wildlife ecologist. Will adapt and apply a spatially explicit livestock foraging/ energetics model to livestock nutrition and nutrient distribution.

Nordheim, Richard, University of Wisconsin-Madison, Department of Forestry and Statistics, Will coordinate the experimental design and statistical analysis, particularly with respect to indicators of sustainability.

Pastor, John, University of Minnesota-Duluth, Professor of Biology Natural Resources Research Institute, Range ecologist. Will advise study of changes in vegetation and livestock nutrition using a mathematical model.

Rutledge, Jack, University of Wisconsin-Madison, Department of Animal Science, Animal Scientist. Will evaluate between and within species crosses in the genus Bos for milk production and adaptation to tropical conditions.

Wattiaux, Michel, University of Wisconsin – Madison, Department of Animal Science, Animal Scientist. Will evaluate feeding patterns and forages of

livestock and will participate in extension/education and preparation of education materials.

Yuill, Thomas, University of Wisconsin-Madison Director, Institute for Environmental Studies, Animal Scientist/Wildlife Ecologist. Will assist in livestock production by advising on animal health assessment and surveillance and with wildlife ecology.

Zepeda, Lydia, Food and Agriculture Organization EASE, Italy, Economist. Will study household and small-holder farm economy, will study income distribution and gender issues, will model local farmer/market system.

Collaborating Institutions

United States

University of Wisconsin-Madison
International Agricultural Programs
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Fax: 608-262-8852

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(collaboration through Dr. John Menke, see Leveraged Funds above)
University of California-Davis
Department of Agronomy and Range Science
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Fax: (530) 468-5654

Mexico

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Mexico
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Ecuador

Heifer Project International (HPI)
San Ignacio134 y 6 de Diciembre,
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Centro de Datos para la Conservacion (CDC)
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FUNAN (Fundacion Antisana)
Av. Mariana de Jesus s/n y Carvajal
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Terranueva (TE)
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Fax: 593-2-507-865

Bolivia

Centro de Estudios Regionales para el Desarrollo de Tarija (CER-DET)
Calle Virginio Lema 0-173
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Fax: 591-66-3-34-54

Centro Interdisciplinario de Estudios Comunitarios (CIEC)
Calle Belisario Salinas No. 228, 2nd piso,
Casilla 159,
La Paz, Bolivia
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Fax: 591-2432-662

Proteccion del Medio Ambiente Tarija (PROMETA)
Mendez 172, Casilla 59
Tarija, Bolivia
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Proyecto Zonificacion Agro-ecologica y Establecimiento de una Base de Datos y Red de Sistema de Informacion Geographica en Bolivia (ZONISIG)
Oficina Regional Tarija
Calle Padilla esq. A. del Carpio Casilla 502,
Tarija, Bolivia
Phone: 591-66-4-46-44
Fax: 591-66-4-56-59

Abstracts and Presentations

T. Moermond, University of Wisconsin-Madison, 16 July, 1998,
Symposium on "Conservation where there will be no parks: Approaches through watersheds, sustainable resource use, and local communities."

Society of Conservation Biology International Meeting, Sydney, Australia. "The watershed as a key scale for the integration of conservation and agriculture: Community planning of natural forests and livestock in Latin America."

Small Grants

Feasibility Study: Development of the Indonesian Cold Chain for Poultry

Principal Investigator: *Andy D. Hale, International Agricultural Programs, Texas A&M University , College Station, TX 77843-2477.*

Background

In late 1996, the Association of Southeast Asian Nations (ASEAN) finance ministers observed that economic cooperation among ASEAN partners had focused mainly on the electronics, apparel and banking industries, with little attention given to agriculture. Agriculture is important to ASEAN nations and comprises a major component of trade with the United States. The ASEAN finance ministers suggested that the US/ASEAN Business Council initiate member cooperation in agriculture. The Agriculture Committee of the US/ASEAN Business Council was subsequently formed and held meetings in Washington, DC in early 1997.

In Chicago in April 1997 the Council's Agriculture Committee adopted the practical approach of choosing one agricultural commodity and one country as a pilot project. The group's goal was to attempt to reduce the cost of a common food product in an ASEAN nation to consumers. The Committee chose poultry and Indonesia for the pilot project. Future efforts would be conducted on the same commodity in other ASEAN nations, and/or action would move to other commodities.

Attendees of the meeting included representatives of Pioneer Hi-Bred, Cargill, McDonald's, Monsanto, Texas A&M University, and the US/ASEAN Business Council—Washington, D.C. office. Subsequent meetings were set to include companies and organizations like TriCon Restaurants, the American Soybean Association and Tyson Foods, Inc. With the steep Indonesian Rupiah devaluation in September 1997, economic conditions deteriorated, but plans for a mission to Indonesia remained firm. Abandoning the project *would give the wrong signal to ASEAN countries*. The purpose of the mission shifted from that of making poultry production more efficient, to assisting its survival.

In February 1998, the US/ASEAN Agriculture Committee completed its poultry mission to Indonesia, observing the following weaknesses in the industry:

- Poultry production and processing firms lack a sufficient number of

trained Indonesian middle and upper level managers.

- Substantial quantities of locally produced feed grains are infected by aflatoxin which can harm the health of poultry and other livestock.
- Feed aid to Indonesia, possibly under PL480, is needed to sustain poultry production because low value of the Rupiah makes imported feed prohibitively expensive.
- Effort is required to develop reliable and safe domestic supplies of protein feeds such as fish meal and/or oilseed meal to help sustain and expand the future poultry industry.
- Indonesia lacks facilities for refrigerated shipping and storage, causing heavy dependence upon trade in live birds and slaughter at the point of retail sale.

Efforts to help resolve each of the weaknesses were undertaken in subsequent discussions with the US Agency for International Development (USAID) and the US Department of Agriculture. Among other steps taken, the US/ASEAN Business Council and Texas A&M offered to pay the costs of graduate studies by Indonesian students in Poultry Science at Texas A&M University.

In July 1998, an assessment of Indonesia's refrigerated storage and shipping system was initiated in Indonesia by the author, under funding made available by USAID through the Global Livestock CRSP. Other cooperators in the project included the American Soybean Association, FAS/ Jakarta, McDonald's Corporation, the US/ASEAN Business Council, and Texas A&M University. Research in Indonesia was completed in August, 1998; analysis was conducted at Texas A&M in the fall of 1998; and the study completed by the author while an intern at the Foreign Agriculture Service in Washington, DC, in June, 1999.

**Findings included in this paper were obtained first-hand by the author through visual observations and personal interviews with representatives from different sectors of the poultry industry, distribution centers, port authorities, container terminal operators, security officers and consumers throughout Indonesia.

Executive Summary

As the importance of food availability increases in Indonesia, so does the importance of an effective food distribution system. At this time, the cold storage and distribution systems throughout the country contain a number of inefficiencies, many caused by infrastructural inadequacies and policy restrictions that inhibit the improvement and expansion of the cold chain. Traditional misperceptions of frozen foods also contribute to this problem. Indonesians typically believe that frozen products are old, unsafe, inferior in quality, or unsatisfactory in taste. Beliefs such as these cause consumption of frozen foods to remain low relative to

fresh foods and investment in the cold chain is not attractive to investors. The continued use of inefficient distribution systems increases transportation costs, driving prices of frozen products higher and further contributing to low levels of consumption.

Indonesians rely primarily on staple foods like rice as dietary mainstays. Meats, which are more expensive, are reserved for the elite and not consumed regularly by the majority of the population, despite the need for animal proteins to facilitate growth and development in children. Beef is imported in Indonesia from Australia and the United States and is considered a delicacy. The population of Indonesia is predominantly Muslim and therefore abstains from eating pork. Chicken, which is inexpensive relative to other meats, seems to be the ideal complement to seafood in Indonesia. Most of the country's poultry is purchased daily in fresh form at traditional wet markets. Wet markets carry broilers as well as a local village chicken, *kampung ayum.* These native birds are preferred to broilers but account for only five percent of total poultry consumption, due to prices of up to four times those of broilers. These high premiums are placed on the village chicken due to the perception of better tastes, according to local experts.

The population of Indonesia is very concentrated, with about eighty percent living in West Java. Indonesian poultry production is equally concentrated in this region. Corn, which is the major input and represents the greatest cost in poultry production, is grown mostly in Sumatra and shipped to West Java. The instability and recent devaluation of the *Rupiah* has caused corn producers to seek export markets in order to acquire a stronger currency. This results in a shortage of corn in West Java, driving up the

production cost of poultry considerably. The poor economic conditions in Indonesia cause demand for poultry to be elastic, so producers are unable to increase consumer prices enough to compensate for increased production costs, and margins are cut dramatically. Although consumer prices have doubled in the last year, production costs have more than quadrupled and many poultry producers have been forced out of business. Surviving producers indicate that total poultry production is down to fifteen percent of pre-crisis levels.

As noted, poultry is now produced in heavily populated areas so that the growers have easy access to the wet markets and increased transportation costs and losses associated with the shipment of live birds over long distances will not be incurred. By producing and processing poultry in areas where corn is grown, and implementing a system for refrigerated distribution and storage, numerous efficiencies can be gained. First of all, the transport costs of shipping a bulk, perishable commodity such as corn great distances will be avoided. Poultry producers would also be able to more easily track corn production and bargain with producers while the corn is still in the field. Although more capital is required for putting processing, storage and distribution systems in place, it is not difficult to see the long term benefits of a fully integrated poultry system. Benefits of shipping poultry in processed form versus live shipping include transport of much greater quantities of consumable meat, no weight loss or mortality of birds during live transport, and elimination of disease transmission from live transport.

A fully integrated poultry system will also open up new markets domestically as well as internationally. As the Indonesian economy continues to rebound, consumers will begin to demand more processed, value-added products. Export markets will also arise as a result of the processed food system. Indonesia has the geographic potential to be the primary player in Southeast Asia for processed foods, and the development of their refrigerated distribution system will enable the country to become global contenders in the markets for value-added products.

The Study: In order to fully explore the possibilities associated with such a system, the different mediums of transportation were reviewed. The following introduces and evaluates three distinct distribution systems that must be understood in order to recognize the long term benefits resulting from usage of modern cold chain practices in Indonesia. These distribution methods are:

1. Transport in densely-populated, urban areas.

2. Overland transport to a remote location.

3. Coastal shipping via sea-going vessels.

Refrigerated Distribution in Densely Populated Urban Areas: The Hub of the Distribution System

The system most commonly used for the distribution of poultry at this time is trucking through densely populated, urban areas. Birds are transported in live form from the growers to processors who are normally located in or around large cities. They are put in small cages individually or by the pair, and stacked high onto the back of trucks. Common transport time is about two hours and normally results in about 2% weight loss to birds, with the loss increasing exponentially as more time is spent on trucks. Mortality rates and the transmission of disease also increases significantly as transport times increase. The total loss due to these factors vary according to temperature, humidity, and rate of traffic flow. Higher temperatures and humidity also cause mortality rates and disease transmission to increase. The same results can be expected as trucks spend more time stopped or in very slow moving traffic. These losses on yield and/or quality have repercussions throughout the value chain, from producer to consumer, and enable one to clearly see the importance of further development of the cold chain in Indonesia.

The ability to transport poultry in processed, frozen form would allow distributors to focus on logistics and detailed route planning to increase efficiencies, rather than concentrating solely on short travel times to minimize the amount of stress put on birds. A refrigerated distribution system will also allow for larger quantities of meat per shipment. A chicken typically dresses out 67% - 75% of live weight (depending on condition) and shipment of the processed bird not only eliminates transport of the unnecessary one-third to one-fourth body weight, but also allows for dense and compact loading practices of the processed product to achieve a much more efficient delivery. Refrigerated distribution allows for optimal use of truck space as well as detailed route planning in order to get the maximum benefit from the shipping process. This requires not only delivering full shipments, but also reloading at an area supplier or processor before returning to the distribution center. Detailed route planning and effective management allow shipments to be divided into categories according to volume, with systematic routes according to category on given days of the week.

Computer software which adapts to changes in price and/or market demand and takes electronic orders to aid in route planning as well as the formulation of strategic loading practices is available and can be tailored to fit almost any distribution needs. A single route often includes many stops, so it is important to organize shipments by order and ensure that each one is easily accessible at its destination. The software can also be used to print labels that include the route, stop, retailer name and store number, products included, as well as date and time of delivery. Placing a label

on each individual order allows them to be arranged in the warehouse for ease in systematic loading and unloading as well as cut down on human error and/or guesswork as the order passes through the cold chain. These programs can also be used by the customer service department to more effectively field any problems associated with orders and evaluate the effectiveness of current systems.

There are a number of logistical difficulties facing frozen or refrigerated distribution through heavily populated, urban areas. Although the roads are generally adequate in metropolitan areas, heavy traffic can make even the shortest trips take hours. It is not uncommon for trucks to sit motionless in traffic for extended periods of time unable to move. Time restrictions and the frequent changing of requirements for trucks is another problem facing urban distributors. Most major cities require special permits for forty-foot containers on roadways. There are different types of restrictions for the various types of trucks that are specific to certain areas or zones. Time restrictions are also common to many areas, allowing the passage of trucks only between the hours of 10:00 pm and 6:00 am. A given restriction is subject to change at anytime however, due to the nature of local law enforcement. Local police are paid very low salaries, and often supplement their income by imposing bogus laws that can be "bent" to varying degrees, depending on the amount of payoff the driver is willing to pay. These encounters have become so common that most distributors give drivers an allowance which is to be kept in the truck at all times to alleviate any problems with minimal hassle. Theft in transit is another area of concern for urban distributors. Desperate times for many who live in cities have increased the need for trucks to remain well secured at all times to avoid loss of shipment. Loss due to theft tends to be greater when shipping live birds, due to inabilities to secure each individual crate. Many companies engage in programs and promotion to generate goodwill and an overall positive image of the company to the public in order to minimize their risks of becoming a target for thieves.

In the forefront of technology in refrigerated distribution are new multi-temperature trucks. These trucks are divided into two or three separate compartments, depending on the needs of the individual shipment, which can accommodate frozen, refrigerated and dry goods. The front compartment usually contains frozen products and is kept a standard temperature at or below negative eighteen degrees Celsius. The rear compartment has a separate gasoline powered cooling unit that maintains a temperature of approximately four degrees Celsius and holds refrigerated products. Special dividers, called bulkheads, are used to separate these compartments and can also be used to create a middle compartment to hold dry goods.

Multi-temperature trucks allow for more diversified shipments, increased

freshness and quality of products, and increased food safety. With state of the art cooling units, they are said to require less maintenance and fewer repairs, which significantly decreases down time and increases business opportunities. The steel-lined inside of the refrigerated container is another advantage. Steel lining allows for forklifts to be driven on and off of the truck for loading and unloading. This practice is not possible on the standard fiber lined trucks because of the risk of contaminating food products with disturbed fibers.

Another issue pertaining to food safety that is important to distributors is the sanitation of the warehouse. Pest control should be done exclusively with mechanical traps, since usage of chemical pesticides puts distributors at risk of contaminating food. These

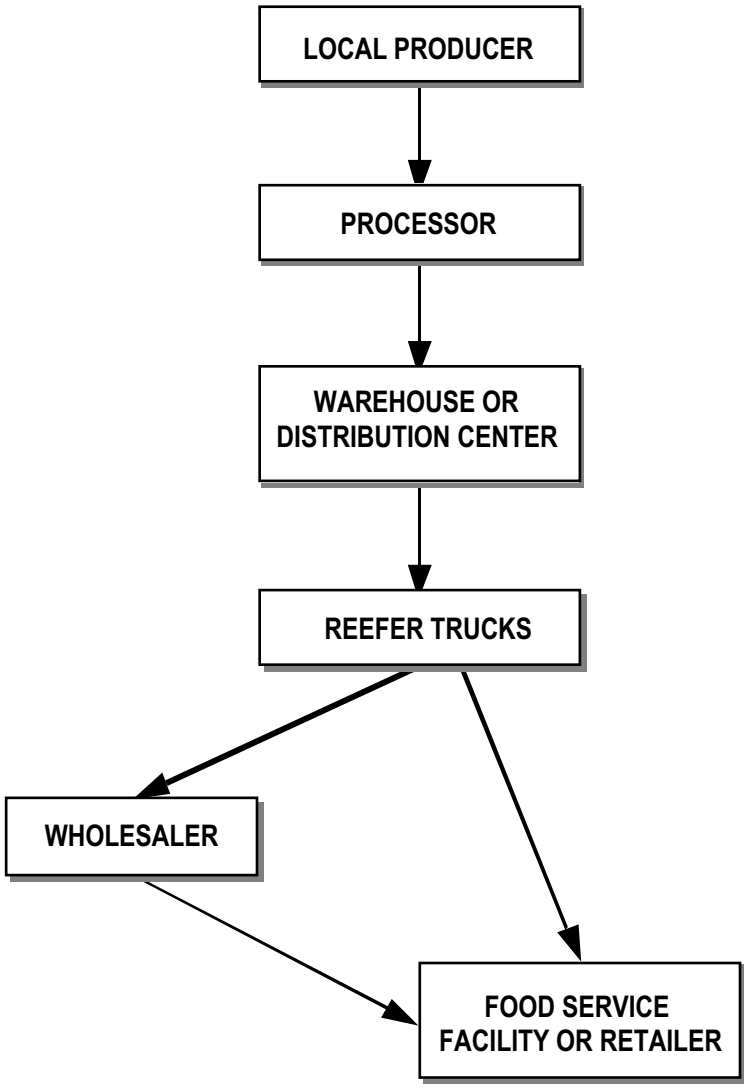

Figure 1: Poultry value chain: The Urban Distribution System

mechanical traps are to be checked and logged twice weekly so that patterns can be easily detected and problems alleviated quickly. Products should be stacked on pallets at least twelve inches away from any walls so that they will not provide cover for any pests. The area surrounding the warehouse should be kept free of debris and organic material such as leaves that could provide cover, bedding, and/or food for insects, rodents, and other pests.

Upon arrival at the warehouse, each food shipment should be randomly inspected for quality. This can be done by visually comparing product samples to photographs of quality products placed around a stainless steel inspection table. Some businesses use an all or nothing policy, meaning that if one sample of a shipment is found to not match the quality photograph, then the entire shipment is unacceptable and discarded. This policy is used by McDonald's Distribution Centers to ensure quality and minimize the risk of distributing an unsafe or unsatisfactory product.

The entire distribution system is dependent on the transport of products through urban areas. Although there is much else to be considered, in order for a product to be made available to most consumers, it is inevitable that distributors face the problems associated with transporting products through heavily populated cities.

Overland Trucking to a Remote Location: The Weak Link in the Cold Chain

For the transport of frozen or refrigerated foods great distances within the country, most Indonesian distributors rely on trucks to carry their products. There are many obstacles to overcome on Indonesian roadways, like infrastructural shortcomings and dense populations, even in rural areas. Narrow, poorly maintained roads across the country carry many pedestrians, bicycles, and other human powered vehicles and inhibit smooth traffic flow. Laborers in rural areas can be found on roads carrying agricultural products to market daily, sometimes backing up traffic for miles. It is not uncommon for roads to be impassable for trucks because of low bridges or power lines. Many of the same problems that face urban distributors, such as heavy traffic, changing requirements, corrupt law enforcement, and theft in transit all

Overland Trucking Costs - Various Indonesian Routes

Route	Cost in Dollars (6 ton capacity)
Jakarta – Solo	$120.00
Jakarta – Surabaya	$136.00
Jakarta –Bali	$220.00
Jakarta – Medan	$400.00
Semarang –Jakarta	$64.00

Table 1: One-way total costs of refrigerated shipment by truck as compiled by McDonald's Distribution Center in Jakarta as of July 24,1998. Based on an exchange rate of Rupiah 12,500/$1.

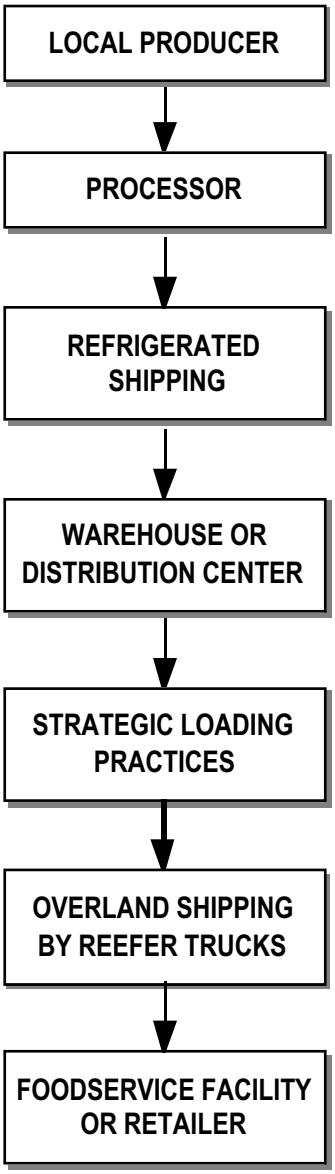

Figure 2: Poultry Value Chain: Overland trucking to a remote location.

impact overland distributors as well.

Seasonal variations such as the rainy season or holiday season also have a major impact on operations. Indonesia has a dry season, which is the optimal time for travel, and a rainy season, where floodwaters frequently reach levels on roads high enough to flood the cabs of trucks. This damages not only the inside of the cab, but can also drown or short out the cooling unit(s), causing food spoilage and loss of shipment. Food distribution is required year-round, and the rainy season plays a part in increasing delivery costs each year. A major Muslim holiday, *LeBaron,* also has an impact on overland distribution. During this time, traffic becomes so thick and roads become so crowded that trucks are prohibited from traveling on rural highways for a two week period surrounding LeBaron (one-week before, one week after holiday). This is a major

concern to shippers because during this time period, consumption of frozen foods is the highest of the year in Indonesia. Muslim employees also are accustomed to spending the extended holiday with families. This makes it important that managers provide incentives like bonuses and/or extended vacations for employees at separate times in order to ensure an adequate workforce in the warehouse and for local distribution during this critical period.

The most important asset that distributors can have to overcome these obstacles is resourceful, competent, well-trained employees (drivers) who are dependable and quick thinking. Effective managers are aware of this and reward good employees in order to cut down on the inefficiencies associated with high employee turnover. Each year trucks are caught in lines of traffic for days at a time and it is important that drivers care for their shipments by maintaining desired temperatures in containers and protecting them from theft.

Overland distribution of frozen and refrigerated products is an overused, inefficient system of transport. Distributors are slowly beginning to see the potential of widespread distribution by coastal means, and although it is currently used as a contingency plan for some of the above mentioned bottlenecks, coastal shipping will slowly replace overland distribution as the primary means for remote transport of food products in Indonesia.

Coastal Shipping : The Future of Cold Chain Development

Although not widely used at this time for the transport of refrigerated products, coastal shipping offers great potential in Indonesia. An archipelago country consisting of about 16,000 islands, Indonesia possesses one-fourth of the world's coastline, and despite modern deep-sea ports located throughout the country, trucking is still the transport method of choice for distributors, even for great distances. Despite the inefficiencies of overland trucking caused by dense populations, poor roads and other infrastuctural inadequacies, trucks are sometimes used for inter-island transport by sending the entire truck from island to island by ferry.

New container terminals are opening up at ports throughout Indonesia to accommodate the demand for a more effective system of distribution. These terminals have state of the art loading and unloading equipment, as well as the capacity to store and transport reefer containers, and as operations continue to smooth out, more and more efficiencies will be gained and costs will decrease. Terminal owners will then start to market their services more aggressively, and distributors will increase their usage of coastal shipping until it becomes the primary method for food distribution to remote locations in Indonesia.

Refrigerated (reefer) containers come in twenty foot and forty foot sizes and may

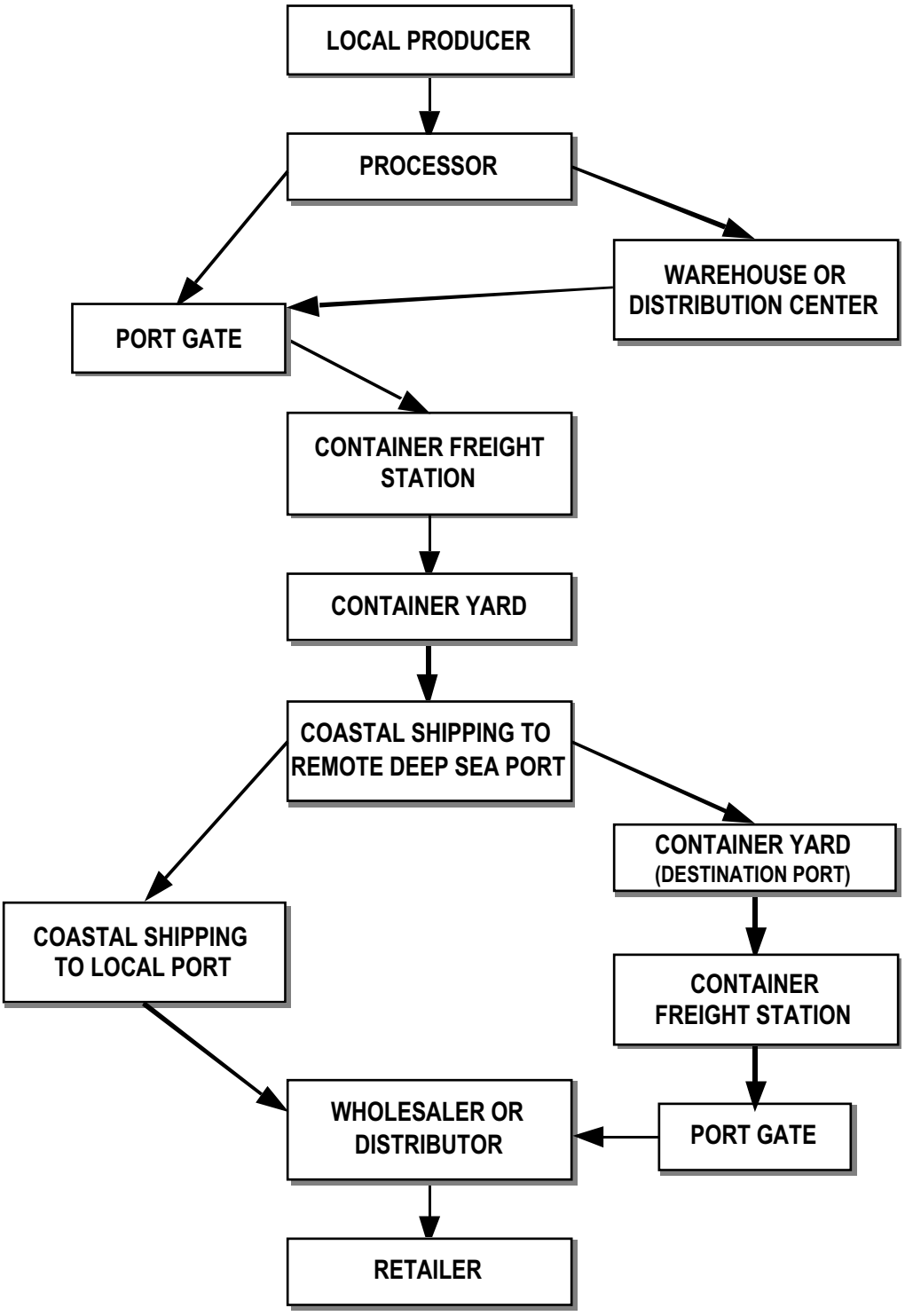

Figure 3: Poultry Value Chain: The coastal shipping system.

be piggy-backed on a truck to the port, where they are removed from the truck and used throughout the cold chain, or they may be leased out by the container terminal. These lease containers are stored at the port where it awaits arrival of its shipment from outside for loading. The loaded container is then placed in the container freight station, where it can be plugged in if necessary, although most

Table 2: Cost components of coastal shipping for reefer containers.

Cost Components of Coastal Shipping

Coastal Shipping Element	20' Container	40' Container
Lift on/off for container	$3.72	$5.60
Reefer container rental	$1.84	$3.20
Monitoring per container/shift	$0.96	$0.96
Transfer per container	$2.76	$3.64
Rental ship from Port Belawan (Medan) to Jakarta	$400.00	$640.00
Total	**$409.28**	**$653.40**

NOTE: Total assumes only one shift of container monitoring. Shipping costs are from a public shipping company from Belewan (Medan) to Jakarta. Decreased costs result from shipping contracts or private ships and/or containers. Based on an exchange rate of Rupiah 12,500/$1.

modern containers have built-in gas powered generators as the primary power source. As arrival time of the ship nears, containers are transported by forklift to the container yard. The container yard has large overhead cranes that allow for efficient loading and high container turnover in the yard. Upon arrival of the ship to the loading dock, the reefer containers are loaded onto trucks at the container yard and transported to the loading docks. The loading docks also have large, overhead cranes that extend over the water for organized loading of the containers onto ships. Containers can be loaded onto ships at normal rates of 22-25 containers per hour. Large ships have the capacity to carry as many as 1,250 containers with individual power sources.

After loading is completed at the docks, ships set out for the destination port. Major deep-sea ports in Indonesia include Tanjung Priok in Jakarta, Tanjung Parak in Surabaya, Port of Belewan in Medan, and the Port of Semerang. These ports can accommodate large ships and all have functional container terminals as mentioned above.

Upon arrival at the destination port, it is not uncommon for ships to wait for several hours for its turn at the unloading dock. Once at the dock, the unloading process is the reverse of the loading process. Cranes unload containers from the ship and place them on a truck to be taken to the container yard. When the time for pickup of the container nears, a forklift carries the container to the container freight station to wait for the truck. It is then loaded onto the truck (or the product is unloaded from the reefer container and loaded onto the truck) and transported to the distribution center, a wholesaler, or directly to a retail market.

If no deep-sea ports are available in an area with a high demand for frozen products such as Bali, ferries are used. In this instance, coastal shipping can be utilized through port Tanjung Parak in Surabaya. A truck is then used to drive the product to the ferry station on the east coast of Java. The station has adequate

Comparison of Costs of Coastal Shipping and Trucking from Jakarta to Medan

	Cost	Capacity (in metric tons)	Cost per Metric Ton
20' Reefer Container on Coastal Vessel	$409.28	17.5	$23.39
Refrigerated Truck	$400.00	6	$66.67

NOTE: Assumes exchange rate of Rupiah 12,500/$1.

Table 3: Cost per metric ton for trucking and shipping frozen poultry from Jakarta to Medan.

loading/unloading facilities and the entire truck makes the ninety minute ferry ride to Bali. The truck is driven off of the ferry in Bali and continues on its route. Government sets a weight limit of twelve metric tons for ferry transport and prohibits forty foot containers.

The primary concern of distributors in Indonesia about coastal shipping is the accumulation of miscellaneous costs at the port facilities. Many are also skeptical about the timeliness of delivery due to potential delays in loading and unloading at the ports. But as more and more terminals open throughout the country and the industry becomes more competitive, the processes will become more efficient and coastal shipping will become the most affordable method for distributing refrigerated foods throughout Indonesia.

Conclusion

With a population of almost 200 million, Indonesia is the fourth most populated country in the world, and is vital to the world economy. This places increased importance on an effective distribution system to ensure basic food availability for the entire country. At this time, the system of distribution for frozen and refrigerated foods is similar to the system used in the United States, but Indonesia is unique in its combined widespread availability of coastline, dense populations, and infrastructural inadequacies. The transport of poultry products through densely populated, urban areas is essential to completing the cold chain. Urban distributors should stay in the forefront of technology and continue to gain efficiencies as the hub of the distribution system. Overland distribution to remote locations by truck is overused, inefficient, and will eventually be replaced by coastal shipping as the prices become more and more competitive.

The above table illustrates the potential of coastal shipping as the most efficient method of frozen poultry distribution in Indonesia.

Recommendations

Poultry Producers in Indonesia

In evaluating the poultry system in Indonesia, it becomes clear that further integration is necessary. Hatcheries, growers, processors, and distribution

centers centrally located in corn producing areas will allow for more efficient poultry production by reducing the transport cost of grains as well as live birds. State of the art distribution centers in the same area would allow for more widespread distribution of poultry and allow the Indonesian poultry industry to penetrate export markets.

Distributors of Frozen and Refrigerated Poultry in Indonesia

It is apparent that the distribution through heavily populated urban areas is essential to achieving widespread availability of frozen and refrigerated poultry in Indonesia. State of the art equipment ranging from software products in the distribution center to the most efficient trucks should be maintained in order to make optimal use of transport times and volumes. Overland distributors should minimize their routes by increasing utilization of coastal shipping as a primary method of transport to remote locations. Usage of coastal shipping will increase as container terminals continue to open throughout the country and the industry becomes more competitive. Distributors must be willing to adapt to the new technologies and accept changes in distribution procedures in order to survive in this changing industry.

International Companies with Interest in Indonesian Markets

It is easy to neglect markets that are suffering due to economic and/or political turmoil, but companies with large international presence and experience, such as McDonald's Corporation recognize the importance of creating goodwill by maintaining business partnerships and relationships at all times. The crisis in Indonesia has the public searching for answers to the economic problems facing each firm. The public not only feels betrayed by the companies who withdraw from the country during economic downturns, but they also gain a sense of loyalty to those who are willing to stay put and "ride out the storm." International companies must keep a long-term vision when dealing with developing markets and remember that the goodwill created by continuing to operate and form an alliance with society when economic conditions are less than ideal will be rewarded for years to come.

Continued collaboration of FAS/Jakarta and the Department of Commerce to keep the channels open for the importation of equipment to be used throughout the poultry value chain is also necessary to allow for the most efficient work processes. This includes facilitating sales or trade of new and used equipment that is occasionally discarded by domestic companies in the process of upgrading.

APPENDIX :
Increasing the Demand for Frozen Poultry

One of the most significant reasons for lack of investment and development in the Indonesian cold chain system is the low consumer demand for frozen

poultry. As mentioned, many consumers view frozen products as old, unsafe, unsatisfactory in taste, or inferior in quality compared to the fresh poultry that is found in the wet markets. Indonesians hold on to the old belief that the rancid meat that sits out all day and is left over from the wet markets at the end of the day is frozen and marketed in that capacity. This is due partially to the lack of education of the general public with respect to frozen foods, but the common preference for fresh foods is also a cultural norm in Indonesia. Most workers are paid daily, and almost 90% of their wages are used to purchase food for the evening and following day. This system, coupled with the lack of refrigeration technology in low-income households, supports the daily wet market system and reduces the demand for frozen products.

Consumption of frozen foods is increasing however, and as incomes rise, Indonesians will move up the food chain, relying less on staple foods and requiring more meats in their diets, and the demand for processed, value-added frozen poultry will continue to increase. At this time, only 20% of the poultry sold in Indonesia is purchased in supermarkets or foodservice establishments. The remaining 80% is purchased at the wet markets. Sogo Supermarket, the largest supermarket chain in Indonesia, is one of the few retailers that carry poultry in frozen form. This limited stock is primarily for supplying the restaurant or foodservice industry and is rarely purchased by household consumers, despite a selling price of about 10% less than chilled or fresh poultry. *The discount in price for the frozen product is due to decreased transportation and handling costs relative to fresh poultry.* There are still a number of inefficiencies that exist in the cold chain at this time, but as prices of frozen poultry decrease due to improved distribution systems, and the purchasing power of Indonesians increase, domestic consumption of frozen poultry will continue to increase.

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- *USDA/Foreign Agricultural Service - Jakarta*
- *Global Livestock Collaborative Research Support Project*
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- *McDonald's Corporation*
- *US/ASEAN Business Council*

Canola Production in Russia: A Potential Source of Animal Protein

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Introduction

According to an Economic Research Service (ERS) report, animal productivity in 1991 in the Former Soviet Union (FSU) was roughly half the U.S.A. level (ERS, 1991). Low protein content in livestock feed has been identified as the primary factor responsible for the extremely poor animal productivity in Russia. While adverse economic and political factors play a significant role in the inferior performance of the Russian livestock sector, tangible improvements may be realized following an examination of the feeding practices in analogous agricultural regions in the world. In particular, many areas of the U.S.A. and Canada are similar to parts of Russia with respect to their soils and climate. An examination of these regions and the development of shared programs have the potential to be very beneficial not only to Russia, but also to the U.S.A. and Canada. By adapting proven technologies from analogous zones, agricultural improvements may be realized in a fast and efficient manner.

Russian Need for a High Protein Livestock Meal

One of the goals set by the Soviet Government in the early 1980s was protein self-sufficiency. According to a 1991 ERS report, however, the protein feed gap did not diminish, but rather widened (ERS, 1991). Exacerbating the protein deficit for many regions was the disintegration of the U.S.S.R. and the resultant breakdown of inter-republic trade. The 1991 report also indicated that both Soviet and Western analysis identified raising the protein content of feed as essential to increasing Soviet animal productivity, feeding efficiency and animal product output. (Poor feeding efficiency was attributed to both a decline in protein meal imports and inferior perennial roughage quality (ERS, 1991)).

The production of livestock outputs in the F.S.U. fell six consecutive years starting in 1989 due largely to diminished demand and deterioration of producers terms of trade (ERS, 1995). Despite lower livestock numbers, animal

productivity has worsened because of (ERS, 1995):

- declining quality and balance of animal rations in an effort to save money (This is especially true of large hog and poultry complexes which previously relied on State provision of feeds and now have significantly reduced their use of oil meals, grains and other costly feed additives in animal rations.)
- reduced use of veterinary medicines
- increased dependence on forage crops in place of (more expensive) grain and oil meals
- declining quality of breeding stock

Russian Need for an Edible Vegetable Oil

The ERS reports that consumption of vegetable oil in the Former Soviet Union has declined since 1990, however, domestic production has fallen even more sharply (ERS, 1995). As a result, prices have risen above world levels and Russia remains a net importer of vegetable oil.

What is Canola?

Canola is a type of rapeseed (family *Cruciferae*) which has been genetically altered in two ways. First, canola is low (<2%) in erucic acid. Erucic acid is a non-essential fatty acid which is important in industrial oils, but detrimental in edible oils. Secondly, canola is low (<30&moles g^{-1} of air-dried, oil-extracted meal) in glucosinolates. Glucosinolates are responsible for anti-nutritional characteristics in rapeseed meal. The name "canola" was adopted in Canada in order to distinguish the improved quality of the oil and meal from rapeseed. Outside of Canada, it is referred to as "double-low rapeseed". Canola is comprised of two species: *Brassica rapa* (Polish canola) and *Brassica napus* (Argentine canola). In general, the *napus* species matures two weeks later than the *rapa*, yields more, has greater straw strength and is more tolerant to disease.

Adaptation

Canola may be grown at relatively low temperatures and it requires far less heat units than other oilseed crops. The cold, continental climate of the Omsk region in Southwestern Siberia (800 km east of the Ural Mountains, bordering Kazakhstan) precludes the production of soybeans for protein. This makes canola (in addition to currently-grown sunflowers) an attractive alternative.

Canola Meal

The meal from canola typically contains 38 - 48% protein. Compared to dehulled soybean meal, canola meal contains less gross energy, less protein and over three times as much fiber. However, canola meal is richer in most of the B-vitamins and essential minerals (Table 1). In terms of amino acid content, canola meal compares favorably to soybean meal. Canola meal has a lower level of lysine but a higher level of methionine,

Table 1: Nutritive comparison of canola and soybean meals.‡

Component	Canola Meal	Soybean Meal (dehulled)
Moisture (%)	8.5	10.0
Crude protein (%)	38.29	48.1
Crude fiber (%)	12.01	3.4
Gross energy (MJ kg^{-1})	18.64	20.07
Minerals		
Phosphorus (%)	1.03	0.65
Calcium (%)	0.64	0.30
Potassium (%)	1.24	2.11
Magnesium (%)	0.52	0.29
Sulphur (%)	0.86	0.42
Sodium (%)	0.7	-
Boron (%)	2.1	-
Copper (&g g^{-1})	5.80	23.00
Iron (&g g^{-1})	144	140
Manganese (&g g^{-1})	50.1	31
Molybdenum (&g g^{-1})	1.4	-
Selenium (&g g^{-1})	1.12	0.10
Zinc (&g g^{-1})	69.4	52
Vitamins (mg kg^{-1})		
Vitamin E	14.5	2.4
Pantothenic acid	9.5	16.3
Niacin	160	28
Choline	6700	2609
Riboflavin	5.8	2.9
Biotin	1.07	0.32
Folic acid	2.3	0.6
Pyridoxine	7.2	6.0
Thiamin	5.2	6.0

‡Values from Bell, 1993.

Table2: Amino acit comparison of canola and soybean meals‡

Amino Acid	Canola Meal	Soybean Meal
	----------% of protein----------	
Arginine	6.11	6.44
Histidine	2.81	2.40
Isoleucine	3.98	4.69
Leucine	6.97	7.49
Lysine	5.98	6.22
Methionine	1.78	1.40
Phenylalanine	4.01	4.80
Tryptophan	1.16	1.20
Valine	5.11	5.00
Total	37.91	39.64

‡ Values from the Canola Council of Canada

therefore, these two protein meals complement each other in rations (Table 2). In Canada, the principal protein supplement in the diet of ruminants is canola meal (Christensen and McKinnon, 1989). Beef, sheep and breeder/finisher pigs may receive all supplemental protein from canola meal (Table 3).

	% Canola
Chickens	
starter, grower	20
layer, breeder	10
Turkeys	
starter, grower	20
breeder	10
Pigs	
starter	5-10
grower	15
breeder, finisher	sole protein supplement (if grain portion of the ration is greater than 10% crude protein)
Cattle and Sheep	
calves	20% of concentrate
dairy cows	25% of concentrate
beef	all supplemental protein
sheep	all supplemental protein

Table 3: Recommended maximum levels of canola meal to be used in livestock and poultry rations‡

‡Values from Manitoba Agriculture

Canola Oil

Canola oil is an excellent cooking oil. The oil constitutes between 40-44% of the seed. Simple presses can extract 90-92% of the oil, thereby eliminating the need for chemical extraction plants (at least in the near term).

Objectives:

1) Determine the soil and climate characteristics of the Omsk and Kurgan regions in Russia and identify the analogous canola producing regions of the U.S.A./ Canada.
2) Determine whether canola varieties from Western Canada and the Northern U.S.A. are well-adapted to production in the Omsk and Kurgan region of Western Siberia.

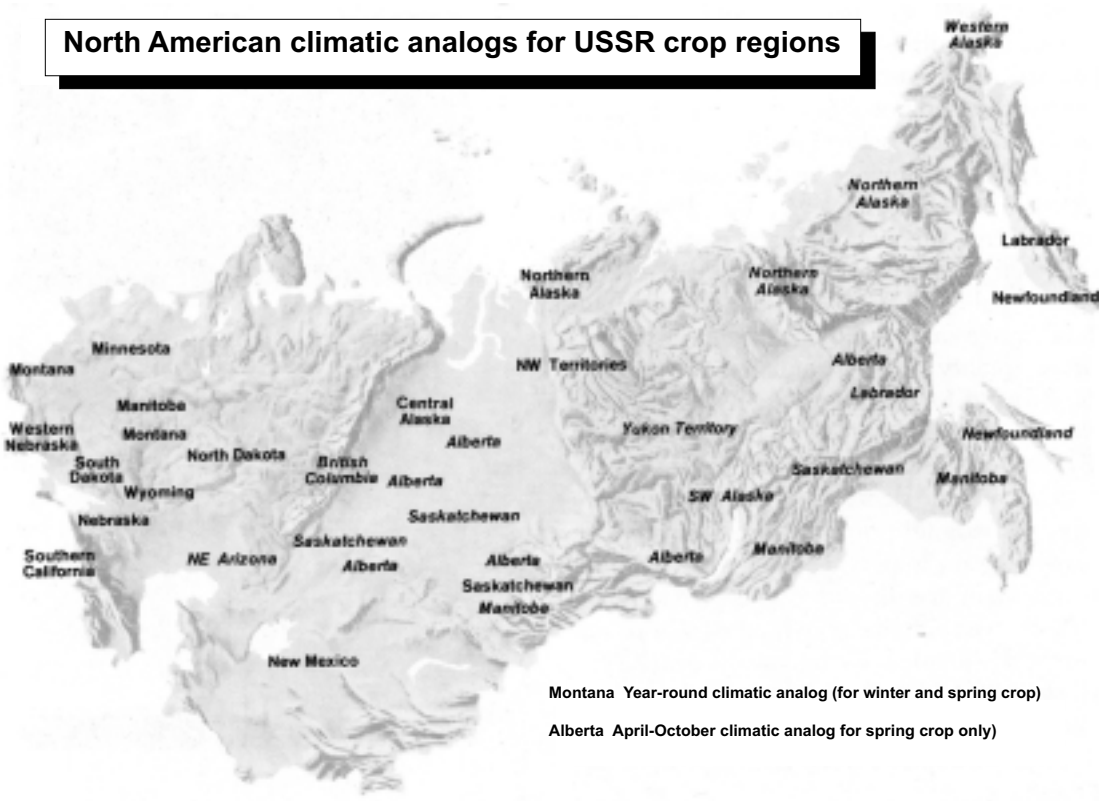
Materials and Methods

Activity 1: *Determine the soil and climate characteristics of the Omsk and Kurgan regions in Russia and identify the analogous canola producing regions of the U.S.A./Canada.*

Three essential variables for the determination of analogous agro-climatic zones were used: soil type, climate and latitude. A Geographic Information System (GIS) (ArcView) was employed to this end as well as the Biological Resources Analysis Support System (BRASS) digital database. BRASS contains monthly climate data from over 13,000 stations around the world as well as the FAO and U.S.A. soil classifications. It is a work-in-progress of the World Soil Resources Department, Natural Resources Conservation Service, USDA. Future refinement of the analogous agro-climatic zone will include more detailed soil and climate data from the Soil Landscapes of Canada (which contains monthly climate data for Canada and the Canadian soil classification).

The dominant soil (luvic chernozems) of the Omsk and Kurgan regions were identified using the BRASS database. BRASS also has the capability of displaying all regions of the world that

Figure 1



share that soil type. Considering the latitude of Omsk and Kurgan (~55°N), potential areas analogous were narrowed to the Canadian Prairies and Northern U.S.A.

To further limit the area of the analogous zone, climate parameters were evaluated. Given the average monthly precipitation and temperature of Omsk and Kurgan, close analogues within the previously identified soil and latitude analogous zone were obtained. This region extends roughly from Camrose, Alberta to North Battleford, Saskatchewan and is characterized by limiting rainfall (300 - 350 mm year^{-1}.) The CIA's U.S.S.R. Agriculture Atlas (1974) includes a map identifying regions of Canada and the U.S.A. which are climate analogues to crop regions of the U.S.S.R. (Fig. 1). This map illustrates that Southwestern Siberia is similar to Saskatchewan and Alberta.

Activity 2: *Determine whether canola varieties from Western Canada and the Northern U.S.A. are well-adapted to production in the Omsk and Kurgan region of Western Siberia.*

This report describes the first year of this two-year canola cultivar trial. It was conducted at three sites, all of which lie

in the same agro-climatic zone.

1) The Siberian Agricultural Research Institute (SARI) - Omsk, Omsk Oblast.

2) The Siberian Branch of the Institute of Oilseed Crops - Isilkul, Omsk Oblast. Isilkul is located 130 km due west of Omsk. (Results from this experimental site are not given in this report since they have not yet been received by us.)

3) The Kurgan State Agricultural Academy - Kurgan, Kurgan Oblast. Kurgan is located 500 km due west of Omsk.

Canola cultivars from the identified analogous zone in Canada were selected for the trial based on factors such as yield, disease and lodging resistance as well as days to maturity. Dr. J. Brown of the University of Idaho also suggested the inclusion of two high erucic acid rapeseed cultivars to meet the interest of our Moscow cooperators who would like to pursue the use of rapeseed oil for industrial purposes. Dr. Brown also recommended one *Sinapis alba* (white mustard, also in the *Cruciferae* family with canola) cultivar which yields well under the dry conditions typical of the target zone and is less susceptible to flea beetle attack due to its rapid growth. *S. alba* has a very high protein content (38%) however, glucosinolates prevent it from being used as a protein source. Dr. V. Zerphus of Omsk State Agrarian University suggested three Russian standard cultivars to be included in the trial. The cultivars selected for the trial and the companies who donated the seed are listed in Table 4.

The experiment was conducted on summer fallow at all locations. Prior to seeding, a soil test was conducted to ensure that adequate nitrogen (N), phosphorous (P) and potassium (K) were

Table 4: Cultivars included in the variety trial.

Cultivar Name	Comments	Seed donator
B. napus		
Cyclone		Curtis Hennings, Hennings Seed Company, Washington
Hudson		Curtis Hennings, Hennings Seed Company, Washington
Garnet	high erucic acid	Jack Brown, University of Idaho
Sterling	high erucic acid	Jack Brown, University of Idaho
Sprint		Manitoba Pool Elevators
Quantum		Manitoba Pool Elevators, Yellowquill Farms, Manitoba
Hyola 401	hybrid	Zeneca Seeds, Winnipeg, Manitoba
Radikal	Russian standard	Siberian Branch of the Oilseed Crops Institute, Isilkul
Sibniik 198	Russian standard	Siberian Branch of the Oilseed Crops Institute, Isilkul
B. rapa		
Goldrush		Curtis Hennings, Hennings Seed Company, Washington
Reward		Curtis Hennings, Hennings Seed Company, Washington
Hysin 110	synthetic hybrid	Curtis Hennings, Hennings Seed Company, Washington
Yantarnaya	Russian standard	Siberian Branch of the Oilseed Crops Institute, Isilkul
S. alba		
Ida Gold	heat/drought tolerant	Jack Brown, University of Idaho

present. No fertilizer was applied in Omsk, however 15 kg ha^{-1} of N and 60 kg ha^{-1} of P was applied prior to seeding in Kurgan. Before seeding, the soil herbicide Treflan (trifluralin) was applied. All seed was treated with a dual purpose insecticide and fungicide (Vitavax RS) to protect seedlings against insect and disease attack for the first two weeks after emergence. On the 17th day following seeding in Omsk, concentrations of the insects *Euridema oleraceae, Euridema ventralis* and *Athalia rosae* warranted foliar application of Decis. Four weeks following seeding, concentrations of *Meligethes aeneus* (pollen beetle) required a second application of Decis to the *B. rapa* and *S. alba* plots. (*B. napus* plots were not treated since all the pests were congregated in the earlier flowering species.) In Kurgan, Decis (-recommended rate, as the local manager was economizing on chemical) was applied 31 days following seeding for control of *Euridema ventralis* and *Plutella maculipennis* (cabbage moth). On the 34th day following seeding, concentrations of *Meligethes aeneus* warranted chemical control and Fastac was applied. (Decis was not used in this case since the local manager of the experiment did not know that it could be used to control *Meligethes aeneus*.)

The cultivar trial in both locations was a split, split plot arrangement in a randomized complete block design with three locations. Randomization was part of the design despite assertions of the Russian cooperators that it wasn't necessary. The two main plot treatments were a high and low seeding rate. In the Canadian analogous zone, the optimal seeding rate is 1,500,000 seeds ha^{-1}. In Omsk, however, the optimal seeding rate is double that: 3,000,000 seeds ha^{-1}. This high seeding rate may be due to poor seed quality and less than optimal seeding equipment for the small-sized canola. The two seeding rates selected were 2,250,000 seeds ha^{-1} and 3,000,000 seeds ha^{-1}. (The Canadian seeding rate was increased from 1,500,000 to 2,250,000 seeds ha^{-1} since we were unsure how well the seedbed would be prepared.) The first split contained the three *Cruciferae* family species (*B. napus*, *B. rapa* and *S. alba*) and the second split contained the various cultivars within each species. The experimental units were the plots (10 m x 0.9 m in Omsk and 3 m x 3 m in Kurgan). The plot sizes were not identical between the sites due to differences in seeding and harvesting equipment.

The Omsk site was seeded with the Russian-made small plot seeder "SSSK-7". Thousand seed weight was calculated by manually counting out 1,000 seeds and a simple blotter test was used to obtain the germination percent. The Omsk site was harvested with a Hege small plot combine. It did a poor job of harvesting the plots in that the seed obtained was dirty with pods and chaff. Therefore, the yield from each plot was then hand-sieved. Seed moisture at harvest was calculated by weighing a given amount of seed, drying it in an oven, and then calculating the moisture. The Kurgan site was hand seeded and

hand harvested with a scythe. (The plots were harvested before maturity and hung upside down to dry, as is standard Russian procedure where harvesting equipment is limited.) Row spacing was 15 cm and the depth of seed placement was 4 cm.

RESULTS

Siberian Agricultural Research Institute - Omsk

Growth Stages

The optimal seeding date for canola in the Omsk region is between May 19 and 21. A freak snowstorm on May 18, 1998 was cause for some initial concern, but subsequent sun and warm temperatures allowed seeding on May 22, 1998. A warm, smooth, level seedbed was obtained and adequate moisture was available. As expected, the *B. rapa* and *S. alba* matured from 9 to 14 days prior to the *B. napus* (Table 5).

Plant Density

Plant stand density was determined at both emergence and maturity. In the 2,250,000 seed ha^{-1} treatment (Fig. 2), Garnet, Quantum, Hyola 401 and Ida Gold and all the of the Russian cultivars (Radikal, Sibniik 198 and Yantarnaya) had >90% emergence. Both Reward and Goldrush emerged very poorly (approximately 50%), while the remainder of the cultivars emerged moderately (between 65 and 80%). The pattern was somewhat similar in the 3,000,000 seed ha^{-1} treatment (Fig. 3). Hudson, Hyola 401, Radikal, Sibniik 198 and Ida Gold emerged at >90%. Again, only 50% of Reward and Goldrush emerged and the remainder of the cultivars emerged between 68 and 86%. One possible explanation for the

Table 5: Growth stages - Omsk, Russia.

Cultivar	Days from seeding to:				
	Emergence	Rosette	Budding	Flowering	Maturity
B. napus					
Cyclone	5	11	33	48	89
Hudson	5	11	33	48	89
Garnet	5	11	33	48	89
Sterling	5	11	33	48	89
Sprint	5	11	33	48	89
Quantum	5	11	33	48	94
Hyola 401	5	11	33	48	89
Radikal	5	11	33	48	94
Sibniik 198	5	11	33	48	94
B. rapa					
Reward	4	10	24	33	80
Goldrush	4	10	24	33	80
Hysin 110	4	10	24	33	80
Yantarnaya	4	10	24	33	80
S. alba					
Ida Gold	4	9	14	30	80

-Trial was seeded on May 22, 1998.

Figure 2

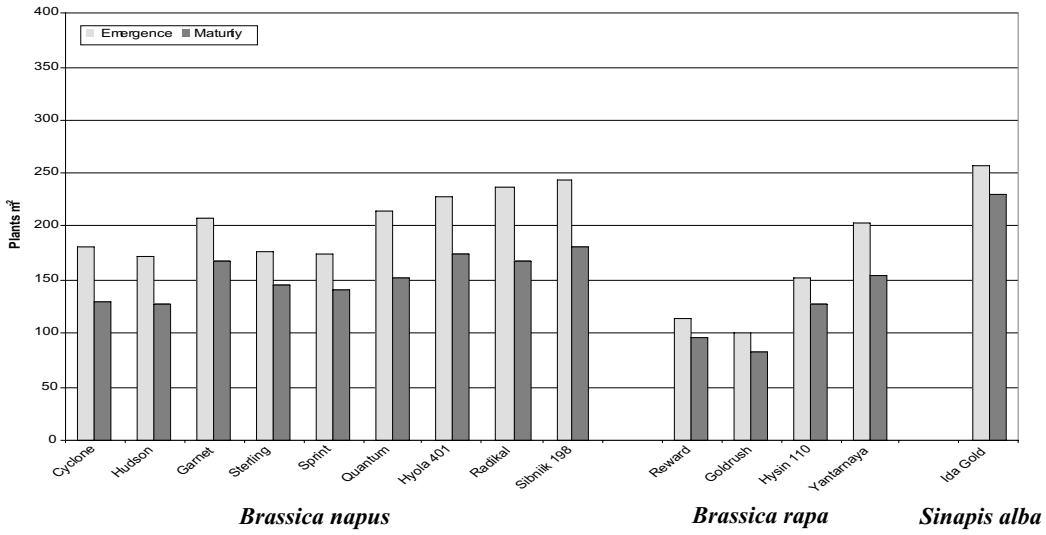
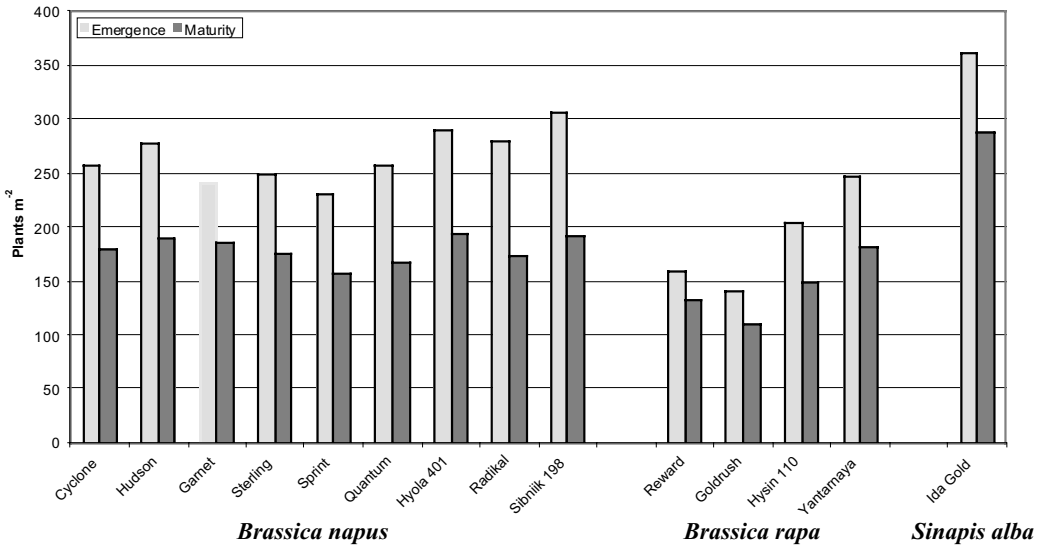


Figure 3



poor emergence of Reward and Goldrush concerns the fact that all *B. rapa* cultivars are 80% self-infertile. It is possible that the Reward and Goldrush seed we received was not pure (but rather an out-crossed offspring), which negatively affected the germination.

Plant density for all cultivars was lower at maturity than at emergence due to die off of the weaker plants. This may suggest that the Canadian seeding rate of 1,500,000 seeds ha^{-1} is more realistic. The plant density of cultivars in the low seeding rate treatment (2,250,000 seeds ha^{-1}) was reduced by only 16 to 30 %, but the plant density of cultivars in the high seeding rate treatment (3,000,000 seeds ha^{-1}) was reduced by 20 to 40%.

Climatic Conditions

As indicated in Figures 4 and 5, there is a region of the Canadian Prairies which

is analogous to the conditions near the city of Omsk. This analogous zone stretches from east-central Alberta to west-central Saskatchewan. Not only do these regions share the same precipitation and temperature patterns for the growing season, but they also share similar latitude. (Omsk is located at 55°N and the cities in the analogous zone sit at approximately 52 to 54°N.) In addition, both regions are characterized by luvic and haplic chernozems andare troubled by solonetzic patches. Of particular note for 1998 was the hot and dry conditions experienced throughout the growing season. (No Omsk data was available for September, 1998.) Not only was precipitation in Omsk the lowest in recent memory (some referred to 1998 as the 1-in-100 year drought, Fig. 4), but the temperatures were also much above average in July and August (Fig. 5).

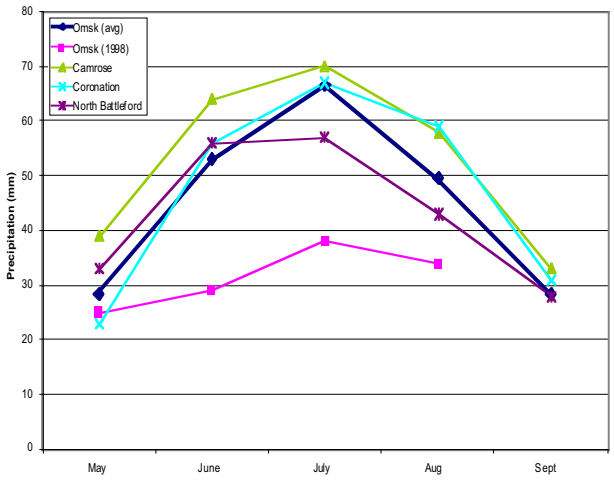


Figure 4

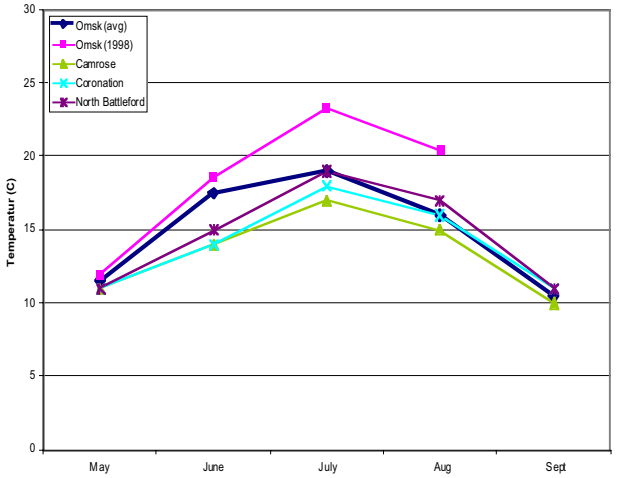


Figure 5

Cultivar characteristics

Adequate soil moisture reserves in the early part of the growing season did not appear to delay growth of the cultivars. The four *B. rapa* cultivars as well as a few of the *B. napus* cultivars (Cyclone, Quantum, Radikal and Sibniik 198) had heights of over 1 meter (Table 6). Hyola 401, the hybrid canola, was characteristically short. Only Hyola 401, Reward and the Russian Yantarnaya exhibited any lodging. The dry summer was not conducive to disease, however, the later maturing *B. napus* cultivars were affected by Alternaria.

Yield

As illustrated in Fig. 6, the hybrid canola (Hyola 401) exhibited the highest yield of the *B. napus* species at 32 quintals ha^{-1} (1 qu = 100 kg = 0.1 tonne). The Russian standard Sibniik 198, Cyclone and the high erucic acid cultivar Sterling were the next highest yielding group. Even the lowest yielding group (Radikal and Sprint) generated over 23 qu ha^{-1}. The shorter season *B. rapa* cultivars were separated into two groups. The synthetic

Figure 6

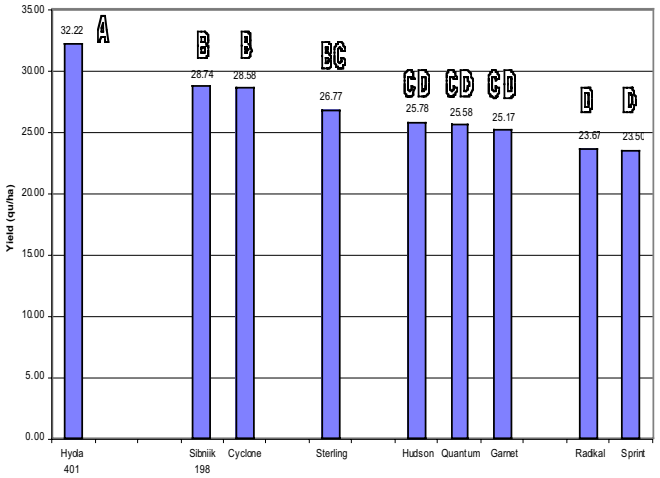
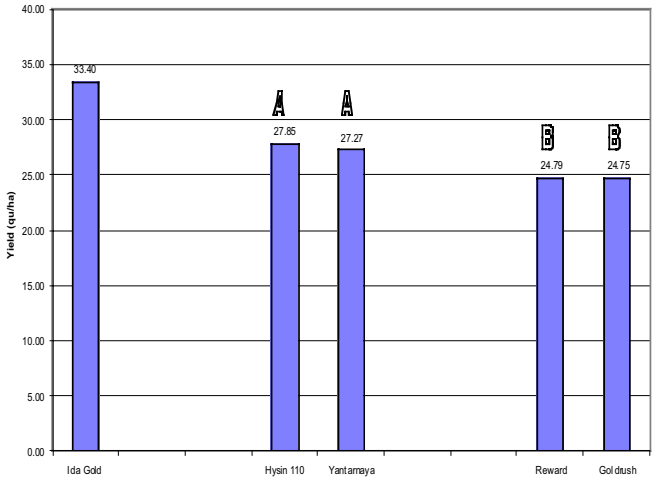


Figure 7



hybrid Hysin 110 as well as the Russian Yantarnaya yielded over 27 qu ha^{-1} while Reward and Goldrush came in at just under 25 qu ha^{-1} (Fig. 7). Ida Gold, the single *S. alba* cultivar, topped all yields with over 33 qu ha^{-1} (Fig. 7). Statistical analysis (proc mixed, *P* œ 0.05) revealed that significant differences exist between species (*S. alba* yielding higher than either *B. napus* or *B. rapa*) and among cultivars within a species (Figs. 6 and 7). Of note is the fact that no significant difference was observed between the yields of the two seeding rates.

Table 6: Cultivar characteristics - Omsk, Russia.

Cultivar	Height (cm)	Lodging-	Disease
B. napus			
Cyclone	108	5	1, Alternaria
Hudson	92	5	1, Alternaria
Garnet	91	5	1, Alternaria
Sterling	95	5	1, Alternaria
Sprint	94	5	1, Alternaria
Quantum	113	5	1, Alternaria
Hyola 401	88	4	1, Alternaria
Radikal	121	5	1, Alternaria
Sibniik 198	113	5	1, Alternaria
B. rapa			
Reward	118	4	0
Goldrush	118	5	0
Hysin 110	118	5	0
Yantarnaya	113	3	0
S. alba			
Ida Gold	98	5	0

–1 = heavily lodged, 5 = not lodged
‡0 = absent, 1 = present

Chemical Analysis of Seed

Chemical analysis of the seed was only recently completed. Initial examination of the results indicates that protein, glucosinolates, oil and erucic acid contents are within expected values for each cultivar.

Kurgan State Agricultural Academy - Kurgan

Growth Stages

In Kurgan, the optimal seeding date falls between May 20 - 25. The experiment in 1998 was seeded a week late (May 29). In contrast to Omsk where drought conditions were experienced in late spring, Kurgan was dry from the very start of the growing season. Progression through the growth stages is displayed in Table 7. (Please note that due to a shortage of seed, only 10 of the 14 cultivars that were examined in Omsk were included at the Kurgan location.) Maturity in Kurgan was reached two weeks earlier than in Omsk for *B. napus*, *B. rapa* and *S. alba*.

Plant Density

Plant stand density at emergence for the *B. napus* cultivars as well as Hysin 110 and Yantarnaya of the *B. rapa* species in the 2,250,000 seed ha^{-1} treatment was roughly the same in Kurgan as in Omsk (Figs 2 and 8). Ida Gold and the remaining *B. rapa* cultivars (Reward and Goldrush) exhibited emergence densities approximately double than of Omsk. Emergence plant densities of the 3,000,000 seed ha^{-1} treatment appear to be similar to Omsk for Cyclone, Hudson, Radikal, Reward and Yantarnaya (Figs. 3 and 9). Emergence was greater in Omsk for Garnet, Sterling, Hysin 110 and Ida Gold, but lower for Goldrush. Plant density reduction from emergence to maturity was noticeably less in Kurgan than in Omsk (Figs 2, 3, 8 and 9).

Climatic Conditions

Kurgan is slightly drier than Omsk, largely due to ~15 mm less precipitation in July (Figs. 4 and 10). Temperature, however, is similar between these two cities (Figs. 5 and 11). Kurgan's analogous zone on the Prairies, therefore, is similar to that of Omsk, but in a slightly drier sector. The soils and latitude of Kurgan are virtually identical to Omsk as both cities lie in the chernozemic soils belt that spans Eurasia. The 1998 drought experienced in Kurgan was more pronounced than in Omsk due to inadequate spring moisture

Table 7: Growth stages - Kurgan, Russia.

	Days from seeding to:			
Cultivar	**Emergence**	**Rosette**	**Budding**	**Maturity**
B. napus				
Cyclone	22	37	49	78
Hudson	22	37	49	78
Garnet	23	38	44	75
Sterling	22	37	43	74
Radikal	22	37	49	78
B. rapa				
Reward	18	31	42	65
Goldrush	18	31	42	65
Hysin 110	17	30	41	64
Yantarnaya	17	30	41	64
S. alba				
Ida Gold	17	30	41	69

-Trial was seeded on May 29, 1998.

Figure 8

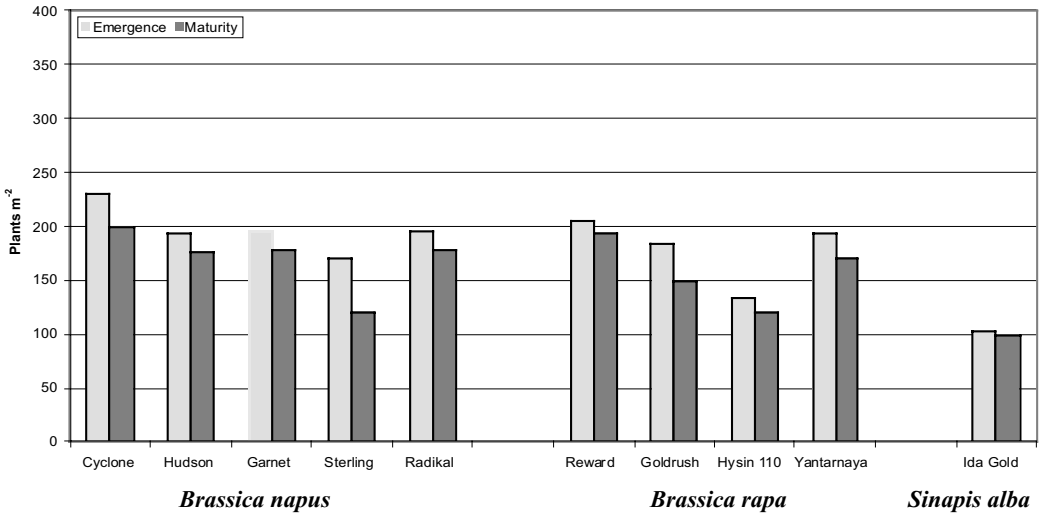
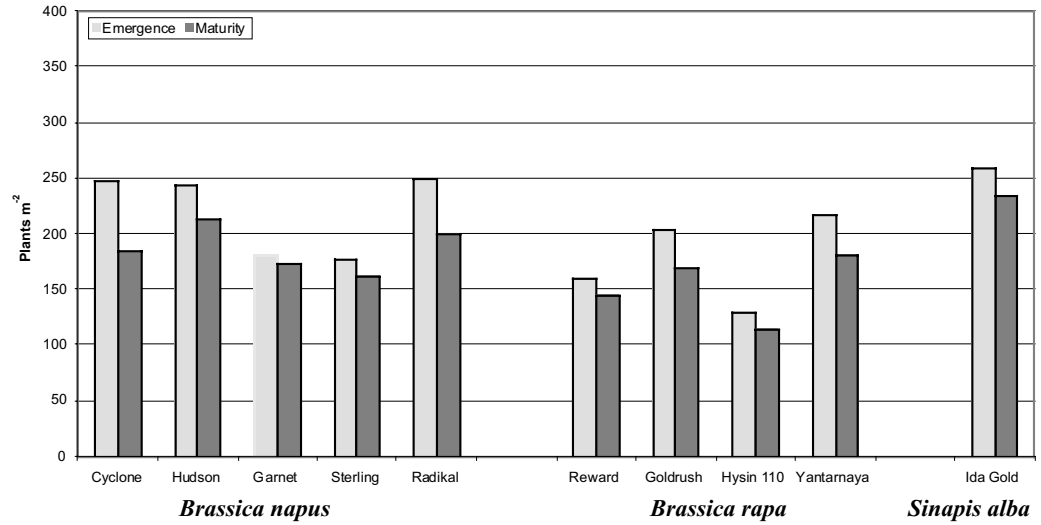


Figure 9



and lower overall summer precipitation (especially in July when moisture is critical for flowering and seed set). Temperatures in Omsk and Kurgan during the 1998 growing season were virtually identical.

Cultivar characteristics

Extremely poor moisture conditions throughout the growing season severely stunted all cultivars (compared to cultivar growth in Omsk). Lodging was, therefore, not a factor. The low moisture conditions also suppressed disease development (Table 8).

Yield

Yields in Kurgan were three to four times less than those in Omsk and reflected the severe drought conditions experienced in 1998. The highest yielding *B. napus* cultivars (Garnet and Sterling) produced only a little over 10 qu ha^{-1} (Fig. 12). The other cultivars came in at roughly 6 qu

ha^{-1}. *B. rapa* and *S. alba* did not fair any better (Fig 13). Yantarnaya led the *B. rapa* cultivars at 7 qu ha^{-1}, Reward was the poorest at a little over 5 qu ha^{-1} while Goldrush and Hysin 110 fell in between. The ranking of top-yielding cultivars in Omsk and Kurgan was not identical (Figs. 6,7,12 and 13), but due to the extreme disparity in yields between Omsk and Kurgan this comparison may not be appropriate. It is interesting, however, to note that:

1) Garnet (high erucic acid) did much better (relatively) in Kurgan than in Omsk,
2) the Russian cultivar Yantarnaya was in the highest-yielding *B. rapa* group at both locations, and
3) Ida Gold was among the top yielders at both locations.

As in the Omsk location results, statistical analysis (proc mixed, P œ 0.05) showed that significant differences existed between species (*S. alba* yielding higher than either *B. napus* or *B. rapa*) and among cultivars within a species (Figs. 12 and 13). Also, no significant yield difference was found between the low and high seeding rates. However, the seeding rate x

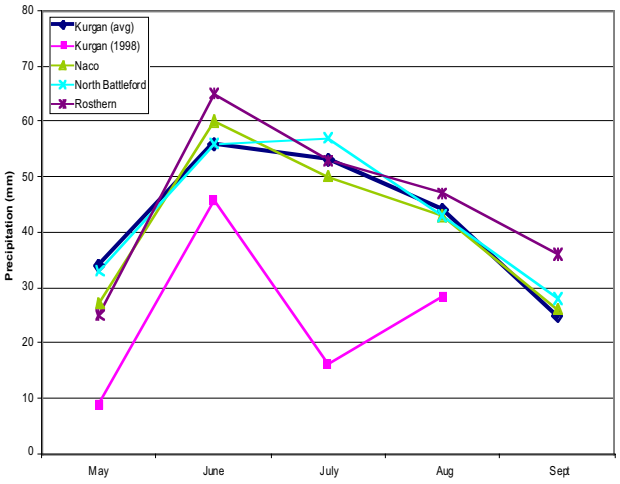


Figure 10

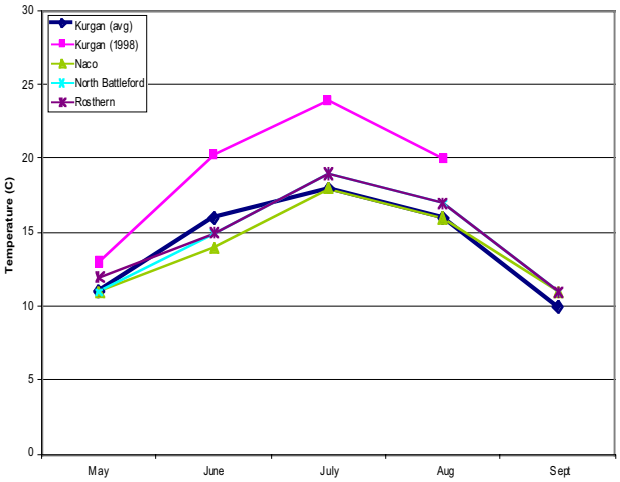


Figure 11

Cultivar	Height (cm)	Lodging–	Disease‡
B. napus			
Cyclone	64	5	0
Hudson	61	5	0
Garnet	58	5	0
Sterling	58	5	0
Radikal	70	5	0
B. rapa			
Reward	55	5	0
Goldrush	65	5	0
Hysin 110	68	5	0
Yantarnaya	67	5	0
S. alba			
Ida Gold	56	5	0

Table 8: Cultivar characteristics - Kurgan, Russia

–1 = heavily lodged, 5 = not lodged
‡0 = absent, 1 = present

Figure 12

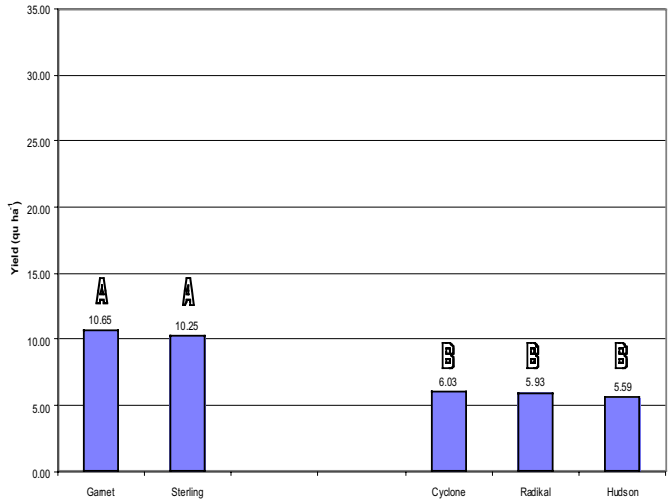
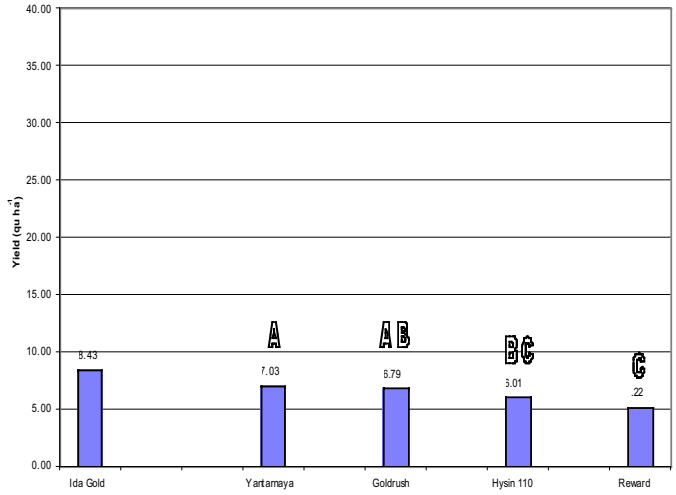


Figure 13



cultivar(species) interaction was found to be significant in Kurgan. Initial visual observation suggests that within *B. napus*, Sterling may yield more at the higher seeding rate, while Garnet's yield may actually decrease at the higher seeding rate. Full statistical analysis is planned to fully uncover the nature of the interaction.

Chemical Analysis of Seed

Chemical analysis of the seed was only recently completed. Initial examination of the results indicates that protein, glucosinolates, oil and erucic acid contents are within expected values for each cultivar.

Discussion

Results from the first year support the concept that crop cultivars may be successfully transferred to an analogous zone. For example, average *B. napus* yields from the analogous zone in Canada are approximately 22 qu ha^{-1} and, despite the dry conditions, experimental yields in Omsk ranged

from 24 to 29 qu ha^{-1}. (It should be noted, however, that top canola producers from the analogous zone in Canada consistently achieve yields of 30 qu ha^{-1}.) In both Omsk and Kurgan, yields of the later maturing *B. napus* species were limited due to the onset of a higher temperature in July at the time of flowering (Figs 5 and 11). Of the *B. napus* species in Omsk, the hybrid Hyola 401 was the most productive, out yielding even the highest yielding Russian cultivar (Sibniik 198) while in the *B. rapa* species, the synthetic hybrid, Hysin 110 yielded as well as the Russian Yantarnaya. Due to the extreme drought in Kurgan, caution must be used in drawing conclusions from the data. However, the local manager of the experiment commented that in this drought year, the canola yields were better (relatively) to those even of the cereal crops. The results from the third location (Isilkul) and a second year of data are eagerly anticipated.

Perhaps the most dramatic result from the first year of data was that in Omsk, the two seeding rates had no effect on yield. This may be partly due to the drought conditions experienced in 1998 as the lower seeding rate plots were not as water stressed as the higher seeding rate plots. That canola has the ability to compensate for low seeding rates with increased production of branch racemes under conditions of low plant densities (Morrison et al., 1990) seems well-demonstrated in 1998. An important aspect of the analogous zone concept is in the appropriateness of technology. The data obtained thus far suggest that the lower seeding rate in Canada is also applicable to (and perhaps more appropriate for) Russia. One must consider, however, that Russian seeding rates are generally double that of their North American counterparts due to poorer seed quality and lack of appropriate seeding equipment. (Canola, as a small-seeded crop with less reserves than cereals, requires greater care in preparing the seedbed and precision in seeding.)

One of the major difficulties in successful canola production is pest control. Canola is susceptible to a wide variety of insect pests, which requires regular scouting of fields and enough cash flow to purchase the necessary insecticides. These two demands are not always easily met under current conditions in Russia. While there appears to be more insect threats to canola in Siberia than in Canada and the U.S.A., there is far less disease potential. For example, Blackleg and Sclerotinia are major concerns on the Prairies, while they are uncommon in Siberia. If canola production increases, however, one would expect this situation to worsen.

Approximately 20 years ago, an intensive, but short-lived effort was made to develop rapeseed production in Southwestern Siberia. Interest in Omsk and Kurgan has recently been renewed in the crop's potential. For example, in the fall of 1998, the Governor of Omsk Oblast announced an ambitious new plan to dramatically increase acreage seeded to canola. Already a 300,000-head pig operation (Omsk Bacon - reputedly the

largest in the world) is conducting their own experiments into optimal production techniques (seeding rates, inter-cropping, irrigation and weed control). They are interested in canola's potential as a high N-user (to recycle manure) and as a potential as a source of high-protein meal. As part of their research, they have imported another successful canola cultivar from the Canadian Prairies - AC Excel. Canada's history of work in canola breeding (particularly with respect to high-yielding and fewer days-to-maturity cultivars) are attractive to them. This concept of transferring agricultural technology among analogous zones has also been adopted by the brewery in Omsk - ROSAR. In the fall of 1998, they sent a delegation to the University of Saskatchewan (Saskatoon, SK) and purchased several malting barley cultivars to evaluate under Omsk conditions.

Southwestern Siberia and a portion of the Canadian Prairies share similar soils, climate and latitude. The work to date indicates that agricultural technologies, specifically canola cultivars, are well adapted between these two analogous zones. A second year of data is necessary to substantiate these preliminary conclusions. Increased production of high- yielding and high-quality canola cultivars is one promising source for animal protein in Russia.

Literature Citations

Bell, J.M. 1993. Factors affecting the nutritional value of canola meal: A review. Canadian Journal of Animal Science. 73: 679-697.

Canola Council of Canada. n.d. Canola meal for livestock and poultry. Publication No. 59.

Central Intelligence Agency. 1974. U.S.S.R. Agriculture Atlas.

Christensen, D.A. and P.J. McKinnon. 1989. Canola meal for beef and dairy cattle. p. 19-22. *In* D.R. Clandinin (ed.) Canola meal for livestock and poultry. Canola Council of Canada, Winnipeg, Canada

Economic Research Service, U.S. Department of Agriculture. May, 1991. U.S.S.R. agriculture and trade report: Situation and outlook series. RS-91-1.

Economic Research Service, U.S. Department of Agriculture. October 25, 1995. Former U.S.S.R. update: agriculture and trade report. WPS-95-S2.

Manitoba Agriculture. n.d. Feeding canola meal.

Morrison, M. J., P.B.E. McVetty. and R. Scarth. 1990. Effect of row spacing and seeding rates on summer rape in Southern Manitoba. Can. J. Plant Sci. 70:127-137.

COOPERATORS

This study was supported by several agencies:

- *University of Maryland, College Park: Principal Investigator*
- *Global Livestock CRSP*
- *USDA/ARS*
- *Omsk State Agrarian University (Omsk, Russia)*
- *Siberian Agricultural Research Institute (Omsk, Russia)*
- *Kurgan State Agricultural Academy (Kurgan, Russia)*
- *Siberian Branch of the Oilseed Crops Institute (Isilkul, Russia)*
- *U.S.A. Canola Council*
- *USDA/World Soil Resources*
- *Natural Sciences and Engineering Research Council (NSERC, Canada)*
- *Hennings Seed Company*
- *University of Idaho*
- *Manitoba Pool Elevators*
- *Zeneca Seeds*
- *Yellowquill Farms*
- *AgEvo, Russia*
- *Dow AgroSciences, Russia*
- *Gustafson, U.S.A.*
- *Uniroyal Chemical, Canada*

Project Expenditures

GLOBAL LIVESTOCK CRSP
USAID GRANT NO. PCE-G-98-00036-00
EXPENDITURES BY PROGRAM

Institutions	Disciplines	Year 12 90/91	Year 13 91/92	Year 14 92/93	Year 15 93/94	Year 16 94/95	YEAR 17 95/96	YEAR 18 96/97	YEAR 19 * 97/98	Total
Univ. of Ca., Davis	Genetics	$331,324.81	$321,288.16	$253,754.00	$178,367.45	$49,738.66	$18,257.07	$0.00	$0.00	$1,152,730.15
Univ. of Ca., Davis	Agric. Econ	$0.00	$0.00	$0.00	$0.00	$0.00	$18,411.18	$0.00	$0.00	$18,411.18
Univ. of Ca., Davis	Range Mgmt							$107,165.38	$394,792.47	$501,957.85
Univ. of Ca., Davis	Nutrition							$90,441.83	$0.00	$90,441.83
UCLA	Nutrition							$106,687.00	$325,000.00	$431,687.00
Colorado State	Animal Hlth	$179,497.99	$195,474.36	$137,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$511,972.35
Colorado State	Natl Res. Mgm							$109,981.82	$310,750.98	$420,732.80
Univ. of Missouri	Sociology	$201,575.76	$353,614.61	$345,687.42	$217,925.32	$132,324.00	$179,530.00	$85,000.00	$0.00	$1,515,657.11
Montana St Univ	Breeding	$110,568.80	$105,196.99	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$215,765.79
Cornell University	Land Use							$63,052.10	$0.00	$63,052.10
N. Carolina St Univ	Nutrition	$383,672.90	$337,642.00	$303,258.17	$305,833.06	$104,548.00	$0.00	$0.00	$0.00	$1,434,954.13
Texas A&M Univ.	Breeding	$141,524.58	$194,460.00	$165,750.00	$150,321.83	$79,135.00	$166,525.00	$84,789.38	$0.00	$982,505.79
Texas A&M Univ.	Info Sys							$129,475.40	$0.00	$129,475.40
Texas A&M Univ.	GIS							$130,855.25	$353,000.00	$483,855.25
Texas Tech. Univ.	Range-Nutr	$84,122.34	$191,010.28	$168,446.05	$132,179.41	$0.00	$0.00	$0.00	$0.00	$575,758.08
Texas A&M Univ.	Poultry								$41,123.00	$41,123.00
Utah State Univ.	Range-Eco	$91,342.42	$133,195.00	$142,270.00	$165,870.00	$100,327.93	$39,000.00	$9,191.86	$0.00	$681,197.21
Utah State Univ.	Risk Mgmt.							$90,290.84	$325,000.00	$415,290.84
Wash. St. Univ.	Health	$160,000.00	$175,000.00	$146,000.00	$197,061.34	$204,073.64	$193,974.87	$87,999.48	$0.00	$1,164,109.33
Winrock Int'l.	Dairy Mgmt.	$233,000.00	$186,690.00	$126,318.17	$78,290.76	$42,014.00	$115,979.19	$77,939.42	$0.00	$860,231.54
Winrock Int'l.	Economics	$212,325.07	$246,906.00	$187,000.00	$173,095.25	$128,125.00	$225,587.19	$21,690.00	$0.00	$1,194,728.51
Univ. of Wisconsin	Networkg	$0.00	$0.00	$28,779.79	$13,829.53	$0.00	$0.00	$0.00	$0.00	$42,609.32
Univ. of Wisconsin	Socio-Econ							$154,669.04	$349,994.87	$504,663.91
Univ. of Wisconsin	Natl Resource							$104,641.20	$119,601.19	$224,242.39
Univ. of Kentucky	Anthro	$0.00	$0.00	$0.00	$0.00	$0.00	$23,659.34	$0.00	$0.00	$23,659.34
	Subtotal	$2,128,954.67	$2,440,477.40	$2,004,263.60	$1,612,773.95	$840,286.23	$980,923.84	$1,453,870.00	$2,219,262.51	$13,680,812.20
HOST COUNTRIES **										
Indonesia		$0.00	$0.00	$7,099.00	$0.00	$81,464.25	$0.00	$0.00	$0.00	$88,563.25
Kenya		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,000.00	$15,687.49	$35,687.49
Morocco		$14,609.18	$10,756.76	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$25,365.94
Bolivia		$42,656.96	$147,330.90	$46,241.74	$34,656.64	$93,290.74	$15,192.28	$0.00	$0.00	$379,369.26
	Subtotal	$57,266.14	$158,087.66	$53,340.74	$34,656.64	$174,754.99	$15,192.28	$20,000.00	$15,687.49	$528,985.94
Management Entity	***	$439,035.03	$498,501.98	$658,193.61	$422,137.36	$297,538.46	$512,194.45	$452,843.12	$648,663.60	$3,929,107.61
Year-end Conference									$122,922.17	$122,922.17
Small Grants		$0.00	$0.00	$0.00	$0.00	$0.00	$38,423.91	$0.00	$12,336.49	$50,760.40
	Subtotal	$439,035.03	$498,501.98	$658,193.61	$422,137.36	$297,538.46	$550,618.36	$452,843.12	$783,922.26	$4,102,790.18
	TOTAL	$2,625,255.84	$3,097,067.04	$2,715,797.95	$2,069,567.95	$1,312,579.68	$1,546,734.48	$1,926,713.12	$3,018,872.26	$18,312,588.32

* These are preliminary figures the final year-end adjustments were not made at the time of this report.
** Most Host Country Expenses are reflected in the expenditures for the participating U.S. institutions.
*** Expenditure for ME includes expenses for EEP, Board Meetings, Technical Committee, publications and other meetings.

GLOBAL LIVESTOCK CRSP
USAID GRANT NO. PCE-G-98-00036-00
APPROVED PROGRAM BUDGETS

Institutions	Disciplines	Year 12 90/91	Year 13 91/92	Year 14 92/93	Year 15 93/94	Year 16 94/95	Year 17 95/96	Year 18 96/97	Year 19 97/98	Total
Univ. of Calif., Davis	Genetics	$281,246.00	$233,000.00	$185,000.00	$223,167.00	$49,876.00	$50,000.00	$0.00	$0.00	$1,022,289.00
Univ. of Calif., Davis	Agric. Econ.	$0.00	$0.00	$0.00	$0.00	$0.00	$18,661.00	$0.00	$0.00	$18,661.00
Univ. of Calif., Davis	Range Mgmt.	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$135,817.00	$401,423.00	$537,240.00
Univ. of Calif., Davis	Nutrition	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$99,878.00	$0.00	$99,878.00
UCLA	Nutrition	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$106,687.00	$325,000.00	$431,687.00
Colorado State	Animal Health	$201,570.00	$175,000.00	$137,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$513,570.00
Colorado State	Ecology	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$117,678.00	$325,000.00	$442,678.00
Cornell University	Animal Nutr.	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$92,891.00	$0.00	$92,891.00
Univ. of Missouri	Sociology	$313,500.00	$202,442.00	$210,000.00	$266,780.00	$132,324.00	$179,530.00	$85,000.00	$0.00	$1,389,576.00
Montana State Univ.	Breeding	$113,025.00	$106,412.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$219,437.00
N. Carolina State Univ.	Nutrition	$295,000.00	$227,000.00	$195,000.00	$352,100.00	$104,548.00	$60,000.00	$0.00	$0.00	$1,233,648.00
Texas A&M Univ.	Breeding	$210,659.00	$140,000.00	$129,000.00	$167,000.00	$79,135.00	$166,525.00	$85,000.00	$0.00	$977,319.00
Texas A&M Univ.	Drought GIS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$130,930.00	$353,000.00	$483,930.00
Texas A&M Univ.	Info Systems	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$138,543.00	$0.00	$138,543.00
Texas A&M Univ.	Poultry Proj.								$41,375.00	$41,375.00
Texas Tech. Univ.	Range-Nutritio	$180,000.00	$115,000.00	$118,000.00	$170,000.00	$0.00	$0.00	$0.00	$0.00	$583,000.00
Utah State Univ.	Range-Ecology	$120,000.00	$115,000.00	$115,000.00	$165,870.00	$114,804.00	$39,000.00	$110,973.00	$325,000.00	$1,105,647.00
Washington State Univ.	Health	$160,000.00	$175,000.00	$146,000.00	$304,327.00	$204,435.00	$196,000.00	$88,000.00	$0.00	$1,273,762.00
Winrock Int'l.	Dairy Mgmt.	$200,000.00	$150,000.00	$107,000.00	$82,500.00	$42,014.00	$138,000.00	$85,000.00	$0.00	$804,514.00
Winrock Int'l.	Economics	$255,000.00	$202,558.00	$177,000.00	$205,000.00	$128,125.00	$228,600.00	$21,690.00	$0.00	$1,217,973.00
Univ. of Wisconsin	Networking	$0.00	$0.00	$40,000.00	$55,000.00	$0.00	$0.00	$0.00	$0.00	$95,000.00
Univ. of Wisconsin	Socio-Econ	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$141,247.00	$350,000.00	$491,247.00
Univ. of Wisconsin	Natural Res.	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$104,655.00	$120,000.00	$224,655.00
Univ. of Kentucky	Anthropology	$0.00	$0.00	$0.00	$0.00	$0.00	$23,669.00	$0.00	$0.00	$23,669.00
	Subtotal	$2,330,000.00	$1,841,412.00	$1,559,000.00	$1,991,744.00	$855,261.00	$1,099,985.00	$ 1,543,989.00	$ 2,240,798.00	$13,462,189.00
Management Entity*		$600,000.00	$610,000.00	$610,000.00	$524,275.00	$311,813.00	$600,294.00	$ 442,030.00	$ 578,750.00	$4,277,162.00
Program Enhancement Funds		$0.00	$43,588.00	$40,000.00	$15,000.00	$71,479.00	$56,021.00	$ 441,199.00	$ 60,151.00	$727,438.00
Host Countries		$310,000.00	$305,000.00	$206,500.00	$41,620.00	$106,293.00	$15,273.00	$ 20,000.00	$ 20,000.00	$1,024,686.00
Linkages/workshops		$65,000.00	$0.00	$70,000.00	$0.00	$0.00	$0.00	$62,750.00	$59,978.00	$257,728.00
Impact Assessment		$0.00	$0.00	$0.00	$3,133.00	$0.00	$0.00	$0.00	$0.00	$3,133.00
Networks		$0.00	$0.00	$14,700.00	$0.00	$0.00	$0.00	$0.00	$0.00	$14,700.00
Funds for Student Training		$0.00	$0.00	$0.00	$20,000.00	$874.00	$0.00	$0.00	$0.00	$20,874.00
New Site/Activity/Grant Renewal		$0.00	$0.00	$459,800.00	$19,000.00	$75,000.00	$266,389.00	$ 30,000.00	$ 52,550.00	$902,739.00
	Subtotal	$975,000.00	$958,588.00	$1,401,000.00	$623,028.00	$565,459.00	$937,977.00	$ 995,979.00	$ 771,429.00	$7,228,460.00
Small Grants						$12,540.00	$40,160.00	$ 15,000.00	$ 46,230.00	$113,930.00
Publications						$6,089.00	$8,770.00	$ 19,795.00	$ 22,530.00	$57,184.00
	Subtotal					$18,629.00	$48,930.00	$ 34,795.00	$ 68,760.00	$171,114.00
	TOTAL	$3,305,000.00	$2,800,000.00	$2,960,000.00	$2,614,772.00	$1,439,349.00	$2,086,892.00	$ 2,574,763.00	$ 3,080,987.00	$20,861,763.00

**** Allocation for ME includes funding for External Evaluation Panel, Board Meetings, Technical Committee, and other meetings.***

Global Livestock CRSP
USAID Grant No. PCE-G-98-00036-00
Summary of Host Country Contributions

Host Country	Year 12 90/91	Year 13 91/92	Year 14 92/93	Year 15 93/94	Year 16 94/95	Year 17 95/96	Year 18 96/97	Year 19 97/98	Total
Bolivia	$809.00	$164,787.00	$81,230.00	$117,013.48	$125,764.12	$0.00	$0.00	$50,632.00	$540,235.60
Ecuador								$27,240.00	$27,240.00
Ethiopia	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$44,717.00	$44,717.00
Indonesia	$1,428,400.00	$3,691,400.00	$4,692,840.00	$5,004,400.00	$4,999,800.00	$5,012,500.00	$0.00	$0.00	$24,829,340.00
Kazakhstan	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$41,128.00	$41,128.00
Kenya	$218,771.00	$216,284.00	$127,919.00	$56,489.00	$254,718.00	$280,995.00	$308,565.00	$38,340.00	$1,502,081.00
Mexico								$29,502.00	$29,502.00
Morocco	$1,044,000.00	$826,000.00	$811,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,681,000.00
Peru	$6,845.00	$6,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$13,345.00
Russia	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$566.56	$566.56
TOTAL HC Contrb.	$2,698,825.00	$4,904,971.00	$5,712,989.00	$5,177,902.48	$5,380,282.12	$5,293,495.00	$308,565.00	$232,125.56	$29,709,155.16
Non-CRSP Support*	$46,615.00	$120,962.00	$166,259.00	$340,472.00	$84,301.00	$0.00	$8,200.00	$75,000.00	$841,809.00
TOTAL External Support	$2,745,440.00	$5,025,933.00	$5,879,248.00	$5,518,374.48	$5,464,583.12	$5,293,495.00	$316,765.00	$307,125.56	$30,550,964.16

* Support from sources other than GL CRSP, e.g., NGOs, other funding agencies, etc. that further the GL CRSP research.

Global Livestock CRSP
USAID Grant No. PCE-G-98-00036-00
Matching Contributions From U.S. Institutions

Institution	Disciplines	Year 12 90/91	Year 13 91/92	Year 14 92/93	Year 15 93/94	Year 16 94/95	Year 17 95/96	Year 18 96/97	Year 19 97/98	Total
Univ. of Calif, Davis	Genetics	$118,292.08	$122,877.02	$103,056.00	$92,682.00	$36,282.00	$18,951.36	$0.00	$0.00	$492,140.46
Univ. of Calif, Davis	Agric. Econ.	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Univ. of Calif, Davis	Nutrition	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$40,000.00	$0.00	$40,000.00
Univ. of Calif., Davis	Range Conservat	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$25,000.00	$100,260.47	$125,260.47
UCLA	Nutrition	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$37,701.00	$81,249.75	$118,950.75
Colorado State	Animal Health	$53,333.04	$87,499.62	$41,861.38	$0.00	$0.00	$0.00	$0.00	$0.00	$182,694.04
Colorado State	Nat'l Resource	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$37,151.56	$84,921.75	$37,151.56
Cornell University	Land Use	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$216,176.00	$0.00	$216,176.00
Univ. of Missouri	Sociology	$66,184.42	$81,894.67	$121,900.45	$91,115.58	$33,601.39	$51,541.90	$36,739.05	$0.00	$482,977.46
Montana State Univ	Breeding	$60,734.04	$52,668.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$113,402.04
No Carolina St Univ	Nutrition	$64,731.14	$55,975.10	$53,631.00	$55,192.79	$20,331.83	$0.00	$0.00	$0.00	$249,861.86
Texas A&M Univ	Breeding	$46,289.63	$53,757.88	$63,822.49	$63,704.89	$25,303.42	$46,172.71	$20,151.32	$0.00	$319,202.34
Texas A&M Univ	Info Systems	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$33,042.00	$0.00	$33,042.00
Texas A&M Univ	GIS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$32,000.00	$270,761.34	$302,761.34
Texas Tech. Univ	Range-Nutrition	$51,422.63	$68,212.94	$49,900.38	$45,924.26	$0.00	$0.00	$0.00	$0.00	$215,460.21
Utah State Univ	Range Ecology	$46,379.09	$84,756.83	$52,639.90	$54,737.10	$73,152.99	$9,750.00	$3,584.83	$0.00	$325,000.74
Utah State Univ	Range Risk Mgmt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$14,673.05	$100,692.00	$115,365.05
Wash. St Univ	Health	$53,333.00	$81,373.76	$48,180.00	$120,470.61	$85,296.23	$117,106.12	$25,412.76	$0.00	$531,172.48
Winrock Int'l.	Economics	$75,406.90	$83,273.79	$102,045.27	$92,258.89	$71,268.24	$65,431.43	$19,992.60	$0.00	$509,677.12
Winrock Int'l.	Dairy Mgmt.	$68,022.61	$56,749.01	$26,262.35	$47,138.48	$26,750.68	$33,149.03	$41,036.81	$0.00	$299,108.97
Univ. of Wisconsin	Natl Resource	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$130,816.77	$28,415.94	$159,232.71
Univ. of Wisconsin	Socio-Econ.	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$190,996.48	$101,146.55	$292,143.03
Univ. of Wisconsin	Networking	$0.00	$0.00	$0.00	$11,795.61	$0.00	$0.00	$0.00	$0.00	$11,795.61
Univ. of Kentucky	Anthropology	$0.00	$0.00	$0.00	$0.00	$0.00	$4,715.00	$0.00	$0.00	$4,715.00
	TOTAL	$704,128.58	$829,038.62	$663,299.22	$675,020.21	$371,986.78	$346,817.55	$904,474.23	$767,447.80	$5,177,291.24
	Percentage	32.21%	31.90%	32.24%	32.62%	28.34%	22%	47%	25%	28%

GLOSSARY

AARD	Agency for International Research and Development, Indonesia
AAU	Addis Ababa University
ABS	American Breeders Society
ACIAR	Australian Centre for International Agricultural Research
ADG	Average daily gain
AFPC	Agricultural and Food Policy Center
AFRNET	African Feed Resources Network
AGRIS	International Information System for the Agricultural Sciences and Technology, FAO
AID	Agency for International Development, Washington D.C., USA
AIGACAA	Asociacion Integral de Ganadevos en Camelidos de los Andes Altos
ALRMP	Arid Lands Resource Management Project
AMREF	African Medical Research Education Foundation
ANP	Applied Nutrition Program
ANPP	Annual Net Primary Productivity
AP	Animal Production
ARC	Agriculture Research Council
ARD	Association for Rural Development
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASF	Animal Source Foods
ASP	Agrosilvopastoral
ASPADERUC	Asociacion para el Dasarolla Rural de Cajamarca
AT	Assessment Team

ATI	Appropriate Technology International
ATW	Assessment Team Workshop
AWF	American Wildlife Federation
B	Barbados Blackbelly Sheep
BASIS CRSP	Broadening Access and Strengthening Market Input Systems Collaborative Research Support Program
BC	Barbados x Sumatra Sheep
BIFAD	Board for International Food and Agriculture Development
BPP	National Rubber Research Institute, Indonesia
BPT	Balai Penelitian Ternak, Bogor, Indonesia (Animal Husbandry Research Institute)
BR	Basic Resources
BW	Body weight
CAP	Common Agricultural Policy
CAR	Central Asian Republics
CARDI	Caribbean Agricultural Research and Development Institute
CARE	Cooperative for American Remittance to Europe, Inc.
CATIE	Centro Agronomico Tropical de Investigacion y Ensenaza
CBE	Commercial Bank of Ethiopia
CBPP	Contagious Bovine Pleuropneumonia
CCPP	Contagious Caprine Pleuropneumonia
CDC	Centro de Datos para la Conservacion
CEDEP	Centro de Estudios para d'Oesarrollo y la Participacion
CER-DET	Centro de Estudios Regionales para el Desarrollo de Tarija
CGIAR	Consultative Group on International Agricultural Research
CHDC	Child Health and Development Center
CIAT	Centro Internacional de Agricultura Tropical
CIDICCO	Centro Internacional de Informacion Sobre Cultivos de Cobertura
CIEC	Centro Interdisciplinario de Estudios Comunitarios

CIESTAAM	Center for Economic, Social, and Technology Research on World Agriculture and Agribusiness
CIP	Centro Internacional de la Papa - International Potato Center
C/LAA	Caribbean/Latin American Action
CLAS-UMSS	Centro de Levantamientos Aerospaciales y Aplicaciones de SIG
CNA	Confederacion Nacional Agropecuario
CNCPS	Cornell Net Carbohydrate and Protein System
CNG	Confederacion Nacional Ganadera
CONDESAN	Consorcio para el Desarrollo Sostenible de la Ecoregion Andina
CORAF	Conference de la Recherche Agronomique des Responsable Africains et Francais
CP	Crude protein
CPV	Capripox virus
CRES	Center for Resource and Environmental Studies
CRIAS	Coordinating Research Institute for Animal Science, Indonesia
CRSP	Collaborative Research Support Program
CSIRO	Commonwealth Scientific and Industrial Research Organization
CSU	Colorado State University
CT	condensed tannins
CURLA	Centro Universitario Regional del Litoral Atlantico
d	day
DANIDA	Danish International Development Agency
DOM	Digestible Organic Matter
DM	Dry Matter
DPG	Dual Purpose Goat
DPIRP	Drought Preparedness Intervention and Recovery Program
DSS	Decision Support System
EE	Effective Environment
EEC	European Economic Community

EEP	External Evaluation Panel
EHNRI	Ethiopian Health and Nutrition Research Institute
ELISA	Enzyme linked immunosorbent assays
EMBRAPA	Brazilian National Agency for Agricultural Research
ENNIV	Peruvian Living Standards and Measurement Survey
ENSO	El Nino and Southern Oscillation
EPG	Eggs per Gram
EPIC	Erosion Productivity Import Calculator
EU	Edgerton University
EW	Extension Worker
FA	FARM Africa
FAO	Food and Agriculture Organization, United Nations
FCC	Fertility Capability Classification System
FD	Full-day
FEWS	Famine Early Warning System
FIRA	Fideicomisos Instituidos en Relacion con la Agricultura
FLACSO	Facultad Latinoamericana de Ciencias Sociales
FMD	Foot and Mouth Disease
FOSS	First in Food Analysis
FUNAN	Fundacion Antisana
GANL	Grazingland Animal Nutrition Laboratory
GIS	Geographic Information System
GO	Government Organization
GPS	Global Positioning Systems
GSE	Greater Serengeti Ecosystem
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
h	hour
H	St. Croix Sheep

ha	Hectare
HC	St. Croix x Sumatra Sheep
HEM	Hemicellulose
HH	Household
HPI	Heifer Project International
HSPC	Human Subject Protection Committee
HW	Health Worker
IADB	Inter-American Development Bank
IAP-MU	International Agriculture Programs - Missouri University
IAR	Institute for Agricultral Research
IARC	International Agricultural Research Center
IBTA	Instituto Boliviano de Technologia Agropecuaria
ICA	Instituto Colombiano Agropecuaria, Colombia
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICIPE	International Centre of Insect Physiology and Ecology
ICRAF	International Centre for Research on Agroforestry
ICRISAT	International Crops Research Institute for the Semiarid Tropics
ICRW	International Center for Research on Women
IDIAP	Agricultural Research Institute of Panama
IDRC	International Development Research Centre (Canada)
IEMUT	French Tropical Veterinary Institute
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGADD	International Governmental Authority on Drought and Development
IICA	Interamerican Institute for Cooperation in Agriculture
IIML	Integrated Information Management Laboratory
IIN	Instituto Investigacion Nutricional
ILRAD	International Laboratory for Research on Animal Diseases
ILRI	International Livestock Research Institute

IMAS	Integrated Modeling and Assessment System
IMECBIO	Instituto Manantian de Ecologia y Conservation de la Biodeversidad
INCALAC	Industria Cajamarquina de Lacteos
INCAP	Instituto de Nutricion para Centro America y Panama
INEGI	Instituto de Estadistica, Geografia e Informatica
INIA	Instituto Nacional de Investigacion Agrarias
INIFAP	Instituto Nacional de Investigaciones Forestales y Agropecuarios
IP2TP	Installation for Research and Assessment of Agricultural Technology
IPB	Bogor Agricultural University
ISLP	Integrated Small Livestock Project
ISNAR	International Service for National Agricultural Research
JESS	Jubba Environmental and Socioeconomic Studies
KARI	Kenya Agricultural Research Institute
KCB	Kenya Commercial Bank
KDPG	Kenya Dual Purpose Goat
KDRSRS	Kenya Department of Resource Surveys and Remote Sensing
KEVEVAPI	Kenya Veterinarian Vaccine Production Institute
kg	kilogram
KLDP	Kenya Livestock Development Program
KNP	Katavi National Park
KRTISB	Kazakh Research and Technological Institute of Sheep Breeding
Ksh	Kenya Shilling
KUSCCO	Kenya Union of Savings and Credit Cooperatives
KWS	Kenya Wildlife Service
KWVA	Kenya Women's Veterinary Association
LAC	Latin American Countries
LAI	Leaf Area Index

LDC	Lesser Developed Country
LEWS	Livestock Early Warning System
LINDA	Livestock Information Network Development for the Americas
LPRI	Livestock Production Research Institute
LS	Livestock
LU	Livestock Units
M	Composite Population Sheep: 25% St. Croix, 25% Barbados Blackbelly, 50% Sumatran Sheep
MALDM	Ministry of Agriculture, Livestock Development and Marketing
MCF	Malignant Catarrhal Fever
ME	Management Entity
MIAC	MidAmerica International Agricultural Consortium
MOA	Ministry of Agriculture
MOH	Ministry of Health
MOU	Memorandum of Understanding
MUCIA	Midwest Universities Consortium for International Agriculture
NAARI	Namulaonge Agricultural and Animal Production Research Institute
NAFTA	North American Free Trade Agreement
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NCA	Ngorongoro Conservation Area
NCRSP	Nutrition Collaborative Research Support Program
NCSU	North Carolina State University
NDF	Neutral detergent fiber
NDVI	Normalized Difference Vegetation Indices
NES	Nucleus Estate Smallholder
NFTA	Nitrogen Fixing Tree Association
NGO	Non-Governmental Organization

NIH	National Institute for Health
NIRS	Near Infrared Reflectance Spectroscopy
NIS	Newly Independent States
NOAA	National Oceanographic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NREL	Natural Resource Ecology Laboratory
NRN	Natural Resources Network
NSDV	Nairobi Sheep Disease Virus
NSF	National Science Foundation
OAU	Organization of African Unity
ODA	Overseas Development Administration
ODI	Overseas Development Institute
OMD	Organic Matter Digestibility
OMI	Organic Matter Intake
OPC	Ovine pulmonary carcinoma
OPMM	Outreach Research Project at Membang Muda
OPP	Outreach Pilot Project
OPS	Outreach Project for the Sosa
ORP	Outreach Research Project
OvLV	Ovine lentivirus
PA	Participatory Appraisal
PAC	Program Advisory Committee
PAR	Photosynthetic Active Radiation
PCV	Packed Cell Volume
PEM	Protein-Energy Malnutrition
PENHA	Pastoral and Environmental Network in the Horn of Africa
PI	Principal Investigator
PL480	Public Law No. 480

PM	Problem Model
PRA	Participatory Rural Appraisals
PROMETA	Proteccion del Medio Ambiente Tarija
PRR	Proyecto de Reconstrucion Rural
PSICA	Information System and Agricultural Census Project
PVO	Public Volunteer Organization
RAINAT	Research and Assessment Installation for Agricultural Technology
REDSO	East African Region US AID
RERUMEN	Latin American Network of the Small Ruminant CRSP
RF	Range Forage
RFA	Request for Assistance
RFP	Request for Proposals
RGR	Rukwa Game Reserve
RH	Relative Air Humidity
RIAP	Research Institute for Animal Production, Bogor, Indonesia
RISPAL	Latin American Network for Animal Production Systems Research, IDRC
RS	Remote Sensing Technologies
RS	Resident Scientist
RSG	Ranching Systems Group
RVFV	Rift Valley Fever Virus
S	Sumatra Sheep
SA	Small Animals
SACCAR	Southern African Centre for Cooperation in Agricultural Research
SAGAR	Secretaria de Agricultural, Ganaderia y Desarrollo Rural
SALTLICK	Semi-Arid Lands Training and Livestock Improvement Centres of Kenya

SARI	Selian Agricultural Research Institute
SBPT	Balai Penelitian Ternak, Sei Putih, Indonesia (Animal Husbandry Research Institute)
SCT	Spatial Characterization Tool
SE	Socio-Economic
SEAD	Servicios de Apoyo al Desarrollo
SECOFI	Secreatria de Comercio
SEMARNAP	Servicio Nacional del Medio Ambiente, Recursos Naturales y Pesca
SES	Socio-economic Status
SICA	Proyecto Censo Agropecuario y Sistema de Informacion
SNIM	Servicio Nacional de Informacion de Mercados
SR-CRSP	Small Ruminant Collaborative Research Support Program
SRNET	Pan-African Small Ruminant Research Network
SRUPNA	Small Ruminant Production Systems Network for Asia
T	Temperature
TA	Technological Alternatives
TACIS	Technical Assistance to the Commonwealth of Independent States
Tair	Air Temperature
TANAPA	Tanzania National Parks
TAMU	Texas A&M University
TDN	Total digestible nutrients
TE	Terraneuva
Techpac	Technology Package
Tsoil	Soil Temperature
TT	Technology Transfer
UACh	Autonomous University of Chapingo
UCD	University of California, Davis
UCR	University of Costa Rica

UCV	Universidad Central de Venezuela, Maracay
UMC	University of Missouri-Columbia
UN	University of Nairobi
UNALM	Universidad Nacional Agraria La Molina
UNAM	Universidad Nacional Autonoma de Mexico
UNDOS	United Nations Development Office for Somalia
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
UNMSM	Universidad Nacional Mayor de San Marcos
USAID	United States Agency for International Development
USAMRID	United States Army Medical Research Inst. of Infectious Disease
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USU	Utah State University
UW	University of Wisconsin
UWI	University of West Indies
VOCA	Volunteers in Overseas Cooperative Assistance
WAN	Wide Area Network
WHO	World Health Organization
WMO	World Meterological Organization
WSU	Washington State University
WI	Winrock International Institute for Agricultural Development
WILD	Women in Livestock Development
WINS	Women Infant Nutrition Support
Wsoil	Soil Moisture
WTO	World Trade Organization
WWF	World Wildlife Fund
ZONISIG	Proyecto Zonification Agro-ecologica y Establecimients de una Base de Datos y Red de Sistema de Informacion