

LIVESTOCK DEVELOPMENT AND RANGELAND CONSERVATION TOOLS FOR CENTRAL ASIA

NARRATIVE SUMMARY

Recent market changes and privatization caused imbalances and dramatic reductions of agricultural stocks, production and productivity in Central Asian Republics (CAR). Central Asia represents a large region in the center of the Eurasian continent that encompasses the territories of Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan. Rangelands occupy nearly 80% of the territory and provide the main source of forage for livestock. Sustainability of extensive production and human nutritional welfare were negatively impacted. Division of state and collective herds into smaller private units caused erosion of animal stocks that started in the early 1990's and is in contrast with the long-term increase of livestock population in the region. The decline in livestock numbers can be attributed to the deterioration of the terms of trade for producers. Lack of winter forages, collapse of marketing networks and poor maintenance of livestock water wells have resulted in hand-harvesting of range plants for feed and fuel and concentration of livestock around populated areas and active wells. In spite of declining livestock numbers, rangeland degradation is accelerating near surface water and populated areas. Thus, this project addresses the immediate need to improve welfare of small landowners, and to prevent further deterioration of rangelands. We take an integrated multidisciplinary approach to improve the welfare of herders that involves not only on-farm solution of technical aspects, but

also the assessment of alternatives and policy instruments to support them.

The GIS and Basic Resources subproject serves as the basis for regional application and modeling of research results. The main activity of this component is the creation of a GIS for Kazakhstan, Turkmenistan, and Uzbekistan. Information is used for direct dissemination and as a basis for the other modules or subprojects. During the second year of the project we expanded the GIS for Kazakhstan and started the compilation and digitization of data for Turkmenistan. A significant amount of time and resources were devoted to training, equipment, and acquisition of maps and weather information.

The main objectives of the Range Forage and Carbon Flux subproject are to: 1) quantify annual net primary production (ANPP) on representative Central Asian rangelands and 2) assess the role of Central Asian rangelands in the global carbon budget. Accurate estimates of ANPP from these rangelands will provide important information on carrying capacity to sustain livestock production in the region. These estimates are also important for evaluating whether Central Asian rangelands are net sources or sinks for atmospheric CO₂. Degradation of rangelands and other ecosystems of Central Asia will likely result in a substantial release of CO₂ and other trace gases to the atmosphere with possible effects on the global CO₂ balance. On the other hand, rational management and

improvement of these rangelands will not only increase their productivity to satisfy growing needs of the population, but also probably allow these lands to be a significant sink for atmospheric CO₂, contributing to a reduction in anthropogenic inputs of CO₂. Our studies in Central Asia will provide data necessary to quantitatively assess the role of Central Asian rangelands in the global carbon budget. Activities during 1999 resulted in the successful measurements of CO₂ fluxes in three sites which support the hypothesis that rangelands can sequester atmospheric carbon.

Under the Animal Production subproject, we conducted extensive analysis of data gathered in 1998. These data were distributed to collaborators in the region, and a comprehensive report was prepared. Results confirm that most of livestock production in Kazakhstan takes place at a subsistence level and is most limited by availability of forages during the winter and early spring. Smallholder livestock production is largely dependent upon range forage. Rangelands are overgrazed near villages and underutilized in more remote areas because of severe problems in availability and cost of transportation and livestock water. Alternative sources of feed are limited or not existent. Current breeding schedules lead to calving and lambing in mid-winter to early spring. Given the severe winter feed shortages reported in the central semidesert and southern foothills, it seems imperative that the breeding period be adjusted to reflect range forage availability in these regions. In the northern dry steppe. Outreach efforts to demonstrate the potential benefits of a later breeding schedule may increase understanding of this readily available means to coordinate livestock demand with range forage availability.

Activities in the Socio-Economics

component of the project focused on the analysis of marketing of livestock. In Kazakhstan, the question of spatial integration of livestock markets was addressed because it has many policy implications. Without marketing orders, support prices, subsidies, and any kind of policy measures, the only platform on which producers perform their activity is the marketplace. The degree of market integration was studied with econometric models. Then, the behavior of the lamb market, which showed good integration, was simulated by constructing a regional equilibrium model. The model was used to preliminarily test the effects of policies to improve transportation alternatives. Investments in the transportation systems would be favorable to the livestock sector and welfare of the general population, particularly when investments emphasize transportation by roads instead of train, and when the price elasticity of supply is increased by investment in livestock technology, production infrastructure, and credit.

In Turkmenistan, studies of the livestock sector indicated that state-owned enterprises are progressively and steadily ceding the sector to private producers and traders. State organizations face serious lack of cash and are not commercially oriented. Thus, they cannot reorganize into financially-viable entities and should not be further supported. Meanwhile, the private sector, both at the level of small-scale traders and large-scale manufacturing firms, is expanding without hindrance from the government. However, a sudden withdrawal of the state from livestock production would create problems as has been evident in Kazakhstan, where livestock numbers plunged after rapid privatization of herds. The minimal amount of state support still given to production units allows these to gradually hand over animals to shepherds through the leasing system. This leasing system gives shepherds the opportunity

to gain experience to find the most cost-effective methods of managing and marketing livestock without having to own the whole herd. This system should be fostered by providing technical help and operational credit to those who lease animals. The wool market is suffering extremely deflated prices, because state organizations no longer provide wool grading and cleaning services. These services, as well as local cleaning and spinning of wool should be developed. Traders involved in marketing live animals have few constraints. A steady domestic demand for meat makes profit margins attractive. Trade is unrestricted, and costs are mainly in buying spare parts for the ancient trucks used to transport animals. However, traders indicated that one of their main problems was to get enough high quality feed to fatten animals. Although a private feed market exists, there is ample room for improvement of quality and reduction of costs through technical change.

RESEARCH

Problem statement and approach. Recent market changes and privatization caused imbalances and dramatic reductions of agricultural stocks, production and productivity in Central Asian Republics (CAR). Sustainability of extensive production and human nutritional welfare were negatively impacted. Division of state and collective herds into smaller private units caused erosion of animal stocks that started in the early 1990's and is in contrast with the long-term increase of livestock population in the region. The decline in livestock numbers can be attributed to the deterioration of the terms of trade for producers. Lack of winter forages, collapse of marketing networks and poor maintenance of livestock water wells have resulted in hand-harvesting of range plants for feed and fuel and concentration of livestock around populated areas and active wells. In spite

of declining livestock numbers, rangeland degradation is accelerating near surface water and populated areas. Rangelands of CAR may constitute a significant part of the "missing sink" that attenuates the increase in atmospheric carbon dioxide. Thus, there is an immediate need to improve welfare of small landowners, and to prevent further deterioration of rangelands. We take an integrated multidisciplinary approach to improve the welfare of herders that involves not only on-farm solution of technical aspects, but also the assessment of alternatives and policy instruments to support them. Alternatives will be evaluated from the point of view of human welfare, sustainability, impacts on the global carbon budget, and economic profits. A GIS model incorporating ecological and policy scenarios will be used to explore the regional impacts of various technical alternatives.

The original plan for the 1998-99 year included:

1. creation of GIS for Turkmenistan (TK) and Uzbekistan (UZ), and expansion of the GIS for Kazakstan (KZ),
2. continued measurements and modeling of carbon dioxide flux in rangelands,
3. analysis of results of surveys and modeling of livestock enterprises from KZ,
4. rural surveys of human welfare and production systems in TK and UZ,
5. implementation of intensive monitoring in a series of agricultural enterprises in KZ, and
6. dissemination of results to the government and producers.

Geographical information systems similar to the one created for KZ were planned for TK and UZ. Survey data was to be analyzed to test the relation between production system, rangeland condition, and human nutritional

welfare, as well as to determine productivity and production bottlenecks. CO₂ flux data would continue to be gathered in Kazakhstan, Turkmenistan and Uzbekistan, and data were to be used to parameterize empirical range productivity models. Surveys were planned to be conducted in Turkmenistan and Uzbekistan to quantify production system, resources, and human nutrition. Role of animal agriculture in rural family welfare and hypotheses about the main proximate and ultimate constraints to profitable and sustainable animal production were planned to be tested with the data. Based on the results of the formal survey, 9-12 enterprises were going to be selected in Kazakhstan for intensive monitoring during 2 years and later application of new technological packages that address identified problems. Results were going to be presented to agencies and producers in a series of reports, brochures, and audio-visual media.

There were significant departures from the originally proposed plan. First, it was determined that a more significant effort in training local scientists and technicians was necessary. Workshops and formal training were implemented with GL-CRSP and additional leveraged funds. Second, it was not possible to conduct rural surveys in Uzbekistan. Local collaborators were not willing to make a research agreement within this project until the blanket MOU between the GL-CRSP and Uzbekistan was signed. This MOU was not signed in time to conduct research in the 98-99 fiscal year. As a result of this, a significant portion of funds were not spent and were returned to the ME. Surveys were conducted in Turkmenistan as planned. Third, we were unable to start the on-farm monitoring activities because of lack of time to coordinate with ICARDA. Fourth, based on the results of the survey conducted in 1998 in Kazakhstan, a new survey was conducted to re-visit a sample of the original households and

conduct a study of livestock market integration in Southern Kazakhstan. Fifth, a detailed spatial sampling of soils was conducted in Northern KZ to determine the relationship between topography, management, and landscape position on soil organic carbon, erosion, and temporal variability of grain yield. The results will quantify the losses of carbon due to erosion and cropping, and will establish a basis for assessing risk reduction and carbon sequestration by integration of animal and crop production at the appropriate scale. In simple terms, we hypothesize that it is possible to improve soils, remove atmospheric carbon and reduce enterprise risk by incorporating livestock production in areas where soils and topography are not well suited for continuous grain production.

GIS for Kazakhstan and Turkmenistan

Progress. The GIS database for Kazakhstan was expanded significantly by incorporating a large time series of weather information and several remote sensing layers (NDVI). Both weather and NDVI are currently being tested to determine different approaches to perform spatial extrapolations of forage productivity, CO₂ flux, and risk associated with weather and landform. Maps of experimental areas in Northern Kazakhstan have been digitized at very high resolution for analysis of effects of topography on snow and rainfall distribution in relation to erosion and wheat yield.

The GIS of Turkmenistan has been started with layers containing political boundaries and rangeland types. A database with detailed weather information was also created.

The activities in this module were significantly complemented with a series of training workshops. K. Olmstead traveled to Tashkent, Almaty and Ashgabat where she

conducted hands-on workshops on GIS, digitizing, CartaLynx, and IDRISI. Representatives from four host-country institutions received the training.

Measurement and Modeling of CO₂ flux (RF module)

Progress. The four Bowen ratio systems at each of the three measurement sites in Central Asia (Karnap, Uzbekistan; Karrykul, Turkmenistan; and Shortandy, Kazakhstan) were installed during early spring for the 1999 growing season. Field data for CO₂ fluxes and associated micrometeorological characteristics were collected continuously at 20-minute intervals. These data were routinely transferred electronically to Logan, Utah, where they are processed into five-day segments. Data were evaluated for reliability, and any equipment malfunctions were identified and collaborating scientists notified. The segmented data sets were subsequently used to calculate daily integrals of CO₂ flux. These data were electronically sent to Dr. Gilmanov at South Dakota State University who evaluated the relationships between micrometeorological characteristics and rates of CO₂ flux. These relationships will be used to develop predictive models of CO₂ flux for each site. Work proceeded as planned with no modifications. A full technical report of the carbon flux measurements is available upon request. (See web site <http://glcrsp.ucdavis.edu> or write the Management Entity).

Smallholder livestock systems in KZ

A significant part of the analysis of the data gathered during the survey conducted in 1998 was completed, and published as a MS Thesis authored by A. Breuer (2000). This thesis contains a wealth of analyses and information about the characteristics of household and smallholder production units in Kazakstan. A

copy of this thesis is available upon request.

Three main aspects of livestock production were studied:

1. Characteristics of farms in crop production, feed availability, and rangeland use;
2. Livestock management calendar and relation between forage demand and supply;
3. Spatial pattern of use and ecological condition of rangelands.

This study of smallholder livestock and range management practices led to the following conclusions:

- Smallholder livestock production today is largely dependent upon range forage. Efficient use of rangeland forage is limited because of multiple factors that impede movement of animals to areas far from villages. Alternative sources of feed are limited or not existent.

In the early 1900's, the vast range resources of Kazakstan supported a livestock population somewhat larger than the present national herd. At that time, a semi-nomadic system of livestock herding enabled use of the best available forage for each season. In order for smallholders today to use seasonally-available forages on a large scale, a system of structured nomadism reminiscent of that used on collective farms, but geared to independent producers, may be appropriate. This system would need to include means of livestock transportation, a network of wells across diverse range types, and support for the everyday needs of herders. Currently, some smallholders and larger production units with significant livestock herds practice limited movement of livestock without government-provision of these services. Thus, it appears that market-driven migration may also develop. An important government role in this situation

would be monitoring and regulation of grazing to preserve range health. Now that land privatization is underway, range tenure could become a barrier to the use of seasonably-available forages. On rangelands where considerable fluctuations in range yield are the norm, systems which enable flexible use of the best forage resources available tend to be more productive and stable than sedentary systems. Incorporation of flexible grazing options in range management in Kazakhstan is key to achieving sustainability. The fact that the country and legislation to regulate land use are in transition constitutes a challenge but also an opportunity to properly plan the use of rangeland resources at a regional scale.

- Supplemental energy fed in the non-grazing period from December-March is far below maintenance in the central semidesert and southern foothill regions, but exceeds maintenance in the northern dry steppe region.

Because feed scarcity is common, smallholders should endeavor to take full advantage of limited supplemental feed resources by feeding livestock primarily when range forage cannot supply adequate nutrition. Improvement of forage quality through cultivation of high value feeds, where possible, and haying at optimal maturity would boost smallholder production capacity. Basic hay storage facilities would also limit nutrient loss from exposure to sun and precipitation. Because smallholders are limited by lack of machinery, land ownership, and irrigation water supply, the formation of cropping and haying cooperatives could enable smallholders to work land more effectively. As agricultural input markets become further developed, smallholders may also have increasing options to purchase better quality feed.

- Current breeding schedules lead to calving and lambing in mid-winter to early spring.

Given the severe winter feed shortages reported in the central semidesert and southern foothills, it seems imperative that the breeding period be adjusted to reflect range forage availability in these regions. In the northern dry steppe, as well, it appears that alteration of the breeding schedule would enable rangelands to provide a far greater proportion of livestock energy requirements. Reproductive success may also increase with better feeding. Outreach efforts to demonstrate the potential benefits of a later breeding schedule may increase understanding of this readily available means to coordinate livestock demand with range forage availability. The extended duration of the breeding season in all regions, in light of low livestock holdings per household, suggests that households may need better control of breeding to effect this change.

- Weaning rates are average to high in the central semidesert and southern foothills, but low in the North.

Weaning rates in all regions can be improved by increasing lactation through synchronization of lambing and calving with range forage availability. In the northern dry steppe, smallholder breeding schedules require that reproductive females be sheltered and fed for a protracted period between calving and lambing and the beginning of the grazing season. Current energy stores and livestock housing do not appear to be able to sustain weaning success at this time of the year. Modification of the breeding schedule would lead to more rational use of rangelands to meet livestock demand and should also improve weaning success.

- Despite the vast rangeland resources of Kazakhstan, past dependence upon an external system of forage provision and farm organization, as well as adaptation to a sedentary

lifestyle means that smallholders are unprepared to use ranges beyond the village periphery.

Empowering smallholders to manage their livestock with available resources may occur through extension efforts. With greater knowledge of means to avoid overgrazing of surrounding range communities, smallholders would gain the ability to design more appropriate grazing systems to fit their individual needs. Development of participatory village and raion-level grazing management bodies could help to structure grazing among multiple users of common range areas. Organized cooperation among villagers to move animals should have significant economies of scale and thus, could make a larger rangeland resource base and a wider market available to villagers who otherwise can only produce at a subsistence level by using nearby pastures.

- Ranges just 6 to 10 km from the village appear to have negligible grazing loads, while those closer are subjected to heavy grazing pressure.

Use of ranges further from the village appears to be limited by labor, transport, and water availability. Distribution of livestock just beyond these boundaries could enable more even use of rangelands. The reliance upon ranges at the village periphery may signal a break down in traditional systems of common herding of household livestock. Organization at the village-level to introduce grazing rotations may alleviate current grazing pressure on rangelands near villages. As herds increase, integrated methods to support increasing forage demand and maintain range health must be employed. On a national scale, this will require development of the transportation and water supply infrastructure to allow use of remote range areas.

- Transect data revealed a greater

proportion of annual and alkaloid-containing species on ranges at village outskirts than at distances beyond 3 km.

The poor range quality at the village periphery may be linked to current grazing practices because overgrazing near watering points during the Soviet era should be reflected by all transect distances. Distribution of livestock across a larger area of rangelands is necessary to prevent continued degradation. Ranges near villages, because of their proximity to winter housing, may be best reserved for winter grazing, while distant ranges are more readily accessible during warmer times of the year.

Livestock market integration in Southern Kazakhstan

Our activities focused on the collection of information regarding the livestock sector in Kazakhstan and preliminary attempts to identify major economic issues related to the sector. Following revision of available information, including a review of the data collected in the survey during the previous year, one of our Ph.D. students traveled to Kazakhstan to observe livestock sector institutional arrangements and to better identify the constraints faced by farmers in their production activities. The student, Mimako Kobayashi, visited Kazakhstan during August-September 1999. She spent about 4 weeks in interviewing individual farmers and collecting basic economic data in Southern Kazakhstan.

A key component of economic reconstruction since Independence from the Soviet Union has been introduction of a market system. In the agricultural sector, the marketing order system was eliminated and input subsidies were terminated. This means that the prices of inputs to and outputs of agricultural production are to be market determined. In practice,

particularly given the economic recession that has prevailed throughout the ex-Soviet Union since its dissolution, input prices are higher and output prices are lower. The sharp decline in the output/input price ratio has caused a sharp reduction in output. This decline has been exacerbated by an increase in uncertainty and control over land, animal and machinery property rights and the reduced functioning of many state agencies that previously played an important role in input supply and output processing and distribution.

A natural question that arises is the extent to which the newly introduced market system is efficiently functioning. We set out to test one aspect of this, i.e. whether the livestock market is spatially integrated. A complete report of the research and analysis is available upon request or at the GL-CRSP web site. The fundamental question is whether livestock markets in different parts of Kazakhstan are appropriately linked so that producers/consumers can be confident that they are equally well off if they sell in their local market as opposed to shipping their products to more distant markets. These tests are carried out using statistical methods developed in the economic literature for this purpose.

Markets in Southern Kazakstan were analyzed by econometric and simulation methods. Both the current degree of spatial integration and simulated effects of investment in transportation infrastructure and local disturbances in supply were investigated. Preliminary results show that livestock markets show substantial spatial integration. We found this finding somewhat surprising, but it has important implications that basic market framework is functioning and that the reasons for Kazakhstan's livestock problems are likely to fall in other areas. Simulation exercises indicated that investments in the transportation systems would be favorable to the livestock sector and

welfare of the general population, particularly when investments emphasize transportation by roads instead of train, and when the price elasticity of supply is increased by investment in livestock technology, production infrastructure, and credit. Not unexpectedly, livestock development in the region will depend on a concerted effort that considers the global picture. These preliminary results indicate that livestock development will not have a significant response to any single intervention or policy modification by itself.

Individual farmers are trying hard to adjust to market changes. Since they are often stuck with the current resource endowment (for example, agricultural land is currently non-tradable, only tractors available are of Soviet size (very large), credit availability is limited for new investment, etc.), farmers need to improve their management and agricultural skills, increase their level of capitalization (the small scale of many farmers is a severe constraint), and develop new mechanisms for sharing capital goods that impose large overhead costs, such as machinery.

It was also found that cooperation among farmers in resource use and management is far more frequent in livestock production than in crop production in Southern Kazakhstan. An analysis of the reasons for this difference would give some ideas about how agricultural production should be reorganized, and will be considered as a research subject for the activities in 99-00. Questions include: what would be the most efficient farm size?; what kind of technology should be developed?; how should land reform would be implemented? These questions will be addressed with a game theoretic approach.

Studies of livestock production and marketing systems in Turkmenistan

Drs. Carol Kerven and O. Soyunova performed independent but coordinated studies of the livestock sector in Turkmenistan during the summer of 1999. These studies were designed to describe the current level of development and structure of livestock production and marketing. In addition, producers were interviewed to determine their perception of the most limiting factors for their activities. Both studies were completed and results were preliminarily analyzed.

In her report, Dr. Kerven reports that marketing of livestock and their products is being increasingly privatised as a result of government policy as well as by default, as the state no longer exerts complete control over product distribution channels. The state still intervenes in price mechanisms and through financial support to state organisations involved in raising or selling livestock products. The market is not therefore totally decontrolled. Willing buyers and sellers within government and private sectors find ways to get around the state controls. Knowledgeable informants suggest that deals can always be done and prices are negotiable, as is also implied from data in this report showing the differentials between official and actual prices paid.

State organisations in the livestock sector are gradually being phased out, but find themselves in a difficult situation common in transitional economies. They are desperately starved of operating capital while retaining obligations to pay staff and other overheads. Their marketing strategies are therefore aimed at maintaining cash flow. These organisations also lack modern business practices - for example cost/benefit analysis - to run efficiently under market conditions. They equally lack processing

facilities required to export their commodities profitably. They are required to value livestock products at unrealistic prices in relation to the open market, which encourages under-the-table dealing. Being state organisations, they are also required to accomplish sometimes contradictory policy targets such as increasing livestock numbers as well as the area of wheat cultivated, which means reducing fodder production as irrigated land area is limited. As state organisations, they are also prey to demands from higher authorities to supply goods without payment. Officials in state organisations are usually quite candid about all these shortcomings, but unsure of how to improve the situation.

Under such conditions it is not possible for state livestock organisations to reorganise themselves into financially-viable entities. Meanwhile the private sector, both at the level of small-scale traders and large-scale manufacturing firms, is expanding without hindrance from the government. Therefore, one may expect that the private sector will soon take over the remaining market segments still controlled by state organisations.

State marketing organisations are not oriented to commercial objectives, and are not pro-active in seeking new markets. Since they are inefficient but powerful competitors to the private sector, further support to these organisations is not warranted.

The immediate withdrawal of the state from the production side of the livestock sector would create further problems, as has been evident in Kazakhstan (Kerven 1999). The minimal amount of state support still given to dihan birlashik (the production units) at least allows these to gradually hand over animals to shepherds through the leasing system. Under the leasing system shepherds can experiment for

several years to find the most cost-effective methods of managing and marketing (Lunch 1999). If the dihans were suddenly dismantled and their assets distributed, many shepherds could not make a viable livelihood from a small flock given present market prices, especially for wool. The result would probably be a sharp decline in animal numbers and a concentration of remaining animals into fewer hands. Unemployment and meat prices would rise, as fewer people would be raising fewer animals. It is therefore recommended that some support to state production enterprises be continued until such time as their shepherds have adjusted to the new market conditions.

For shepherds, the greatest problem in marketing their livestock products lies in the extremely low price for wool paid to producers. Wool from the Turkman Sarja sheep breed is of the coarse type considered by national experts as the best wool for carpets. While there is demand for this type of wool from other countries (e.g. India, Pakistan), there are insufficient commercial companies competing with each other within Turkmenistan to buy wool from producers, to bid up the price. The state organisations which still control a large share of the wool market undervalue the wool received from their shepherd employees. Such wool as is exported is sold at much higher prices than received by producers, through the state marketing system. Moreover, producers now have to sell their sheep wool directly without benefit of cleaning or grading, as these functions are no longer performed by the sovkhoz. Sale of unsorted and dirty wool further devalues the price received. The potential for exporting raw or processed camel wool has also not been developed (in Mongolia, for example, camel wool is well-processed and yields export revenue).

Dihan livestock professionals and

shepherds argue that village-level wool-processing facilities would improve the quality and thus the price for wool received by producers. While several private wool-processing factories have opened up very recently, these are located in the cities. There is still a need for newly-privatised shepherds to be able to grade and clean their wool before selling on to commercial firms, in order to obtain higher returns. Local processing facilities could include dyeing and spinning wool for making into carpets, which would further raise the value of wool to shepherd families.

For entrepreneurs involved in marketing live animals, there appear to be few constraints. There is a steady domestic demand for meat and profit margins are attractive. Trade is unrestricted, and costs are mainly in buying spare parts for the ancient trucks used to transport animals. As profits increase, more successful traders will undoubtedly be able to upgrade their vehicles. However, all traders mention the difficulty of obtaining good-quality fodder to fatten animals for resale. High-quality feed concentrate (Kombicorn) is no longer available, and traders find that residues of grain and cotton processing contain fewer nutrients than previously in the Soviet period. Processing and storage of fodder crops is also less than ideal. While a private market in fodder has developed, the quality and cost of fodder production could be further improved with technical support.

Businesses involved in exporting wool and karakul pelts face a number of challenges at present. Interest rates are high, technical and marketing expertise is lacking. The owners of such businesses are keen to make international contacts which would increase their sales and profits, but do not always know how to make these connections. Provision of technical and marketing information, as well as low-interest loans, would be a vital step towards helping these

new private firms to become more commercial.

Dr. Kerven summarizes that there is both need and potential for developing the commercial livestock marketing sector in Turkmenistan. The government is steadily giving up control, as production and marketing have become privatised. Small-scale shepherds need to be able to gain more value from selling wool, if they are to be able to remain in production. Traders need to be able to buy better fodder to provide urban consumers with higher-quality animals. Business people need information, advice and credit to take full advantage of the new commercial environment. The deserts of Turkmenistan have long been able to support livestock whose wool and pelts are highly valued elsewhere. This capacity should not be wasted in the future.

The complete technical report by Dr. C. Kerven is available upon request or at the GL-CRSP web site.

Dissemination of results

A complete database with the results of the survey conducted in 1998 was distributed to collaborators, together with the software necessary to use the database (FileMaker).

Results of all aspects of the project were formally presented at the 1999 Annual Meeting of the LDRCT, which took place in Tashkent, Uzbekistan, during 15-18 March 1999. Over 40 participants from a variety of institutions, representatives of host country governments, and representatives of USAID participated in the meeting. The meeting, which emphasized the establishment of a strong connection between research and impacts, was reported in the public press of Tashkent. Proceedings are being edited for publication in Russian with English

translations. A complete list of participants and the meeting agenda are in Appendix 2.

The PI and other members of the research team visited government and farmers institutions in Kazakstan, Uzbekistan and Turkmenistan. Host country scientists were briefed and consulted on the progress and plans of the project.

In response to comments from farmers and local authorities, we distributed the Russian version of the GL-CRSP newsletter to those villages that were visited in 1998.

The following articles were published in the popular press and included information and results from the present project:

Reviving agriculture in Central Asia, by P. Bailey. Dateline, UC Davis, 26 Feb 1999, page 3.

The distant graze. International ag program takes stock and re-, by P. Bailey. Dateline, UC Davis, 30 January 1999, page 3.

The heat is on, by D. Weinshilboum. The Enterprise, Davis, California, 13 June 1999, page C1.

Natural Resource Conservation, by B. Agzamov. People's Voice, Tashkent, Uzbekistan, 18 March 1999.

Global Livestock CRSP Represented at HPI Human Nutrition & Livestock Symposium. Ruminations Fall 1998, page 15.

Annual Meeting Held in Tashkent. Ruminations, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 1.

NIDFF in Turkmenistan Hosts GIS Training Workshop, by K. Olmstead. Ruminations, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 6.

Carpenter and Grivetti Present Poster at FASEB, by M. Carpenter. Ruminations, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 19.

Cropping Systems and Ecological Analysis in North Kazakhstan, by A. Wolf. Ruminations, Newsletter of the Global Livestock Collaborative Research Support Program, Spring 1999, page 2.

Carbon Cuts and Techno-Fixes, by Robert Kunzig Carl Zimmer. Discover Magazine, June 1998 (see <http://208.226.13.177/archive/output.cfm?ID=1456>)

Scientific articles and abstracts are reported in the appropriate sections.

GENDER

Data from this project will provide information that will benefit both the male and female portions of the general population in the region. Results from the project will hopefully encourage women in host countries to become involved in further research that will enhance rangeland primary productivity, develop the livestock sector, and affect regional policies.

This project raised \$500 of leveraged funds to support collaborative research with female rangeland researchers in Kazakstan.

Because adult male family members were often in the field, we frequently interviewed the

female household head during the market survey of Southern Kazakstan. Local women also actively participated in the field survey by providing services of translation, and interpretation.

This project has continued to support women at all levels: as direct beneficiaries of the research results, as employees to support regional activities (Sidelnikova, Nabat, Raushan, Lydia), as collaborating scientists (Abouva, Karbayeba, Shabanova, Kerven, Soyunova, Lebed, Gaziantz), as graduate students (Breuer, Carpenter, Olmstead, Kobayashi), and as student assistants (Nash, Gavrilets, Darmina, Wilson, Kaur).

POLICY

Important linkages developed in the past and reported last year continued to operate. This year, we successfully concentrated in furthering our connections with scientists and government institutions in Uzbekistan.

Although Kazakhstan is ahead of the other two countries in terms of reforms, it still does not have well-developed agricultural policies. Local researchers are trying hard to construct such policies. The development of additional objective information at both the aggregate market and also the individual farmer level – and policy analysis that could be based on such information - would be extremely useful for future agricultural policy making. In our analysis of results, we are gravitating towards a spatial analysis of limitations to livestock development and economic growth; a point well illustrated by the analysis of market integration. This type of analysis should allow optimization of development funds and of policy design.

One of the aspects of our research that has attracted the most interest from policy-makers

has been the study of Central Asian rangelands as potential carbon sinks. We envision that if we continue this effort, it is realistic, albeit optimistic, to develop a technological package for range management and livestock production that produces agricultural commodities and carbon “credits.” International and regional scientists and policy-makers are just beginning to seriously consider agricultural ecosystems as potential sites for mitigation of climate change. We have taken steps to inform regional scientists and policy-makers about these possibility, and have obtained significant leveraged funding to create a regional network for carbon flux measurement and modeling. One of the main goals of this network is to enhance the regional human capacity so the participating countries can rely on their own scientists for the expected future negotiations and measurements that will be necessary. This aspect of our project received very strong (moral) support from the Central Asia USAID Mission.

OUTREACH

The problem of quantifying the magnitude of CO₂ flux and assessing the carbon sequestration potential in principal rangelands of Central Asia were acknowledged to be of prime importance by administrators at a number of key governmental, research and management institutions in Kazakhstan, Uzbekistan and Turkmenistan, including ministries of the environment/nature conservation, academies of sciences and leading agricultural, land management, and rangeland research institutes. During visits to the region in spring 1997 and 1998, the institutions interested in receiving the data and modeling results from the CO₂ flux subproject included: Kazakhstan (Ministry of Science; Academy of Science; National Academic Center for Agrarian Research; Ministry of Agriculture), Turkmenistan

(Academy of Sciences; Regional Center for Prevention of Desertification; Ministry of Natural Resources and Environmental Protection; Research and Production Center of Ecological Monitoring), and Uzbekistan (Ministry of Agriculture, Institute of Karakul Sheep Breeding). The extension approach adopted in the CO₂ flux subproject will be based upon: 1) informing the target institutions and individuals about the results of the CO₂ flux evaluations at the three monitoring stations; 2) sharing quantitative models to predict CO₂ flux rates as functions of environmental factors and management decisions; and 3) discussing with the target institutions the resultant maps of CO₂ flux rate and estimated carbon sequestration potentials derived from combining flux models with the GIS of basic ecological resources of the Central Asian states.

During the Livestock Production study, Mimako Kobayashi had a number of formal and informal discussions/collaborations with local economists and other government agency staff regarding economics issues and policy.

DEVELOPMENTAL IMPACT

Obtaining information of the magnitude and distribution of CO₂ fluxes in the principal rangeland types of Central Asia has direct relevance to understanding the environmental situation in Central Asia and its improvement through scientifically based management decisions. For example, the 30-year long study of carbon balance of the chernozem soils in northern Kazakhstan conducted at the Barayev Institute of Grain Farming (Shortandy, Kazakhstan) indicated a 25 to 30 percent reduction of humus reserves under cultivation. Transformation of at least part of these lands (especially in the region of marginal agriculture in northern and central Kazakhstan) into managed pastures constitute a significant reserve

of carbon sequestration that could minimize subsequent wind and water erosion. In Uzbekistan the opposite process of plowing desertified steppes and semidesert rangelands in the foothill zone for wheat production is taking place.

Estimation of the potential effect of these processes on the carbon balance of the affected soils (where presumably a substantial loss of soil organic matter will take place through accelerated wind and water erosion of those light-textured, loess soils) will help in making wise decisions regarding the management of foothill ecosystems. The desert shrub rangelands of Turkmenistan are being over-exploited by year round grazing. Data concerning the seasonal dynamics of ecosystem productivity from continuous CO₂ flux measurements will provide critical information necessary to make rational decisions concerning the management of forage resources. The RF subproject has established close links with the USDA-ARS Rangeland CO₂ Flux Network, including the sharing of data processing algorithms. Results of the CO₂ flux research on the rangelands of Central Asia will be used to compare and inter-calibrate flux measurements and models in the steppe and semidesert regions of the western U.S. The RF subproject also cooperates with the International Center for Agricultural Research in Dry Areas (ICARDA), which contributed expertise, equipment, and resources to the establishment of the CO₂ flux station in Uzbekistan. Scientists from ICARDA who contributed to the project in 1999 included: Drs. Gustave Gintzburger, Rick Tutwiler, Luis Iniquez, and Mustapha Bounejmate.

Degradation of rangeland is one of Kazakhstan's most urgent problems. Since livestock prices are low and transport costs are high, it is usually unprofitable to produce livestock in geographic locations that are far from

major urban centers (except for subsistence production). Since land is generally held in some type of communal property framework, a large proportion of Kazakhstan's livestock are now found within a fairly short distance of urban areas, and the livestock range in this region is degraded. In contrast, potentially productive ranges farther from urban areas are underutilized and not degraded. Our analysis will provide some understanding regarding how, with expected changes in input (including transportation prices) and output prices, a growing proportion of Kazakhstan's rangeland can be economically and sustainably exploited.

Large agricultural enterprises and specifically the large state farms that previously accounted for the bulk of Kazakhstan's agricultural output have largely broken down. Many of their assets have been distributed or sold to previous workers, or simply consumed in the case of livestock. As a result, a large number of individual farmers have come into existence, though most of these farmers possess little capital (livestock, machinery) and few are skilled in farming. Few at all have prior experience with how to work within an economic market framework. It seems unlikely that large state enterprises provide a future for the agricultural sector. Issues of management expertise, trust, access to capital, and the like are very difficult. While individual farmers (as opposed to large enterprises) have a great potential to increase agricultural production, great efforts are needed to create a more positive framework within which these farmers and their farms can develop profitably and efficiently. Our analysis is focusing on the effort to better understand the strategies currently being followed by smaller farmers, the constraints that they face in achieving higher productivity and efficiency, and developing helpful policy recommendations. Part of this analysis will focus on the conversion of common or state land to

individual use, whether by sale or lease. Our analysis, focusing on individual farmers, will fill such gaps in the knowledge of the behavior of small farmers, which would lead to direct improvement of government infrastructure and policy and, indirectly, the welfare of independent farmers.

LEVERAGE FUNDS AND LINKED PROJECTS

Scientists with USDA-ARS at Logan, UT (Drs. Douglas Johnson and Nick Saliendra) and Dubois, ID (Drs. Harvey Blackburn and Wolfgang Pitroff, who recently left Dubois) are participating in a joint sheep/range project in Central Asia with scientists from ICARDA (Drs. Gus Gintzburger and Euan Thompson previously, and now more recently Drs. Rick Tutwiler, Luis Iniquez, and Mustapha Bounejmate). The RF subproject has benefited considerably by significant in-kind support from the USDA-ICARDA project. This includes support to purchase and install two Bowen ratio systems at the Karnap Site in Uzbekistan, fencing and security guards to secure the CO₂ monitoring site, a vehicle for travel to and from the research site, and a portable shelter at Karnap for research and security personnel. Salary support for two Uzbeki field scientists was provided through the USDA-ICARDA project. Support from the USDA-ICARDA project for CRSP-related research in Central Asia is estimated to be about \$60,000. In addition, USDA salary and benefit support for Johnson (10% time) on CRSP-related activities is estimated to be another \$12,000. Thus, a total of about \$72,000 has been leveraged through interaction with the USDA-ICARDA project.

This project obtained leveraged funds from ALO and UC Davis to train regional scientists and enhance the regional human capacity for measurement and modeling of carbon fluxes. This grant is completely complementary with

LDRCT, and it included over \$90,000 in cash and \$110,000 of in-kind matching funds from UCD and regional institutions. The first phase of the ALO project will finish in April 2000, when six scientists will have spent about four months in training in the US.

TRAINING

In March 1999, Dr. Saliendra traveled to Turkmenistan and Uzbekistan and provided on-site training in the installation, operation, maintenance, and trouble-shooting of the Bowen ratio equipment. Central Asian scientists who participated in this training included Drs. Nasyrov and Mardonov (Uzbekistan) and Dr. Dourikov (Turkmenistan). Drs. Johnson, Gilmanov, and Saliendra assisted in the preparation of a proposal entitled "Enhancement of Human Capacity for a Network of Carbon Dioxide Flux Studies in Central Asian Rangelands", which was selected for funding by the Association Liaison Office for University Cooperation in Development (ALO) through USAID. All scientists involved in the RF subproject took an active role in this training activity at Logan, UT and Davis, CA, December 1999 – March 2000.

Karen Olmstead traveled to Tashkent, Almaty, and Ashgabat, where she conducted workshops on the use and creation of GIS. More than 10 regional scientists and technicians participated actively in these workshops. The workshops were described in detail in an article published in *Ruminations* (Spring 1999).

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ABSTRACTS AND PRESENTATIONS

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In addition to the abstracts listed above, fourteen papers were presented in the LDRCT Annual Meeting and will be published.