

Small Ruminant/
Global Livestock
CRSP

CENTRAL ASIA
REGIONAL LIVESTOCK ASSESSMENT

**WORKSHOP
PROCEEDINGS**

Tokyo, Japan
January 27 - March 1,
1994



ICARDA



CENTRAL ASIA
LIVESTOCK REGIONAL
ASSESSMENT WORKSHOP

TASHKENT, UZBEKISTAN

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FOREWORD

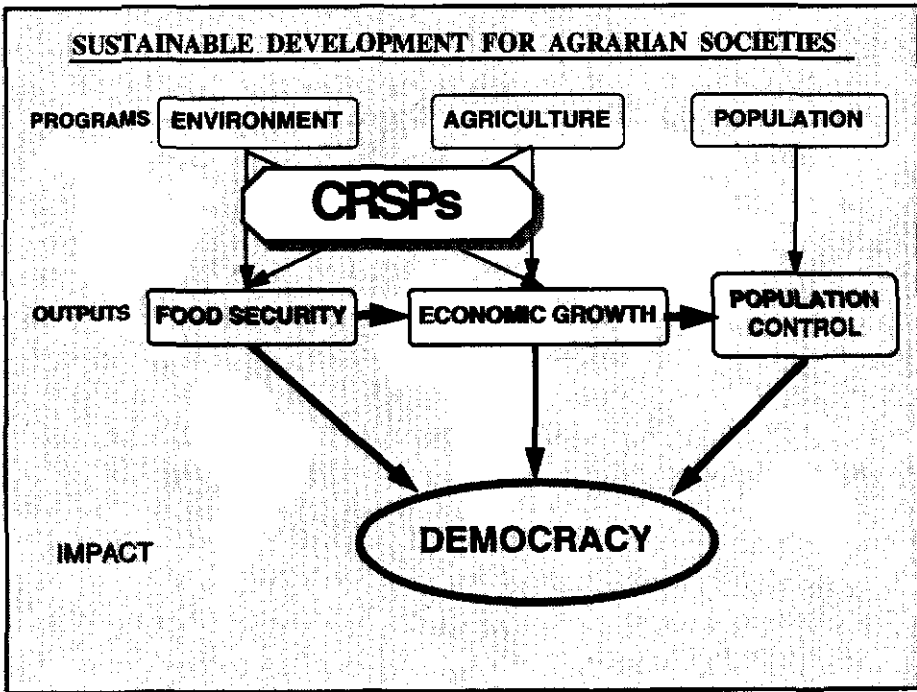
By Montague Demment
Small Ruminant CRSP Program Director

This year has been one of change. In 1995 Dr. John Lewis, the Director of the Office of Agriculture and Food Security at USAID, asked the SR-CRSP to reengineer our programs and its structure to respond to USAID's new vision. We initiated the process at Winrock in May of 1995. We convened some of the best people in the field of livestock development from US Universities, the CG system, NARS and the private sector to develop a plan for the renewal of the SR-CRSP. At that meeting we decided to take some new directions and those new directions required a broader focus on more than just small ruminants, hence the SR-CRSP will become the Global Livestock CRSP in 1998.

The reengineering proceeded at a rapid pace through the year, involving Advisory Panel meetings to set broad agendas and approve process, three regional workshops that set regional priorities, a call for Assessment Team (AT) proposals, the selection of ten ATs and one continuing team, an AT workshop at University of California, Davis and the initiation of AT field work. The details of the process I describe below, but the impact is that our CRSP is now active in Central Asia, East Africa and Latin American with sixteen US universities, six foreign universities, ten foreign research institutes, five IARCs, five NGOs, two NARs, six private sector companies, three other CRSPs and the USDA. We are taking on livestock to address economic growth, impact on the environment and the role of animal products in the development of children.

With growing concern about the environment and population, the importance of agriculture to the developing countries increases. This view is reflected in Figure 1. The assumption of this conceptual model is that for democracy to develop and be maintained, three elements must be in place. First, economic growth must provide the majority

Figure 1:



of people with the aspiration of reward for work and the security that the future is worth the work. Second, the environment and agriculture must be productive and sustainable to insure that food is available and nutritious enough for children to develop into productive adults. Third, when economic growth and food security are in place, people reduce their reproductive rates and do so faster when population control mechanisms are available to them. Economic growth, food security and reduced population growth combine to form a context for democracy.

The Collaborative Research Support Programs (CRSP) are strategically focused to address the issues of economic growth, food security and environment. The central role of agriculture in food production, the economic growth of most developing countries and the impact of production practices on the environment, place the CRSPs in a key position to have a major development impact. With a shrinking USAID portfolio in agriculture in the 1990s, the CRSPs have become a major component of the Agency's activity in agricultural research in developing countries and the major linkage between USAID and the US Land Grant University System. However, they now operate on budgets that in real terms are 40% of their original allocation 10 years ago.

TITLE XII

The CRSPs were created under the International Development and Food Assistance Act of 1975. The intent of the act was to use the resources in the US Land Grant University system to improve the US Government's efforts to bring food security to the developing countries of the world. The US Land Grant system has a proven capability to transfer the benefits of basic science to application and in doing so has been a major reason for the remarkable capabilities of US agriculture. The US Land Grant system has great scientific depth and diversity. For example, there are more soil scientists at UC Davis than in the entire CG system. The US Land Grants are deep in disciplinary expertise that not only spans the traditional agricultural sciences but also includes the social sciences, the environmental sciences, ecology, demography and human health and nutrition.

The other intent of the legislation was to have a domestic impact. By engaging US Universities in the Title XII Act the federal government was influencing the focus of university activities. The Act built an international capability that developed connections to train and focus US scientists in international issues, open new markets overseas, provide genetic material and new more global scientific insights. In a more diffuse but equally important way, the program would help develop countries that would share a common ideal of free markets, democracies, and global responsibilities. These shared values would reduce the requirements for US foreign interventions and allow all to reap the benefits of a safer global society.

GENERIC STRUCTURE AND ORGANIZATION OF THE CRSP

Advantages to the CRSP model

The CRSPs have developed two images in their 19 years of existence. The first, perhaps the more wide spread image, is that of entitlement programs. The development community, familiar with the politics that have supported the CRSPs sees them as an instrument of Congress that binds the Agency to US Land Grant Universities. This view is partially correct in fact but not in spirit. The concept of entitlement suggests an inappropriate or undeserving dependancy. In fact there is indeed a benefit to US Universities from this linkage, a fact important to congressional support of foreign assistance today. Moreover US

universities represent the world's largest and most capable assemblage of agricultural researchers and the utilization of these institutions by the US congress to address food security issues is a rationale use of the nation's resources. Much of what is done by the government has political roots, be it in environment, population or agriculture. In the truest sense, politics should reflect the collective will of the people expressed through the legislative process. That said, all programs also should incorporate mechanisms for change and renewal.

The second image is less well known and appreciated. This image is the one of a creative set of time tested structures that have evolved among the CRSPs to optimize the collaborative process between universities and NARs. This research/development model (Figure 2) links US universities through Principal Investigators (PIs), NARs and their resident scientists (RSs). The programs have research problems as their focus and traditional activities of development such as training, institution building, and technology development all flow naturally from the research theme.

The CRSP model is cost effective. Because of the PI/ RS linkage there is little need to base expatriates overseas. The cost to maintain expatriates and their families is a major expense in overseas development programs. The CRSP legislation also incorporates a requirement for the US Universities to match 25% of the USAID contribution to the grant. Furthermore, all the CRSPs have been very successful in attracting additional funds from host countries and other funding agencies. On average the CRSPs have added \$.74 for each dollar contributed by USAID and the SR-CRSP has led all other CRSPs by more than matching USAID's contribution over the life of the CRSP. This level of outside matching contribution is unprecedented in USAID programs.

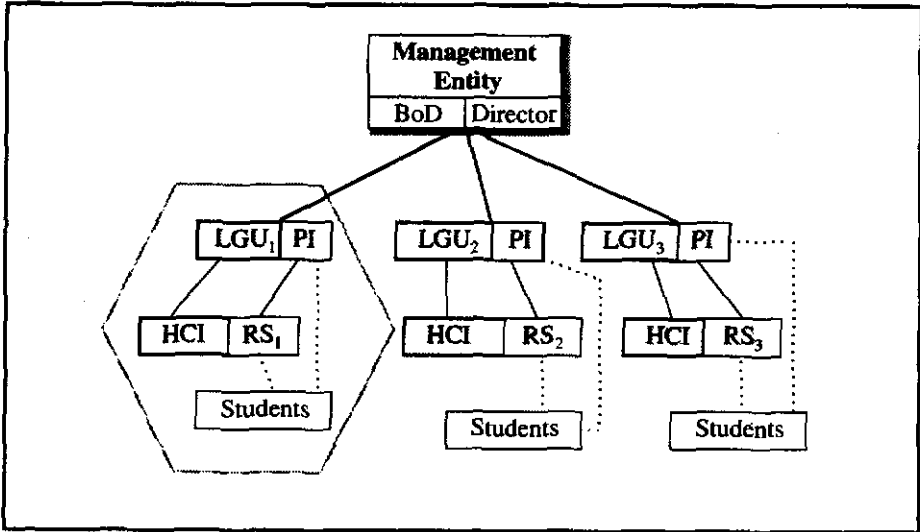
As mentioned above, the developing countries have access to the world's most powerful agricultural research institutions through the CRSPs. The quality and extent of this contact is dependent on the quantity of funding available and the effectiveness of the development mechanisms that make the connections. The CRSP mechanism is flexible, allowing constant adaptation of missions and objectives to changing research and development needs; personal, fostering close relationships between US scientists and host countries that persist and enhance the careers of both parties; and responsive, making connections between the varied

research requirements for development, host country scientists and appropriate disciplinary scientists in US universities.

The CRSP model has an innovative training role. First, it has internationalized US Land Grant institutions by providing overseas research opportunities for US students. In a culture as powerful and pervasive as America's, it is easy to spend ones entire scientific life within its boundaries and have a complete and fulfilling career. If we are to be active in global problems, solutions and markets we must have scientific participation overseas. CRSPs use what might be termed a "Peace Corps" model. US students establish a research project in the host country in the context of the program's research agenda. They must function within the country in the same way host country scientists operate. In the process they learn to conduct research in an international setting, respond to cross cultural differences and solve problems of both science and society simultaneously. In the end they are scientists ready to conduct research in other cultures, inclined to have an international perspective as teachers and educators and usually remain active collaborators on the international scene.

Second, the CRSP is a very effective training mechanism for foreign students. Most foreign students in other programs received their graduate training wholly in the US. The contacts that a graduate student makes during their graduate student tenure are some of the most important

Figure 2:



in their careers. They establish scientific networks with other researchers in their field that serve to enhance the quality of their science. Then, upon completion they are required to return to their home countries where they have few if any professional contacts. This situation places them in a major disadvantage in their community of scientists. The CRSP model allows a certain amount of course training to occur in the US, but, because the program has a research project in the host country, the students spend most of their graduate education completing their degree research in their own country. They develop and maintain the contacts with their compatriots and this network is an attractive and supportive framework to which they return at the end of their training. For this reason, CRSP programs have very high rates of return of foreign students.

The long-term nature of the CRSP programs has built strong bridges between the cooperating institutions and their scientists. Within this culture, students and young scientists benefit from the trust that has built up over time and this atmosphere allows US scientists to continue to assist and support young host country scientists as they advance through the early years of their careers.

CURRENT ENVIRONMENT

The current development environment is characterized by shrinking funding, and shifting focus and influence from the sustainable agriculture movement. The last 10 years have seen the agricultural research budget of the agency decline from about \$225M in 1985 to about \$50M presently. The funding for CRSPs have remained at about \$15-17M but the number of CRSPs has increased. In real dollars the SR-CRSP operating budget is 25% of what it was 10 years ago. While these numbers are bleak and reflect a major programmatic shift to de-emphasize agriculture within the Agency, the Administrator has made recent statements that this trend will be reversed. The reconstitution of BIFAD, with its advisory role, has assisted greatly as a voice for agriculture at USAID. I see considerable other activity in Washington to increase funding for international agriculture and a greater understanding of the importance of this sector to our own national interests.

The Clinton administration's vision for a development agenda included a strong emphasis on population control and environment. These areas

have received increased funding in USAID in the last four years. Unfortunately, while conceptually linked to agriculture, they are administratively separated. This separation means that some of the most important topics in environmental sciences and agriculture, which lie at the intersection of these fields, have institutional barriers that prevent creative approaches.

The maturing issues of sustainable agriculture have had a major impact on the field of international development. The sustainable agriculture movement has a strong base in grass roots farmer organization and, as such, has championed the view that the end customer should have a major role in setting agendas. This concept is fundamental to USAID reengineering.

Two issues were the central themes of the sustainable agriculture movement: long-term performance of systems and environmental impact. The word sustainability indicates a concern with time. Clearly one of the most important issues in agriculture is the long-term performance of agricultural systems, how we measure it and predict it. The importance of this topic for development is the introduction of the long-term concept of performance into the development context. The other issue is the elevation of the importance of environmental impact. Many of the impacts are slow, almost unnoticed, degradation in the environment that have insidious consequences for the food production system and the natural resource base. Because many of these processes occur slowly and are chronic, the joining of environmental issues and a long-term timeframe is a critical conceptual link for international agricultural development and the environmental sciences.

By raising these topics, sustainable agriculture has had other impacts on our field. The problems of environment, agricultural systems and long-term performance are all aggregated problems. They are large in time and space and therefore require interdisciplinary teams with the capacity to integrate lower level process to understand system function. Interestingly, the CRSPs have used this model for close to 20 years.

CHARACTERISTICS OF THE NEW CRSP

A series of meetings and discussions, initiated at Winrock International in May 1995, produced an agenda of change for the SR-CRSP. The new characteristics were developed in response to identified weaknesses

in the present CRSP program, to new visions for the operations of federal programs (Vice President Al Gore's National Performance Review), and to the reengineering effort at USAID. A number of issues were raised in this discussion and they were distilled into the following major characteristics:

Reduce Transaction Costs. The amount of reporting and governing bureaucracy in the CRSP were viewed by most researchers and administrators as excessive to the point where the very best scientists were not interested in participating. The mandate was to streamline operations.

Diversify Granting Mechanisms. The SR-CRSP, partly because of the nature of the program's research agenda, has used about all of its funds in major grants to lead universities. These grants and the governing structure were important in maintaining continuity but were not as responsive or open as necessary to meet new needs and recruit new scientists. Because of the nature of the CRSP research, which has involved long-term breeding projects, the grant renewal process (every five years) has not been an opportunity for major changes in direction. Now that the agenda has changed, the Winrock meeting produced a consensus that new mechanisms should be incorporated that would allow more open access to CRSP funds, provide the ability to respond rapidly to changing development issues and expand opportunities to attract young faculty into the international arena.

Effective Assessment and Problem Resolution. The reengineering approach places considerable emphasis on team building and results orientation. The initial results of the Agency's experience in reengineering is that, although planning and team building require considerable time and resources, the outcome is quite positive. The CRSP planning process was designed to devote considerably more effort to the assessment and team building stages. Moreover, a problem/results orientation was developed from the onset.

Diversify Partnerships. The clear lesson, learned from a survey of past collaborations across all CRSPs, is that collaborations that succeed are those where the partners participate in the early stages of the collaborative process. The assessment process provides an excellent entry point for the collaboration, as well as an efficient mechanism by which partners in collaboration are identified based on the problem

instead of the collaboration defining the problem. The assessment phase allows sufficient time for partnerships to be developed in the region with IARCs, NARs, NGOs and farmer organizations.

Regionalization. With the number of countries having USAID missions declining, USAID has taken a regional approach to development. Regionalization is an effective tactic as countries open markets and borders, develop regional associations in research, trade and politics, and have similar problems of environment, pastoral people, animal disease, human nutrition and policy. The regional approach was adopted also to encourage broad views of research application, a diversity of institutional contacts and a compatible match with USAID organization structure in the field.

Customer Oriented. A major emphasis of the reengineering effort has been to provide more grass roots input into the identification of research/development problems. In our planning process we attempted to have input at all levels, but gave considerable resources to middle level and grass roots. By combining regional conferences and a considerable assessment phase, input into the problems models, team formation and implementation of the project has been achieved.

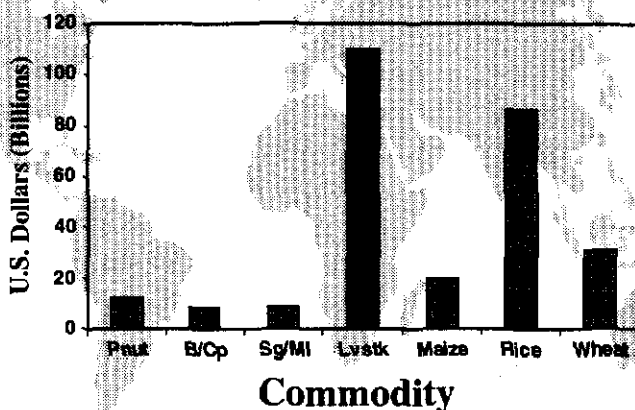
THE MAJOR RESEARCH AREAS

The meeting at Winrock and the Advisory Panel Meeting in Washington DC in October 1995 provided the input into the choice of research issues. The issues identified were economic growth, environmental impact and human nutrition. An overriding theme of inquiry, in addition to those of biology and social sciences, was to be a policy focus.

In terms of economic growth, livestock is the single largest component of agricultural GDP (Figure 3). In most of the developing countries, agriculture is the largest single sector of the economy, usually accounting for 30-70% of all revenues. Of that, livestock represents from 30-50% of agricultural GDP. Clearly if economic growth is to proceed in these agrarian based economies, even if they are to become more industrial based, agriculture must be more productive and profitable. The impact of improved economic growth from the agricultural sector has benefits beyond just profits. The security of that growth and the increases in human nutrition affect the ability of these societies to develop human capital.

Figure 3: Source, CGIAR 1992

Global Production Values of Major Commodities in LDC's

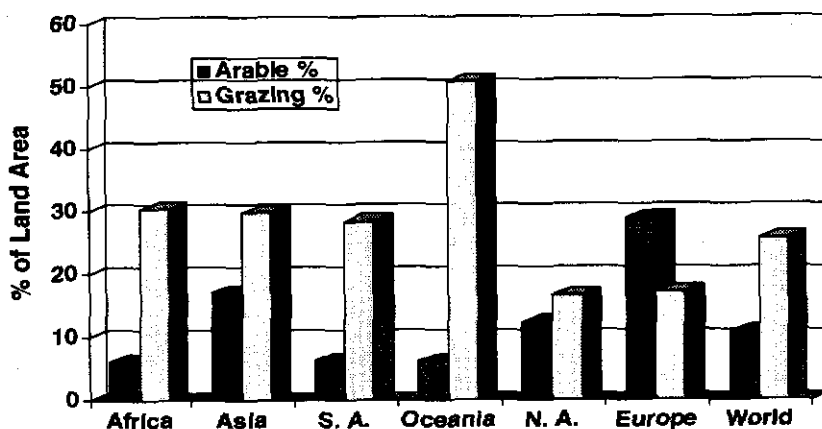


Livestock is the single greatest anthropogenic use of the land (Figure 4). While there is considerable debate about the positive and negative impacts of grazing animals, there is no question that they change the landscape and in doing so are major factors in the functioning of many of the ecosystems of the world. In Africa, for example, the competition between land for grazing and food production, on the one hand, and conservation of biodiversity and the economic importance of tourism, on the other, sit in juxtaposition in many countries. This complex relationship requires approaches that cross the traditionally strong boundaries that separate livestock and wildlife administrative and research entities.

Perhaps one of the most important and positive issues in the livestock research and development agenda is the role of animal products in child development. Animal products have a critical role to play in providing the micronutrients required by children for normal cognitive and physical development (the key points in this argument are summarized in Figure 5). The critical point is that as many as 50% of the children in sub-Saharan Africa may suffer from these deficiencies and this malnutrition has an insidious impact because it lowers the overall creative capacity of the population to develop, compete and live normal lives. In essence it takes away their ability to develop themselves. Animal products appear to be a very effective mechanism to introduce critical micronutrients into the diet, and do it in a sustainable and profitable way.

Figure 4:

Comparison of land use -1992



In the past, livestock development research, while not ignoring policy, strongly emphasized the biological and physical environment. Several authors, including Dr. Kevin Cleaver of the World Bank, have argued that the policy environment is at least as important, if not more, than the others because the implementation and adoption of technological knowledge requires an enabling policy/economic environment. For this reason, where appropriate for the problem chosen, policy study will be a component of the research agenda.

SHIFTING THE FOCUS TO LIVESTOCK

Why shift the focus from small ruminants to livestock? The broad topics chosen by the Advisory Panel represent a subtle, but important response to the changing development agenda of the Agency. The Administrators emphasis on economic growth, environment and human populations and their health is strongly reflected in the Advisory Panels selection of topics for the CRSP. The characteristics of these topics are that they are broad, taking in large scales of time and space, and highly aggregated, combining many lower level processes and disciplines. Because of these characteristics, the problems can not be considered solely from the study of small ruminants. Issues of environment, human nutrition, economic growth and policy cut across species making the appropriate research focus animal agriculture.

Figure 5:

Livestock, Nutrients & Child Development

- ◆ Shortages in calories and protein are not as serious a problem as has been assumed.
- ◆ Shortage of suite of micro-nutrients implicated in growth stunting and irreversible problems in cognition, behavioral and physical development.
- ◆ Animal products in diet are only dietary variable that predicted child development.
- ◆ Cereal diets are associated with micro-nutrient deficiencies, especially Fe.
- ◆ Children 6 - 24 months cannot meet nutritional requirements for normal development without supplementation or fortification when animal products are not in diet (WHO).

The CRSP, like many programs and agendas, within USAID is conducted at the will of the Congress. Support, direction and funding flow from Congress dependent on the perceived value of the program. Recently Congress has shifted from supporting programs for purely humanitarian reasons to those where foreign assistance has an important domestic impact. Because small ruminants are relatively unimportant in our national economy relative to other species of livestock, the CRSP is placed at a major disadvantage in this regard if it is to be judged on its domestic impact. Clearly related to this issue is the fact that the SR-CRSP was developed in the late 1970s when cattle research was strongly supported by donors. The design of the SR-CRSP was a clear attempt to differentiate the program and address other needs outside cattle research. During the 1980s cattle research support declined precipitously (and with it research activity) but is presently on the rebound, presenting an opportunity to expand into areas presently not addressed in this major livestock species.

Perhaps there is no more compelling a reason for the more general portfolio than the link between animal products and human nutrition. In development circles the emphasis of research and intervention has been through supplemental pills or plant breeding for enhanced nutrient composition. Animal products are likely to provide a very effective, efficient and sustainable way to supply some of the most important and limiting micronutrients. Yet, which animals and which products,

in which situations (economically feasible, environmentally predictable, socially acceptable) is a research question. Small ruminants will likely supply part, but not all, of the answer.

DESIGN OF THE GLOBAL LIVESTOCK CRSP

Customer Orientation

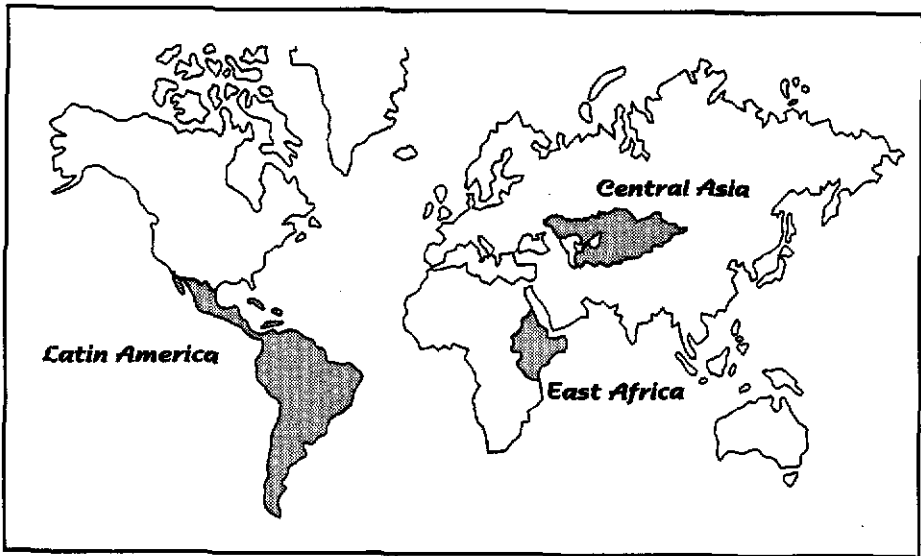
The first step in involving the customer is to identify the customers. In the CRSP we have three sets of customers: programmatic level customers, the first is the Agency itself, Congress and the domestic livestock industry; the next level are the national research institutes in the developing countries, the NARs, governmental agencies, and national universities; third are the users of the research products in the field, the farmers, households, and consumers. We planned the modification of the CRSP to have input at all three levels.

First, the Winrock and the Advisory Panel Meetings provided a forum for level one input. In this forum wide ranging discussions occurred and consensus was reached on the broad agenda that would satisfy interests of USAID, Congress, and the domestic private sector, and the University research community. This top down approach represents a planning exercise common to many CRSPs.

Second, the level one agenda served to direct the three workshops that were held in regions (Figure 6) identified as critical for CRSP participation and to allow level two participation. These workshops held in early 1996 were conducted with a regional organization as a cosponsor and regional representatives of the countries to provide a prioritized list of problems for the CRSP to address. The four day meetings developed problem models, which were analogous in form to a research model, providing a working hypothesis, a conceptual model of the processes influencing the problem, a set of activities that would be engaged in to solve the problem and a list of the institutions and individuals active in this problem in the region. In general, ten or so of these problem models were developed and they formed the basis for RFAs for Assessment Teams.

The third level of input is being addressed through the assessment process. Once the assessment teams were chosen (ten new plus one from continuing activity), they received a budget and about nine months

Figure 6: In 1996, the SR-CRSP sponsored workshops in Central Asia, East Africa and Latin America.



to work closely with their regional partners to redefine the problem model, identify new team members and provide mechanisms for grass root input. This process allows considerable activity in the region to fully explore possible linkages and garner a diversity of inputs from which to design the project before submission for the final competition in 1997.

Reduce Transaction Costs

The Management Entity (ME) is working closely with administrators at USAID to reduce the reporting load on the project scientists. The present reporting requirements for USAID are far greater than for other federal funding agencies, such as NSF (National Science Foundation) or USDA (US Department of Agriculture). Since we compete for many of the same scientists it is critical that Agency funding not be disadvantaged. Furthermore, the recent unpredictability of funding, above and beyond the macro-funding problems, have given USAID, in general, and the CRSP programs, in particular, a image of a risky place to invest scientific capital.

In an attempt to reduce management costs and remove conflicts of interest, the functions of the Board of Directors and the Technical Advisory Committee have been amalgamated in the responsibilities of

the Advisory Panel. This panel draws from all sectors of the development community (World Bank, IARCs, US Universities, NGOs, Private Sector, USAID) and provides a broad perspective about the development field while removing the inherent conflicting interests of the member institutions. The Panel will provide technical advice, as well as an organizational structure of the PIs and Resident Scientists that will be formed when the composition of the CRSP members is determined in the final proposal selection.

Diversify Granting Mechanisms

In the past, the SR-CRSP has been characterized by relatively stable research components that have been funded for long periods. This stability has been a very valuable characteristic for the small ruminant research that required considerable time for completion such as the breeding programs in Kenya and Indonesia. However with a refocusing of the program to topics with shorter time horizons, the CRSP needs to develop mechanisms that provide both continuity for long-term research and also the opportunity for attracting new participants. To achieve this goal, sub-contracts will be restructured to make the relationship between the ME and US Land Grant Institution dependent on the participation of the original PI. Grants will run for 3 years and be renewed in an open competition.

A small grants program will be instituted that will be used to respond to new issues that develop within the framework of the grant that requires scientists of new expertise and focus. These grants would also be used to attract young scientists into international work and allow the CRSP to identify capable faculty that show an aptitude for international science.

Effective Assessment and Problem Identification

The commitment of resources and time in the problem identification and assessment process is unprecedented in the CRSP. From the Advisory Panel to the regional workshops to the assessment team regional conferences, there is a demonstrated attempt to have quality input from all our customers. The problem models are the central component of the process. With research areas broadly defined by the Advisory Panel, the problem models were developed by the regional workshop participants and then modified and refined in the assessment

institutions than ever before. However the goal is not diversity for diversity's sake. The problem model and team building principles encourage the formation of meaningful collaborations. Every attempt will be made to identify and reward those ATs that successfully achieve that goal.

Regionalization

The workshops accomplished several goals related to regionalization. First, they demonstrated that the CRSP was and would be actively involved in the region. Given the recent funding history, it was important for the CRSP to be seen as an active player and a program with a viable future. Second, in Central Asia the workshop educated the participants about the CRSP and strengthened their contact with the US. Third, the workshops provided a strong message that the CRSP program would involve regional and grass roots participants. In both East Africa and Latin American where the CRSP has been active in a single country over a long period, the workshops signified the change to a regional program with projects that would be active in several countries. Workshop participants also recognized that the regional approach would be a flexible and dynamic one that would allow country focus to change as necessary with the maturity of the individual projects.

The assessment process also was a catalyst for regionalization. It provided the time required to make multiple alliances with institutions and researchers within the region. The regionalization model is conceptually simple but operationally complex. Time is a critical resource to develop each linkage and ensure that all collaborations fit with the problem model. The benefits are that ATs have a greater pool of institutions from which to choose and therefore a greater ability to select those with the greatest comparative advantage. For the region this approach has the obvious benefit of making linkages between regional centers of excellence, allowing regional connections to drive a strategy for effective institution building and strengthen the newly formed regional organizational endeavors.

GRANT RENEWAL PROCESS

The SR-CRSP will be applying to USAID for a renewal of the overall grant for the CRSP to occur in 1998. The proposal that will be submitted will represent the culmination of the assessment process, selection of

full proposals and the writing of a new proposal to USAID based on the full proposals selected. The process is presented in Figure 8. There are two mechanisms by which projects can be funded in the renewal. The first is the assessment process, described above, that has gone through the priority setting at the regional workshops, selection of assessment teams and selection of the full proposal. The second is the continuation of ongoing work, redesigned to fit the criteria of the Global Livestock CRSP.

The first process has been described in detail above. The second avenue to funding was initiated with the report of the External Evaluation Panel on continuing activities. The Kenya project was recommended for consideration. The project, focused around the CRSP/KARI breed of goat (Kenya Dual Purpose Goat), has formed an AT and received funding for those activities. They will be submitting a full proposal for the regionalization of their activities, previously focused in Kenya, and in line with the criteria for full proposals. The continuation proposal and the other AT proposals will form the pool from which the projects for the renewed CRSP will be formed.

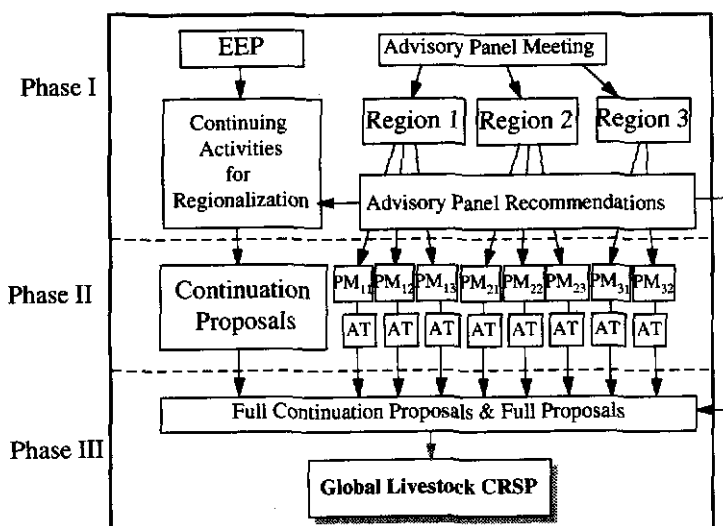
CONCLUSIONS

This year's reengineering efforts have been a stimulating and demanding experience for the CRSP team, but an essential one if the intent of Title XII is to be translated into action in the next century. We must recognize that the spirit of the Title XII legislation was a noble one: to use our best resources in agriculture to help those less fortunate in the world. Lofty goals and aspirations are often easy targets in a modern world of downsizing, "enlightened self-interest" and "trade not aid". What really gives value to what we do in the world of international development is a process that makes all people healthier, more creative, more productive and more self sufficient. Agriculture, as the food it produces and the land it uses, is the foundation of this process.

The reengineering of our CRSP has responded to a wide range of suggestions to make our work more effective and efficient: to make our impact greater and in the end address the fundamental problems of development. We hear recognition of the key problems of development residing in the root causes of chronic poverty, strife and famine but unfortunately often the lack of political will and leadership to attack those issues requiring long-term attention. One of Title XII's



Figure 8:



great contributions has been its commitment to fund programs that attack these long-term problems. It is unfortunate in the extreme that this congressional wisdom is often viewed as political pork barrel when in fact it remains one of USAID's most effective and cost efficient programs.

OVERVIEW

Workshop Objective: To identify, prioritize and describe the researchable problems of animal production of Central Asia that will be used to develop the SR-CRSP program in the region for the next five years.

In October of 1995, the Advisory Panel set forth a process for the grant extension of the Small Ruminant Collaborative Research Support Program (SR-CRSP). The renewal process, which emphasizes bottom-up inputs, places considerable importance on customer input, team building and planning. The process endorsed by the Advisory Panel closely follows reengineering principles and the new vision of AID.

In addition, the Advisory Panel identified three major themes on which the SR-CRSP program should focus in the next five years: nutrition and its implications for child development, livestock impact on the environment, and the role of policy environment to enable the economic development of the livestock sector.

The first step towards the SR-CRSP grant renewal, was the organization of regional workshops designed to identify and prioritize perceived problems and potential areas for research and development. As a forum for client input, the workshops were conceived to allow maximum opportunity for nationals of the region to present their perceptions of the issues and constraints. The problem models developed by the workshop participants will establish the potential scope of the CRSP's regional activities and form the topical basis for the renewal proposal. Using the specific problems identified at the workshops, the Management Entity of the Small Ruminant CRSP issued Requests for Proposals (RFPs) for assessment teams in June 1996. The Assessment Teams will have nine months to undertake comprehensive studies to identify the major constraints and issues associated with a specific problem. Within a year, each assessment team will prepare and submit a comprehensive proposal for review and possible funding for implementation.

The Advisory Panel recommended the SR-CRSP program concentrate in three regions of the world: East Africa, Central Asia and Latin America. In early 1996, the Management Entity of the SR-CRSP organized and sponsored three workshops in each of those regions. The

workshops were held in collaboration with a regional organization active in each region. The SR-CRSP teamed with ASARECA in East Africa, ICARDA and the Uzbek Academy of Sciences in Central Asia and IICA in Latin America. Workshop participants included representatives of the countries in the region, NGOs, NARs, IARCs, USAID, local universities and the private sector.

The workshops will play a significant role in the design and structure of the SR-CRSP extension. The workshop participants looked at problems of livestock in the region, identified major institutions involved in relevant research and established general guidelines for the Assessment Teams. The workshops were structured to provide each member country the opportunity to fully participate in the identification and prioritization of the problems that will serve as a basis for the future agenda of the SR-CRSP.

CRSP MODEL: STRUCTURE AND FUNCTION

At each workshop Dr. Montague Demment, SR-CRSP Director presented the history of the CRSPs, the advantages to the CRSP model and the SR-CRSP program goals and objectives. Details of his presentation are included in the foreword of this publication.

Advantages of the CRSP Model

Cost Effective. The CRSP model is designed to take advantage of the comparative advantage of the partners to ensure that USAID funds are leveraged to a maximal extent. The backbone of this cost efficiency is the spirit of partnership inherent in the formation of the CRSP. This partnership results in matching funds from both host country and US universities. In the SR-CRSP this funding has amounted to \$50M over the life of the CRSP and exceeded the USAID contribution over that period. This level of matching and leveraged funds is the highest among the CRSP programs and certainly represents a major efficiency for the Agency. The other benefit of the partnership relationship has been the Principal Investigator (PI) and Resident Scientist relationship. This partnership, structured to provide strong linkages between the PI in the US and the Resident Scientist in the host country, makes obsolete the need for expatriate scientists in country and hence removes major costs of housing, transport, schooling that accompany expatriate positions in host countries.

Collaboration with US Universities. The success of American agriculture is due in large part to the productive partnership created between the Land Grant Universities and the farmer. This system has connected the power of basic science with the food production systems of the nation to produce a secure, cheap and profitable food supply. The US land grant universities also represent a major resource for expertise in the sciences related to agricultural production. For example there are more soil scientists in a single major land grant university than there are in the entire CGIAR system. The opportunity to link with such a rich system of scientific expertise provides NARS with a diversity of potential contacts that they can not achieve within their own countries. These linkages can be particularly productive as the ability to communicate quickly and cheaply become increasingly available.

Internationalization of US Scientists and Host Country Training. The power of the US culture and economy can be a force that isolates and limits the international perspective of its scientists. Because of the ease with which scientists can focus on domestic problems, it is essential to create mechanisms to expose developing US scientists to the international scene. This is especially true in the age of globalization. We need to develop a strong cohort of internationally focused scientists to make the international linkages that are the basis of intellectual and technologies exchange in the emerging markets. The training provided to US students through the CRSP does just this. The CRSP has also been a highly effective training mechanism for host country students.

Long Term Collaborations. The long-term nature of the CRSP programs has built strong ties between the cooperating institutions and their scientists. The relationships built during the program are a major link that provides stability to institutions and individual scientists that fosters creativity and accomplishment.

COUNTRY PRESENTATIONS

At each regional workshop, country representatives were asked to present a paper on the constraints of livestock production in their respective countries as well as identify potential collaborators. The presentations began with a look at the livestock production systems of the respective countries and the policies governing the use of land in the country. Representatives described the structure and interaction

between the institutional components playing a role in the development of policy, information and extension in the livestock sector. Linkages and reporting responsibilities of the national and regional institutions were also indicated. Data on the number of scientists in relevant fields to livestock was provided for each of the research institutions. Discussion time was allotted following each presentation.

Resource Presentations

In addition to the country representatives, resource people were invited to represent the thematic subjects. Presentation topics included Policy, Human Nutrition, Wildlife/Livestock interactions, Livestock/Environment, Livestock Production Systems, Impact of Decollectivization and NGOs.

Priorities

Thematic working groups were charged with the task of producing a set of prioritized constraints related to livestock production that are the assessment and description of the underlying processes responsible or connected to the identified problem model in their theme. Themes included: Human Nutrition, Economic Growth, Policy, and Livestock/Environment. The groups were further given the responsibility to identify and characterize potential partners for US Land Grant Universities with the capabilities of addressing the problem model. At the conclusion of the workshop, participants ranked the priority topics with the SR-CRSP goals and objectives in mind.

INTRODUCTION

In collaboration with the International Center for Agricultural Research in Dry Areas (ICARDA), the Small Ruminant CRSP sponsored the Central Asian Regional Livestock Assessment Workshop February 27 – March 1, 1996, in Tashkent, Uzbekistan. Five countries of Central Asia were represented at the workshop: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

THEMATIC GROUPS

Two workgroups were formed around the following themes: Livestock/Environment and Economic Growth. The stated goals for the thematic workgroups were:

- To produce a set of prioritized constraints (problem models) related to livestock production that is the assessment and description of the underlying processes responsible or connected to the identified problem model in each theme.
- Identify and characterize potential partners for US Land Grant Universities with the capabilities of addressing the problem model.

The results of the group discussions are presented below.

PROBLEM MODELS

PRIORITY RESEARCH TOPICS

Economic Growth/Policy Group

1. Decollectivization: what must be learned and preserved
2. Studies of household level changes in livestock management
3. Analyses of the institutional environment for livestock development
4. Feed and animal resource balances in Central Asia: Past, Present and Future, To the year 2025
5. Adaptation of livestock production to new economic conditions
6. Recapitalization of livestock farmers
7. Best practices in the restructuring of livestock-support services

8. Methods to alleviate the negative impacts of transition by provision of social services to livestock producers
9. Options for rangeland tenure under decollectivization

Livestock/Environment Group

1. Development of Sustainable Rangeland Management Systems Suited to the Changing Economic and Private Environment
2. Strategies to Reduce Desertification and Develop Vegetation Improvement of Degraded Rangelands
3. Cattle Production Systems
4. Small Ruminant Production Systems
5. Development of Methods to Characterize and Monitor Rangeland Condition Using Remote Sensing, GIS and Modeling
6. Conservation and Evaluation of Locally Adapted Species of Animals of Central Asia
7. Emerging Animal Health Problems in the Changing Economic Environment
8. Processing, Quality Control and Marketing of Livestock Products
9. Intensification and Optimization of Fodder Crop Production on Irrigated Land

PRIORITY TOPICS FOR RESEARCH IN LIVESTOCK AND ENVIRONMENT

(1) Development of sustainable rangeland management systems suited to the changing economic and private environment

Objectives: The arid regions of Central Asia have a wide variety of climatic and rangeland types and effective technologies to preserve these rangelands should be based on sound ecological principals.

During the period of transition to a market economy, pasture management and water supply systems as well as economic and social conditions are changing. This may result in a need to alter the structure of farming systems. Research is therefore urgently needed which takes

these factors into account to design alternative farming and pastoral systems.

Activities:

- Studying and evaluation of ecological (climate, soil, plants) conditions in different regions of Central Asia.
- Studying of water availability on the rangelands: a. artesian wells, b. wells for stock water supplies, c. water delivery, d. domestic water.
- Optional regimes of usage and different types of property (private farmers, cooperatives, collective and state farms, farmers associations, etc.)
 - Moderate use with rangeland rotation system
 - Intensive use with rangeland rotation system
 - Transhumant system.
- Solving the problem of determining the optimal balance and intensive and extensive sheep production.

Outputs:

- Advantages of different and appropriate rangelands management system demonstrated.
- A 10% improvement in rangeland and animal production compared to present grazing systems.
- Appropriate range management systems identified.
- Improved quality of pasture forage in terms of botanical composition, including the introduction of forage crops.
- Recommended extensive sheep husbandry practices for different economic and ecological environments.

Actors:

- Kazak Research Institute of Karakul Sheep Breeding
- Uzbek Research Institute of Karakul Sheep Breeding
- Turkmen Research Institute of Animal Husbandry and Veterinary Studies
- Turkmen Institute of Deserts
- Kyrgyz Research Institute of Forage and Pasture
- Tadjik Institute of Animal Husbandry

(2) Strategies to reduce desertification and develop vegetation improvement of degraded rangelands

Objectives: Anthropogenic influences may have a marked effect on arid lands and in the new economic environment rangelands and pastures may have lost their self-regulating capacities. The extreme desert conditions of Central Asia demand appropriate methods for effectively using the limited pasture resources without disturbing the ecosystem.

There is a need to design new pasture-based systems that will tolerate more intensive use without degradation under the difficult ecological conditions. Rainfed pastures can provide cheaper feed without the associated risk of secondary salinity. Previous experiments have shown that sown pastures of appropriate species under rainfed conditions can yield several times more than native pastures.

Activities:

- Studies and collection missions to areas of Central Asia, to collect seeds of potentially productive and useful forage species and to evaluate and multiply them for further use in various ecological zones.
- Studies of the capabilities and adaptation of new forage species, introduction of nurseries and creation of germplasm banks of forage crops.
- Developing technologies for forage crop production in Central Asia.
- Producing higher yielding cultivars of forage crops.
- Developing methods to combat desertification.

Outputs:

- Germplasm collections of forage crop and range species established. (This material will provide the basis to improve forage production in the region and other similar ecosystems of the world.)
- Optimal seeding and cultivation techniques developed for range species.

Actors:

- Kazak Research Institute of Karakul Sheep Breeding
- Uzbek Research Institute of Karakul Sheep Breeding
- Uzbek Institute of Forestry
- Complex Institute of Regional Problems of Samarkand (Branch of Uzbek Academy of Sciences)
- Botany Institute (Uzbek Academy of Sciences)
- Kyrgyz Scientific-Production Association of Forage, Pastures and Range Improvement
- Turkmen Institute of Deserts
- Turkmen Research Institute of Animal Husbandry and Veterinary Studies

(3) Cattle production systems

Objectives: During the transition period to a market economy there are different forms of farming- state farms, collective farms, joint-stock company farms and small private farming. The production and processing of livestock products, breeding, reproduction and feeding systems which were developed for large state livestock complexes may no longer be appropriate for use on small private farms and emerging systems. Thus, it is important to develop new technologies suitable for these new farming systems.

Activities:

- Conduct surveys to describe and analyze the present production systems and to identify constraints to milk and meat production.
- Describe and analyze the production characteristics of local breeds and develop appropriate breeding programs.
- Adapt the systems of production and processing of meat and milk to the new conditions.
- Evaluate the conditions, technology and potential improvement of animal husbandry (barn, shelter, etc...).
- Evaluate and adapt established methods of feeding to provide a mechanism for optimal feed use and optimal production.
- Assess the impact of farm ownership on farm mechanization.

Outputs:

- Production systems appropriate to the new economic environment.
- Prioritized list of constraints arising from the systems analysis.
- A standardized regional feed rationing system suitable for the new intensive production systems.
- More efficient food production systems.
- Recommendations about farm ownership policy appropriate to the new economic environment.
- Suitable forage production and utilization systems.

Actors:

- Uzbek Research Institute of Animal Husbandry
- Kazak Research Institute of Animal Husbandry
- Tadjik Research Institute of Animal Husbandry
- Kyrgyz Research Institute of Animal Husbandry
- Turkmen Research Institute of Animal Husbandry and Veterinary Studies

(4) Small ruminant production systems

Objectives: Sheep production is one important branch of the livestock industry in the Central Asian countries. Breeding of Karakul sheep is an important agricultural sector, with an annual production of about 300,000 tons of milk which is used to produce brinza cheese. This sector also produces 3-4 million units of rennet, 800-850 tons of fermented products such as yogurt, and 3-3.5 million Karakul pelts. During the last 5-6 years sheep wool and meat production decreased by 15-25% and the quality of Karakul pelts deteriorated. The changing farming environment requires the development of new diversified systems of small ruminant production.

Activities:

- Collection of climate, soil and vegetation characteristics of representative rangeland types.
- Collection and analysis of representative satellite images covering cropping and rangeland zones of the Central Asian Republics at five years intervals.

- Development and adaptation of deciphering methods for remote sensing information on rangelands.
- Construction of models and algorithms to estimate moisture stress and above ground biomass of range and croplands using remote sensing data and related information collected on representative polygons.
- Development of remote sensing methods to estimate the spread and degree of desertification and soil degradation (including variation of humus content) on rangelands.
- Developing a regional rangeland GIS to integrate soil, vegetation and climate data and to estimate rangeland conditions and the productivity.

Outputs:

- Methods of deciphering remote sensing information on rangelands.
- Models relating pasture biomass and productivity to spectral vegetation indices and relevant environmental parameters.
- Construction of electronic and hardcopy maps of phytomass productivity and desertification of rangelands.
- Characterization of long-term trends of land use and desertification.

Actors:

- Kazak research Institute of Karakul Breeding
- Turkmen Institute of Deserts
- Institute of Space Exploration (Kazak Academy of Sciences)

(6) Conservation and evaluation of locally adapted species of animals of Central Asia

Objectives: Central Asia is the center of origin of many animal breeds which are well adapted to the local climatic, pastoral and feed conditions. These breeds include the Shviuezebuvidny cattle population, the Altauzskaya and Bushuevskaya breeds of cattle, the Karakulskaya, Saradjinskaya, Alayskaya, Gissarskaya and other breeds of sheep and the Arvana breed of camel. Introduced (exotic) breeds are potentially more productive than these indigenous breeds although clearly less adapted to local conditions. For this reason it is necessary to design

new management systems for local breeds and to increase productivity by studying their genetics and feed requirements.

Activities:

- Characterize and evaluate local breeds of farm animals.
- Determine their role in new livestock systems.
- Assess the size and structure of the local breeds and races and their regional distribution.
- Develop (and test) effective genetic methods to improve the productivity of cattle.
- Study the useful biological specificity of meat breeds (adaptation to native vegetation, forage and disease environment).
- Develop recommendations for the improvement of elite races (populations).

Outputs:

- Better *in situ* conservation of local breeds (races, populations) of farm animals.
- Elite (nucleus) flocks created (which conserve and improve farm animals under various environments for the benefit of private and government farms).
- Better genotypes from nucleus flocks distributed to improve productivity of local flocks.

Actors:

- Uzbek Research Institute of Animal Husbandry
- Uzbek Research Institute of Karakul Sheep Breeding
- Kazak Research Institute of Karakul Sheep Breeding
- Kyrgyz Research Institute of Animal Husbandry
- Turkmen Research Institute of Animal Husbandry and Veterinary Studies
- Tadjik Research Institute of Animal Husbandry
- Kazak Research Institute of Animal Husbandry

(7) Emerging animal health problems in the changing economic environment

Objectives: Intensification of livestock production systems requires reliable protection against infectious, invasive and non-infectious

diseases and the privatization of state farms is resulting in many small private farms with flocks of 30-100 small ruminants. This is leading to a change in the prevalence of different diseases, particularly a reduction in the number of infectious diseases (*Salmonellosis*, *Pasteurellosis*, *Colibacteriosis*) and an increase in some non-infectious diseases such as helminth parasites. It is important to understand the reasons for this change to enable better prediction possible epizootics and better planning of control measures. Furthermore, the need to develop new veterinary services to serve the small private farms is evident due to the increasing importance of this sector.

The domestic production and supply of veterinary medicines made from local materials (microbial preparations, feed additives, macro- and micro-elements) is one of the main challenges facing the livestock industry. Another is the need to study zoonoses (*Brucellosis*, *Echinococcosis*) and the development of prophylactic control measures.

Activities:

- Study the epizootiology of infectious, non-infectious and invasive diseases affecting animals kept under new management conditions.
- Study the seasonal prevalence of diseases, including zoonoses, determine the mechanisms which spread them and the economic losses they cause.
- Study the effectiveness of new and improved veterinary preparations, including those made from local strains of pathogens, raw materials and phyto-preparations.
- Develop effective health control programs and veterinary services suited to the conditions of management on small private farms.

Outputs:

- a better understanding of the epizootiology of diseases of animals kept under new management systems, the seasonal prevalence of different diseases including zoonoses, the factors causing the spread of the diseases, and the economic costs of the disease.
- effective veterinary preparations, including those made from local strains of pathogens, raw materials and phyto-preparations.
- effective health programs and veterinary services appropriate for the new conditions of management on small farms.

Actors:

- Uzbek Research Institute of Veterinary Studies
- Turkmen Research Institute of Animal Husbandry and Veterinary Studies
- Kazak Research Institute of Animal Husbandry and Veterinary Studies
- Tadjik Research Institute of Veterinary Studies
- Kyrgyz Research Institute of Veterinary Studies
- Samarkand Agricultural Institute

(8) Processing, quality control and marketing of livestock products

Objectives: It is important to increase sheep production and improve the quality of processing and product conservation in all regions of Central Asia. Privatization of farms is also important. For these reasons the processing of sheep products - meat, wool and karakul pelts - is an important question in the emerging farming systems. It is therefore necessary to carry out research to create new processing and preservation technologies which are adapted to these new farming systems.

Activities:

- Assess technologies for processing and storing of livestock products while taking into consideration the different forms of ownership and regional ecological conditions.
- Define basic parameters for defining ecologically safe and clean livestock products.

Outputs:

- Constraints to the processing and storing livestock products.
- Quality standards for the main livestock products.
- Appropriate technologies for processing of livestock products adapted to new the conditions of ownership and regional specificity.

Actors:

- Uzbek Research Institute of Animal Husbandry
- Uzbek Agrarian University

- Uzbek Research Institute of Karakul Production
- Kazak Research Institute of Karakul Production
- Kyrgyz Research Institute of Animal Husbandry
- Uzbek Research Institute of Veterinary Studies
- Turkmen Research Institute of Animal Husbandry and Veterinary Studies

(9) Intensification and optimization of fodder crop production on irrigated land

Objectives: Rational use of irrigated lands to produce fodder in the Central Asian Republics has considerable importance. Indeed, with appropriate use of water and soil resources, two-to-three crops can be harvested each year to provide livestock with different kinds of fodder. Research is needed to study ways to produce high yielding and nutritious fodder crops that use suitable management systems and make optimal use of the limited water resources.

Activities:

Determine the contribution and the optimal proportion of different irrigated crops in the rotations of Central Asia.

Establish the most effective combination of main, replicate(?) and intermediate irrigated fodder crops which achieve the highest output.

Determine the different agroecological zones where highly productive and early maturing varieties of irrigated fodder crops can be grown in the main crop rotations, replicates and intermediate planting.

Outputs:

- Irrigated fodder crops in rotations which augment productivity and production levels.
- High yielding and early maturing varieties of irrigated fodder crops for the different regions of Central Asia.

Actors:

- Uzbek Research Institute of Animal Husbandry
- Kazak Research Institute of Karakul Production
- Turkmen Institute of Agriculture

- Kyrgyz Scientific-Production Association of Forage, Pastures and Range Improvement
- Kyrgyz Research Institute of Agriculture
- Kazak Research Institute of Forage and Pastures
- Uzbek Research Institute of Cotton Production
- Agrofirma "ERKIN"

PRIORITY TOPICS FOR RESEARCH IN POLICY AND ECONOMIC DEVELOPMENT

Introduction: Population growth is rapid in the Central Asian republics: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Compared with a total of 54 M people in 1990, the region will be the home of a projected 92 M by the year 2025 (World Bank, 1993).

Permanent pastures (rangelands) account for the largest share of the land surface in the region, totaling about 260 million hectares (FAO, 1995). This is comparable with the total area of 272 million hectares of steppe land (100 - 400 mm rainfall) in all of West Asia and North Africa. Irrigated farming in Central Asia covers some 9.4 million hectares and is a major source of feed in the form of crop residues and by-products.

Livestock inventory statistics (FAO, 1995) can be aggregated into Livestock Units (LU = 500 kg bovine at maintenance). Small ruminants are prominent in all five republics. The aggregate number of Livestock Units of Central Asia in the early nineties was about 25 million, compared with about 21 million in the late seventies. Increases in the intervening years and recent sharp reductions in livestock inventories since the collapse of the Soviet Union are hidden in this comparison, however.

There are many points where human capital (including policies and institutions) need strengthening in Central Asia: rangeland tenure and private farm-level development need attention; where pastoralists and farmers are insecure tenants, they cannot be expected to take a long-run view of sustaining the natural resources they use. Large economic gains appear feasible also through devolving property rights and decision taking from state bodies to individual farmers or well organized small groups. These questions deserve strategic research support.

Nine research titles on policy and economic development of livestock production in Central Asia are proposed here. The proposals are defined in two main lines.

The first line is evaluation of the current situation and a 'stock-taking' of the emerging dynamics of livestock production in the region: lessons from decollectivization, household livestock management, the institutional environment and the balances of livestock, feed and food resources (past and future).

The second line of proposals are for optimization of future development paths: adapting livestock production to the new economic conditions, recapitalization of livestock farms, restructuring of livestock support services, and provision of social support services to livestock producers.

A. EMERGING DYNAMICS (positive analysis: 'taking stock')

(1) Decollectivization: what must be learned and preserved

Objectives: To summarize lessons from experiences in decollectivization of livestock operations in various countries in and beyond central Asia, showing the conditions and consequences of the various options for different farm structures and production systems.

To identify the 'public goods' aspects of collective and public livestock organizations that may be lost in privatization; of particular interest is preservation of high quality genetic stock (both animal and plant).

Hypothesis: Radical privatization may cause the loss of irreplaceable genetic material and important public services, as well as causing unnecessary losses and human suffering. Lessons can be learned from a study of various decollectivization processes, and their contexts and consequences, both within and outside the Central Asian Republics. A summary and analysis of these experiences will enable the most important lessons to be taken into account in any new decollectivization.

Activities:

- Review of literature on decollectivization of livestock and land, particularly rangeland;

- Case studies of contrasting examples of decollectivization in the five Central Asian Republics by survey of experiences in privatization of farms and farm services in general, and livestock farms and services in particular. Special attention will be given to organizational aspects, social aspects and preservation of valuable genetic stock and other production factors;
- Cross-case analysis of decollectivization experiences based on key attributes, contexts and consequences, to draw out the most important lessons;

Outputs: Publication of a report in Russian and English by-mid 1998.

Relevance: There is great concern and confusion regarding the privatization process, This study aims to provide information to policy makers, farm leaders and the general public regarding experiences and options in the process of decollectivization.

Actors: The studies will be designed by multidisciplinary teams of livestock scientists, social scientists and pasture/forage specialists, with advice and participation of international scientists.

(2) Studies of household-level changes in livestock management

Objectives: To rapidly obtain information on the changes on private and collective farms during the transition period.

To develop methods for continuous monitoring of livestock development

Hypotheses: The previous farm data collection systems are breaking down, as they depended on state and collective farm reporting. There is great need for solid information on what is happening in the sector, as governments should base their decisions on sound data. Therefore, there is good reason to initiate an immediate program of participative rapid rural appraisals, and use this experience to develop a large-scale farm data collection system.

Activities: Design and carry out a set of participative appraisals. Use the experience and the findings to develop long-term monitoring system. There will be a series of short, informal studies of different types of livestock-owning communities and families. A representative sample will include different ecological zones in each participating country. Standard

Participative Rural Appraisal (PRA) techniques will be used, and training on these techniques will be provided to the design and data collection teams. At a later stage these studies will form the basis for designing large-scale statistical surveys, to monitor changes at the household level.

Outputs: Analyses of livestock management practices in different ecological zones. Description and analysis of management strategies currently employed by different kinds of livestock producers.

Relevance: Such data, not currently available, are essential for informed government planning and design of livestock improvement projects.

Actors: The studies will be designed by multidisciplinary teams of livestock scientists, social scientists and pasture/forage specialists, with advice and participation of international scientists. The field data collection and participative studies will be carried out by junior scientists working together with regional and district specialists. Rural producers will participate in the studies.

(3) Analyses of the institutional environment for livestock development

Objectives: To identify the main policy instruments which assist or hinder development in the livestock sector.

To understand and strengthen the institutional links between research and policy-making.

Hypothesis: The governments of Central Asia have a number of mechanisms which can be applied to influence the direction of livestock development in the process of transition. Such mechanisms include:

- subsidies on inputs(water, veterinary drugs, fodder, etc).
- tariffs on livestock product exports.
- protection of domestic livestock processing industries.
- trading regulation on livestock products.
- domestic pricing policies on livestock products.
- state and private investment for infrastructure related to the livestock sector.

Activities: An examination of each country's laws and regulation which directly or indirectly effect livestock production and marketing. Comparisons will be drawn with other countries where similar ecological and economic conditions prevail.

Outputs: Recommendations for changes in national laws and policies which promote the livestock sector. Presentation of various options for development of the sector, drawing out economic, social and environmental costs and benefits of each option.

Actors: An international team of policy analysts, with expertise in both intensive and extensive livestock sectors, working together with senior Central Asian scientists in pasture and livestock and with senior economic policy advisors in the national governments.

***(4) Feed and animal resource balances in Central Asia:
past present and future, to the year 2025***

Objectives: To provide a picture of past and present balances of livestock inventories and feed resources, including rangelands, crop residues and forage crops, and feed grains and other concentrates.

To provide a picture of food production balances, and the role of livestock products in human diets in the region.

To project the effects of human population growth to the year 2025 on feed and food demand in the Central Asian republics.

Hypothesis: Heterogeneous natural resource bases among the five Central Asian republics lead to differentiation in crop/livestock/range systems, differences in food production for the growing human populations. An assessment of these relationships will help in focusing research and development support.

Activities:

- Study the development over time (early '70s, late '80s and early '90s) of country-by-country inventories of feed resources from cropland, rangelands and agro-industrial by-products in Central Asia;

- Study the development of livestock numbers, country-by-country, for the same periods;
- Study the production of all foods and their relationships with livestock production;
- Study the balances of feed, livestock and food for past, present and future periods (to 2025) in light of past and projected human population growths.

Outputs: A report in Russian and English by mid-1998.

Relevance: This study is needed to show livestock production in perspective with the natural resource bases and human populations of the Central Asian republics, enabling objective assessments of the relative importance of the different elements of agricultural production in the planning and focusing of livestock research and development.

Actors: This work would be lead by ICARDA but can only be completed satisfactorily with the direct participation of experts on the feed and food situations in each of the Central Asian Republics.

B. OPTIMIZATION (normative analysis: how to go in the future)

(5) Adaptation of livestock production to new economic conditions

Objective: To elaborate suitable methods for constrained optimization of individual farm management (size, enterprise mixes, market focus), illustrated with case studies under contrasting conditions; in support of privatization ('firmerization') of livestock production that is more efficient, equitable and environmentally sustainable than centralized production.

Hypothesis: Each particular physical environment, location with respect to markets (for livestock inputs and outputs), and each farm household (labor and capital and risk preference) condition may have a different optimal farm plan; therefore, farmers need a choice of visible options to choose among, not blanket recommendations.

Activities:

- Elaboration and illustration of multiple goal optimization methods, using contrasting case studies of livestock farmers;

- Development and illustration of methods for calculating comparative advantages;
- To identify examples and best principles of farmers' organizations (for input supply, credit, marketing);
- Development and illustration of methods for on-farm trials, to test and demonstrate animal health, nutrition, reproductive and financial management by small farmers.

Outputs: Training of NARS staff of Central Asia and joint publications in Russian and English on:

- multiple goal optimization methods, using contrasting case studies of livestock farmers;
- methods for calculating comparative advantages with respect to local, regional and world markets;
- best principles of farmers' organizations (for input supply, credit, marketing);
- methods for on-farm trials, to test and demonstrate animal health, nutrition, reproductive and financial management by small farmers.

Relevance: Guidelines for small private farmers is lacking and very much needed. The research outputs here, will provide part of the basis for developing location-specific extension material for farmers.

Actors: An international team of agricultural economists, with expertise in both intensive and extensive livestock sectors, working together with senior Central Asian scientists in pasture and livestock and with senior economic policy advisers in the national governments.

(6) Recapitalization of livestock farmers

Objectives: To find practical options for the recapitalization of livestock farms, and related services.

Hypothesis: The financing of new small farms with livestock enterprises is a crucial area of need which, if not ameliorated, could retard rural development in Central Asia.

Activities: Studies of practical options for provision of credit to small farmers.

Outputs: Guidelines for practical steps in recapitalization of livestock farms in Central Asia, published in Russian and English by mid-1998.

Relevance: Credit for long-term financing of capital equipment, facilities and livestock, as well as shorter term credit for purchase of key inputs, is often lacking and is a reason for underemployment of land, labor and management resources for livestock production in Central Asia.

Actors: An international team of agricultural economists, with expertise in both intensive and extensive livestock sectors, working together with senior Central Asian scientists in pasture and livestock and with senior economic policy advisors in the national governments.

(7) Best practices in the restructuring of livestock-support services

Objective: To study various options and develop policy recommendations and best practices for the restructuring of livestock farm support services, including animal health services, input supply, small and large scale processing and marketing of livestock products.

Hypotheses: With decollectivization, a lack of support services to livestock production is hindering development of the sector.

Activities: An appraisal of the 'public good' and market prospects for provision of livestock support services will be carried out in Central Asia. Practical options will be explored and the missing elements for bringing these into operation will be identified.

Outputs: An analysis of practical options for development of economically viable livestock support services, published in Russian and English by mid 1998.

Relevance: Support services provide the bridge between subsistence and market oriented livestock production, lowering transaction costs and increasing efficiency of resource use.

Actors: An international team of agricultural economists, with expertise in both intensive and extensive livestock sectors, working together with senior Central Asian scientists in pasture and livestock and with senior economic policy advisors in the national governments.

***(8) Methods to alleviate the negative impacts of transition
by provision of social services to livestock producers***

Objectives: To determine the most cost-effective way of providing essential social services to remote shepherding families in the extensive livestock areas.

Hypothesis: Decollectivization has caused a breakdown in the provision of both social as well as technical services to families in the livestock sector. Such services include health, sanitation, schooling, water, power, public records and security. These services were provided through the state to large collectives, but as some Central Asian republics move towards privatization, these services are not being maintained. As yet, these services have not been replaced. One result is that families, especially in remote grazing areas, may abandon livestock-keeping, and migrate to town in search of alternative employment. Another result is a decline in animal production. Both results are negative, at least in the short term.

Activities: Review the experiences of other countries in providing cost-effective social services to low-density populations of mobile livestock-keepers. Evaluate whether producers in Central Asia could afford to pay for these services, and at what level of payment. Identify possible sources of social service provision in the private sector, and what would be required for these to be activated (e.g. financial credit and training). Examine the possibility of encouraging producer associations which could receive and international assistance in providing services to their members.

Outputs: Recommendations on how to improve social and to the livestock sector. The roles of the state, regional administration, producer associations and the private sector to be specified. Identification of the needs for credit and personnel to implement the recommendations.

Actors: An international specialist in participative rural development (working with producer associations), an international economist with experience in costing social services, national economists and regional planners from the Central Asian republics, and livestock producers.

(9) Options for rangeland tenure under decollectivization

Objectives: Review the current laws and practices in each participating Central Asian republic, regarding access rights for livestock and their owners on different types of rangelands.

Identify and assess the options for rangeland use as decollectivization proceeds in each country. This will include comparison with other countries.

Hypothesis: Some current systems of livestock husbandry are no longer economically viable with the reduction of state support for fodder. Other systems are also thought to be environmentally damaging causing soil degradation and loss of biodiversity due to overuse of pastures especially those nearer to settlements. As the large-scale collectives are broken up, new patterns of rangeland use are being adopted by newly privatized livestock owners. Which methods of rangeland use should be encouraged by the state is not at present clear. Further field research and comparative analysis is required.

Activities: Carry out empirical studies of rangeland uses being adopted by different types of livestock producers undergoing decollectivization. Studies are to be carried out in various agro-ecological and climatic zones. Each use is to be assessed in terms of economic returns, social impacts, sustainability and environmental consequences. New concepts and methods of semi-arid rangeland assessment developed in Europe, Australia, North America and South Africa will be applied in these assessments.

Outputs: Recommendations on the options for rangeland regulation, access and management which can be considered by national and regional administrations, and groups of livestock producers. The recommendations will be accompanied by estimates of costs and benefits for each option.

Actors: International biological and social scientists with an understanding of new models of rangeland ecology, to work together with senior pasture and livestock specialists in Central Asia in designing a set of field studies. These studies to be carried out by junior scientists in participation with regional and district officials, with the participation of livestock producers.

OPENING REMARK TO THE CENTRAL ASIAN ANIMAL PRODUCTION REGIONAL ASSESSMENT (SR-CRSP / ICARDA)

by G. Gintzburger

Program Leader, Pasture, Forage and Livestock, ICARDA

His Excellency, Mr. Jumaniyozov, Minister for Agriculture,
Acad. Usmanov, President, Uzbek Academy of Agricultural Sciences
Acad. Khuzanov, Vice-President, Uzbek Academy of Agricultural
Sciences

Dr. M. Demment, Program Director SR-CRSP
Colleagues from the Central Asian Republics,

Ladies and Gentlemen,

It is a pleasure for me to be again in Tashkent.

GREETINGS

As an ICARDA representative, I would like to convey to this assembly the greetings and the best wishes of success from our Director General, Dr. Adel El-Beltagy, from Dr. R. H. Booth, Assistant Director General (International Cooperation) and Dr. M. Saxena, our Research Coordinator. They were here in Tashkent last December. I can assure you that they greatly appreciated your hospitality and your eagerness to collaborate.

ICARDA FUTURE STRATEGY

Action has been since taken by ICARDA to develop a collaborative program on seed production of cereal and legumes. But ICARDA interest is not only for crops related activities. I must remind you about ICARDA's commitment to biodiversity and natural resources conservation. Natural resources conservation is often at risk with agriculture intensification, especially when countries want to attain self-sufficiency in grain and meat and other essential commodities. These issues are going to be on the forefront of ICARDA's future strategy as well as for public policy questions in collaboration with IFPRI, another institute from the CG System. We, at ICARDA, have established strong links and collaboration with the National Agricultural Systems

of North Africa and West Asia. With the CGIAR support, ICARDA's attention is now directed towards the Central Asian Republics.

WHY THE CENTRAL ASIAN REPUBLICS?

We are all aware and, myself, as a range scientist more than others, have been long aware of the scientific achievements of our colleagues from the different institutes dealing with rangelands and desert from the *Central Asian Steppe*.

The vast steppe areas of the Central Asian Republics devoted to livestock industries and especially to small ruminants are essential to ICARDA and to the Pasture, Forage and Livestock Program (PFLP). PFLP scientists built their activities on the small ruminants productions systems of the *Mediterranean zone*. We recognize the importance of small ruminants, herdsman and pastoralists in linking the rainfed farming systems and the Rangelands. We are aware of the communality of agricultural problems and ecology between WANA and the Central Asian Republics. We know also that some of you have worked in the countries of WANA, in Algeria and in Libya for example, as your leaders had at one stage recognized similarities between the ecology.

SHARING KNOWLEDGE AND EXPERIENCE

You certainly have the experience of managing agricultural systems in low rainfall zones; you have the experience of managing pastoral systems and communities in these environments. You have experienced the devastating effect of uncontrolled agricultural practices in Steppe country. You have the experience of range rehabilitation practices. So do we. This is why ICARDA and PFLP are keen to exchange and collaborate with you. Let us share our knowledge and experience and broaden our horizon.

I would like to recognize here the golden opportunity which was offered to ICARDA by the Small Ruminant CRSP to run this joint meeting with you here in Tashkent. Thanks to Dr. Demment.

To conclude, Ladies and Gentlemen, we are certainly here to learn. This "Central Asian Animal Production Regional Assessment" should guide us to a better common understanding of the problems of the region and to the necessary actions leading to their resolution.

Thank you.

COUNTRY PRESENTATIONS



RATIONAL USE AND PHYTOAMELIORATION OF ARID PASTURES IN KAZAKHSTAN

By S. Abdraimov, A. Ombaev and J. Abdraimov

Scientific Research Institute of Karakul Breeding, Almaty, Kazakhstan

The Republic of Kazakhstan occupies a territory of 2.72 million square kilometers. This territory extends 3000 km from West to East, and from North to South more than 1700 km. Kazakhstan has borders in the North and West with Russia, in the South with Turkmenistan, Uzbekistan and Kyrgyzstan, and in the East with China. It is situated continentally within Eurasia (Figure 1). There is a large diversity of physical and geographical zones: forest steppes, steppes, semideserts and deserts. About 60% of the territory (162 million ha) is situated in the Northern and Southern deserts of the Afro-Asian arid zone. Kazakhstan deserts and semideserts which are part of this zone have several unique natural features resulting in certain specific forms in the desertification process (Figure 2).

Livestock production constitutes 58.8% of the Republic's gross agricultural product. On the vast territories of the Republic there are 38 million head of livestock. Of these, there are 6.6 million cattle, 2.9 million pigs, 1.2 million horses, 30.2 million sheep, and 0.09 million camels. These livestock are kept in 44,800 different agricultural farms which constitutes 73.4% of all farms in the Republic.

Figure 1. Landscape map of Kazakhstan

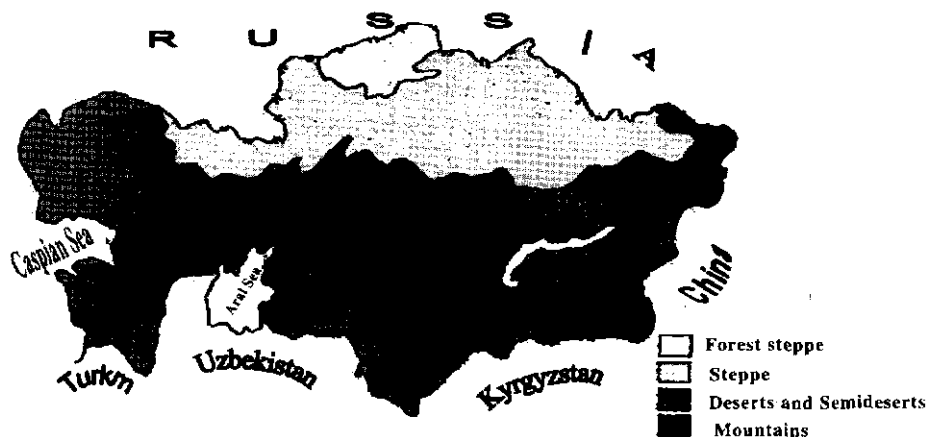


Figure 2. Desertification



There are two state organizations which manage the agricultural sector and scientific research in Kazakhstan: Ministry of Agriculture, and Kazakh Academy of Agricultural Sciences (KAAS) (Figures 3, 4). Animal husbandry is very important for supplying the population with food. It is managed by the state.

In the private sector of the economy there are 43,200 farms and peasant private production units (data from January 01, 1995). These represent 8.6% of all farms. Social and economic conditions at present do not allow this sector to expand. In our opinion, climatic factors and shortcomings in the functioning of the market economy are the main reasons for this constraint.

Figure 3. Management structure of livestock system of Kazakhstan

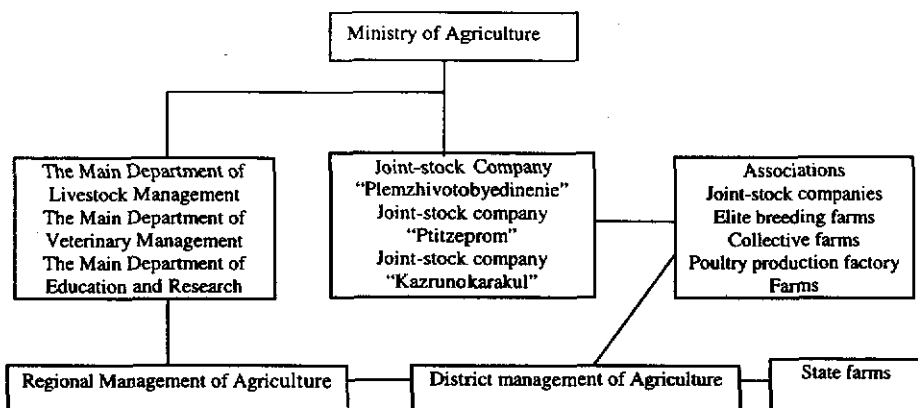
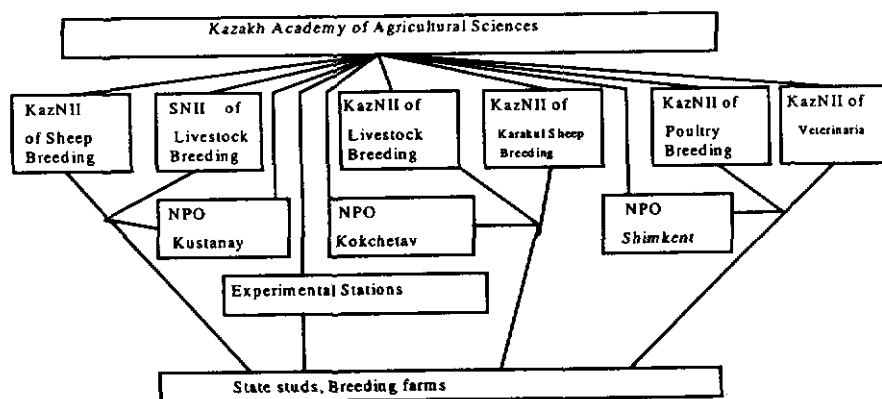


Figure 4. Scientific research in Kazakhstan livestock breeding



KazNII - Kazakh Research Institute
NPO - Scientific Production Association

The bulk of production (90%) is generated by the state sector. While livestock systems are spread around the entire Republic and they are mainly focused in the arid zone. They use distant ranges mostly on multiseasonal rangelands. As economic difficulties are getting more and more complicated, they directly or indirectly influence livestock production.

The regional agricultural administrations which provide legal, consulting and marketing help to farmers, play a primary role in the complex conditions of the transition period. But in the future, different scientific research institutions will play the key role. Their research work increases the economic potential of livestock intensification. A total of 1500 research and support staff are connected with these institutes.

The above mentioned institutes have worked out scientific programs for livestock development. These programs take into account the integration of different property and economic reforms. The Karakul sheep breeding system is one of the components of these programs.

The huge territories of deserts or arid rangelands (100 million ha) create considerable economic potential for the Republic. These territories have optimal natural resources. Rangelands are an important part of these resources, and maintain 17 million sheep, all camels and the majority of horses. Desert rangelands of Kazakhstan are unique because they are the most northern points of Karakul sheep breeding

(3.6 million head) in the world. The animals grazing on these rangelands get about 70-75 % of their total forage requirement in the field. But the rangelands, due to their over use, have deteriorated.

The break in the traditional system of livestock grazing on distant rangelands and seasonal migration caused overgrazing of the rangeland and their gradual degradation. The landowners are to a great extent responsible for this. In order to quickly pay back their credits and debts, farms situated on these territories started exploiting the ecosystem more and more. As a result of development of marginal lands and irrigation, the steppe rangelands were lost and this encouraged grazing on desert rangelands. Overgrazing led to formation of new deserts and 63 million ha of rangelands are no longer productive. Simultaneously, the index of intensity of usage of these pastures was increased by biological and ecological factors.

Devastating human interference in the natural ecology (cenosis) and succession processes in the desert led to disappearance of the most valuable feed crops, resulting in the appearance of non-edible weeds and unsuitable environmental and soil conditions. The productivity of desert rangelands is inherently very low and fluctuation by years and seasons varies from 0.1 to 0.25 tons of dry matter per hectare. Besides that, pasture productivity diminishes by 30% every 20 years. In the regions of the Aral Sea, Balkhash Lake, the sand deserts of Muyun-Kum, Kysyl-Kum and Rin Sands of the Pre-Caspian zone, the process of turning lands into deserts brings dust storms and formation of greater sand areas.

Because of this, research work on morphogenesis of desert communities, systematization of the processes of desertification, and methods of countering them have been carried out for more than 30 years.

To restore the ecological potential of arid rangelands we would suggest the following.

1. Reasonable and controlled use of natural rangelands.
2. Creation of a technological basis to improve the biodiversity of plant communities.

These methods are original and extremely appropriate for the existing situation. They consist of using a special agrotechnique, the introduction of wild cultivars, turning one-seasonal pastures into multiseasonal, and creating irrigated pastures in the regions of winter pastures, etc. These actions should stop erosion. Due to the severe climate of deserts and semideserts in this area, growing of common feed crops is unproductive. Therefore, the creation of seasonal pastures, using wild forage crops especially selected for this purpose is recommended.

To solve the complex environmental protection problems to effectively use and enrich arid pastures of the Republic, and, in general, to create a stable feed base for Kazakhstan livestock, we suggest the following guidance.

1. Rational Usage of Arid Pastures

Arid zones of the Republic are not homogeneous in their ecological, climatic and forage conditions. The theory of elaborating effective technologies for development of arid zone rangelands in Kazakhstan is based on the principle of natural zonation.

The general area of arid rangelands used by Karakul sheep farms of Kazakhstan is 37 million ha (mainly in the South-Eastern part of the country). The problem of feed supply in the development of Karakul sheep breeding can be solved only if its solution is based on ecological principles. The activities of specialized, cooperative and individual farms should be looked upon as a complex of ecological systems. Undoubtedly the already existing ecological equilibrium which has been developing for thousands of years should be preserved as it best suits the corresponding soil and climatic conditions of the zone. At present there is much data available on how to use desert rangelands both abroad and in respective research organizations of CIS countries and in South Asia. However, the application of their recommendations to the arid zone of Kazakhstan is very specific.

As the results of scientifically based recommendations of the Institute of Karakul Sheep Breeding show, one of the ways of raising the effectiveness of pasture use is by dividing them into enclosures, and fencing and watering them. The experimental results prove the effectiveness of enclosure grazing with moderate feeding of animals

when compared with the control plots. The botanical composition of grasses is improved, the stock of edible mass increases, and the pasture period is prolonged.

The inclusion of restricted grazing into a pasture rotation system enhances the productivity of Karakul sheep by 15-20% (wool and Karakul lambskin). Also, inclusion of the pastures at rest into the pasture rotation system with enclosure grazing can solve the problem of pasture overgrazing. The overgrazed areas are localized and the spread of desertification is prevented. Thus, the advantage of enclosure grazing and pasture rotation over free grazing is unquestionable. It does not have to be proved again. It makes it possible to develop the schemes for a pasture rotation system of the arid zone of Kazakhstan.

In perspective the research should be expanded to cover the rational use and development of arid rangelands in the following way.

1. Start research on the ecology of arid rangelands by zones (measuring the feeding productivity of the existing pastures by way of aerial and terrestrial survey).
2. Introduction of pasture rotations as the first step of ecological evaluation of arid systems.
3. Development of recommendations on the effective use of water sources for the vital activity of people and animals on the basis of monitoring research.

2. Improvement of Arid Rangelands

The influence of human activity on arid territories of the desert zone appeared to be so significant that the rangelands lost their ability for self-regulation. The extreme ecological situation of Kazakhstan deserts needs a special approach which takes into consideration the limits of natural resources. The ecological systems should not be upset, as they are apt to degrade.

The new system of pastures should intensively use the complex abiotic factors of the desert zone and should not be exposed to degradation in extreme conditions. Such pastures have superiority over irrigated lands, as their exploitation is comparatively cheaper without

the threat of secondary soil salinization. While creating such pastures two elements should be used, i.e. plowing and sowing. Our data show that such elements lead to better physical and chemical characteristics, the introduced plants better display their effectiveness, and favorable conditions of water and air regimes for nitrogen fixation are created. In a rainfed dryland situation, only the plants that are adapted to severe environmental conditions can grow. The representatives of different desert vegetation, viz. *Aellenia subaphylla*, *Eurotia ceratodes*, *Kochia prostrata*, *Holoxylon aphillum*, *Calligonum aphillum* positively react even to the insignificant improvement of ecology by using agronomy.

Sown perennial agrophytocoenoses created according to recommendations of Scientific Research Institute of Karakul Breeding have valuable biological and economic characteristics in that they mature earlier and quickly form an above ground biomass and root system. It has been noted that different biomorphs of these agroecosystems make good sequential and ecological use of natural resources, i.e. the younger organisms consume the maximum quantity of the resources. The productivity of the ecosystems is 4-12 times higher compared to natural rangelands (Figure 6). The money invested in generating these ecosystems pays back in five years and it can generate profit for next 15 years.

It should be emphasized that the pasture varieties should be changed periodically and new species from desert vegetation should be introduced. At present breeding and introduction is being done for this purpose. More than 150 species of feed crops have been tested and the perspective ones selected. Introductory work is done by adopting the

Figure 5. The yield capacity of the sown forage crops in the arid zone of Kazakhstan

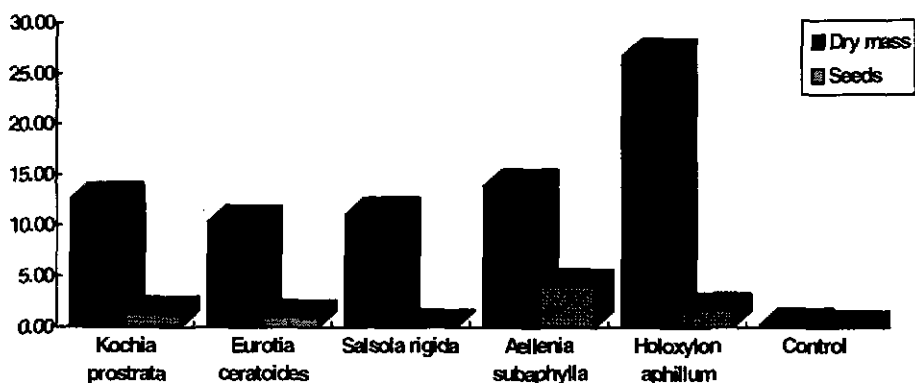
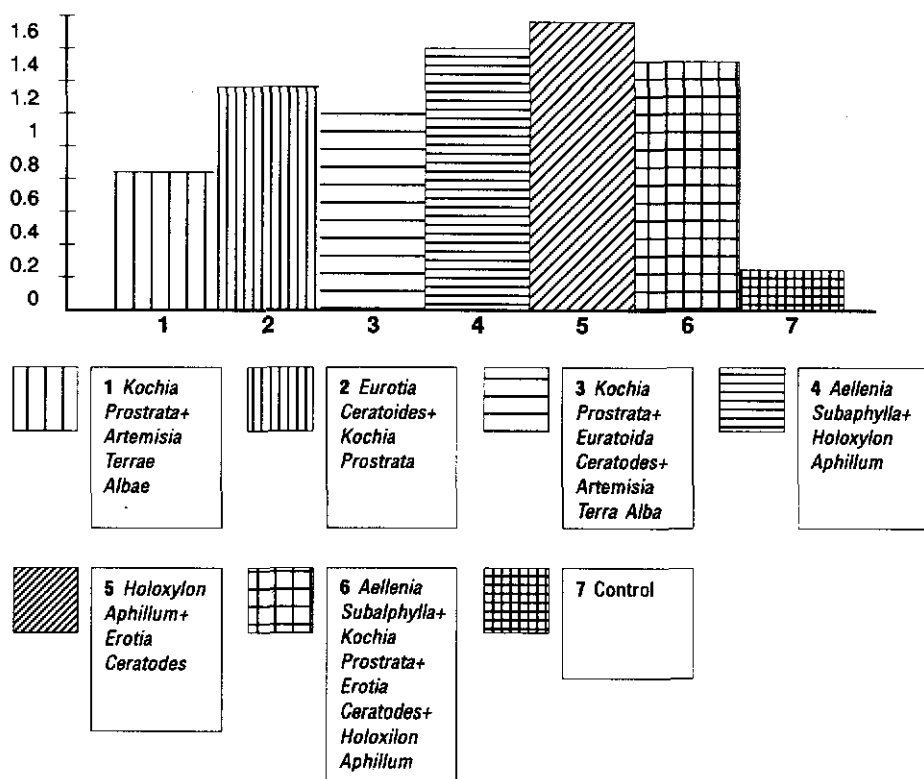


Figure 6. The yield capacity of the perspective types of sown agrophytocenosis



following scheme: studying of the flora of arid zones, collection of seeds, ecological and biological research in introduction nurseries, elaboration of primary agronomy and testing species of crops in industrial experiments. We have been carrying out such research works since the 1960s (Table 5). Significantly higher indexes on yield rate and ecobiomorphic characteristics compared to natural rangelands allow the formation of the basis for technological operations. The fundamental study of intravarietal diversity and intravarietal mutability will continue as a part of this work. The most up-to-date methods of plant breeding, such as induced mutagenesis and experimental polyploidy will be employed. Also, research on the productivity and longevity of seeds will be continued.

In conclusion, we would like to say that the further intensification of research efforts to find the optimal solution for preventing desertification should be conducted on the basis of international cooperation.

KARAKUL BREEDING AND ARID FORAGE PRODUCTION OF UZBEKISTAN: CONDITIONS AND THE DEVELOPMENT OF PROBLEMS

By Prof. U. Aripov, Prof. R. Valiev

Uzbek Research Institute of Karakul Sheep Breeding

Karakul breeding is an ancient traditional livestock system of Uzbekistan. For many centuries the Karakul breed of sheep has been a unique breed of world significance. It was created by special selection methods and is a valuable national property of the Uzbek people. Karakul breeding is widely popular in Central Asian countries, Africa, Europe and South America.

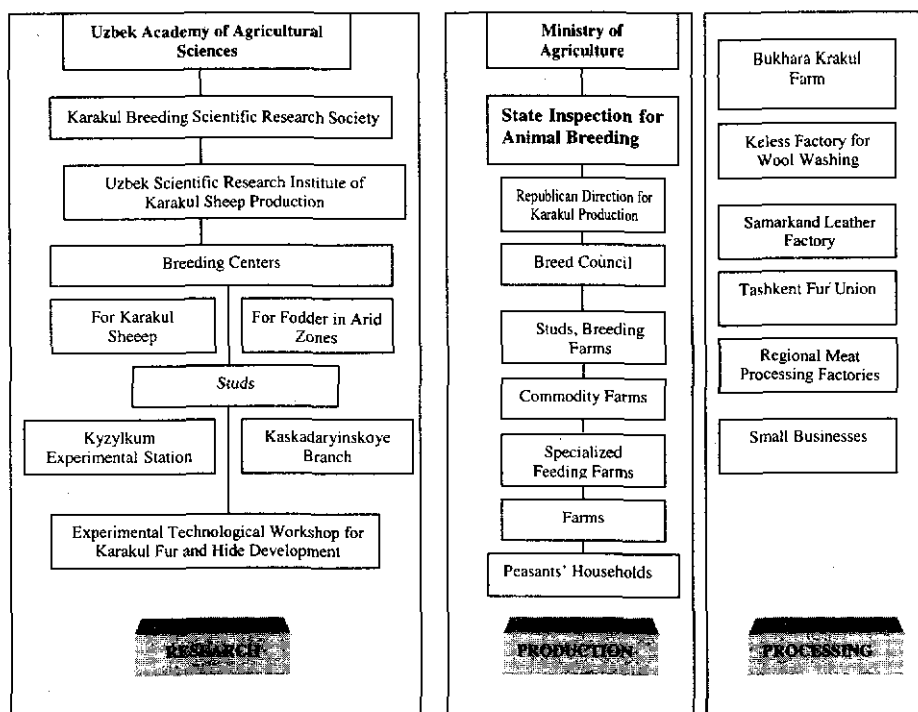
Karakul breeding occupies an important place in the complex national economy of Uzbekistan, a main means of development of deserts and as the basis of life and well being for more than two million people of the desert regions. Karakul sheep have a very high level of adaptation for extreme pasture – forage and natural climatic conditions of arid territories. At the same time they provide a diverse set of products. Meat production, wool, milk and the unique quality of their original Karakul skin are in high demand by consumers in domestic and international markets.

In our Republic's entire volume meat production, the share of ecologically clean, high, and nutritional mutton is about 20%. Karakul production has the potential of annually producing about 100,000 tons of high quality milk for processing high quality brynza cheese (sheep's milk cheese) and other dairy produces. With a small effort and without any expenditure we may have about 2000 tons of dietary meat from the carcasses of the newborn lambs slaughtered for Karakul skin. Karakul wool production from Karakul sheep constitutes about 30% of the total amount of the wool produced in our republic (about 9000 tons). It is a required raw material for producing carpets, wool materials, and woolen yarn and it is widely used for technical purposes. The Karakul sheep industry may produce about one million newborn rennets, to make 200-250 tons of preparation for the milk processing requirements of the country. This branch supplies about 1.5 million sheepskins, of which 80% may be used for sewing a wide range of goods demanded by the population. And finally, the main output of Karakul production is Karakul skin, produced annually in the amount

of more than 1.0-1.5 million units. With its type and original color, they have a high market value at home and abroad, serving as a significant source of foreign currency.

The Karakul breeding area of Uzbekistan includes several natural-climatic zones differing from each other by natural-economic characteristics. About 65% of the sheep graze on extensive territory of sandy deserts, the rest graze on sagebrush, ephemeral deserts and foothill semideserts. Karakul sheep are kept on rangelands all the year around where their forage requirements are met at least for 75%, the deficit being met with additional feed purchased by farms. Generally this breed is rather heterogeneous in color and Karakul-curl characteristics (Figure 1), the main part consists of black sheep (55%), about 8% gray sheep, 15-20% golden sheep and 12-15% sheep with other colors (white, kambar, guligas, mixed). Of the total number of animals, there are about 60% with semicure type, 15-20% with ribous (white and black lines), 2-3% with plain, and 20% with Caucasus Karakul type. About 30% of the flocks consist of the breeding animals and the other 70% are used to produce Karakul and other products. These breed characteristics form the basis for inter-branch specialization

Figure 1. Karakul Breeding Structure in Uzbekistan.



within the karakul breeding units to produce an array of diverse Karakul products of the most valuable types and colors.

The major part of the thoroughbred core of the breed is represented by a high production type of Karakul sheep which constitutes the main part of the genetic pool. In the structure of flocks, 2.5% are breeding rams, 66% females, and 20-25% juveniles. The average body mass of breeding rams is 55-60 kg, of females 45-50 kg, and the newborn lambs weigh 4-4.5 kg. The fecundity of sheep is 110-115 lambs from 100 ewes, maximum milk yield 65-70 kg per lactation, and the average wool clip is 2-2.5 kg in physiological mass.

A fundamental component is formed by a combination of the branch and territorial principles of management of activities of specialized Karakul farming. Depending on the environmental conditions the number of sheep on the farm may vary from 20000 to 70000.

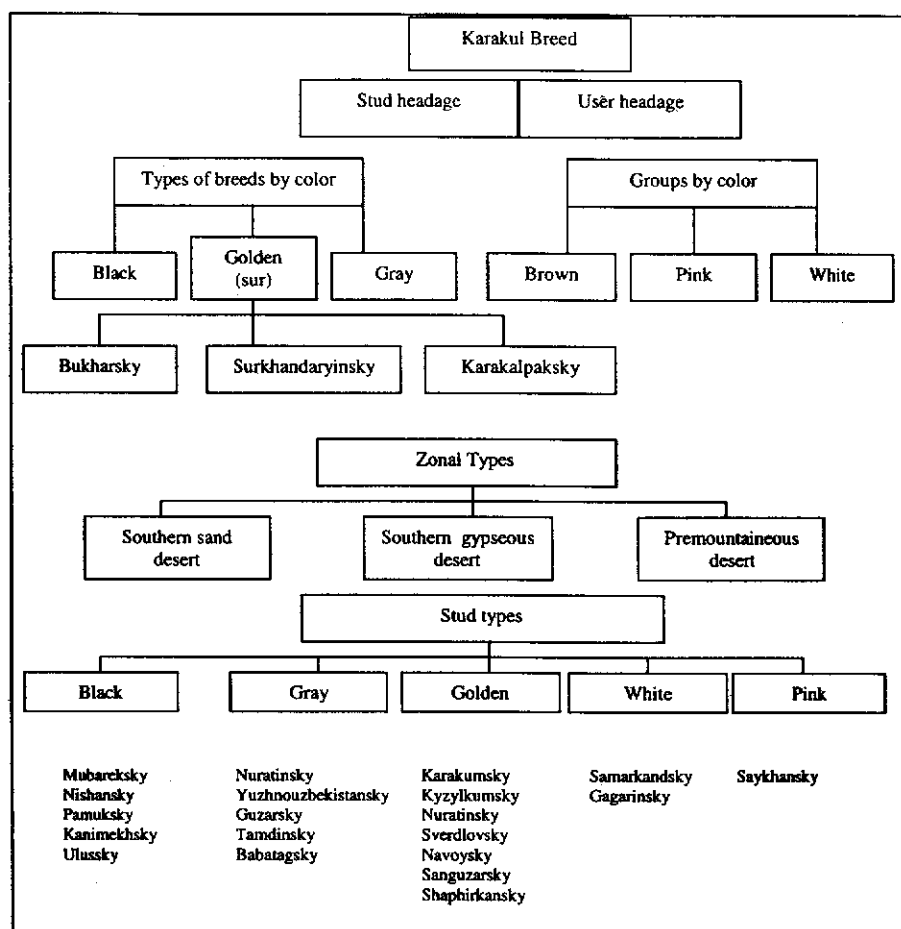
The functional and structural scheme of Karakul breeding includes Republican Karakul Management, affiliated with the Ministry of Agriculture and through this Ministry the country implements the program of the branch development, coordinates production and economical activities of Karakul farming, creates the conditions for realization and the processing of products and effects social and economic policy on arid regions of the country (Figure 2). Similar functions are carried out by branches of Karakul breeding in small towns and regions, and by administrative and production groups of Karakul specialists at regional agroproductional centers.

The Council of Karakul Sheep Breed is organized under the auspices of the Karakul Husbandry Department of the Republic to deal with the problems of breeding work, the improvement of the structure of thoroughbred breeds, and increasing the productivity of Karakul sheep.

To carry out a unified scientific and technical strategy to achieve state and regional development goals for thoroughbred livestock, a law "About Thoroughbred Livestock" was passed in the Republic. This law regulates this sector of State policy through the State Thoroughbred Inspections.

As indicated below, Karakul production is generally concentrated at the special Karakul breeding farms, and pursuant to the strategy of

Figure 2. Structure of Karakul breed



economic reformation, the agricultural production system has changed its structure into collective ownership farms (51), lease farms (48) and Karakul breeding associations - sherketi (25). As enumerated above, 22% belong to Karakul farms for breeding and 78% are used for commodity production.

As a whole, all Karakul breeding farms and main structural branches are changing their production activities on the basis of market relations with consumers and suppliers.

An inherent part of the Karakul breeding complex consists of the enterprises which process branch production. Our Republic has enough industrial capacities for processing and manufacturing consumer goods

from wool, sheep skin coat and leather raw materials for dress. In recent years in specialized regions and farms, small enterprises were created which process the bulk of Karakul skins into high quality half finished products and great variety of fur goods. Newly established farming structures of Karakul production, and emerging economic relations between self governing and mutually interested producers demonstrate the beginning of the process of branch reorientation. These relationships hold the promise for a new production cycle that is both efficient and effective at producing consumer goods.

The Karakul husbandry, as was already mentioned, is based on the all year round use of the range-forage resources. Therefore here, as in no other branch of livestock production it is important to maintain the long-term productivity of rangelands through their rational management. The total rangeland area used for Karakul breeding is 17.5 million ha, including about 3 million ha of drifting sands, overgrazed areas and lands with inedible plants, and 14.7 million ha of productive pastures with average yield of 1.21 feed units per ha per year. Low yielding pastures, a deficit and instability of well water supply, and the need for ecological balancing put Karakul breeding in a position of full dependence on natural forage conditions. Therefore, this branch is rightly considered to belong to the high risk category of farming activities. The problems of range management are very important for this branch of livestock husbandry.

In the technological toolbox of Karakul breeding production there are many aspects of scientifically based, zonally oriented norms for the exploitation of natural rangelands with due regard to their carrying capacities, the organizing system of pastoral farming, the rational use of fodder resources, and methods of maintaining of long term productivity. There are new technologies for creating high yielding multi-seasonal rangelands and a phytoamelioration system for arid territories, which provide stable fodder production and guarantees the forage reserve. In this respect, the focus of attention of scientists is on the dominating type of sand rangelands of Kyzylkum, which occupies 70% of arid territories of the republic.

In the region of Karakul breeding, the land remains the property of the government and was given to Karakul breeding farms for long term use. The government regulates the use of desert rangelands. In the process of economic reorganization and reformation of Karakul

breeding, the questions of treatment of arid lands and well waters as economic categories, the system of transferring and using pastures, the system of taxation, and control of its management, exploitation, and the maintenance of its stable fodder productivity were addressed. Organization and investment policies are the domain of state which is directing the system of reconstruction and phytoamelioration of low productivity rangelands, and the maintenance and renewal of wells to provide a guaranteed water supply for Karakul breeding.

However, at the present time, the pastures of arid territories raise very serious concern due to the continuing process of degradation and desertification, the influence of social and technological factors, and the increase of the uncontrolled number of grazing livestock there. More than 30% of desert rangelands lost by 50-70% of their natural feed capacity. National-economic consequences of these processes which are taking place in the main sand desert region of Kyzylkum may be more dramatic, than the ecological catastrophe in the Aral region. Clearly ecological events of this magnitude are not only of the interest of Uzbekistan but as well of other Central Asian countries.

One of the main aspects of State scientific-technical policy in Karakul breeding is to support scientific development. The functioning of the branch is carried out by financing the scientific technical work and projects which are conducted by the Agricultural Academy of Sciences and Uzbek Scientific Research Institute of Karakul Sheep Breeding. The Institute of Karakul Sheep Breeding is a scientific technological and selection center of Karakul breeding, and also a breeding center of new forage plants for desert and semidesert regions. This Institute is a main structure for a science productional unit of Karakul breeding, which consists of three thoroughbred plants and two field trial stations in the main regions of Karakul breeding. The Institute is scientifically and structurally connected with the main Republic Research Institute of Livestock and other scientific organizations concerned with Karakul breeding research. At the present time the Karakul Breeding Institute is a large modern research facility with a highly qualified scientific staff and equipped with necessary research instruments. At the 15 scientific branches of the Institute 180 staff members are employed, among them 80 scientists, including one correspondent-member of Uzbek Academy of Agricultural Sciences, 5 scientists with Doctor of Science, and 40 with Ph. D. degrees. All scientists have higher education, 5 of them can speak English.

Scientists of the Institute contributed greatly to the development of the branch of Karakul sheep breeding at all stages of its development in Uzbekistan. A system of Karakul breeding work was developed, resulting in the creation of 22 inter-race and stud types of Karakul sheep. The scientific foundations of sheep reproduction, their classification, and rational management of animal herds on rangelands were elaborated. The methods of stud selection and export assessment and sorting of Karakul pelts, and the State Standards (GOST's) for Karakul raw materials were developed. The Institute plays a leading role in the development of the efficient system of radical improvement of arid rangelands, breeding and seed production of desert forage plants, as well as its studies on the regional biogeochemical cycles of the rangelands of Uzbekistan.

At the present time all efforts of staff scientists are directed to work out new principles of interbreed systematization and classification enhancement of Karakul sheep. They are also focused on reorganization of Karakul sheep breeding, development of a population based regional program of animal selection of rare lamb types and original colors, and creation and maintenance of high production flocks, lines and genotypes. Studies are conducted on the genetic and biological basis of immune adaptation of Karakul sheep to extreme conditions, on the system of monitoring the vitality and reproductional functions, and the methods and ways of increasing effectiveness of the selection process in Karakul sheep.

A large block of the research and development work of the Institute is represented by the studies on the scientific foundations of the regional system and the technology of arid forage production combining the rational use of plant resources, phytoamelioration of natural rangelands, maintenance of the genetic pool of the arid forage plants, and the breeding and seed production of the high-yield varieties with the demands of nature conservation and optimal resource use.

The work continues on effective technologies of Karakul production, feeding and management of Karakul sheep, technological processing and principles of evaluating Karakul goods, sheep skin and other Karakul production, as it is required by domestic and international markets.

The above mentioned complex of scientific research does not completely encompass a number of fundamental problems directly

linked to the process of reorganization of Karakul breeding in the conditions of the market economy. In our opinion such problems include:

- development and implementation of the state program of combating desertification and arid rangeland degradation, and of restoration and phytoamelioration of the Karakul sheep rangelands;
- development of the optimal economic-organizational forms and principles of the production-economic relations between the producing and processing enterprises of the Karakul breeding complex and related branches;
- development of new highly effective technologies for processing Karakul production and manufacturing goods which satisfy the demands of domestic and international markets.

The solving of these problems is complicated by a lack of material and technical resources in our Republic and their scope is sufficiently great that individual Republic cannot address these issues alone. Therefore these challenges become regional ones demanding the mobilization of the multilateral research and investment potential of Central Asia.

THE MAIN TRENDS IN THE REFORMING OF LIVESTOCK FARMS IN THE KYRGYZ REPUBLIC

By I. Botbayev

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Livestock breeding is one of the main branches of Kyrgyz agriculture. Today the agriculture is surviving the difficulties of a transition period. Nonetheless, during the execution of land and agrarian reform some stabilization was achieved in this branch in 1995. Gross agricultural production was 98% of the level of 1994. The wheat production increased by 68,000 tons, the production of raw cotton, potatoes, vegetables, melon crops and oil crops has increased. Unfortunately in livestock breeding, results are negative. The recession continues. In general, gross production of livestock husbandry decreased from the 1994 level by 10.4%. Meat production is 319,700 tons (10.7% lower), milk production is 863,500 tons which remains at the 1994 level.

In general, profitability of agriculture in 1995 was about 2%. Profit was half of twice as low as in 1994 levels (22 million soms against 46.4 million soms). The reasons for the recession are known, and measures are being taken to eliminate them.

1995 was a crucial point in carrying out land and agrarian reform. The level of privatization in agriculture reached 39.3%; 23,000 peasant and farm holdings were created, the areas and boundaries of land redistribution were defined, citizens' plots and the documents regulating the land-tenure were outlined, and 10 legal documents for land reform were prepared. In all 293 farms out of 450 were reorganized, 60% of the rural population got land plots which constitutes 469,600 ha of arable land (47.8% of the total arable area of the Republic).

However, there are quite a number of important factors which stand in the way of solving the crisis in agriculture. For example, there are no market structures to serve the farms and peasant holdings, and no information services though foreign investors to participate in the work of this sector. To develop private enterprises foreign organizations invested about \$200 million in agriculture.

Kyrgyzstan is considered a zone of developed livestock rearing. Working at domestication of the local livestock landraces for 60 years,

researchers and breeders have created a republic wide base of pedigree stock, highly productive breeds of animals adapted to the extreme conditions of highlands. They are Alatauskaya and Aulieatinskaya breeds of cattle, and Kyrgyz Tonkorunnaya, Tyan Shan Polutonkorunnaya and Alayskaya Polugrubosherstnaya breeds of sheep, Novokyrgyzskaya breed of horses, Kyrgyzskaya breed of hens, Kyrgyz breeds of wool and down goat. When the reforms started in 1990, sheep constituted 10 million head, cattle 1.2 million head, horses 0.32 million head, poultry 0.63 million head, sow 0.31 million. The average wool yields were more than 3.2 kg; the average milk yields were 3200 kg. This was the highest output among the republics of the USSR. Livestock breeding was organized at a high level. The state studs and the network of pedigree institutions were allowed to meet the needs of all farms and supply them with pedigree stock. However, the crisis brought a sharp decrease in the number of pedigree stock and their productivity, deterioration of feeding and maintenance conditions, which lowered the production quality and broke many technological processes. Genetic resources are threatened. By 1995 the number of sheep was lowered by $\frac{1}{2}$, cattle by 15.1%, horses 6.7% and sow by 2.5 times. Stud farms suffered a sharp decline, and they ceased to be centers of the high zootechnical culture of livestock rearing. Pedigree stock decreased 2-3 times. For the past 3-4 years for all intents and purposes not a single stud farm has sold any young pedigree animals because no finances are available to buy pedigree material. It has become a tradition in the republic to slaughter pedigree animals. These factors cause a great concern for the future of existing pedigree gene banks, and of research work, because having lost the pedigree studs we will lose the research experimental base of livestock breeding. Today we are considering establishing at least zonal experimental stations of livestock rearing and passing them to the ownership of KyrgNIIZH.

Due to privatization of state property, and the appearance of small cooperative and private farms, it is necessary to apply changes to the system of organization and pedigree work at the farms. We have foreign experience that suggests that these functions can be delegated to scientific production associations by departments, species and breeds of animals. They deal with the registration and placing of pedigree stock, export-import of pedigree resources, evaluation of sires by phenotype and genotype and their rational usage, and some questions of price policy on pedigree stock, semen, embryos and others. More powerful Associations solve the problems connected with genetic improvement

of livestock, creation of pedigree nurseries, and the introduction of the elements of modern biotechnology. However this work has no legal basis, which restrains the further development of the department as the only production in the republic. The Ministry of Agriculture of Kyrgyzstan together with the World Bank for Reconstruction and Development, with the researchers of KyrghNIIZH actively participating, have developed a business plan to create a Sheep Breeders Association during the years of 1996-2000. If it is realized successfully, the same projects will be implemented for other branches of livestock breeding: cattle breeding, horse raising, etc.

The main highlights of today's livestock breeding are geared towards the development of scientific research on marketing service, testing and certifying agricultural produce, introducing modern biotechnological methods, preserving and rational use of genetic resources of the animals, and up-to-date efficient technologies, etc.

To stop the recession in livestock production and stimulate the further development of its branches, it is first necessary to create all the conditions for an enlightened market instead of the existing uncontrolled one. At the first stage it is necessary to form the market infrastructure for sale of livestock production. It is important that in the building stage where market relationships are being established, a market be governed by the state using its economic and administrative influence to create stability instead of allowing self-regulation. For self-regulation, a structure which includes the producer should be established through time. The state role would consist of guaranteeing the minimum prices on produce to preserve and develop the branches of animal husbandry.

The main factor in eliminating the economic slump in animal husbandry is the preservation and improvement of the pedigree resources, and effective animal breeding. The main purpose of organizational measures should be the protection of pedigree herds. For this, the existing law on preservation of the animal gene pool should be followed and gene pool herds, nurseries, and gene banks created. The formation of regional breeding centers would allow improvement of the organization of pedigree and research work.

The reproduction of herds and pedigree stock is poorly developed in the republic. At the existing biotechnological center at KyrghNIIZH,

a bank of sperm of eminent sires of local and foreign breeds should be created. This action would help preserve the gene bank and improve it. While conducting the artificial insemination of sheep, the category of a farm and the form of property should be especially considered. It is time that overall principles of application of artificial insemination were developed. Questions of livestock production technology should be oriented towards the needs of farms and peasant holdings. Modern technologies should be implemented for small production units.

Today it is impossible to save livestock husbandry without the help of the state. That is why pedigree stock breeding should get financial support during the transition period as is practiced in many foreign countries. During the land and agrarian reform, sheep breeding which is the most important and ancient branch of agriculture in Kyrgyzstan is undergoing some negative changes. Original natural and economic conditions favored the development of sheep breeding in Kyrgyzstan, especially its continental climate and the mountain relief of the territory. The republic is situated in the largest mountain system of the world, the Tyan Shan and Pamire-Alay. There are dispersed valleys and hollows between the mountains at altitudes from 500 up to 7000 meters above the sea level. Almost half of the 200,000 km² of its territory is situated at an altitude of more than 3000 meters. Out of its 53.5% of agricultural land more than 80% are highland and mountain rangelands which mostly are of a short grass type. These rangelands are best used by sheep and goats in different seasons of the year.

At the beginning stage of building a socialist society in the republic, nomadic sheep and goat rearing were represented by rough-wool fat-tailed sheep and goat. In 1925 there were 2341.4 million head. The weight of fat-tailed sheep was 59.4 kg in fall and 49.2 kg in spring, and the weight of tail was 3-3.5 kg. The annual rough wool yield did not exceed 2 kg (1.06 in spring, 0.93 in fall) or 1.4 kg of pure wool when washed by cold water. The fertility of fat-tailed sheep was low, 105-107 lambs per 100 ewes. The rough wool of the sheep was multicolored, of low quality with low physical characteristics and could not serve as a raw material for the textile industry. At the same time they had strong stature, and were adapted to the pasture environment. However, such low productive fat-tailed sheep could not meet the requirements of big state and collective farms which started to be organized since 1930. Since then, sheep breeding of the republic underwent the change towards fine-wool and semifine-wool sheep. (M.N. Luschikhin, 1958, 1964; N.E. Loboda, 1941).

This work was considered important by the state and it was supervised by the government. As a result, in a very short period in the republic where the local population had not known fine-fleece sheep, highly productive fine-wool, semifine-wool and semirough-wool sheep rearing was created. The basis for this were three breeds of sheep: Kyrgyz fine-wool (introduced in 1956), Tyan Shan semifine-wool (1966), and Allay semirough-wool fat-tailed (1981) which were well adapted to the harsh conditions of mountain ranges. During their breeding the undesirable elements in the breeds and the scientific challenges were overcome quite successfully. World class science was combined with valuable global genetic resources and the extensive experience of Kyrgyzes in sheep rearing to achieve this success

The Kyrgyz fine-fleece breed was developed under the supervision of academician M.N. Luschikhin and researcher N.E. Loboda between 1939 and 1956 by combining, absorbing, reproductive and introductory crossing of fat-tailed rough-wool ewes with rams of Novokavkazsky Merinos (1928-1932), Rambulie 1929-1933) Wurtemberg (1928-1933), Prekos (1932-1940) breeds and at the last stage in 1950 with Groznenskaya and Stavropolskaya breeds. The sheep of this breed are rather big, well developed, and have a strong constitution. They combine such important characteristics, ranges inherited both from fat-tailed sheep and fine-fleece sheep, as good wool and meat productivity, early maturity, and adaptiveness to mountain. This is the first hornless wool and meat breed. The sheep have on their neck one or two incomplete skin wrinkles. The hair on the head goes as far as the line of the eyes, and on the legs up to wrist joint and hock. The average live weight of the rams is 98-105 kg, ewes - 58-60 kg, and wool yield is accordingly 11-12 kg and 3.8-4.5 kg with the hair length of 7.5-8.0 cm and the thickness of 60-64 units. The washed wool yield of 52-53% is the best result among the fine-fleece breeds of the former Soviet Union. The fertility rate is high — 120-150 lambs per 100 ewes.

The development of a new semifine-wool breed of sheep initiated in 1950 by the Tyan Shan experimental station in Kara-Kudjur. The station is situated at the altitude of 2700-2900 m above the sea level under the supervision of G.I. Druzhenkov and E.S. Druzhenkova. It was developed by complicated reproductive crossing of Prekos and Fat-tailed ewes of the first generations with the rams of Lincoln breed by long rearing "in itself" hybrids of the first generation using purposeful, homogeneous, and heterogeneous selection. In 1966, the breed was

approved under the name of Tyanshanskaya. Its breeders received the state award of Kyrgyz SSR in 1974. Tyan Shan meat-wool sheep are big and mature early. The weight of the rams is 105-110 kg, maximum 147 kg, ewes - 60-65 kg, maximum 96 kg, wool yield respectively 8-10 kg and 3-4 kg, with 67-70% of washed fiber output. The wool is semifine, its length is 11 cm and more, white with lustrine glow, silkiness and large crossbred waviness.

One of the major achievements in livestock rearing in the republic has been obtaining a new unique Alay breed of semirough-wool fat-tailed sheep which have high combined meat-lard-wool productivity and early maturity. The breed is also better adapted to feeding in year round pastures under the severe conditions of mountain semidesert. The basis of this achievement was a small number (300-400) of crossbred different-colored sheep from the Alay experimental farm of UKOS institute.

The Alay breed was obtained by complicated reproductive and introductory crossing techniques using the gene pool of 3 breeds: Kyrgyz fat-tailed (rough-wool), Prekos (fine-fleece) and Saradjinskaya fat-tailed (semirough-wool) from 1934-1981. The creation of the breed was based on the crossing of the desired traits of the existent basic forms as the result of recombining genes as well as mobilizing covered hereditary variability.

The body mass of sheep of the Alay breed is a little smaller than that of the Gissar and Tajik breeds. The weight of Alay rams is 105-110 kg, the best ones are 147 kg, ewes - 62.3, the best ones - 85, the wool yield 6.3 and 12 kg and 3.2 and 6.1 kg, respectively. The washed wool yield is 65-70%. The wool of Alay sheep is semirough, white, long, wavy, and without dead hair. It can serve as a world standard of semirough wool. The Alay sheep are mainly white (80-85%). They have colored spots on the ears and facial part of the head and legs which are the characteristic trait of the breed and used in breeding as morphological markers.

An important breeding method in the Republic since 1934 has been artificial insemination. The number of head in the republic increased four times in 1990 compared to 1940, and wool production increased 10 times. Every year 130-140,000 tons of lamb and 36-37,000 tons of mainly fine wool are produced. Of total meat production lamb is 45-

50%. Fine-fleece sheep rearing has been developed as the main trend. The number of fine-fleece sheep and the quantity of produce constituted more than 90% of all sheep.

For the last 20 years (1970-1990) a relatively constant number of sheep (10.0-10.5 million) have produced 19-20,000 tons of washed wool of improved quality. The fine wool production rate of the highest category, Merino, was increased 80-85%, and the first class wool to 60%. This increase was the result of using Australian rams to improve the wool quality of Kyrgyz fine-fleece sheep since 1971. The production of *semifine wool by crossbreeds increased as did the production of semirough wool or carpet wool*. However, at the same time, there was practically no increase in sheep productivity. The average wool yield from each sheep was 3.2-3.4 kg or 1.75-1.84 in pure fiber. This figure includes also the lamb's wool which was sheared annually from 0.5 million lambs. The production of lamb per head remained at the same level, 11-12 kg. A decrease in weight and increase in mortality occurred. Every year about 3.0 million head of sheep were slaughtered for meat, 30-35% of them were below average nourishment. The survival of sheep was low, 90-93%, and lambs, 82-85%. This mortality was due to poor feeding, increase in diseases, and lowering of the vitality of the animals. A decrease in numbers of sheep in the public sector took place as well. It was accompanied by an increase of low quality wool.

During one year the number of head declined by 715,000. The situation in sheep breeding was made even worse by the rise in cost of construction materials and machinery widely used in the sheep production. A small increase in the purchase price for sheep production does not cover the production costs. These factors brought an increase in the cost of production of lamb and wool and a lowering of profit rates. This profit squeeze was particularly severe in years of bad winters (for example, 1985) and resulted in losses for the Department. The disintegration of the Soviet Union, and the sovereignty gained three years ago, brought the Kyrgyz Republic to a crisis because traditional economic ties were broken. The current state of sheep husbandry in Kyrgyzstan is a vivid example of this sad affair.

In comparison to 1990, on January 1, 1996, the number of sheep and goats constituted 4.3 million head, a 2.5 times reduction in holding of all types in the republic. Catastrophic reduction in the number of sheep heads continues. Farms cannot meet the needs of the population.

They sold only 20,700 tons of meat, 34,000 tons of milk, 2,600 tons of wool, and 2.5 million eggs in 1994. Farms rearing Alay sheep are in a better situation. The demand for Alay sheep exceeds that of fine-fleece sheep. Experts of the World Bank recommend that semirough-wool sheep rearing based on Alay sheep should be developed in the Republic in order to satisfy the raw materials needs of Kara-Baltinsky carpet factory to produce the high quality goods for export which are relatively low in cost.

The rearing of Alay sheep is mainly concentrated in the farms of the Chon-Alaysky region and in many peasant holdings of the Osh region. The number of Alay sheep is 250-300,000 head. To meet the needs of Kara-Baltinsky carpet factory the number of Alay sheep should be increased to 1.5 million head. The demand is for 2,000 tons of pure wool, 1,350 tons of which is white and light gray color. To provide this we should have a stable pedigree base. The only pedigree stud farm for the Alay breed "Kashka-Suu" has lost its old functions and split into three small private cooperative farms in the last four years as a result of the economic slump in agriculture and the negative effect of the crisis in the republic.

To meet the demand of the domestic and foreign market in sheep rearing and the rational use of highlands and mountains rangelands, it is necessary to survey trends of this branch of agriculture as a precondition to addressing the recession. It has been recommended, considering the demands on sheep rearing, that the republic have only 7.5-8.0 million head of sheep and goats, 50% of which should be Kyrgyz fine-fleece, 25% Tyan Shan, 20% Alay sheep and 5% goat.

Raising goats is also a traditional branch of stock rearing in Kyrgyzstan. In most of the region people reared the local Kyrgyz goat with low productivity. During the improvement of breeds local she-goats were crossed with male-goats of Pridonskaya down and Angora wool breeds. As a result of the long-term breeding, new Kyrgyz down and Kyrgyz wool breeds of goat were produced. They are well adapted to the mountain ranges and are very productive in down and wool (I.A.Almeev, I.M.Botbayev, 1995). Kyrgyz down goats have predominantly light gray and dark gray down. The average male-goat yield is 600-700, and sometimes up to 1500-1800 grams of down, and the she-goat's average yield is 450-500, sometimes up to 800-1000 grams of down.

The wool of Kyrgyz wool goat is close to the Angora type - mohair. Bucks give on average 2.5-2.8 kg, the she-goat - 1.5-2 kg. The goats have satisfactory meat qualities. At slaughter castrated goat's meat production is 45-51%. The hide is also an important product. To produce a new type of goat with improved hides would require - crossing Kyrgyz down goat and the wool goat. In some regions near the cities and resorts, milk goats should be reared. For this female and male goat of specialized milk breeds should be brought to the republic and pedigree reproduction should be organized. The natural climatic conditions and existence of hardly accessible stony and bushy natural pastures allow keeping up to 1 million head of goats in Kyrgyzstan.

PRESENT STATUS AND PROBLEMS IN THE DEVELOPMENT OF FORAGE PRODUCTION IN TAJIKISTAN

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Tajikistan is a country of mountains and mountain valleys characterized by uneven terrain. An increase in irrigated and rainfed production and an improvement of pastures is very important for livestock development. Livestock production is one of the most important agricultural activities in the Republic. With irrigation, abundant solar energy, and continental climatic conditions it is possible to raise forage at altitudes from 250 to 7000 meters above sea level. There are no other examples in the world where forage crops are grown in alpine and subalpine zones of such altitude. The composition of animals is also different in the Republic. Forage production and the strengthening of the forage resource for the livestock production is the main factor in developing livestock production.

Researchers at the Institute of Farming have developed a system for year round use of farmland. This intensive method of use is possible with the introduction of a system of intermediate, post harvest, and repeated sowing together with the planting of main crops. It is possible to obtain three yields a year from one plot of farmland. More than 25% of irrigated farmland in Tajikistan is sown with forage crops. It is possible to increase productivity up to 5.3 T per ha, and in some farms up to 10-12 T per ha, of forage units from one irrigated ha. There are significant possibilities for increasing forage production. One of them is better use of agricultural climatic resources by growing crops with different ecological and biological peculiarities.

Intensification of field forage production by year round use of irrigated lands is one of the most effective means to increase forage production and quality. However, the system has not been adapted throughout the Republic for a number of reasons. Generally the subject has not been well studied. There is an absence of varieties of forage crops which completely meet the needs of intensive production and progressive growing technologies, as well as a lack of well functioning seed production which would provide stable forage production. Farms suffer from a lack of special technical means for sowing and harvesting intermediate crops, and especially for lack of soil preparation prior to

sowing main crops. This has become especially critical as the Republic is now in an economic slump.

Special attention should be given to rational land use to provide the necessary nutrient balance of forage composition, and to reduce losses at all stages of production. Due to existing constraints on forage production, the productivity of cattle in the Republic is low. The mechanism by which cattle are provided with forage in early spring and summer-fall seasons depends mainly on the correct choice of forage crops and varieties, creation of a continuous supply of green forage, and getting the guaranteed yield of forage from the sown area. The deficiency of feed protein is one of the important problems of forage production. The lack of protein components in the rations leads both to low production of livestock output and overuse of fodder. The reason for such a large shortage of fodder protein is the low overall productivity of forage crops, losses of forage quality during the preparation and storage of fodder, and the content of protein in the forage produced.

The protein problem cannot be solved just by increasing the yields. Crops with high protein content should be grown (legumes, legume cereals, cruciferae crops) which are richer sources of protein. The vegetative component of legumes is higher in protein than that of cereals. To obtain forage balanced with proteins and some essential amino acids, it should contain at least 25-30% legume crops. Research have proved that about 40-50% of yield depends on variety or hybrid. This is especially important in forage production where the main product for which the crop is grown is forage. The productivity of a forage field depends on how intensively species and varieties gain the biomass during the vegetation period.

The opportunity to extend the planting of forage crops on irrigated arable land is constrained by the small quantity of land available, hence the need to focus on increasing forage production per unit land area. As a result researchers of Central Asia have developed the methods of year round usage of arable land. However, not all the released varieties of annual forage crops grown in the main and intermediate planting, meet the requirements of the production. The main shortage is in quickly maturing crops which are more adapted to winter conditions and capable to maintaining high quality yields with the optimal term of sowing for cotton and other forage crops. In field forage production the principle goal is the use of complex measures to increase the

harvesting of high quality fodder per ha by finding the best combination of forage crops in each zone and the employment of optimal technology for growing them.

The evaluation of annual forage crops is widely practiced in our Republic because there is always a deficit in green biomass in summer. The advantage of maize, sorghum, soybeans and the blends of annual grasses as annual crops is that they can successfully be used in post-harvest planting. In certain regions after harvesting of the main forage, winter, early spring and grain legume crops there is a long period free of frosts (60-70 days). This period can be used for second harvesting and planting of the post-harvest crops. Increasing grain production, including forage grain as the main foundation of the forage base in the rearing of livestock, has always been and remains as the main task of agriculture. The principal crop for the animal feed industry of the Republic is maize for grain.

At present the potential for expansion into new areas and increased production of maize are not completely realized because of lack of highly productive varieties and hybrids, adapted to different soils, climates and altitudes of the Republic. The best mechanism to increase production is to replace low producing varieties with varieties of higher yield and simultaneously develop capabilities for seed production of these varieties. Many papers in the last 15-20 years have been dedicated to agrophytosociology of annual forage crops. According to the data obtained by many authors, the yield of blends of species is higher and of better quality than that of pure plantings; natural conditions are better used; the soil fertility increases, enriched by nitrogen and phosphorous compounds. The blends with legumes produce a higher quality protein fodder with a better proportion of nitrogen and nitrogen-free components that are exhibit higher intake levels than pure sowings.

In some farms of the Republic fodder production has grown in the past years, however, it does not meet the current requirements. In many collective and state farms and peasant holdings of the Republic a small set of crops is grown at the main, replicated and intermediate sowings for silos and green fodder, especially the legumes. Researchers identified a series of possible varieties of cereals, legumes, and cruciferae and demonstrated that they should be introduced into plantings with positive results. One of the main mechanisms to increase yields and forage production is developing, studying and releasing non-traditional, new

and perspective forage crops and the concurrent development of production technologies to incorporate these forages into year round production on irrigated land. Researchers of the Republic have proved that the limiting factors for vegetative production are the air and soil temperatures and soil moisture levels. In Central Asia when the sum of active temperatures above + 30 equals 12000, then 15-20% of the year yield of pastures can be obtained, in summer above 25000, then 40-45% is achieved, in fall over 16000 yields 25-30% of production, and in winter over 600-7000 will yield 10-15%. In general, 20-25 thousand fodder units per year can be obtained from irrigated lands. The protein concentration is 130-160 grams per fodder unit.

The Vakhsh branch of TajNIIZ developed a series of complex agricultural methods for combined, post harvest and intermediate plantings, new highly promising ways of year-round land use, and mechanisms to intensify crop rotations. In the alfalfa rotation, the first year alfalfa is sown in pure stands and cover crop plantings with cereals. However, this gives relatively low yields of fodder (3.5-4 and 4.5-5 T per ha of forage units). The method of sowing alfalfa with sorghum, developed by the Vakhsh branch, allows for multiple harvesting while sowing in spring, and with maize in spring sowing or with grass sorghum. The techniques are high yielding. Depending on the timing and technique of sowing, they provide yields of forage from 20-25 up to 40-50 T per ha.

The Institute developed the technique of sowing of cereals in the fall after alfalfa had been planted in the previous years. This method was used in Uzbekistan. The yield of alfalfa was 14-16 T per ha (7-8 T per ha of fodder units). With the fall sowing of early ripening cereals into fields previously planted in alfalfa the land can be used year-round and an increase in gross yields is provided. Under production conditions of the Republic yields of 8-14 T per ha of fodder units are obtained. More effective ways of using the annual forage rotation can be developed. 3-4 yields are obtained by spring planting of sorghum No. 10-B after fall wild cabbage plowed-in in early spring or by plowing in spring rye No. 116-B of winter sowing for feeding. The Institute developed the maize spring planting and, depending on the conditions, combined maize and Persian clover, sorghum with berseem, sorghum grass with berseem and oats; oats with rye; Persian clover, berseem and mustard for late-fall plowed fields. These systems of production provide in the annual forage wedge from 15-25 up to 35-50 T per ha.

The developed system of year round usage of arable land in cotton production is used only on small areas because of a lack of resources and seeds. If sowing the early ripening varieties, the wide use of intermediate sowing in the cotton rotation could be established.

The intermediate sowing of cereals in cotton wedge by the 20th-30th of March helps to obtain the average forage yields of 30 T per ha of green biomass containing 5.0 T per ha of fodder units and helping to increase cotton yields by 0.3-0.4 T per ha. The usage of this method in two wedges of ten-course rotations gives for each 100 ha of rotational arable land an additional yield of 3-4 T of cotton per ha which equals the production of an additional ha. The use of this method in all wedges of the cotton crop rotation is a powerful means for improving irrigated farming, and for increasing the efficiency of cotton rotation and productivity of irrigated land.

Developing the scientific basis for intensification of field feed production without further expansion of arable land, researchers of the Republic have achieved positive results. The production systems for field feed production were scientifically proved and tested. They enable the use of the irrigated valley, foothill, and mountain rainfed lands of Tajikistan for greater agricultural production. The climatic resources of valley regions of the Republic are characterized by the abundance of warmth, light, and a long frost free period. These conditions translate into a spring-summer season in the valley regions of Tajikistan with 4.8-5.0 billion kcal of photosynthetically active radiation (PAR), and during the fall-winter-early spring season about 3 billion kcal PAR. Such a large quantity of photosynthetically active radiation all year round with artificial irrigation allows the production of fodder during the entire year and the introduction of highly intensive irrigated field feed production.

The production of feeds on irrigated lands should be scientifically based. The research should be carried out not only in the valleys of the region but also in foothills and mountains. Systems of farming should be developed and high yield varieties of forage crops determined for these areas. In order to solve this problem the potential agricultural climatic resources of each region should be determined. These data would form the basis for decisions on the most appropriate forage crops for the favorable thermal resources of the valley and mountain regions of Tajikistan and project their biological, agrotechnical, economic and feeding value for further planning and improvements in agricultural production.

THE STATUS AND PROSPECTS OF LIVESTOCK PRODUCTION IN TAJIKISTAN

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In Tajikistan animal husbandry is the second largest agricultural sector after the production of cotton and accounts for one third of the national income. However, at present it is in crisis, due to the fact that the total numbers of animals and production volume have been reduced and are unstable. Overall numbers might decrease even further which will mean increased uncertainty in the food supply and rising tension in the consumer market. The cause of this situation is well known. First, civil conflict and war have resulted in high casualties and brought about long-term political and social instability. Second is the recent shift to a market economy.

As in many Republics of Central Asia, it should be emphasized that the majority of livestock was concentrated in public associations such as collective farms and State farms or in so-called interfarm enterprises. These farms used to supply the cities and industrial centers with agricultural products. In addition, they formed the basis for the development of the private sector.

Studies in production dynamics during three decades show that the peak number of animals by species and productivity was reached in the period 1986-1990. However, subsequent to this period, during the civil war, a devastating decrease in the livestock numbers and production occurred. For example, by comparison to 1990, in 1995 there was a 46% decrease in the number of cattle, a 35% decrease in goats and sheep, 97.8% in pigs, and 93.5% in poultry. During this period the meat production fell by 75.8%, milk production declined by 73.3% and egg production was down 94.3%. During this period, the slaughter of almost half the cattle and a dramatic decrease in the numbers of other animals significantly affected the base for livestock production. In the past year the milk yield per cow was only 1070 kg. During this same period, the number of privately owned animals increased slightly but not by enough to cover the losses of past livestock output. Currently, the average per capita production is 4.8 kg of meat, 14 kg of milk, and 6 eggs. These figures compare to 20.3, 108.5 and 111.6, respectively in 1990. In spite of this, although declarative measures have been

undertaken, implementation of governmental privatization measures has been slow and degradation continues, especially, in terms of genetic basis of livestock.

In our opinion, at the end of the civil war, the country should work out the scientific and technical program aimed at the restoration of the agricultural and industrial sectors of the economy, especially agriculture which is the guarantee for the country's economic independence. This program should be implemented at the State level with the use of foreign capital and the revenue from foreign currency sales by other sectors of the economy.

Tajikistan has less land than other Central Asian Republics, only one tenth of a ha of irrigated land per person. This creates a competition between people and livestock for natural resources, especially feed grains. For livestock breeding, this means the following:

- development of all forms of property with an emphasis on the private sector stimulated by State grants. This will be a reliable basis to establish and further develop this type of property.

- distribution of land to those who work on it to ensure the better production of fodder. In order to insure adequate hay production in mountainous areas, 0.5-0.8 ha of irrigated pasture lands and 1.5-2.0 ha of rainfed lands per cow is needed.

Twenty percent of the country's population lives in the mountains. These mountainous regions, which contain one fifth of the country's arable land and all of the summer rangelands, are where the raising of beef cattle, yak, sheep, goat, and the breeding of horses is concentrated. A livestock revival is impossible without preservation and better use of pedigree animals. At present, the overall number of pedigree animals is low and does not meet long-term requirements. The management of pedigree studs should be centralized and supervised by the State. In the past, science has played an important role in livestock development. The Tajik Scientific Research Institute of Livestock Production is now 60 years old. During this period, researchers of the Institute have developed "Svitzezebuvidnaya", a national breed of cattle; a breed of sheep for mutton, lard and wool, a highly bred group of the Pamir fine-fleece sheep; black and gray Karakul breed, and a unique

breed of curly-haired horses. Together with their Uzbek colleagues, a Soviet breed of wool producing goats was also developed. Tajikistan is the home of the unique Guisar breed (for mutton and lard) and a special breed of the Guisar was created at the Institute. However, recent civil unrest has forced many researchers to leave the country. There are now only 22 researchers in the Institute with PhD or DrSci degrees. In spite of these hardships, the Institute staff is continuing its research efforts in five departments, two laboratories, two experimental stations and one outreach branch. From 1991-1995, research efforts of the Institute were focused on the development of the Tajik Chernopestraya and Svitzezebuvidnaya breeds of cattle, the Pamir breed of fine-fleeced sheep and the golden Karakul sheep.

A technology has been worked out for grazing young beef cattle in the mountain zones. This process allows cattle to achieve an average daily weight gain of 560-700 grams without additional feeding. Problems of farm animal feeding, husbandry, poultry breeding and apiculture are also being researched.

It is well known that Tajikistan is a unique country where you can encounter the agro-ecological, soil, climatic, and pasture conditions of every continent. The climatic conditions of the valleys, foothills, and mountains vary greatly. These variations have defined the research task. For instance, the Pamir Mountains, which constitute 45% of the country, and are home to 15% of the total number of yaks in the CIS. There is no alternative for yaks in this region. The Tibetan origin of the Pamir yak has been proven. Together with Russian researchers for the first time a hybrid of the Pamir yak was bred by crossing it with a special Kalmik breed. This hybrid created a meat producing breed of the animal. The half-breds are bigger, weigh more and have a strong skeleton. In Northern Tajikistan, the breeding of goats for wool and the production of diary cattle is important. The number of goats used to be half of the total number in the former Soviet Union. Scientific efforts are concentrated on increasing wool production and developing a native breed of wool-producing goats.

The prognosis for progress in various sectors indicates that due to the deepening shortage of feed and forage grains, the priority efforts in livestock research will be: specialized beef cattle, sheep and goat breeding. The biological characteristics of these animals allow us to use natural and climate resources most effectively. To achieve this we

must concentrate our scientific and practical efforts on developing new types, breed groups, and breeds. By following the world experience in different natural climatic zones, an intensified effort should be successful based on scientific livestock management and the demand of the market.

In order to be successful in solving nutrition problems and general economic tasks, we must first make decisions on the priority of research efforts to accomplish the most critical requirement of preserving the genetic pool of the nation's livestock. Unfortunately, we have lost a great deal of what was developed during past decades. In the present agricultural crisis, the restoration and development of a genetic base of pedigree livestock is only possible by strengthening research efforts and, with State support, training a staff in the developed countries. However, this support is currently very limited and only enough to subsist. Scientific progress is now dormant. It is very important for us to cooperate with research centers of the CIS and other foreign countries, especially with the research programs of ICARDA.

STATUS AND PROBLEMS OF LIVESTOCK DEVELOPMENT IN TURKMENISTAN

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The overall production of livestock in Turkmenistan is second to crop production and thus is very important for the food supply of the country. In 1995, 96,800 tons of meat were produced in Turkmenistan (21.5 kg per capita compared with the annual requirement of 41 kg), 706,900 tons of milk (157 kg per capita, compared with annual requirement of 180 kg), and 258.7 million eggs (57.5 eggs per capita). The farmers in Turkmenistan raise small ruminants, cattle, camels, poultry and pigs on public and individual farms (Table 1). However, sheep production dominates because climate, pastures and forage favor it. Pastures occupy a total of 49.1 million ha, of which 38.7 (79%) are desert rangelands of Kara-Kum where sheep and camels graze all the year round.

The Karakul (70%) and Saradjinsky (mutton-wool breed with white semi coarse wool) are the main sheep breeds. From the Karakul breed, black, gray and high quality golden Karakul is obtained. These fleeces are in great demand on international market. Turkmen Karakul is of very high quality because of the conditions of pastures, forage, and due to the fact that the sheep are on pasture all the time. It has a fine inner side consisting mainly of medium size curls, of the jacket (costate) type, with good silky and shining hair. The Ashgabat Institute's breeders have bred five new stud types of Karakul sheep: "Uchdjinsky" and "Ravninsky" of the jacket type, "Tedjensky" of the costate astrakhan black type, "Saradjinsky" gray, and the "Talimardjansky" golden color.

In 1994, the scientists of Turkmen Agricultural Institute succeeded in breeding a multifetative intravarietal type of Karakul sheep with lamb production of 121-123 heads per 100 ewes. The animals of the new stud and intravarietal types make a pedigree core of the breed and increase the total number on other pedigree and commercial farms. The production of first rate black Karakul constitutes 91% of state farm output and 78-80 % of collective farm output. The private sector farmers usually raise Saradjinsky sheep and do not slaughter lambs for Karakul. In the 1970s, production reached 1.2-1.3 million lambs per year, but

now the lamb slaughter for Karakul has decreased dramatically (300-400 thousand per year). The recent decline in production is due to a loss of international markets and the necessity to produce more meat. If there is a demand, Turkmenistan could supply the international market with unlimited quantity of different colors of high quality Karakul. Our objective today is to increase the total number of sheep to 13-15 million head. To achieve this, it is necessary to improve pastures and irrigated feed production.

Improving desert pastures and developing irrigated forage supplies are the main prerequisites for steady expansion of livestock on rangelands. At present the yield of pastures depending on rainfall varies from 0.06-0.1 T/ha of dry matter in the Northern and Central Kara Kum to 0.23 T in the South-Eastern Kara Kum. The average annual area of pasture per head is 9.4 ha. Out of all desert areas only 23.7 million ha (61.3%) have enough water to meet animal drinking requirements. At present, in winter and spring when animals do not leave the pastures frequently to drink water, 28.9 million ha (74.8%) of pastures are used, however, 25.2% of pastures are not used because of lack of water. The majority of pastures are used all the year round. In Turkmenistan, the pastures are distributed among the public sector farms but individual farmer's livestock also graze on the same pastures (it is more than 2.7 million head on January 1, 1996). In some regions, especially in the Central Kara Kum, this causes overgrazing and degradation of pastures. Further increases in the number of sheep might intensify this process and lead to greater desertification, especially in predisposed territories with drifting sands, such as the Central, Western, Northern and Zaunguz Kara Kum.

The Ministry of Agricultural Production and The Ministry of Nature Conservation have initiated activities to irrigate pastures and to improve them by sowing shrubs and semi shrubs. However, due to the lack of sufficient moisture (annual rainfall in Central Kara Kum is 80-120 mm) only 20-30% of them germinate. Thus, in the majority of cases this approach has not been efficient. In the Retepek Nature Reserve, belonging to the Turkmenistan Academy of Sciences saksaul (*Haloxylon spp*) was successfully introduced under normal rainfall (150 mm/yr and above), resulting greater forage production and enhanced stabilization of the sands.

The Livestock and Veterinary Research Institute obtained valuable results in its experiments in the Galatzmor State Farm of Kushka district

in the South-Eastern Kara Kum. On more than 200 ha they created agrophytocoenose by enclosing territory and sowing shrubs and semishrubs: *Haloxylon persicum*, *Salsola richteri*, *Calligonum L.*, *Aellenia subaphilla*, *Salsola orientalis*, *Seriphium cembrudikum*, *Kochia prostrata*, etc.

Due to lack of shrubs there are no winter pastures in the Western Kara Kum. Although the reserve of edible forage is great enough (0.25-0.3 T per ha), it is formed mainly by grasses. Research has proved that more productive pastures could be created by using identified high yielding cultivars. Many shrubs grow for 3-4 years resulting in yield increases up to 2-3 times and sometimes providing yield up to 2.3-2.5 T of dry matter per ha. The industry has been offered the most efficient option for plant composition, the agronomic techniques for their introduction,, and seed production technology. The farms were advised on the organization of seed production of wild shrubs and subshrubs. Putting into practice the proposals of the Livestock and Veterinary Research Institute in the South-East Kara Kum will result in doubling of the number of sheep and goats in the region.

Surveys were also undertaken in the mountain zone of West Turkmenistan and it was found that these pastures could be established there also.

Because there is a tendency to overgraze pastures, similar research would be very important in the Central, West, North West and Northern Kara Kum. However, research institutions of the TAAS are unable to undertake these tasks in the coming years since machinery, equipment and finances are insufficient. No funds are available to go to foreign countries to study their techniques to improve deserts by planting drought-resistant crops, or to buy seeds from world collections and carry out experiments. However, the task could be accomplished if finances are available to the staff of Livestock and Veterinary Research Institute. Research would also allow undertaking major ecological actions to stabilize sands, stop pasture degradation, and fulfil a significant economic program aimed at increasing the numbers of livestock and their production.

Developing techniques for growing salinity resistant forage crops using drainage water on watersheds outside irrigated zones is particularly important for Turkmenistan. Survey data have indicated the possibility

Table 1. Number of livestock and poultry at the beginning of the year, in thousands of heads.

Livestock	Total			In Public Sector		
	1991	1995	1996	1991	1995	1996
Cattle	829	1164	1181	362	365	336
Cows	331	477	534	90	87	81
Small ruminants	5477	6459	6500	3705	3900	3772
Camels	86.7	101	111.0	54.6	53.6	51
Pigs	267	122	71	240.4	115	63
Poultry	7393	4912	4137	4797	2476	1637

of getting 15-20 and more T per ha of green matter of halophytes which are good for feeding camels and sheep. According to calculations it would be possible to solve the problem of forage supply by preparing millions of tons of forage every year. Again, funds for research and obtaining seeds from world collections are needed. Using drainage waters for growing forage crops will result in reduction of the discharge from irrigated lands, which would be of great environmental significance.

Sheep and goats (Table 1) are now concentrated in public sector farms but there is a trend towards their augmentation in the private sector. The private sector started developing after the Republic obtained its independence. During 1990-95, the number of small ruminants decreased by 8.0% in the public sector, but increased by 25.4% in the private sector.

In the future, the Saradjinskaya breed most probably will dominate in flocks. It is a mutton sheep breed with a mass for a mature ewe of 55 kg, or 20-22% greater than that of Karakul sheep. For this reason the Government has decided to breed this sheep in all velayats (provinces) by creating a pedigree reproduction program in each region.

As far as Karakul breed is concerned emphasis will be placed on creating new commercial flocks, types, and lines. For the Saradjinskaya breed the breeding efforts have raised its fertility up to 115-120 lambs per 100 ewes.

The Government of Turkmenistan has worked out measures to increase the number of sheep and goats. The number in the private sector will grow along with an anticipated decrease in the public sector, and it is expected that all livestock will eventually be in the private sector. In the transition period a lease form of livestock management has been adopted which is carried out by an agreement with peasants' associations. The peasants are financially responsible for keeping the animals and do not get wages. Later, the peasant associations get 40% of the lambs and all the wool clipped from the flock. This method has proved to be efficient at several farms and it teaches the peasants to be owners.

Camel breeding goes well with sheep breeding and its development does not interfere with raising the number of small ruminants. On average there are 16-17 head of camels per 1000 head of sheep in Turkmenistan. On some farms this number is 35-40 head. The breed of dromedaries is "Arvana". Females of the breed weigh 500-550 kg, breeding males weigh 700-800 kg, sometimes up to 1000-1200 kg. As a rule, non-breeding males weighing 400-450 kg at the age of 3-3.5 years are slaughtered for meat. The milk yield is 800-1000 kg per female per year. Camel milk is processed for sour products - chal, agayran, and doyrán which are used for treating gastritis, tuberculosis, etc.

The Institute developed a method for the early weaning of calves - at the age of 9-12 months (normal age is 18 months). An increase in the number of camels is expected because of intensification of production and the changes in property rights.

In the irrigation zone, which constitutes 1.5 million ha, there are branches of livestock, poultry, and swine breeding. Ahalteke and Emut riding horses are also being bred for sports purposes.

In this zone 28.5% of the cattle are kept in specialized milk and feeding complexes and dairy market farms. Up to 90% of the production goes to industrial processing. Most of the cattle (71.5%) are kept on private farms. Production is mainly used for family self-support. In the past, the number of cattle per family was restricted to 1-2 head and they were not the main source of income. Since these restrictions have been eliminated, farms of 20-100 head of cattle have appeared, although their number is small and their share in milk production is only

10-15%. Nevertheless, the process of privatization is under way and the Government has worked out the reforms on property rights in this field. In the first stage, public livestock will be leased and then will be sold out. On several farms livestock has already been privatized, but industrial connection of the new farms with peasants' associations continue, as the associations supply them with machinery and buy their products. In 1994, such farms were established in a peasants' association named after S. Rozmetov of Dashhovuz etrap. Each family was able to buy 20-100 head of livestock at state prices. However there was a requirement to follow the state order and state prices while selling meat and milk. The association gave them irrigated lands (0.5 ha per animal head) to grow forage crops, machinery at wholesale prices, and helped them, whenever necessary, with services in preparing forage, zooveterinary, and agrochemical use.

Public sector mechanized farms exist that balance concentrate feeds from agronomic sources with fodder produced and stored from pasture. While a Veterinary Network also exists, due to the lack of motivation in the staff, a lack of a market economy, and the absence of a central command system in the economy, the public sector farms have not been able to achieve much. During 1991-1994, the network became unprofitable. In 1994 the losses in the public sector in milk production were 6.79% and in beef were 4.10%. In general, the production went down from 1990 to 1995: milk yields from 2551 kg to 2127 kg, meat from 398 kg to 320 kg, reproduction rate from 77 to 61 calves per 100 cows. However, the productivity in the private sector is still lower (by 850-900 kg) because of bad forage supply and non-availability of pure bred animals.

The following breeds of cattle are used in Turkmenistan: 25% Shvitz, 50-55% red Steppe and brown Latvian; 15% Cherno-pestraya. Now Cuban Zebu and Charolese breeds are being used for pedigree reproduction. They are well adapted to local climatic, epizootic and feeding conditions. Although the potential for dairy cattle production, based on data from the stud farms and the Institute, is 4000-4500 kg, it is not achieved because of a lack of forage.

The cattle are kept in an outdoor stall regime. It receives only laid-in fodder. They have virtually no access to pastures and furthermore the grasses die in May due to lack of rains. The amount of laid-in fodder

is steadily decreasing because of numerous problems such as: bad management, lack of machinery and lack of hybrid maize seeds, etc. However, the market economy is slowly being introduced into forage crop production. During 1994-95, hay resources were reduced by 12.0%, silage by 32.0%, forage by 1.0%, and feed units by 11%. Due to the shortage of grain ingredients the amount of mixed fodder has also dropped. Both the diversity and quality have deteriorated. Only 321,000 tons were produced in 1994 compared with 532,000 tons in 1990, and only three feed recipes were available in 1994 (compared with 14 in 1990). This is the result of breaking the established production system in the transitional period to a new independent state and new economy.

The program "Grain" is being completed in Turkmenistan now. The program will help solve the problems associated with livestock development and poultry breeding. In 1995, 880,000 tons of grain were produced which is 560,000 tons more than in 1990. Grain production is planned to increase to 1.250 million tons. Lease forms of work are spreading more and more in this sector. Up to 50 ha of land per family are given to farmers for constant use. At present 80,000 ha of land have been given out to farmers to use as they wish and dispose of the production according to their choice. The peasants get land and water free, get credits, machinery for tillage as aid, and they also get help in selling their produce. This Program is under special control of the President who encourages any measures which would help fulfil its goals.

Poultry breeding (mainly for egg production) is concentrated in nine specialized farms united in Ptitseprom, in collective and state farms, and in individual farms. Specialized factories and state farms which have incubators supply the private sector and small farms with hybrid chickens. In the past, poultry used to be supplied with industrially produced fodder. Presently, there are no pedigree studs for poultry. Until now, pedigree eggs came from the CIS countries (from crosses of Belarus-19, Zarya-17, Alatau-1) and were reproduced in the system of Turkmenptitseprom. Their delivery has been greatly reduced lately and the farms have now their own hybrids of II or III generations. Simultaneously, due to the deficiency of high quality mixed fodder enriched with premixes, the levels of poultry and egg production have declined, especially in the public sector. During 1991-95, the number of head decreased by 3,256,000 (44%) (from 7,393,000 head in 1991) and was reduced to only 4,137,000 million head at the end of 1995.

On the contrary, the private sector levels rose by 1 million head. Egg production during the same period was reduced from 300 million to 258 million eggs. For the same period, the share of private sector increased from 35.7% to 57.5%. Poultry production in 1994 was unprofitable with a loss of 46.3% per egg, although the free market prices were in operation. Now, the Government of Turkmenistan is undertaking complete privatization of poultry in the public sector.

Swine breeding is mainly practiced in public sector farms and is restricted to the needs of the sausage producing industry. There are three big swine breeding complexes in the country each of which is home to 12,000 head and produce 1,200 tons of pork. There are also some collective and state farms which have pigs. However, lately because of the fact that the local population traditionally does not consume pork and because of the deficiency in fodder, the numbers of swine have decreased from 240,000 in 1991 to 71,000 by the end of 1995. A lot of collective farms have been eliminated, and the complexes now work up to 30-40% of their capacity. The decision to privatize this branch has also been taken. It seems probable that this branch will lose its importance in near future.

Livestock production in Turkmenistan is being privatized. Within the period of 5-6 years, calculations show that if the conditions of animal feeding and husbandry are adequate, available livestock breeds will supply requirements of Turkmenistan with milk and dairy products (1.2-1.3 million tons annually), eggs (800-850 million), and with meat up to 70% of demand (210,000-220,000 tons).

The reform in livestock production, as well as in other sectors of agricultural economy, is taking place at a controlled pace under the supervision of the Government. The land, pastures, and irrigation water, which are owned by the state, are proved through finite leases to private farmers. The Ministry of Agriculture and Food Production, through both its central and local branches, is actively developing, adjusting and implementing these reforms. The TAAS and partially the Turkmen Agricultural Institute provide the required scientific research.

The TAAS, named after S.A. Niyazov, is autonomous and is not a part of the Ministry of Agriculture and Food. The plan for research institutions is approved by the Presidium and is carried out on a contract basis by the TAAS. Scientific research is accomplished in big breeding

farms. The focus of the research is to improve the breeding and production qualities of livestock, introducing new types/lines of livestock including poultry, and engendering a rational use of local resources. The Institute's recommendations to the Ministry are made free of charge.

About 100 researchers are working in animal husbandry, 75 of which are working in the Institute of Livestock and Veterinary Science, and of these 51 have scientific degrees. However, none of these individuals has English language capabilities. Research is conducted by experimental and production methods and in laboratories.

The breeding program has been continuously conducted on the same farm for a long period. Experiments for the developing of desert pastures are established sections of the farm depending on the region, pasture type, soils, and botanical composition of plants. The resulting improved pastures are given to a state (collective) farm for exploitation. Animal feeding and physiology experiments are done in laboratories. At present, the research in the system is financed by the Academy while that in other research institutions is supported by the state.

Due to the lack of funds, the Institute does not have experimental stations equipped with modern equipment to employ modern techniques for the rapid development of new highly productive breeds of animals and crosses of poultry. Multiplication efforts are also similarly limited. These conditions also limit the development of improved variants of pastures, identifying local feeding and mineral resources in order to incorporate them in stock breeding programs. Research institutions are in need of modern laboratory equipment and technologies for chemical testing of fodder and livestock products, producing experimental mixtures, additives, premixes, and biological and medicinal components.

The language barrier, scarcity of scientific networks are serious constraints on our researchers' ability to actively contribute to and participate in world science. Turkmenistan is unique with its climate and natural riches. Their extensive use for livestock development might provide stimulus to expanding food production of the country and to accelerate the needed reforms. The practical results would have the greatest impact if the problems of reform, supply of technical equipment, and adequate forage resource were solved in the entire country. However, this endeavor requires a major investment necessitating a gradual and planned approach.

THE SYSTEM OF ANIMAL HUSBANDRY: ITS STATUS AND DEVELOPMENT PROBLEMS IN UZBEKISTAN

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Animal husbandry is very important for Uzbekistan. The main effort in increasing its efficiency is intensification of the private sector (this is the sector composed of private farms), privatization of state and collective farms, development of peasants farms as well as further intensification of state pedigree livestock complexes, their conservation and the transition to joint-stock companies and corporations.

A number of important measures have been adopted by the government of Uzbekistan which outline the perspectives and practical measures to provide fundamental changes in the village, to bring back the peasant and the farmer as the owner of the land, to introduce new farming methods, and last but not least to solve the problem of food supply.

Cattle breeding occupies an important position in supplying Uzbekistan's population with livestock production. It is the main branch of animal husbandry, followed by sheep breeding, poultry breeding, horse breeding and others. Territorially these branches of animal husbandry are located in accordance with natural and economic zones of the country. Dairy production is concentrated in the farms of an intensive zone of irrigated farming mainly in outlying district areas of big cities and industrial centers. Meat production is important in the foothill and mountain zones of rainfed farming and in floodplain meadows of Amudarya. Sheep breeding (and its main subdivision Karakul sheep breeding) is found in the steppe and desert parts of Kashkadaryinsky, Surhandaryinsky, Navoiysky, Bukharsky, Djizaksky and Samarkandsky regions, whereas mutton wool sheep and goats are located at the foot of the mountains and in mountainous regions and also in collective farms of Fergana valley. Pig breeding and poultry are concentrated near big cities and industrial centers.

The main feeding bases for dairy cattle are the irrigated lands where alfalfa is grown for hay, and green forage, corn for silage and rootcrops and annual forage legume/grass mixtures in intermediate and recurrent

Table 1. The number of animals and production growth on private farms

Indices	1991	1993	1994
The number of cattle (in thousands heads)	3478.9	3874.3	4041.6
Cows	1685.1	1869.3	1925.3
Sheep and goats	4780.4	5244.0	5343.0
Horses	43.8	64.4	78.3
Milk production (thousand tons)	2366.2	2872.7	2899.1
Meat production (thousands tons)	482.3	563.5	610.9

sowing (in fall and summer). It should be mentioned that due to expansion of wheat cultivation, the area planted in the main forage crops on irrigated lands has been reduced more than three times. However, the same amount of feed production will supposedly be supplied at the expense of straw and other wheat residues and coarse and rich fodder on irrigated lands after wheat harvesting.

For raising beef, sheep, horses and camels the main feeding facilities are pastures and hayfields (the area of which is 22.6 million ha), and cereal straw (500,000 ha on rainfed lands). Before 1990 livestock development in Uzbekistan had an elaborate system of specialization, and concentrated on the industrial technology of milk and meat production. Big beef complexes were erected (for 6-12 thousand head) as well as dairies (for 400-800 cows). Pig-breeding and poultry complexes were functioning efficiently. However, during the last five years, the material and technical base of animal husbandry in state farms and complexes has deteriorated greatly due to poorly mixed fodder and low vitamin supplies. Thus, the production capacity is not fully utilized resulting in declining production and profitability. At present, livestock production is increasing in the private sector but decreasing in the public sector. The former is responsible for the expansion of production of meat and dairy products in the country. The proportionate number of cattle owned by farmers to the national total was 68.0% in 1991 and 78.3% in 1995. Cows were 79.5% and 84.2% in 1991 and 1994; sheep and goats were 47.2 and 56.7% respectively. The figures for milk production were 71 and 82.8% respectively and for meat production were 60.2 and 77.9% respectively.

Since 1993, the privatization of dairy cattle commercial farms has been under way. At present the number of cattle on privatized farms is nearly equal to that of the state farms. However, private farms have some unsolved problems - they have bad fodder supply and are under-equipped. In 1995 the number of cattle and the amount of meat and dairy products have decreased. From 1960-95 republic organizations and industries and livestock institutions made a big contribution to livestock intensification. During this period of time the livestock population grew by 2.4 times (cows, 2.6 times; sheep and goats, 1 million head), meat production increased by 2.5 times and milk production by 4.5 times. At the same time, the animal productivity grew, and more stud-farms were established. Pedigree work improved, better breeds of livestock were created, and thus its productivity increased. Presently, farmers are keeping pedigree cattle, sheep, goats, horses and poultry on farms of all types.

There is a well established management system in Uzbekistan through which policy is worked out and information is spread. The system consists of the following institutions: the main office of the Ministry of Agriculture for Livestock Breeding And Veterinary Affairs, and its regional networks; Myasomolprom (meat and dairy industry); Karakulprom (Karakul producing industry); Ptitseprom (poultry producing industry); Republican Association for Pedigree Work and its regional branches; and the scientific research institutes for stock-breeding, Karakul-breeding and veterinary medicine. Associations for scientific research, industrial implementation and research institutes of the Uzbek Academy of Agricultural Sciences (UAAS) provide research services to livestock intensification such as developing production technologies, improving the forage crops cultivars and cultivar agrotechniques, developing methods of animal treatment, and the creation of effective vaccines and serums, etc.

Other republican institutions for animal husbandry and their networks are supervised by the Ministry of Agriculture. They manage the production organization, extension of advanced research into public sector farms, private and individual farms. Research work is financed by the Republican Committee for Science and Technology under the Cabinet of Ministers of the Republic of Uzbekistan.

Specialized agricultural educational institutions are engaged in training zoo-engineers and veterinarians. Predoctoral and postdoctoral training is done in research and educational institutions.

There is a scientific base in the country for training research and teaching staff. In research and educational institutions there are a total of 450 research workers. Among them 38 are professors, 176 are Ph.Ds. and/or assistant professors, 8 academicians and corresponding members of the UAAS. However, very few of them can speak, read or write in English. This creates a major problem and necessitates the organization of short-term English courses with the help of certain scientific centers.

For animal breeding, scientists supervise the improvement of cattle breeds (Cherno-pestraya, Shvits, Bushuevskaya, Red Steppe, Kazakhskaya Belogolovaya and Aberdin-angusskaya), sheep (Karakul, Guissar for mutton and wool), goats (wool and down), horses (Karabair), pigs (Big White, Landras, Northern Caucasian), poultry (chicken and turkey). Thus a number of highly productive dairy and beef cattle, Karakul sheep of different colors, mutton larder and mutton wool sheep, wool and down goats, and chickens for eggs have been developed for Uzbek conditions. The pedigree and productive qualities of these animals greatly exceed those of the commercial farm livestock. However, it should be emphasized that only 60-70% of potential productivity is being presently utilized. The main reason for this is the low level of the animal feeding. Poor forage base and a low quality of mixed fodder do not allow the balanced feeding of animals or introducing intensive technology of livestock production though Uzbek scientists long ago elaborated such technology and made recommendations for its implementation. Its effectiveness is very high: as it could raise the productivity of animals by 20-40% and reduce the labor costs by 15-20%.

Researchers of Uzbekistan Scientific Research Institute of Karakul Breeding, Samarkand, have developed feeding schedules for animals and poultry which provide an increase in livestock products together with economic use of grain feed. Creating a solid feeding basis has always been and is still a problem of livestock production in Uzbekistan. Uzbek scientists aimed their research at finding new feeding resources and using preservatives and other ways to reduce the loss of nutrients during processing, storing and use. They have worked out techniques for preparing silage from stems and walls of cotton boll, wheat, barley and rice straw, field remains of kenaf, maize straw and others. At present as the wheat sown areas are expanding and feed crops are decreasing, it is very important to create and introduce into production technologies that produce few waste products. Huge amounts of organic matter

produced in fields (more than 6 million tons) such as straw, grain remainders, corn bobs and stem residues, kenaf boon, etc. should be processed and used for livestock feeding. They contain a lot of usable energy in the form of ligno-cellulose complex.

In Uzbekistan irrigated lands for growing alfalfa and corn still hold the most potential for enlarging the feeding base. Important actions to expand the feed base will require an increase in soil fertility by land improvement, effective use of mineral and organic fertilizers, and improved ways of growing high yield crops. In this area we have some research results and experience on the farms. High yield cultivars of feeding crops have been developed for the main, intermediate and recurring crop. They are alfalfa, corn, beetroot, oats, triticale, rye, etc. Intensive technology of feed production providing yield increases of alfalfa to 18-19 tons (100 kg of hay) per ha, corn for silos to 40-45 tons per ha, beetroot 80-100 tons, etc. has been developed. However, these progressive technologies are not properly introduced into farm production resulting in 40 to 50% less yields of feed crops.

At present, technologies for obtaining twice the yields of feed crops per hectare are being tested. The preliminary results indicate that the volume of feed crops could be augmented by about 10-12 tons of feed units which is 2-2.5 times higher than the average index for Uzbekistan.

For beef cattle breeding, sheep breeding and goat breeding both pedigree work and pasture improvement and their increase in productivity are important. In addition, steppe, foothill and mountainous pastures need improvement. Their present productivity is low and they do not supply feed to animals in fall and winter. Uzbek scientists in general, and those of the Institute of Karakul Breeding in particular, are now working to improve steppe pastures and hayfields. However, the work on the improvement of foothill and mountainous pastures and hayfields as well as water meadows of Amudarya for beef cattle breeding, mutton lard sheep and wool goats are not as intensive as they should be. There are no effective measures to augment the productivity of these pastures and hayfields. Here the animals graze very well in spring and at the beginning of summer but later the stock loses its productivity.

Scientific research institutes of the UAAS are in charge of the above mentioned research, but their equipment and machinery are not up to

the mark. They are also in need of contacts with world scientific centers for implementing the following scientific projects on animal husbandry and feed production:

- animal husbandry on private farms;
- genetic and biotechnical methods of improving animal breeds;
- intensification of irrigated feed production, pastures and hayfields;
- a system of integration of research and industry and implementing scientific achievements and advanced experience.

Research and extension of the above mentioned scientific projects require financial and technical support from world livestock and forage centers. It should be mentioned here that the young Uzbekistan Republic with its huge natural riches, ancient culture, and hard-working people has good prospects for further development and scientific intensification.

PROBLEMS OF FEED PRODUCTION IN KYRGYZSTAN DURING THE PERIOD OF TRANSITION TO THE MARKET ECONOMY

By K.T. Tynaliev

Kyrgyz Research and Production Institute for Fodder,
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The annual requirement for fodder in Kyrgyzstan used to be 7.0 million tons of fodder units. It was supplied from two sources — field production and natural forage. However, its annual production did not exceed 5.0 million tons which means that livestock husbandry suffered a shortage of two million tons of fodder units. This limitation was the main reason for its low productivity. Lately this tendency has been aggravated.

As a result of poorly planned farm animals privatization in Kyrgyzstan, the livestock population was cut in half. It also caused a decrease of similar magnitude in fodder storage which is now insufficient even for remaining animals. There is a shortage in mineral fertilizers and the supplies of grain forage from other republics have been curtailed. Moreover, the areas sown in forage are now being replaced by grain and technical crops. In this situation broad based scientific research on forage production in all agricultural systems regardless of their form of property is the only solution capable of making up for forage losses of the Republic.

In 1980-90 the growth of the areas under the forage crops was only 24% but fodder production almost doubled. This remarkable increase is due to the application of scientific recommendations. Therefore scientific research is a comparatively easy and inexpensive way to increase fodder production in the Republic. According to our research one of the major ways to increase the yield of field fodder production is the introduction of the rotation of forage crops, but it is rarely used on the farms. The correct rotation of the crops alone, without any extra expenses, could provide 20-30% yield growth. This is the easiest and least expensive option for increasing the farm fodder resources.

In our research on rotation of crops the main rotation was legume-cereal-grass which is used for no more than three years. Its yield is 20-24 tons per ha of hay while the average yield on the farms of the republic is 6-7 tons per ha. Thus, the reorientation of all the farms and

peasant holdings to sow perennial grasses for no more than three years is another substantial option to increase fodder production in Kyrgyzstan.

The researchers of our Institute also have developed the best legume-cereal-grass mixture suitable for all zones of the Republic. It makes it possible to obtain a 25-30% increase in the grass yield compared to the areas sown purely with alfalfa and sainfoin. According to our estimation the annual shortage of legume protein in Kyrgyz livestock breeding is more than 100,000 tons which leads to the ineffective use of 260,000 tons of fodder units. It has been scientifically proven that in the Chui and Fergana valleys, sowing a mixture of maize and soy beans, could result in 60 tons of green matter per ha with 50% growth of protein concentration. To have our own soybean seeds, the Institute has developed the technology of growing this protein maize that enables us to get a yield of 2.8 tons per ha. By bringing the proportion of combined sowing up to at least 50% we would be able to decrease the shortage of fodder protein in livestock breeding. As you can see, the wide range introduction of the above mentioned recommendations is a very important reserve for increasing the forage production.

Rangelands are another source of forage production in Kyrgyzstan and presently they are the main source. Their area is 9 million ha or more than 86% of all the agricultural area. Unfortunately, the ranges are in a bad condition now. More than 3 million ha of range are contaminated with weeds and 1.7 million ha are degraded. The problem is that the livestock load per ha of ranges reached 3 agreed sheep head (compared to 1 agreed sheep head in the countries of CIS). Significant overgrazing of the ranges leads to the yield decrease, 0.4-0.5 tons per ha comparing to 0.89 tons in the 1960's.

The scientists of the Institute have succeeded in improving the range management. The frequency and longevity of grazing and the carrying capacity on the ranges have been considered. So called simplified pasture turnover has been developed and introduced in every agricultural holding. According to those schemes 20-25% of summer pastures should be left for "rest" or later grazing. Studying the resting lands on big ranges we have observed that in several years the grass stand almost restores itself and yields increase. The additional yields on the protected lands in the Osh district made up 0.18 tons, in Issyk-Kul – 0.15-0.3 tons and in Chui 0.2-0.3 tons of dry matter per ha. During the last five

years practically all the summer pastures of the Republic were rested for a set period and their yield capacity restored.

Effective measures for weed control have been developed. The main weeds are caragana (*Caragana sp.*), hellebore (*Helleborus*), horse sorrel (*Rumex confertus*) and tarragon (*Artemisia dranunculus*). The scientists for the first time expanded their focus from the small experimental plots to vast areas to deal with weeds. Recently using the low toxic herbicide "Sangor" in Issyk-Kul district, 900 ha of land were cleared of caragana and 800 ha were cleared of hellebore. Also tarragon in Susamyr and horse sorrel in Osh district were effectively exterminated. The spring-fall pastures of the republic are in the worst condition. The problem is that in spring and fall all the animals are grazing there and the animal density reaches 5-6 sheep per ha. For this reason their productivity does not exceed 0.2-0.3 tons per ha.

The researches of the institute made efforts to improve spring-fall pastures using the seeds of drought resistant arid crops, such as prostrate summer cypress (*Kochia prostrata*), crested wheat grass (*Agropyrum pectiniforme*) and lomkokolosnik. The main varieties of the crops were developed by our breeders. We have concluded that prostrate summer cypress and crested wheat grass give the highest yields in the South and crested wheat grass and lomkokolosnik in the North. During the last seven years, 30,000 ha of pastures have been created on degraded rainfed spring-fall rangelands. Their longevity is 15 years and productivity is 2-2.5 tons of dry matter per ha, that is five times greater than the yields of unimproved rangelands. In the Southern part of the Republic, pastures of this kind cover the area of 10,000 ha and in the Ravat valley (Batken region) prostrate summer cypress has been sown on 1000 ha. The prostrate summer cypress and in some parts both prostrate summer cypress and crested wheat grass pastures have been created in the North. In the Kenes-Anarkhay cattle breeding station 400 ha of crested wheat grass have been sown.

The researchers of the Institute have developed a new technology for creating and using irrigated pastures for horned cattle, the productivity of which is 8-9 thousand tons of fodder units (40-50 tons of green matter per ha). To create such pastures and to provide the optimal sugar protein ratio, a blend of legume and grass crops have been recommended. Fertilizer application with a lowered ratio of nitrogen and methods of improvement of the physical conditions of

soils using special ploughing has been proposed and new brands of electric herders provided. The longevity of such pastures is four to five years. As fuel and lubricant prices are expected to rise more, all the holdings and private farms will need such pastures.

For a number of years our researchers have been recommending that dairy cattle graze on the natural mountain rangelands in several farms of Issyk-Kul district using a new brand of electric herder which provides for the fencing of 250 ha of rangelands. This herder is also used for night grazing of dairy cows.

There are more than 100,000 ha of arable land suitable for ploughing in the republic. They are located in high mountain valleys at altitudes of 2000 to 2300 meters above the sea level. They are Kara-Kujur, Alay, Arpa, Ton and Jetti-Oguz natural boundaries. In these valleys farmers have grown annual grasses and barley for years. Due to annual tillage and sowing, the farms bore huge expenses and lately because of an increase in the price of fuel and lubricants they are no longer used. However, there are techniques developed by the Institute that could radically change the situation. These techniques involve creating sown irrigated hayfields with perennial grasses (wheat-grass (*Agropyron*), brome grass (*Bromus*) and black-eyed Susan (*Rudbeckia Hirta*) which provides 4-6 tons per ha of hay. The longevity of such hayfields is five to eight years.

Unfortunately the state and collective farms of the Republic have paid very little attention to this research and kept on sowing annual grasses. The reason for this was that the perennial grasses do not produce good quality hay cutting mass during the first year and for the better rooting of the plants it is not recommended to graze on them. But starting from the second year the hay harvest reaches 4-6 tons per ha.

It would be relevant to mention the difference in approach of people from public and private sectors. Having seen the advantages of the perennial grasses methods created by our researchers the owners of the private farm "Lakhol", in the Kara-Kujur natural boundary of the Tyan Shan region started sowing perennial grasses. The results of the research of the Institute have an enormous potential to increase the productivity of pastures there. Their practical application could significantly improve the forage resources of Kyrgyzstan. Considering the fact that alfalfa

is the most significant fodder crop, our Institute aimed all its research efforts to increase the productivity of alfalfa seeds.

Our Republic used to be the biggest producer and supplier of alfalfa seeds to the countries of CIS. However, its yield remains low in Kyrgyzstan: 0.17-0.24 tons per ha. In alfalfa seed production technology, pollination, pests, and disease protection and weed control present the biggest problems. Our researchers have developed the technology that allows us to obtain 0.3-0.4 tons per ha of alfalfa seeds of local landraces. Taking into account significant (almost 20%) alfalfa seed losses during the seed processing we offer a new technology of seed cleaning which would use the existing equipment and provide a minimum loss - from 1 to 5 per cent.

In spite of temporary difficulties in the alfalfa seed market at present time, it will be the main crop in Kyrgyzstan crop production in the future. That is why our Institute is carrying out the research on improving the technology of cultivation of Northern varieties of alfalfa, the seeds of which are expected to be in demand in Russia, Baltic republics, Belorussia.

As you can see using the results of our research, the newly established peasant holdings could quickly increase the production of low-cost fodder and restore the number of heads of livestock in Kyrgyzstan. Logically the farmers in their efforts to improve their business should be looking for our services. Unfortunately they do not understand it yet. Some of them do not have enough knowledge and financial and technical opportunities, others simply are not aware of the scientific achievements. The majority of them do not think about the future, living and working they consider only today's needs. As a result, the production suffers and researchers keep working as usual in vain.

At the same time the above mentioned scientific recommendations which were not accepted by the old command system are suitable for newly established farms and peasant holdings. The problem is their practical extension. Due to this we have made a decision to change the existing extension system.

Look at how these problems are solved in the United States. There every county has a team of specialists of 15-20 people dealing with

the extension service who introduce the results of scientific activities that they receive from the universities. The work of these teams is financed from the state budget built from the taxes paid by the farmers. The Kyrgyz government intends to organize the work of the Ministry of Agriculture and its district and regional offices to put scientific achievement into practice considering this experience.

We are very grateful to our colleagues from Small Ruminant CRSP and ICARDA for their initiative in organizing this workshop. We believe that such meetings will contribute to restoring and strengthening our scientific relations and provide a rise of agriculture in our countries under the market economy.

RESOURCE PRESENTATIONS



IMPACTS OF DECOLLECTIVIZATION ON RANGELANDS AND LIVESTOCK MARKETING IN CENTRAL ASIA¹

By Carol Kerven and Roy Behnke
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RANGE AND LIVESTOCK POLICY RESEARCH ISSUES FOR CENTRAL ASIA

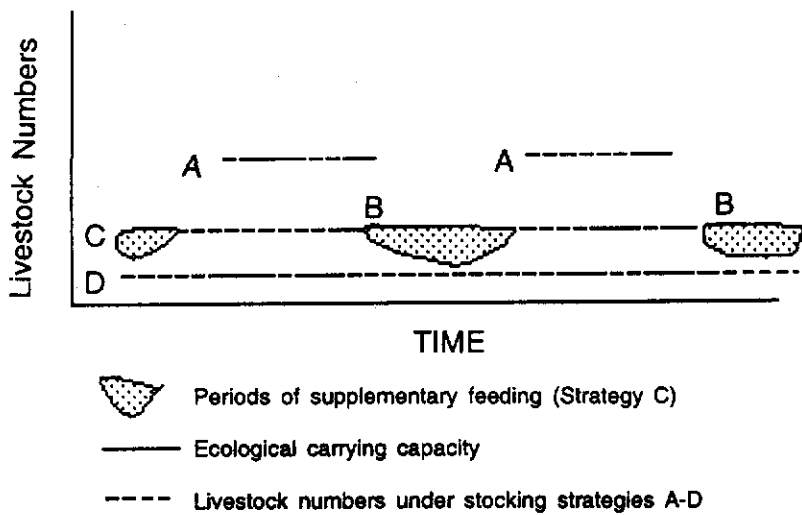
Anticipating the policy and research implications of the fundamental changes now occurring in the range livestock sectors of Central Asia requires a framework for analysis. The economic and environmental repercussions of new production systems now emerging cannot be foreseen in detail and - in all likelihood - these systems will not generate comparable benefits and costs. One way of constructing such a framework is to examine the characteristic problems, which beset different types of range livestock production. Whatever the future may hold, these problems are unlikely to completely disappear. Focusing on these problems will provide a relatively stable context for evaluating policy and research options.

For management of range livestock, perhaps the most persistent problem is balancing livestock feed demands against feed supplies. Natural pastures rarely produce constant quantities of animal feed. Many rangelands are used for grazing precisely because they are too dry or rainfall is too unreliable to support other forms of agriculture. Rangeland production is also severely limited by seasonal restrictions on plant growth caused by fluctuations in moisture (in the tropics) or temperature (in temperate zones, or at high altitudes). Because they rely on natural forage, extensive livestock producers must find some way of adjusting to these fluctuations in primary production by bringing the feed requirements of their animals into line with available supplies.

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Figure 1: Alternative stocking strategies within a defined grazing area



Ranchers and pastoralists have a limited number of techniques for reasserting these balances. Figure 1 illustrates the common alternatives. The solid line in Figure 1 represents changes in livestock carrying capacity in a particular region due to the effects of unpredictable weather or regular seasonal changes. The dotted lines A, B, C, and D represent different stocking strategies - which emphasize either herd mobility, stock sales, feed supplementation, or conservative stocking rates - employed by producers in response to environmental fluctuation.

We first examine each of the four alternative stocking regimes depicted in Figure 1. We then turn to a brief discussion of the research which might facilitate the operation of different stocking strategies in Central Asia, and close with an examination of rangeland degradation, an issue of general concern under all stocking regimes.

Strategy A — Herd Mobility

High stocking rates are insupportable within the geographical confines of any single grazing area subjected to massive swings in rangeland productivity. As suggested by the discontinuous dotted line representing Strategy A, the long-term sustainability of this strategy is contingent upon the exploitation of grazing resources outside the area depicted in Figure 1. Put simply, under strategy A, animals walk away from their feed problems by seasonally or intermittently migrating between a number of grazing areas.

Figure 1 also suggests some of the ways in which migratory livestock husbandry contributes to high levels of national and regional livestock production. With the partial exception of the 'tracking' strategy B, none of the other stocking regimes depicted in Figure 1 are in a position to maintain sufficient animal numbers to consume surplus primary production during localized periods of peak carrying capacity. If they can efficiently 'mop up' these surpluses, migratory stock can contribute significantly to total livestock output.

CENTRAL ASIAN RESEARCH ISSUES: SERVICE PROVISION TO DECOLLECTIVISED, MOBILE LIVESTOCK-KEEPERS

In Central Asia migratory stock husbandry is a response to a heterogeneous grazing environment in which different grazing zones reach peak carrying capacity at different time periods (Gilmanov 1995; Nikolaev 1989). Mobile herds can then move from zone to zone, region to region, avoiding resource scarce periods and exploiting optimal periods in each area they use. Environmental gradients of this kind have promoted both "meridional" (cross-latitude) and vertical (high-low altitude) migrations, concentrating on access to water supplies in summer and fodder in winter, over distances from 1500 to a few kilometers (Alimaev et al. 1986; Khazanov 1984; Schillhorn van Veen 1995).

These movements may permit mobile livestock producers to maintain, within a wide geographical region, a total livestock population and levels of productivity in excess of that which could be sustained by several separate herds confined to their individual areas (Behnke and Scoones 1993). This "in the language of modern specialists...[is] the basic law for the rational use of pastureland" (Alimaev et al. 1986). Pastures are used from the onset of maturity up to the time of their greatest productivity, and then abandoned before excessive damage is caused by either trampling or grazing. Envisaged here is a form of industrial nomadism which employs modern organizational techniques and inputs and uses seasonal pastures on a wide geographical scale (Asanov and Alimaev 1990).

Research on land tenure, fodder utilization and the environmental impacts of seasonal grazing would address the technical underpinnings of industrial nomadism, and are discussed later in this paper. What remain are institutional questions regarding the organization of pastoral

communities vis-a-vis local government, to facilitate service delivery to dispersed pastoral households. Central Asian governments have considerable experience in providing services to semi-nomadic populations, but rural settlement patterns, government funding levels and local community organization are changing (van Leeuwen 1995). Outside Central Asia, NGO's, multi- and bi-lateral donors have pioneered new methods for servicing remote, mobile populations (Scoones 1994). Discussions of service provision and financing for Central Asian pastoralists could fruitfully begin with a comparison of these very different sets of experiences.

Strategy B — 'Tracking'

Strategy B depicts a production system in which livestock owners refine their capacity to off-load or acquire stock according to forage availability. As in the migratory strategy, livestock leave the local grazing system, in this case primarily through disposal or death rather than relocation. Effective and rapidly responsive marketing systems are therefore crucial to this stocking strategy. What is required of these marketing systems is a capacity to absorb massive fluctuations in throughput, thereby relieving grazing pressure, preventing wastage and helping to stabilize producer prices. Markets appear to perform these functions fairly well when forage scarcities and peak sales periods are seasonally determined and regular, as in North American cow-calf production systems. Markets are less accommodating when unpredictable events such as droughts or catastrophic freezes cause sudden feed scarcities, leading to sharp increases in livestock product prices and/or reduction in output. Some cushioning to stabilize producer and consumer prices may then be necessary.

CENTRAL ASIAN RESEARCH ISSUES: NEW SYSTEMS OF LIVESTOCK AND LIVESTOCK PRODUCT MARKETING

Until recently, output from the extensive livestock sectors of Central Asia was geared to the requirements of a large and secure domestic market - the Soviet Union - which subsidized the cost of cultivated (and usually irrigated) fodder in return for wool, meat, leather and dairy products at below-world prices (Marks 1992). Demand patterns for livestock products have altered radically, both within the newly independent republics and internationally, since the break-up of the Soviet Union (Foster 1994; Theunissen and Kimmo 1994).

Domestically, the costs of producing meat, wool and milk have risen enormously, as state subsidies are reduced. Liberalized markets have meant that product prices have risen and demand for meat and dairy products can no longer be met at prices many consumers can afford. International competition, especially from Australian fine-fleece wool, has meant a sharp decline in the market value of wool for Central Asian producers (Abdurasulov 1995). China rather than the FSU is now the major purchaser of Central Asian wool (Çeviköz 1994; International Wool Secretariat 1995). Demand for Karakul lamb pelts, the major livestock output from Turkmenistan and Uzbekistan, is also subject to international fashion trends.

Producers, now with some choices in how to manage their livestock (Kaliev et al. 1994), have responded in several ways to the cost-price squeeze and changing demand patterns. Some producers have switched from fine-fleeced wool breeds of sheep to local meat and tallow breeds, which are less dependent on expensive cultivated fodder (AGRER 1994b). Producers gain more profit from domestic sales of meat and dairy products at open market prices than selling wool at depressed prices to international markets. Other livestock producers prefer to sell through unofficial (thus unrecorded) channels to cross-border markets (as was found in post-independent Mongolia; Kerven 1993). What appears as a massive de-stocking through deliberate slaughter (ULG 1994c), may be partially accounted for by the sub rosa emergence of high-value regional or international trade in animal products in Central Asia (Duncan 1994). A further choice being made by some producers is to withdraw from a market in which input and output prices are highly volatile, and retain an increasing proportion of their own livestock products - this is recorded for Mongolia (Humphrey and Sneath 1995).

Strategy C — The Supply of Additional Feed Inputs

Strategy C describes a situation in which farming and pastoralism are closely integrated, either through market exchanges or mixed systems of agro-pastoral production. Supplementary feed can come in several forms - crop residues, specially cultivated forages, or manufactured feed supplements and concentrates. Historical precedents worldwide suggest that agro-pastoral intensification through supplementation can lead to dramatic improvements in rangeland output (McIntire et al. 1992; Pingali et al. 1987).

There are, however, a number of potential constraints that must be overcome. If producers are to cultivate their own forage, then they need access to land suitable for cultivation, and yield fluctuations from that land must occur asynchronously or be less variable than production from surrounding natural vegetation. If intensification is based on irrigation, there arise questions about the costs of water, the maintenance of infrastructure, and the environmental costs. When herders purchase rather than produce their fodder, these technical considerations as well as fodder transport costs are reflected in the sale price of feed. It then becomes a question of how much fodder a herder can afford to purchase given prevailing prices for livestock products, and how this fodder can be most effectively used, given other sources of feed available to the herd operator.

CENTRAL ASIAN RESEARCH ISSUES: FODDER PROVISION - EXTENSIVE VERSUS INTENSIVE LIVESTOCK HUSBANDRY

Winter fodder supplies are the limiting constraint - the scarcest resource in the harshest season - for Central Asian livestock production (Babaev and Orlovsky 1985; Khazanov 1984). Western donors involved in Central Asia have identified inflated fodder prices and diminished supplies as probable outcomes of agricultural privatization, as subsidies are removed and the real costs of production become evident (ULG 1994a). Rising prices for human food grains have also induced producers to abandon the cultivation of lower value livestock feed crops. As production costs increase, the demand for fodder by livestock producers may also be falling, as herd owners discover that they cannot afford to use large quantities of expensive fodder unless they also receive much higher prices for livestock commodities.

These changes have ramifying effects that are at present poorly understood, but appear to alter the comparative advantage of different classes of producers and different livestock feeding regimes.

In settled areas, sharp increases in the cost of fodder have resulted in poor livestock nutrition and declining output (Medeubekov 1995). Comparable problems may be experienced by herders located in colder or high altitude regions if they lack grazing rights to low altitude winter pastures, by those without supplementary income (ULG 1994a) and by those who own small, commercially unviable flocks. As output falls

and incomes deteriorate, these disadvantaged producers may be forced to disinvest through animal sales and slaughter until only a residual herd remains to provide supplementary food for the family (Howell 1995).

Other classes of livestock producer could be prospering under the new conditions. The beneficiaries may include:

- i) flock owners located in open-range areas with year-round access to pastures
- ii) owners with supplementary sources of income (from wages or private business) who can afford to invest in their flocks by purchasing winter fodder
- iii) individuals who are able to accumulate large flocks that - despite low profit margins per animal - can generate net revenues large enough to sustain the families dependent on them.

For all these types of flock owners, weathering the storm of fodder price inflation may bring prosperity in the long run, when input and product prices eventually adjust. How these developments affect local areas or particular classes of producers, or their ultimate effect on levels of output, remains uncertain. Further research is called for.

Equally important will be studies which explore the technical and economic efficiency of alternative feeding regimes, under the new national and international conditions. Without clear research results, both local officials and outside advisers will, in all probability, favor intensive systems of livestock husbandry (Medeubekov 1995; Landell Mills 1994b). These systems are common in advanced industrial countries, are perceived as modern, maximize output per animal, and justify contracts to develop infrastructure or supply inputs.

Less intensive feeding regimes may, however, offer advantages that are obscured by a fascination with the most advanced technologies. A case in point is provided by the use of fodder for maintenance or survival in husbandry systems based on a mix of natural and cultivated feeds. In these feeding regimes, supplementary feed is not used to increase animal output, but rather to maintain animal numbers through the period of greatest nutritional stress. The productive and reproductive phase of herd growth then occurs in more favorable seasons, with the largest possible herd, and is sustained by abundant supplies of inexpensive

natural forage. Despite relatively modest levels of output per head in these semi-intensive systems, low production costs may support profit margins which are better than those produced by more intensive feeding regimes.

Strategy D — Conservative Stocking

The low stocking rates depicted in Strategy D exemplify the husbandry practices of some freehold commercial ranchers or ranching corporations with sufficient capital to forgo immediate profit, and with the legal right to exclude other producers from private ranges. Because stocking rates are low and feed is plentiful, output per livestock unit from these systems tends to be quite high. But output per unit land area may be modest in comparison with more intensive or mobile forms of range utilization (Behnke 1985; Behnke and Abel 1996; Ruthenberg 1980).

Private land holdings big enough to support a family therefore tend to be large, and the total number of people that can be supported on the land declines. Conditions conducive to this form of range exploitation arose historically in European settler economies - in parts of North and South America, Australia and East and Southern Africa - where settlers were few and large segments of the native population were excluded from land ownership. More densely settled rangelands in the Old World may provide a less favorable environment for large ranches.

CENTRAL ASIAN RESEARCH ISSUES: RANGELAND TENURE UNDER DECOLLECTIVIZATION

The privatization of agricultural land is being promoted as an essential component of economic reform (ULG 1994b:33; Landell Mills 1994a; Boye-Lord 1995). Some EU/TACIS advisers would like to see the introduction of rotational grazing under fenced conditions, on the Australian ranch model, and view unfenced open pasturing as "traditional" behavior. The standard argument is that individual land ownership and range enclosure will encourage on-farm investment, provide collateral for agricultural loans, increase output and provide incentives for rangeland conservation.

There are also, however, a number of technical considerations which apply particularly to rangelands and urge caution. In Central Asia, periodic localized shortfalls in natural feed supplies are a recurrent problem. Non-exclusive rangeland tenure regimes solve this problem by giving herders access to a variety of distant communal pastures, which facilitates herd movement. When feed is insufficient in one place, livestock rather than fodder are relocated. If rangeland is subdivided and access to distant pastures is restricted, then livestock must stay where they are and feed must be grown and brought to them. This is the system which developed under collectivization, with irrigated fodder production and mechanized transport compensating for declines in herd mobility.

Decollectivization and further subdivision of the rangeland into private holdings would likely *increase* the dependence of individual small livestock owners on cultivated fodder. This would occur, however, after economic liberalization had increased the costs of mechanized transport, threatened the availability of cheap fodder.

The impact of rangeland subdivision will also differ according to the scale of the enterprise. Individuals who, by one means or another, can gain exclusive rights to large areas of rangeland could prosper, by incorporating sufficient ecological diversity within one ranch such that livestock can be rotated between different kinds of pastures. It is rather the small livestock owners who would be disadvantaged by rangeland privatization, by increasing their vulnerability to input and output markets which have either broken down or are evolving quickly and unpredictably. This is precisely what has happen in parts of Inner Asia, where the most severe rangeland degradation has occurred are areas where grazing lands were privatized and subdivided into numerous small holdings (Humphrey and Sneath 1995).

Current economic theory suggests that there is little to be gained from privatizing natural resources that are intrinsically difficult to subdivide, or are of low or erratic productivity (Bromley 1989; Ostrom 1990; Runge 1981; Wade 1987). Both past and present attempts to administer rangelands generally confirm this position. In pastoral Africa, by far the most durable systems of property and resource control have been "customary" tenure systems managed by rural communities in response to changing commercial, political and demographic conditions. In the western United States and semi-arid Australia rural ranching

communities managed their own rangeland tenure systems, sometimes for well over half a century until appropriate formal legislation could be enacted (Dobie 1980; Hartwell 1955; Osgood 1970; Shann 1930; Webb 1931). Little is yet known of comparable indigenous institutions in pastoral Central Asia. For purposes of practical rangeland management, there exist few theoretical or methodological certainties that can substitute for such knowledge.

Rangeland degradation

The preceding discussion has considered research issues for particular stocking and production systems. But cutting across all these systems is the issue of rangeland degradation. Relevant to the success of almost all stocking strategies, this is an issue of general concern irrespective of the prevailing type of stocking regime.

The global significance of Central Asian rangelands is appreciated, as is the responsibility of both the international community and national governments in their management (Gilmanov 1995). Despite these concerns, important questions about the extent and causes of degradation remain unanswered. Either singly or in combination, arable farming, nomadic settlement and the sheer weight of livestock numbers have all been implicated by various regional and international authorities as agents of localized and/or generalized degradation. No single, authoritative interpretation prevails.

Some argue that excessive livestock numbers and overgrazing are to blame and that the effects are widespread (Gilmanov 1995; World Bank 1993a and b; Abdurasulov 1995; Medeubekov 1995). By some accounts, up to 60% of the arid areas of Central Asia are subject to desertification caused mainly by overgrazing and the cutting of fuel wood (Babaev and Kharin 1992; Kurochkina 1995).³

Other analysts point to arable farming as the source of damage, particularly the Soviet policy of increasing the cultivation of marginal

3 Desertification here is defined in terms of vegetation degradation (changes in species composition which lower the productive yield for livestock), wind and water erosion, salinization of soil (particularly as a result of poorly-managed irrigation) and causes which are technical, e.g. by mineral exploration or construction (Babaev and Kharin 1992).

land subject to wind erosion (Asanov et al. 1992; Maul et al. 1993; Rozanov 1990), and the removal of crop residues for livestock feeds, a practice which has reduced soil organic matter by an estimated 28% in the last quarter of a century (Maul et al. 1993).

Finally, a number of senior range experts in Central Asia have argued that the degradation of pasturelands in Kazakhstan is "not so much because of saturation in numbers of animals and increase in the loading [stocking rate] per unit of area of pastureland as because of unsystematic grazing" (Alimaev et al. 1986: 14). "Unsystematic grazing" refers here to the early and continuous use of pastures so that the vegetation has no opportunity to grow and re-seed, as a result of policies to reduce livestock mobility by concentrating animals and herders around water points and within settlements. By confining livestock within the "fixed boundaries" prescribed under the collective system of farming, vegetation zones which had been used once or twice a year, were subjected to grazing three out of four seasons, or year-round, to the detriment of both the soils and vegetation (Asanov and Alimaev 1990:38). Much the same argument has been advanced for Kyrgyzstan (ULG 1994a).

Rangeland degradation and desertification were topics of vital concern to Soviet science in Central Asia, as they are to the donor community today. An assessment of the empirical legacy of this Soviet environmental research would be a major undertaking. Despite the difficulties of bridging both theoretical differences and historical changes, such a review might provide our best chance of estimating the probable environmental impact of current economic changes. It is also a project that Central Asian and Western scientists could undertake from positions of mutual respect and comparative advantage.

THE FUTURE

Many issues arising from decollectivization and a new market economy for land and livestock have not yet been closely studied, while national policy-makers and international donors demand guidance and information. Important decisions with long-term implications are being made now in the context of a policy debate about the future organization of agriculture undergoing transformation. This is a period in which insights and findings on the processes of change at the household level could contribute to a critical debate.

The challenge now is to carry out policy-relevant research in an environment in which prices, husbandry systems and institutional arrangements are all changing. Research is needed to discover how producers are responding to rapidly-shifting economic parameters. Which choices pastoralists make will have a cumulative effect on people's lives, national economies and trade patterns. The direction and impacts of these trends are at present unclear. Only when there is sound knowledge of how the new pastoral livestock husbandry systems are evolving can relevant advice be given on how to develop the extensive livestock sector in Central Asia.

But it is not only the economic and institutional environment which is altering. When political or economic circumstances enforce sub-optimal management methods, livestock can also cause environmental damage. Large tracts of open rangeland and more valuable irrigated areas have been degraded and their productive capacity thus undermined, by the more intensive livestock husbandry and fodder cultivation enjoined by the Soviet governments. With mobility reduced, animals were kept at a higher density for longer periods of time on the same pieces of land. Increased grazing pressure, as animals were no longer moved quickly over the land, has meant a reduction in plant species diversity. Soil erosion by wind and water followed from the ploughing up of grasslands to be replaced by fodder and food crops. Now there is the added pressure of labor and input costs, which means that owners, even if they wished, cannot always afford to take their animals to faraway pastures, or to feed them supplementary food. As a result, grazing pressure has increased around settlements. These are important environmental considerations which need to be researched at the local level, as changing economic factors bring new hazards but also new solutions to the conservation of natural resources in Central Asia.

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NEW CHALLENGES FOR THE LIVESTOCK SECTOR IN CENTRAL ASIA: OVERCOMING OLD LEGACIES AND ADAPTING TO NEW POLICIES, MARKETS AND FARMERS

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SUMMARY

After independence in the early nineties, the Central Asian republics are facing the challenge of restructuring their economy, including the agricultural sector. Livestock production has been a major part of the sector and, considering the climatic conditions and (range) land resources, as well as an expected diversification of crop production.

Many of the problems in the livestock subsector are related to the legacies of the previous central plan economy with assured (export) markets, imported feed, low transportation and heating costs, and disregard for the environmental consequences of intensification. In order to increase the efficiency and sustainability of the production systems attention needs to be given to (i.) market responsive production; (ii.) increased production efficiency; (iii.) sustainable use and quality control of rangelands and (iv.) the restructuring the support services. Some countries, such as the Kyrgyz Republic, have indeed advanced in restructuring, but at considerable economic and social costs.

The transition is likely to be difficult and lessons can be learned from experiences in other countries, either former Soviet Union countries, or others. Major assets of the Central Asian agricultural system include the relatively well educated human resources, and the availability of feed resources and adapted animals. However, there is a need to increase efficiency in the use of feed and fodder, and in particular in sustainable rangeland use. Recommendations are made regarding the more efficient use of these resources.

¹ The opinions expressed in this paper are those of the author and do not necessarily represent those of the World Bank and its affiliates.

Processing of animal products and marketing are considered a key in the development of the livestock sector, and it is recommended to pay more attention to marketing in general, and specifically to market development and quality control.

Finally, the need for supporting research is highlighted. The livestock research systems in the various Central Asian countries may have to be made more efficient through consolidation and re-programming, and the research itself should be farmer-responsive, and help farmers, many with very limited experience, to accommodate the challenges of the transition.

INTRODUCTION

Livestock production, especially of sheep, cattle and horses, has been the mainstay of agriculture and rural life in most of Central Asia. The reasons are obvious as the continental climate, with a low (typically less than 300 mm.) rainfall, preclude intensive agriculture, except in areas where additional water sources allow irrigation. Over 50 % of all land in Central Asia is classified as rangeland, and most of it is arid grazing land (table 1). These conditions, combined with a low population density, allowed extensive exploitation by pastoral people. During the last century, however, this system changed, mainly imposed by Russian occupation. Further drastic changes took place in the former Soviet Union from 1920-1960, leading to a centrally planned economy, collective farming and state controlled marketing.

After 1990, Central Asia as well as southern Russia, Mongolia and western China are facing major changes associated with the collapse of the Soviet system and/or a central plan economy. These socio-

Table 1. Distribution of grazing lands in Central Asia, Mongolia and China

	Total range / grazing land (HA)	Percent of all land	arid (%)	mountains (%)
Kazakhstan	270,000/186,000	67	70	11
Kyrgyz Republic	19,600/ 9,100	46	5	95
Uzbekistan	29,000/ 23,300	52	85	15
Tajikistan	14,250/ 3,500	2	10	90
Turkmenistan	49,500/ 35,900	83	89	11
China (pastoral regions)	361,770/ nd	52	nd	nd

Data: FAO 1995; National Government data

economic changes have far reaching implications for the agricultural sector, which is slowly moving towards a market driven system.

The transition is slow, painful and often not well comprehended or managed by policy makers and producers. Older farmers often do not understand why markets and/or prices collapsed, and why the rules by which they lived for their lifetime are no longer applicable or relevant. Many new farmers, who were narrowly trained workers (tractor drivers, cow milkers etc.) are trying to learn farming, but often do not comprehend the situation either. Others are making use of the overall confusion through rent seeking or other opportunistic actions.

As such it may be useful to take stock of what has been happening so far, and indicate some major developments. First, we will seek to find the reason behind the collapse of the livestock systems by looking at the legacies of the previous systems. Some of the transition problems will be mentioned. Then the major resources will be reviewed and, finally, some overall thoughts on possible future developments, and the related need for research.

LEGACY

It may be risky to neglect major regional and local differences in the performance and development of the livestock sector in the different countries, where the environment varies from low desert to high mountain meadows, and where people are derived from different origins and experiences. But some major developments appear applicable to most Central Asian countries, as they are a result of previous economic and political conditions, especially the central plan economy, that were to a large extent comparable.

Traditionally, the major livestock system in Central Asia was based on sheep, horses, to a lesser extent cattle, and regionally, yaks and camels. The system was basically self-sufficient, e.g. did not depend on imported inputs. Major outputs were wool and carpets (whether woven or felt), (Karakul) skins, meat, milk, and horses (for military and other use). The Russian occupation in the second part of the century marginalized this system somewhat, as much of the better grazing lands were ploughed up and used for mainly irrigated agriculture. The traditional livestock system was completely broken up after the forced collectivization in the early thirties. Since that time a more settled system developed characterized by:

- sedentarization of herders on state or communal large farms/ranches; building of permanent shelters and stations;
- abolishment of previous land tenure² and creation of state ownership of land and state management land use;
- a cotton monoculture, but also some fodder cultivation, on irrigated land;
- increasing transformation of the small ruminant production system into fine wool or pelts, using Merino and Karakul sheep;
- state controlled land use and land management decisions;
- increasing dependence on imported input such as protein feed, and in some areas grain;
- state controlled and managed marketing of farm output.

Livestock numbers increased considerably from the very low numbers after the forced collectivization in the thirties (when sheep numbers in Kazakhstan, for example, reached 2.6 million compared to 18 million in 1916, Table 3). Previous "natural" controls preventing rapid expansion of herds and flocks, such as massive die-off after severe winters or drought, were counteracted by supplementary feeding and or large scale movement of animals, and contributed to a steady increase in animal inventory. However, these higher inventories increased the demand on fodder resources, and concerns were expressed about the carrying capacity of Central Asian rangelands as early as the mid-sixties. Indeed the increase in the number of sheep, mainly depending on grazing, stagnated, but the number of cattle continued to increase. The latter was related to an increasing emphasis on supplementary feeding of grain, which led to grain production using non-economic and ecologically risky systems such as large scale irrigation, feedlots, and to the ploughing up fragile rangelands. The concerns regarding the ecological problem became increasingly clear during the eighties with an estimated 25-50% of the land under severe threat of erosion. Although the occurrence and risk of overuse has been pointed out by many scientists, the response of the governments to this threat was not cohesive, and the reactions after the break-up of the Soviet Union are often limited to reshuffling of the responsible government bodies (Zakota 1994), and decreasing inspection and oversight.

2 Land tenure before Russian occupation varied, and included communal lands, state land (*āmlak* owned by the khan but given out to individuals); large estates (*mulk*; mainly irrigated) and, mainly in Turkmenistan, *waqf* (religious trusts) and *karanda* (leased by the community) lands.

THE CHANGES IN THE EARLY NINETIES

After independence most Central Asian countries initiated laws, regulations and programs to adapt to a market economy and, in some cases, to private ownership of production factors (although rarely land). The importation and production of manufactured feed dropped steeply, leading to an initial drastic reduction in feed dependent livestock such as pigs and poultry. Macro-economic conditions and insecure markets, however, led to a marketing system based on barter, and to poor terms of trade between agricultural and industrial goods. This, together with further reduction in feed and fodder³ availability, was leading to further destocking of livestock.

During the transition, new types of farms and farmers are emerging. The understanding of the ultimate land-tenure systems, agricultural models and farm types as well as of the transition process is not clear, and the speed and type of land reform vary considerably by country and region. Major changes include:

- restructuring, mainly through different forms of decollectivization, privatization and/or commercialization, but at very different speed in individual countries and regions;
- shift in ownership of assets through privatization, voucher privatization, creation of stock holding companies, reforming of collectives; confiscation or sales;
- an increased climatic risk (drought, ice storms), as previous buffers such as feed imports, social security are disappearing;
- increase in unemployment, and in rural urban migration;
- slow emergence of price responsive producers and markets;
- a lack of experienced farmers, farm input- and equipment suppliers, leading initially to a shift towards simple production systems, that bring either food or cash;
- some decentralization (with shifts in initiative and power from the central government to regions and people; initially seen in the Kyrgyz Republic for example).

This process is on going and the outcome still open. Future changes depend on political, economic as well as social developments. There is some early evidence, that point to the importance of the extended

³ Other factors include the lack of fuel, both for field cultivation and for animal transportation, leading to under utilization of remote (and high mountain) pastures.

Developments in the Kyrgyz livestock sector and rangelands

Beneficiary:

Drastic decline in inventory, to rational numbers;
Decreasing need for (imported) feed;
Shift in responsibility to users/owners;
Decreasing use of summer pasture
Recuperation of summer pasture;
Decreasing use of herbicides to control pasture weeds;
Rational marketing system is very slowly developing but may lead to greater attention for quality and; consumer demand

Detrimental:

Uncoordinated contraction of livestock inventory, loss of quality genetic stock;
Decreasing monitoring of pasture use due to increasing number of owners, and less government control, but not yet replaced by other control structures;
Decreasing flock migration (privatization; and due to higher fuel cost);
Increasing use of winter/fall pasture (in summer) leading to overgrazing of winter/fall pasture land
Increasing use of fire wood;
Increasing rural poverty and rural-urban migration.

family as a possible optimal production unit. The other common unit is a somewhat reformed collective farms (often named *joint stock company*). This development is, for example, seen in Mongolia where family units dominate (Potanski 1993), and seems also to occur in the Kyrgyz Republic and elsewhere.

The paradigm of change is not universally accepted, however. The process and expected outcomes are continuously debated and adjusted. Governments are concerned about the social effects of privatization of collective and state farms, which previously fulfilled a major social role (operating schools, clinics, power supply etc.). Some farmers and farm communities neglect the debate and act by themselves. These local reform initiatives, albeit somewhat disorganized, may serve a purpose as they function, by default, as pilots and may demonstrate what is feasible and what is not. Moreover, the paradigm of a single overall solution or system is most likely ill conceived, as it does not take local conditions and traditions into account⁴. Overall, however, the slow speed of these reforms, provides opportunities for other forces to both seeking rents and profits, or delay and obstruct.

4 In a small country like the Netherlands, for example, at least ten forms of farm land tenure or ownership are known (including private ownership, various forms of short and long term leases, a few corporate farms, and state land given out in long term, inheritable, leases). Importantly, however, this system is based on centuries of common law, and backed up by a functioning cadastre, and sound legal system.

MAJOR RESOURCES

HUMAN RESOURCES

The population of the Central Asian republics is diverse, and has a diverse history. Some countries (Kazakh, Kyrgyz) were, before russification, mainly livestock producers, while others such as the Uzbek were involved in a more diverse agriculture (see Bacon, 1980 and others). The major benefit of the Soviet system was the considerable effort made in the education of Central Asian people. The educated rural population is a major asset of the agricultural production system at present.

Unfortunately, however, agricultural education was not geared towards creating farmers, but rather on narrow specialisation whether tractor driver, milker or cotton pickers. Moreover, in contrast to China, many of those with private farming experience disappeared after the "dekulakisation" campaigns in the 1930s. More recently, many rural residents grew some crops and kept some livestock, but this system was completely dependent on the collective for the supply of inputs and marketing. The experience of new farmers is very limited in production and non-existent in processing and marketing. The experiences in decollectivization in the Kyrgyz Republic, not unlike that in the Baltic States and elsewhere, were rather traumatic and most of the livestock received (often without the needed fodder) were sold or slaughtered.

Although transformation may be difficult, it is greatly assisted by the high literacy rate of rural people and by the reasonable infrastructure. Some new farmers are emerging. Although generalization may be risky, these new farmers appear to be young (30-40 years old), come from a farm/rural background, are well educated (but not necessarily in agriculture or livestock production), have a great desire to learn, and are supported by an extended family. As such, there is an opportunity for the agricultural education and extension system to (i.) help these farmers in expanding their knowledge, and (ii.) to use these farmers to educate other new farmers.

RANGE RESOURCES

The present changes affect the use of land, which for the last 60 years has been in the public domain with state or collective farm as

the main custodian. The effects of 60 years of state and collective control have been described elsewhere (Schillhorn van Veen 1995, Tynaliyev 1995 and others). Although in some other countries a collective or state ownership of rangeland is not unusual, in Central Asia there appeared to be serious flaws in state controlled policy making and implementation. First, this situation occurs because the state promoted maximum production (through state orders etc.) and, secondly, because production decisions were too often based on increasing the animal numbers rather than improving productivity. Consequently, the animal inventory often expands beyond the availability of feed resources. This expansion then led to (i.) increasing dependence on imported feed, and (ii.) overutilization of existing fodder resources, especially grazing land. The present drastic reduction in inventory may correct the previous anomaly, but also may overshoot the optimum⁵.

More difficult, however, are the issues of land use, land tenure and associated rangeland water rights. The re-allocation or privatization of such lands and wells causes major debate, often based on limited understanding of the options in (range) land tenure, use and management⁶. It is too early to determine the direction. Few improvements are likely to be made before clarification of land tenure rights. The design of such rights needs careful consideration to prevent non-sustainable use and deterioration (as seen in parts of Jordan or Algeria where large tracts of land are owned and often exploited by absentee owners in the cities). It is undeniable that rangeland will continue to be the major source of fodder and grazing for Central Asian livestock, and that serious attention has to be given to maintain, or improve the quality of that resource.

Much of the research on rangeland in Central Asia has been done on technical aspects such as botanical composition, weed control, water provision, etc. (Larin 1962, Nechaeva 1985, Babaev et al. 1991, Gilmanov 1995 and others), and some on land quality (Koshkariyov et

5 This is illustrated by the rapid decline in inventory in the Kyrgyz Republic, where the market for sheep (meat) absorbed an extra million sheep/yr. during 1992-1995, indicating a drastic decline in mutton consumption (and, consequently, considerable price increases) after 1996.

6 This debate is further complicated by the ambivalent approaches in the settlement of previous (collective or state) farm debts. A complicating factor with respect of livestock is that farm land privatization sometimes preceded establishment of livestock drive routes.

al. 1994) but little on cost-effective and sustainable land use in which the quality of the resource is maintained and controlled. Higher priority should be given to research on land tenure and leasing arrangements, land quality and land quality parameters, and the cost recovery of land improvement. This research does not have to be original but can use existing experiences from Central Asia, the Middle East, North Africa, as well as comparable land in Australia, southern Africa and the America's. The major issue is not only to determine technical criteria of land use and quality, but how to select those criteria that are technically, economically and socially acceptable, and can be implemented. This requires socio-economic study as, for example, has been done in the World Bank supported study on farming in the Aral Sea basin, in which the focus was more on people than on technologies. It may be of interest to review the vast volume of work on rangeland in Central Asia (mainly in Russian) in view of the new concepts in the thinking about range management (Behnke, Scoones and Kerven 1993) developed for sub Saharan Africa, and assess to what extent some of the ideas are applicable under Central Asian conditions.

FODDER AND FEED RESOURCES

Apart from marketing constraints, the lack of feed, both in total volume as well as in quality has, during the last decade, been a major limiting factor in the subsector. This lack was to some extent compensated by imports, but these have been difficult to organize and finance under recent conditions. Whereas, overall, the feed availability of fodder in Central Asia is good, there are problems with distribution, seasonal availability and quality. Range and pasture fodder is seasonally abundant, but access and utilization are limited by geography and climate. Access to high mountain pasture is difficult, and early or late winter storms may severely limit the use of rangeland. Long distance migration may, as compared to previous periods, be less common as the cost of movement (especially if transported) is increasing to non-economic levels. This will increase the risk of farmers, especially the poor, who no longer benefit from protection against calamities (drought, icestorms) provided by the collective farm or state in general. Further research is needed on the cost/benefit of various production systems in view of present and future cost increases in fuel, irrigation water, and farm inputs such as fertilizer, chemicals, and equipment. The present debate in Uzbekistan, for example, to diversify from a cotton

monoculture (that led to major soil and land deterioration), may lead to an increasing interest in the use of lucerne in crop rotations.

It is also likely that the geographical distribution of livestock production systems will also change with the increasing transport costs. Production systems of perishable products such as milk and eggs may increasingly concentrate either near major markets (e.g. cities such as Almaty, Bishkek, Shimkent, Tashkent etc.), or close to cheap high value fodder resources (cotton seed cake, lucerne hay etc.). Production of wool and beef may be found mainly in areas with low cost land. It has to be stressed, however, that such developments are highly dynamic, and the agricultural policies should allow for such dynamism.

Further improvement can be made in the cultivated fodder production (and proper preservation) as well as crop residue utilization. It is unlikely, however, that cultivation of low quality fodder and forage under irrigation will be economical, unless part of a crop rotation with high value crops. There is potential for rainfed/snowmelt production of high quality hay (with some water supplementation) and silage in a few areas, and some of the private farmers are already exploring this market. New farmers, however, will require considerable help to improve the volume and quality of preserved fodder. In addition, there is a need for a better developed market in fodder as well as livestock. The major paradigm is that fodder (not grain) and crop residues (cotton seed etc.) should be the major feed resource in the region⁷. Still, in areas with grain production, further improvement should be made in utilization of straw; for example the utilization of urea enriched straw in livestock feeding.

Previously, insufficient attention has also been given to the proper feeding to meat protein, mineral and vitamin requirements. Major deficiencies were somewhat masked by feeding imported feed, and by the annual migration on animals. The increase in settlement may lead to major deficiency diseases (common in some areas are iodine, selenium, copper and fluoride deficiencies). These are already observed in privately held herds and flocks that do not migrate. The economic importance and geographical distribution of major deficiencies needs further study, followed by recommendations about supplementary feeding.

7 With some exceptions, such as the major grain producing areas in Kazakhstan.

Table 2. Animal numbers (x 1000) in selected countries, and change 1980-1994.

		1916	79/81	1994*	Change (%)
Cattle	Netherlands	nd	5,071	4,600	-9.3
	Nw Zealand	nd	8,063	8,705	8.0
	Kazakhstan	5,062	9,000	9,347	3.9
	Uzbekistan	nd	4,000	5,431	35.8
	Kyrgyz Rep.	519	1,200	1,062	-11.5
Sheep	France	nd	12,133	11,420	-5.9
	Nw Zealand	nd	67,393	51,000	-24.3
	Kazakhstan	18,364	34,000	33,500	-1.5
	Uzbekistan	nd	10,000	10,333	-1.5
	Kyrgyz Rep.	2,544	8,500	6,972	-18.0

Source: FAO, 1995; Bacon, 1980

* = Jan 1 data

LIVESTOCK

In the past, livestock production was often defined by the animal inventory (e.g. by numbers) rather than by production *per sé*, and without much consideration for productivity and quality of production, environmental effects. The present drastic decline in livestock inventory, as such, does not come as a surprise⁸, as the feed supply and animal numbers were not always properly balanced. Although the reduction in livestock inventory created alarm among farm managers and other specialists, these changes were (till 1994) not very different from changes in inventory seen in other countries in response to changing market conditions and increasing productivity, (Table 2). For example, the 9% reduction in the Netherlands is related to the an increase in milk yield from 5,025 l/yr in 1979/81 to 6,289 l/yr in 1994⁹. The decline in sheep numbers in New Zealand is a result of declining wool prices and abolishment of government subsidies. The presently lower inventories in Central Asia offer an opportunity to emphasize productivity. Central Asian specialists should try to convince their governments and farmers that production and animal productivity should be the major goal, not animal numbers.

8 Part of the correction may be also be a result of the use of more realistic data (not "adjusted" based on production goals) after exposure of this practice in the "cotton scandal" in the mid eighties.

9 The increase in the Netherlands is mainly due to improvement in genetics and in concentrate feeding, supported by EU subsidies.

EFFICIENCY OF PRODUCTION

Major gains can be made in productivity, even under the resource conditions in Central Asia (Table 3). Milk yields of 3,000-4,000 can be obtained in fodder-based systems without using much grain or concentrate, as can an overall yield of 100 kg beef (equivalent to 200-250 kg live weight). Other indicators of potential efficiency are daily weight gains of 200-500 gm/day for growing cattle and sheep, a feed conversion of pigs of 1 kg gain per 4 kg feed, and for poultry of more than 1 kg gain/2 kg feed (de Haan *et al.* 1992). Considering the available fodder resources, the majority of farms have to look at the productivity in grassland systems, as high input systems are unlikely to be competitive in the near future due to depressed local markets, and limited export opportunities. In the longer term, opportunities may arise for feed-dependent systems such as poultry, initially targeting an expanding local market, but able to compete with international imports. As such, producers should keep a close eye on production costs and compare their costs to those of other major producers worldwide (Table 4).

Table 3. Cattle production and productivity in selected countries (1994 data)

	Cattle	Cows	Beef	Milk	Yield/beef *	Yield/milk
	x1000	x 1000	MT x 1000	MT x 1000	Kg/animal	Kg/animal/year
<u>High input systems</u>						
Netherlands (+)	4,600	1,710	564	10,755	123	6,289
United States (+)	101,749	9,575	11,039	69,848	108	7,295
<u>Grassland based systems</u>						
Ireland (+)	6,300	1,230	520	5,200	83	4,309
Spain (+)	4,744	1,300	506	6,026	107	4,635
New Zealand (-)	8,705	2,835	556	8,379	64	2,956
<u>Central Asia</u>						
Kyrgyz Republic	1,061	440	70	750	66	1,705
Turkmenistan	1,104	250	18	204	16	968
Tajikistan	1,250	465	35	450	28	816
Uzbekistan	5,291	1,700	250	2,600	47	1,529
Kazakhstan	9,347	3,150	615	5,300	66	1,683

Source: FAO* = beef produced per animal per year (counting all animals)

+ = degree of producers subsidization (no data on Central Asia)

Table 4. World market prices for selected meat and dairy products (in US\$)

Product	Price (Ton)			Producer prices	
	1980	1985	Price mid 1995	1995*	US farmgate
Skimmed milk ¹	850	600	1,950	0.26 ⁵	0.30
Butter ¹	1,300	1,200	2,000	0.30 ⁵	-
Ched. cheese ¹	1,350	1,150	1,900		-
Beef (Argentina) ²		1,000	1,893	1.36	0.78
Mutton (Austral.)		nd	1,351	0.75	
Lamb (NwZeal.)		1,855	2,619	1.40	1.40
Wool (clean, 56) ³	4,600	3,558	4,880	2.44	nd

Sources: 1 = WTO, 1995. 2 = FAO, 1995b; 3 = FAO, 1995a; 4 = US farmgate = St. Louis, Feb. 1996./Live-weight; 5 = calculated: based on a 1:7.6 conversion of skimmed milk or 1:6.6 for butter.

Efficiency increases can be obtained through:

- Improved management
- Better feeding and fodder handling and storage
- Improved genetics of breeds adapted to local conditions
- Improved animal health
- Better product handling and storage.

Improved management includes, most importantly, farmer training since new farmers have limited experience. Apart from the technical aspects of farming, this includes training in book keeping and development of farm budgets (production cost calculations) to enable correct production decisions. Good management also includes close attention to quality and quality control of products as well as resources, requiring some understanding of the environmental aspects of agriculture.

Better feeding and fodder handling and storage. Feeding has been discussed above. Better forage preservation, handling and storage will greatly improve the quality of fodder, and consequently productivity. Good forage production has often been a victim of the post Soviet transition, when large scale equipment was poorly distributed, and its use further limited by the lack of fuel or spare parts. Consequently

many small farmers reverted to small scale hay production, but lacked the experience in good hay making, let alone in the production of good silage. Training and extension may remedy this situation, but will take time to achieve.

Improved genetics can indeed lead to major gains, especially in well managed production systems. Improving genetics requires a reasonable breeding infrastructure (and consequently herding), the use of artificial insemination (with good service at affordable cost), and establishment of good record keeping. In most countries, this is done in the private sector, and less so in research centers. Although there exists extensive experience with AI in Central Asia, the cost efficiency needs to improve in order to convince private farmers (who increasingly shift to natural breeding) to use this tool. In the selection of genetics, more attention should be given to the quality of the production process and to the market demand. Breeding objectives, other than productivity may also be considered, such as the breeding for disease resistance. In wool sheep, for example, it may be worth considering the selection of a hardy animal with some meat production capabilities rather than a very fine wool Merino. The decline of the latter in the Kyrgyz Republic seems an unfortunate but probably unavoidable adoption to present production and marketing realities.

Animal health is of obvious importance. Major changes are being made in the cost-effective delivery of animal health services. During the Soviet period a good system was developed to monitor and control epizootic diseases. Some of these diseases were eradicated or considerably reduced (for example, anthrax, bovine brucellosis), but the system often neglected production diseases such as mastitis or deficiency disease found in small private herds and flocks. The previous system was based on close cooperation with the state and collective farms, including responsibility of state- and collective animal health specialists over privately owned animals. The latter relationship is threatened down, and guidance and training is required for farmers, veterinarians and other service staff to adapt to the new system. In some countries this is leading to the privatization of animal health services. It has indeed been demonstrated in other part of the world that private animal health services are more efficient, and often provided at a lower cost. However, privatization requires a number of pre-conditions including government support, some financing, and prevention of competition between government and private services.

Product handling and storage need significant improvement starting at the farm and continuing throughout the marketing line. The major goal is to produce a better and cleaner product, thereby increasing its shelf-life and making it more attractive to consumers.

MARKETING

Whereas one of the reasons for the decline in annual inventory has been the lack of quality feed, the other major reason was the lack of markets. Previous central planning systems rarely paid attention to marketing, as all products, irrespective of quality and volume, were "sold" to the state. Prices were generally determined by a "cost plus" calculations, and did not reflect consumer demand or quality of the products. When consumer incomes and consumer subsidies declined, the demand for agricultural products also diminished.

Recently, the more open economies allowed import of foreign goods, and consumers became aware of quality. Local producers and processors were not able to adapt rapidly to the new market conditions, and lost markets and market share. The major challenge in most of the former Soviet Union is how rapidly the agro-processing system can adapt to consumer demand. In fact this may be the crucial factor, as the agro-processing industry will provide producers with the signals on what to produce. This is a major change: no longer do the processor and consumer depend on the products available from the farm, but the farmer has to respond to the demand of the consumer.

Example of quality control problems in wool marketing

On the farm

- Variable feeding quality leads to wool with poor strength and increased risk of breakage;
- Mediocre control of flock management leads to contamination of wool with burrs and other plant materials etc.
- Poor quality shearing leads to variable staple length and poor quality. Poor shearing also lead to wounds etc. and ultimately to lower leather quality;
- Poor sorting, and excessive mix-in of low and high quality wool;
- Poorly controlled on-farm grading, limits the trust of wool buyers.

Suggested solutions:

- Closer cooperation between buyers, wool mills and producers;
- Better education and extension to farmers, shearers, sorters, graders etc.

Source: Visiting US shearers; wool specialists; 1995

As can be seen in some areas, this new environment is leading to a different product mix, different production systems and different marketing systems. The latter is, during and after the transition, increasingly relying on small processors and markets rather than on the, often inflexible, large scale state enterprises. In the early phase after the break-up of the former Soviet Union, producers and traders had high expectations for foreign markets. They soon discovered, however, that foreign markets (and prices) are volatile, require a homogenous good quality, and prompt delivery and payment. These requirements are often difficult to fulfill¹⁰, and there are good reasons to concentrate in the short term on local markets or on old clients. Simultaneously they may use small scale export of good quality niche product to build up their relations with international markets. An important additional factor in the agro-processing is its potential contribution to rural employment. This is of importance in Central Asia, where policy makers express considerable concern about the increasing unemployment associated with farm structuring.

LIVESTOCK RESEARCH

Good agricultural research and extension are the key to reforming the sector, that absorbed a great number of inexperienced farmers, has required to develop completely new farming systems, is facing new market conditions, and is cash poor.

Research system. Thought may be given to develop closer ties between (or combine) the agricultural research and the agricultural education systems. This is part of a larger change, as the total research system (including agriculture and livestock) may need downsizing and restructuring. This is a painful process, and is likely to be opposed by various interest groups including the researchers themselves. As such, it may be useful to organize a wider debate with all groups interested (see box). Lessons may be learned from the restructuring in other countries such as East Germany¹¹ and Hungary. Lessons should also be learned from Europe and the US where the agricultural research

10 The reasons are often beyond control of the sector; for example poor transportation, improper handling storage, lack of a working banking system etc.

11 That restructuring can be painful was evident in East Germany where nearly half of the research capacity was closed down; an equivalent percentage of staff was retired.

Some of the participants and issues in agricultural research policy debate

Participants:

- Producers
- Farm workers
- Consumers
- Agro-industry
- Academia, research
- Environmental/tourism interests
- Public health interests

Issues:

- How to manage change
 - Provision of wholesome, healthy, and low cost food
 - Public/private sector roles
 - Efficient delivery of farm input and advisory services
 - Environmental safety
 - Rural sustenance/development
 - International trade
-

systems were also restructured and downsized, but over a longer time period (1970-1990) making the change somewhat less painful.

Apart from the physical change with downscaling of staff and infrastructure, the other major change is to find directly applicable solutions to present farm problems. In the short run, these problems are related to the change in farm structure (requiring advice on land tenure, farm business, farm budgeting etc.), in farm organization (requiring advice on land and water allocation, livestock trails, input supply), in farm size (requiring different equipment etc.), in cropping patterns (including new crops or production systems), and in processing and marketing. Moreover, the relationship between farms and the research system will change. In the old system the collective and state farms were not only the main type of farm, but also acted as the intermediary with respect to the small plot farms in their villages. The contact with the research systems was centrally controlled through the agro-technical complexes. In some parts of Central Asia this structure is changing and new relationships have to be developed. Some Central Asian countries are indeed trying to develop new extension systems¹² linking research and farmers, where the extension staff is mainly serving farmers, and no longer responsible for data collection, implementation

12 Assisted by foreign agencies funded by donors such as EU-TACIS.

of annual plans, and for input supply. In this new world, the research system has to prove to farmers that it really has something to offer, and is indeed responsive to farmer problems.

Livestock research. One of the difficulties facing researchers at present, is the lack of a clear understanding of optimal production systems. There are already a number of examples of new production systems and new products preferred by consumers/traders and farmers for reasons of product, cost of production, price or limitation on land or water. An interesting example is the Kyrgyz fine wool production system, which was well developed (and supported with ample data and research), but is now in decline, after a (mediocre-designed) restructuring to new market conditions in which quality and price are the major determinants of buyers, and where the Russian market is no longer guaranteed.

As such, the needs for research have to be carefully evaluated. This can be done through:

- farm/herder surveys, e.g. questioning a representative sample of producers about their problems and prospects¹³;
- economic analysis, e.g. developing crop and farm budgets and determining the most profitable crop/livestock mix under given conditions;
- overall study of present and potential markets.

There are numerous examples of the need for a good understanding of what is happening on the farm, and the importance of listening to farmers opinions on research priorities.¹⁴

Overall, the recommendations for livestock research are not very different from those made for Eastern Europe, e.g. grassland and fodder production, environmental clean-up of oversized and polluting

13 Interesting results have been obtained, in other countries, through surveys by extension personnel on indigenous knowledge and practices. This method not only provides useful information, but also help to improve the dialogue between farmers (including farm women) and extension staff.

14 A good example was the farm survey carried by the Lithuanian Extension Service in cooperation with the two major farmers organizations and in the Ministry of Agriculture in the preparation of the World Bank funded Private Agricultural Support project.

production and processing systems, land consolidation, value added production and market development, conservation of local livestock breeds, and development of mixed farming systems (de Haan *et al.* 1992). In addition, Central Asian livestock farmers may need further research on restructuring of large farms/ranches, rangeland management, animal and public health, and on overall economics of the sector.

INTERNATIONAL ASSISTANCE

Some project and technical assistance has been provided to Central Asian countries. Major investments are still lagging mainly because the sector is still struggling with old legacies (centralized systems; large farm debts, etc.), and the future is not clear. Most donors are not very flexible and require economically stable conditions. Some investments are made or planned, based on previous production systems (irrigation rehabilitation; sheep/wool etc.) but questions have been raised about the feasibility of investing in production systems with an uncertain future. On the other hand, it is argued the agricultural sector will further deteriorate, without such (albeit risky) investments, affecting the livelihood of rural people, and creating further poverty and rural-urban migration.

Still, at least for the short term, investments will be limited, and are likely to concentrate on either low risk projects (education, training, extension and maybe research) or on projects that remedy some of the major problems created by either the previous systems or by the transition, such as environmental clean-up (various Aral Sea related initiatives). Other candidates for investments may be technical assistance in data collection, management and in policy development, and in the privatization of services and land ownership/tenure issues.

These investments are not specially targeted to livestock or any other sub-sector, as they should be based on sound economics, e.g. investment are only made if the rate of return is acceptable, and have socially and environmentally positive effects.

CONCLUSIONS

The future of the livestock system is difficult to predict, but major factors in the prediction include:

- the incentives to farmers and their security (in terms of land, other production factors and technical skills);
- the (local) availability and efficient use of feed and fodder resources;
- the ability of the government to remove itself from directing the sector, e.g. change its role from directing to supporting;
- the access to and efficiency of local and nearby international markets;
- the ability of the agro-processing sector to transform livestock products in attractive preservable consumer goods;
- the quality of inputs and input services;
- the quality and training of producers;
- the need to understand and to collect data on farm operations and structure during the economic transaction;
- the need to produce and process livestock and livestock products in the way that will improve, rather than be a burden, the environment.

To achieve the recommended improvements require a thorough debate on the future of agriculture is required based on sound data¹⁵ and ideas and with full participation of the new farmers. This discussion should also focus on land tenure, rural development in general, and the required policies that may guide the transition process.

Secondly, improvements and farmer training will require good farmers and farmer training through formal training in agricultural schools and universities, and through participatory farmer training and extension. The major constraint is the lack of experience of the majority of farmers in the operation of farms in the new technical and economic setting. Foreign advice also has its limitations, and a major effort should be made to extend information through farmer to farmer training.

A related challenge is the development of local (and later national) farmer/herder/farm women's organizations, as well as professional organizations such as veterinary medicine etc. Farmer to farmer contact can greatly help in the debate and in the dissemination of new ideas and better technology.

15 Most of the present data sets are deficient (partly because it is much more difficult to collect data from fragmented private farms; partly because some governments still work with production goals, and partly because of the lack of equipment, fuel and staff to carry out such a job).

The third challenge is to develop a supporting structure of extension service, research service and quality control service that closely works with producers, and helps them to improve their production efficiency and marketing.

The fourth challenge is to change the role of government, both in terms of decentralization as well as in function. The state is becoming less involved in setting production targets, marketing and multi-annual plans, but is increasingly active in facilitating the development of the sector by providing advice and information, introducing some regulation and by increasing the transparency of the system. Of major importance is the resolution of social issues such as rural unemployment and poverty created by the restructuring of farms.

The fifth challenge is the development of private input and support services such as breeding services, animal drugs, animal health services etc.

The sixth challenge is the development of a private responsive, agro-processing sector that is able to produce and market local products in a safe, cost effective way on local and international markets.

Finally the overall challenge is to affect these changes in a way that is environmentally sustainable, reducing and where possible reversing the environmental deterioration such as ground water pollution, water and wind erosion, and the careless use and handling of agrochemicals in farming as well as in agro-processing.

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Appendix table 1. Changes in livestock inventory and production in Central Asia and Russia since 1985 (x 1000)

<i>Cattle</i>	1985	1990	1991	1992	1993	1994	1995	Change 85-94*
Kazakhstan	9,165	9,757	9,592	9,576	9,347	8,073	6,600	-11.9
Kyrgyz Rep.	1,110	1,205	1,190	1,122	1,062	920	900	-17.1
Uzbekistan	4,100	4,581	5,113	5,275	5,431	5,466	5484	33.3
Tajikistan	1,351	1,352	1,391	1,246	1,250	1,168	nd	-13.5
Turkmenistan	738	829	899	1,004	1,105	1,160	1,180	57.2
Russian Fed.	59,600	57,000	54,700	52,200	48,900	43,300		-27.3
<i>Sheep</i>								
Kazakhstan	34,647	34,678	33,559	33,376	32,038	31,000	30,200	-10.5
Kyrgyz Rep.	9,868	9,545	9,107	8,362	6,972	4,783	4,000	-51.5
Uzbekistan	8,496	8,406	9,192	10,329	10,391	9,942	9,434	17.0
Tajikistan	1,688	1,632	1,613	1,391	1,256	1,162	nd	-31.2
Turkmenistan	5,500	5,481	5,599	7,265	7,000	6,000	6,000	9.1
Russian Fed.	57,777	52,287	52,140	45,014	37,504	29,030	nd	-49.8
<i>Meat</i>								
Kazakhstan	1,133	1,560	1,524	1,258	1,312	1,048	nd	-7.5
Kyrgyz Rep.	169	254	230	228	223	194	nd	14.8
Uzbekistan	386	484	492	469	504	nd	828	30.5
Tajikistan	179	185	151	126	113	112	nd	-37.4
Turkmenistan	86	104	100	98	110	99	97	15.1
Russian Fed.	8,500	10,100	9,400	8,260	7,513	6,803	nd	-20.0
<i>Milk</i>								
Kazakhstan	4,673	5,642	5,555	5,265	5,577	5,128	nd	9.7
Kyrgyz Rep.	771	1,185	1,131	961	942	866	nd	12.3
Uzbekistan	2	3	3	4	4	4	2,481	100.0
Tajikistan	547	575	587	510	475	467	nd	-14.6
Turkmenistan	348	436	458	471	712	710	707	104.0
Russian Fed.	50,200	55,700	52,000	47,236	46,524	42,174	nd	-16.0
<i>Wool</i>								
Kazakhstan	98	98	104	96	95	79		-19.4
Kyrgyz Rep.	33	39	37	34	31	21		-36.4
Uzbekistan	24	26	25	27	27	22		-8.3
Tajikistan	5	5	4	4	3	3		-40.0
Turkmenistan	nd	nd	nd	nd	nd	nd		
Russia	217	227	204	179	158	122		-43.8

Source: FAO, World Bank and country data. Inventory = December 31 data.

Note: data from previous Soviet Union are somewhat unreliable; recent data from Central Asia also as previous data collection system is slowly breaking down.

FOOD AND FEED PROSPECTS FOR RESOURCES IN CENTRAL ASIA

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ABSTRACT

This paper presents a simple summary of statistics for Central Asia, with analyses and projections of *grain and livestock production* to the year 2025. Human population growth in Central Asia, and the collapse of Soviet economic arrangements between the republics, present great challenges for the development of means for efficient, equitable and environmentally sustainable management of natural resources. In this context, the challenges for integrated crop/livestock and range management are substantial indeed.

We begin with statistics on land use and on the production and consumption of all grains in the early 1970s and early 1990s, and go on with projections to the year 2025. Next, we look at livestock numbers and a way of aggregating their feed needs. Then we attempt to catalogue the feed resources in each republic, including rangeland grazing. An analysis of livestock diet compositions reveals the relative importances of range grazing, crop residues (particularly cereal straws) and of feed grains and other concentrates.

Finally, a simple analysis which takes into account human population growth and different scenarios of crop production, allows us to project relative surpluses and deficits of feeds to the year 2025. The great disparities among the republics suggest opportunities for highly economic cross-border seasonal movements of livestock and or feeds. In any case, seasonal movement of animals within each republic to take advantage of both range grazing and crop residues, will likely remain an important characteristic of livestock systems in Central Asia. Finding how this can be organized by private producers, or groups of producers, following the collapse of past arrangements, is one of the main challenges.

POPULATION GROWTH

As in West Asia and North Africa (WANA), the region of ICARDA's main focus until recently, population growth is rapid in the Central Asian republics: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Population pressures in these republics are expected to increase in the coming decades. We have taken projections for the years 2000 and 2025, published by the World Bank (1993), for our analysis (Table 1). These figures suggest a population of 92 million people will live in Central Asia by 2025, compared with 51 **million** in 1990. This is the "medium" projection; higher or lower growth of population is possible, of course.

LAND RESOURCES

Permanent pastures (rangelands) account for the largest share of the land surface of each Central Asian republic (Table 2). The total rangeland area of the five republics is about 260 million ha (FAO 1995). This is comparable with the total area of steppe land (100 - 400 mm rainfall) in all of West Asia and North Africa, about 272 million ha (El-Beltagy 1996). Irrigated farming in Central Asia covers some 9.4 million ha, with cotton as a key crop.

Table 1. Human population, projections to year 2000, 2025, and per capita GNP (1990) for the Central Asian Republics.

COUNTRY	Per capita GNP (\$)	1961	Human Population (millions)				
			1970	1980	1990	2000	2025
KAZAKHSTAN	2600	10.5	13.1	14.9	16.7	18.0	22.0
KYRGYZSTAN	1570	2.3	3.0	3.6	4.4	5.0	7.0
TAJIKISTAN	1130	2.2	2.9	4.0	5.3	7.0	13.0
TURKMENISTAN	1690	1.7	2.2	2.9	3.7	5.0	8.0
UZBEKISTAN	1340	8.9	12.0	15.9	20.4	26.0	42.0
TOTAL						50.5	92.0

GNP data are from ERS/USDA (1993) for 1990.

Population (1961-1990) from FAOSTAT. PC 1995.

Population projections from World Bank, World Development Report (1993)

Table 2. Land distributions in Central Asian Republics in 1980 and 1990

COUNTRY	YEAR	Arable permanent crop land 1000 ha	Permanent pastures 1000 ha	Irrigated area 1000 ha
KAZAKHSTAN	1980	35869	188000	1961
	1990	35842	186526	2300
KYRGYZSTAN	1980	1460	9100	955
	1990	1451	9072	1030
TAJIKISTAN	1980	890	3470	617
	1990	843	3498	640
TURKMENISTAN	1980	3000	35000	927
	1990	1435	39552	1295
UZBEKISTAN	1980	4280	23620	3476
	1990	4845	23362	4222

Source: FAOSTAT. PC 1995.

PRODUCTION AND CONSUMPTION OF GRAINS, PAST AND FUTURE

Total annual cereal and pulse production in the 1990-1994 period ranged from 46 kg per capita in Tajikistan, to 821 kg in Kazakhstan (Table 3). Increases in grain production can be achieved in all the republics, but we are not able to predict the most likely growth paths. Instead, we define a range of possibilities between zero and three-percent annual growth rates. Sustaining a three-percent growth rate through the year 2025 could be considered very good performance indeed. It would require economical availability of all necessary inputs, including seeds of adapted crop varieties (with strengthened research on crop genetic improvement), fertilizers, improved agronomy and pest control, among other innovations, including new policies, institutional arrangements and infrastructures that facilitate economic production.

According to a USDA study (Shend 1995), farmers in most of the former Soviet Union are cutting back on areas planted to less profitable crops, and "over the next 10 years, grain yields are projected to rise, while area will likely stabilize, thereby resulting in higher output".

Given the projected population growths for the individual Central Asian republics, we project the per capita production of all grain for

the years 2000 and 2025, assuming annual production growth rates of zero, one, two and three percent (Table 4). These are not predictions; they are simple projections based on production in the five-year 1990-1994 period, taken with the population projections. We use these projections later in the paper to project the amounts of feed that could be available in the form of crop residues in future years.

Table 3. Production and consumption of all grains for feed and food, including pulses (kg per year per capita): 20-year shifts in Central Asian Republics.

COUNTRY	Production		Consumption
	1974	1994	1994
KAZAKHSTAN	1407	821	540
KYRGYZSTAN	232	200	260
TAJIKISTAN	48	46	150
TURKMENISTAN	33	190	302
UZBEKISTAN	62	86	235

Source: Production numbers from FAOSTAT.PC 1995.

Consumption numbers from ERS/USDA (1994)

Table 4. Per capita production of all grains, including pulses, in the years 2000 and 2025, based on population projections and annual growth rates in production of 0, 1, 2 and 3% from 1990-94 levels.

COUNTRY	Per capita annual production (kg)							
	2000				2025			
	0%	1%	2%	3%	0%	1%	2%	3%
KAZAKHSTAN	762	817	875	937	623	857	1175	1605
KYRGYZSTAN	176	189	203	217	126	173	237	324
TAJIKISTAN	35	37	40	43	19	26	35	48
TURKMENISTAN	141	151	162	173	88	121	166	227
UZBEKISTAN	67	72	77	83	42	57	78	107

Sources: Population projections for 2000 and 2025 are from World Bank Development Report (1993),

Crop production levels are from FAOSTAT.PC 1995.

LIVESTOCK NUMBERS

We have borrowed livestock inventory statistics from FAO (1995), and present them as five-year averages for the 1970-74 and 1990-94 periods for each republic (Table 5). Livestock numbers are aggregated to TLU (Tropical Livestock Unit) values according to factors equating 1 TLU to a 250 kg liveweight bovine at maintenance

PRODUCTION OF DOMESTIC FEEDS

Feeds in Central Asia present a challenge to anyone wishing to describe them briefly. Crop residues of all sorts are used as well as grazing of rangelands. Feed grains and other concentrates are also widely used. Feed sources are summarized in Table 6.

Crop residue production is not reported in FAO or other statistics. Quantitative estimates for these can be derived with more or less confidence, however, by taking the reported statistics for the relevant crops harvested and multiplying by a factor specific to each (Table 6). Alfalfa (*Medicago sativa*) is grown in all five republics but data on quantities were not available for our analysis. Likewise, we were unable to find estimates of how much cotton is grazed after hand-harvesting (as widely practiced in WANA); machine-harvest of cotton has been common on the state farms of Central Asia, and defoliation (with loss of considerable feed value in the leaves) is necessary for this. Thus, we understate by some unknown amount the quantities of crop residues and forage crops available in Central Asia.

Native pasture (rangeland) grazing areas are the most important feed resources in the region. The data source for pasture areas was FAO (1995). **Quantities** of grazing offtakes from these lands are not reported in any regular series. We estimated grazing offtake (Table 6) by multiplying the reported native pasture areas by an assumed 200 kg per ha (Gilmanov, personal communication).

Feed grains and other concentrates including barley grain, maize grain, cottonseed (whole, meal and cake), comprise the smallest feed category for three of the Central Asian republics, in contrast to Tajikistan and Uzbekistan where this category of feeds makes up nearly 40 percent of the livestock diet. Feed grains and concentrates gained importance in all five republics since the early seventies, however.

Table 5. Livestock numbers and total Tropical Livestock Units (TLU) in the Central Asian Republics (in 1000 head)

COUNTRIES	Year	CATT	BUFF	SHEEP	GOAT	HORSE	ASS	CAMEL	PIGS	CHK	TUR	TOTAL TLU (million)
KAZAKHSTAN	70-74	9785	101	31980	580	1260	20	101	2423	31	0	12.02
	90-94	9584	116	34325	700	1531	45	59	2864	57	2	12.73
KYRGYZSTAN	70-74	926	0	9343	205	51	3	20	263	7	0	1.78
	90-94	1130	0	8928	279	310	10	50	288	13	1	2.23
TAJIKISTAN	70-74	1031	0	2194	464	9	7	15	86	3	0	1.06
	90-94	1292	0	2240	842	51	35	50	91	6	0	1.40
TURKMENISTAN	70-74	456	0	4039	197	4	3	10	85	3	0	0.80
	90-94	907	0	5569	247	20	25	40	229	7	0	1.39
UZBEKISTAN	70-74	2977	0	7401	455	114	70	10	329	15	0	3.21
	90-94	4892	93	8173	894	112	130	22	607	34	1	5.07
TOTALS	70-74	15175	101	54957	1901	1438	103	156	3186	59	0	18.9
	90-94	17805	209	59235	2962	2024	245	221	4079	117	4	22.8
FACTORS / TLU		0.7	1	0.1	0.1	0.8	0.5	1	0.3	0.01	0.035	1.0

Sources: Livestock numbers from FAOSTAT/PC 1995; TLU factors from Kosilla, 1988.

CATT = cattle, BUFF = buffalo, ASS = asses, CHK = chickens, TUR = turkeys

Table 6. Production of domestic feeds in Central Asian Republics for years 1970-74 and 1990-94 in 1000 mt

COUNTRY	YEAR	WHTS	BRG	BRS	MZG	MZS	RICS	M&SG	M&SS	CSED	RYE	OAT	SBR	PUL	CAKE	PAST	TOTAL
KAZAKHISTAN	70-74	22638	4391	5708	187	561	473	363	1452	160	162	589	225	100	37	37312	74359
	90-94	16123	6548	8512	346	1038	584	397	1588	147	589	638	91	105	156	37312	74174
KYRGYZSTAN	70-74	738	276	359	128	384	1	0	0	100	1	24	175	0	0	1740	3927
	90-94	787	514	668	271	813	4	3	12	41	2	12	9	0	20	1740	4896
TAJKISTAN	70-74	129	48	62	11	33	36	0	0	510	1	6	0	0	0	709	1546
	90-94	209	41	53	47	141	31	2	8	440	2	3	0	8	211	709	1906
TURKMENISTAN	70-74	60	37	48	10	30	22	0	0	400	0	0	0	0	0	6160	6767
	90-94	590	139	181	171	513	103	0	0	797	0	0	0	0	383	6160	9037
UZBEKISTAN	70-74	369	269	350	227	681	309	0	0	2500	1	0	0	0	0	4160	8866
	90-94	1093	340	442	367	1101	688	10	40	2582	9	0	1	0	1241	4160	12074
Factor		1.3	1.0	1.3	1.0	3.0	1.3	1.0	4.0	1.0	1.3	1.3	0.1*	1.0			

Item codes: WHTS=wheat straw and stubble; BRG=local barley grain; BRS=barley straw and stubble; MZG=local maize grain; MZS=maize crop residues; RICS=rice straw; M&SG=millet and sorghum grain; M&SS= millet and sorghum residues; CSED=cottonseed; RYE=rye straw; OAT=oat straw; SBR=sugarbeet crop residues; PULS=pulses straw; CAKE=oil cakes. Data on crop yields from FAOSTAT.PC 1995 were multiplied by these factors from Kosilla (1988), except * from Nordblom (1988). PASTURE=estimated grazing offakes by multiplying pasture areas, from FAOSTAT.PC 1995, by 200 kg/ha

MEGA-TRENDS

Aggregate national total feed use (in millions of metric tons, Table 6) and aggregate animal numbers (in millions of TLUs, Table 5), summarized for the two five-year periods (1970-74 and 1990-94), are shown together in Figure 1 as arrows depicting changes over the twenty-year span. Only in this combined perspective do the relative feed abundances of Turkmenistan and Kazakhstan appear in such contrast to the relative feed shortages of the other three republics. Except in the case of Kazakhstan, feed use and livestock numbers have increased markedly, and in similar proportions, across Central Asia.

LIVESTOCK DIET COMPOSITIONS

All feeds and grazing offtakes were estimated in Table 6. For each republic, the three feed categories, (1) crop residues and forage crops, (2) rangeland (natural pasture) grazing and (3) feed grains and other concentrates, nominally add up to 100% of feed use at a given point in time (Table 7). Thus, we are able to plot 20-year trend lines for each of the countries in a composition chart (Figure 1) which works on the same principle as a soil chart showing the fractions of sand, silt and clay. That is, every point within the triangle represents a particular percentage combination of the three feed sources summing to 100%. Each arrow joins two points, 20 years apart in time, each summing to 100% at a particular time. Contrasts in the feed resource endowments and general shifts toward greater proportions of feed grains and crop residues, away from range grazing, are apparent in four of the republics; Kazakhstan's feed balance, in contrast, shows little change in use of range.

Figure 1. Tropical Livestock Units and all feeds in Central Asian Republics, 1974 and 1994 (log-log scale)

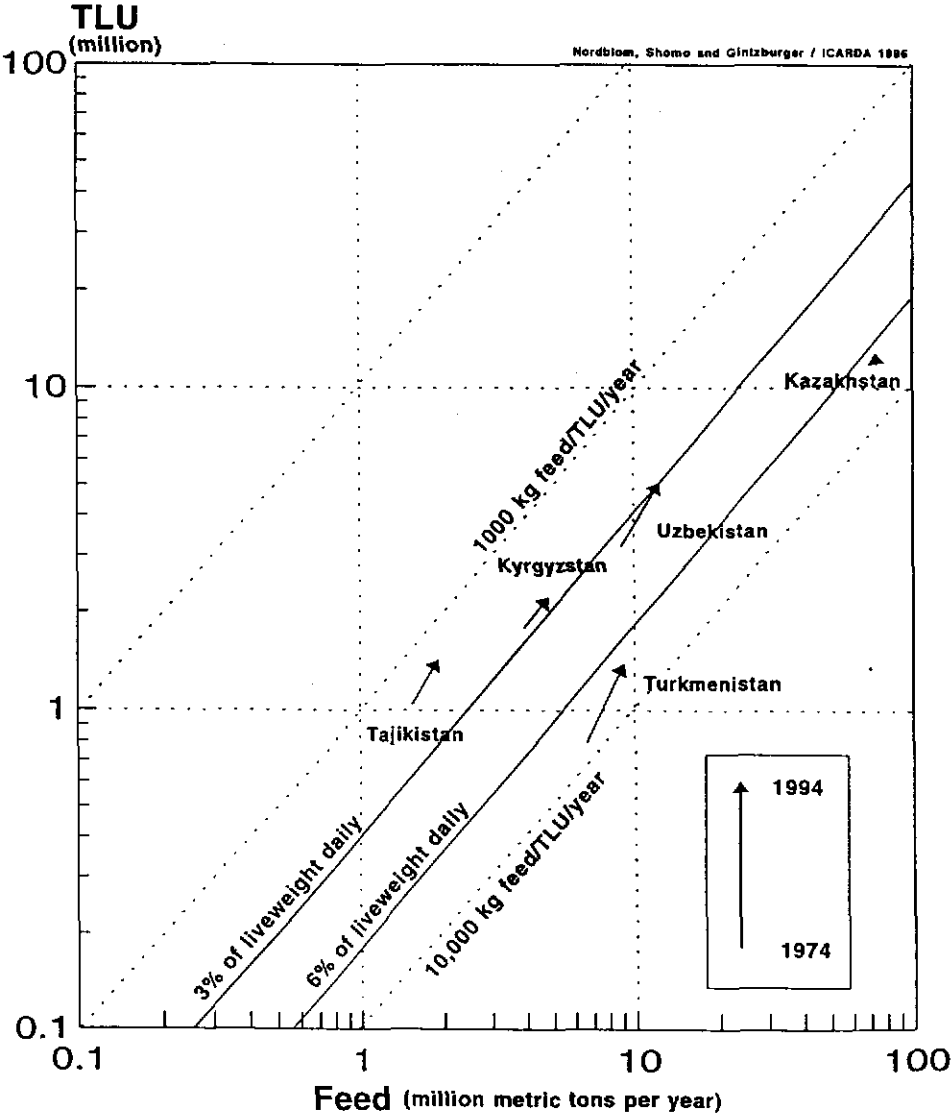


Table 7. Diet composition of livestock by feed category: 20- year (five-year means for 1970-74 and 1990-94) for Central Asian Republics.

COUNTRY	YEAR	Range grazing (%)	Feed gain and other concentrate (%)	Crop Residue (%)	TOTAL (%)
KAZAKHSTAN	70-74	56	7	37	100
	90-94	56	11	33	100
KYRGYZSTAN	70-74	54	13	34	100
	90-94	46	18	36	100
TAJIKISTAN	70-74	52	34	14	100
	90-94	44	38	18	100
TURKMENISTAN	70-74	94	5	1	100
	90-94	79	13	9	100
UZBEKISTAN	70-74	57	30	13	100
	90-94	44	36	21	100

Source: compiled from Table 6.

Though, in Figure 2 (and Table 7) rangelands provide diminishing proportions of livestock diets in the other republics, this result was obtained without accounting for degradation of rangelands (for which we have no quantitative estimates). It is simply the outcome of increased livestock populations, increased cropping activities (generating crop residues) and increased use of feed grains. If we could have allowed for the range degradation which has likely occurred in the five republics (UNEP 1992), the reduced place of this feed source would be more pronounced. If poor management of livestock has caused degradation of rangelands, as in WANA (Cooper and Bailey 1991), better management of livestock as well as range re-seeding are essential for the achievement of range resource rehabilitation (Gintzburger 1987, Gintzburger and Skinner 1985). Indeed, better livestock feeding management may offer a key means for significant environmental benefits. Examples include seasonal deferment of grazing at the time of flowering and seed-set for range plants, by providing an economic combination of hand-feeding and grazing of sown pasture.

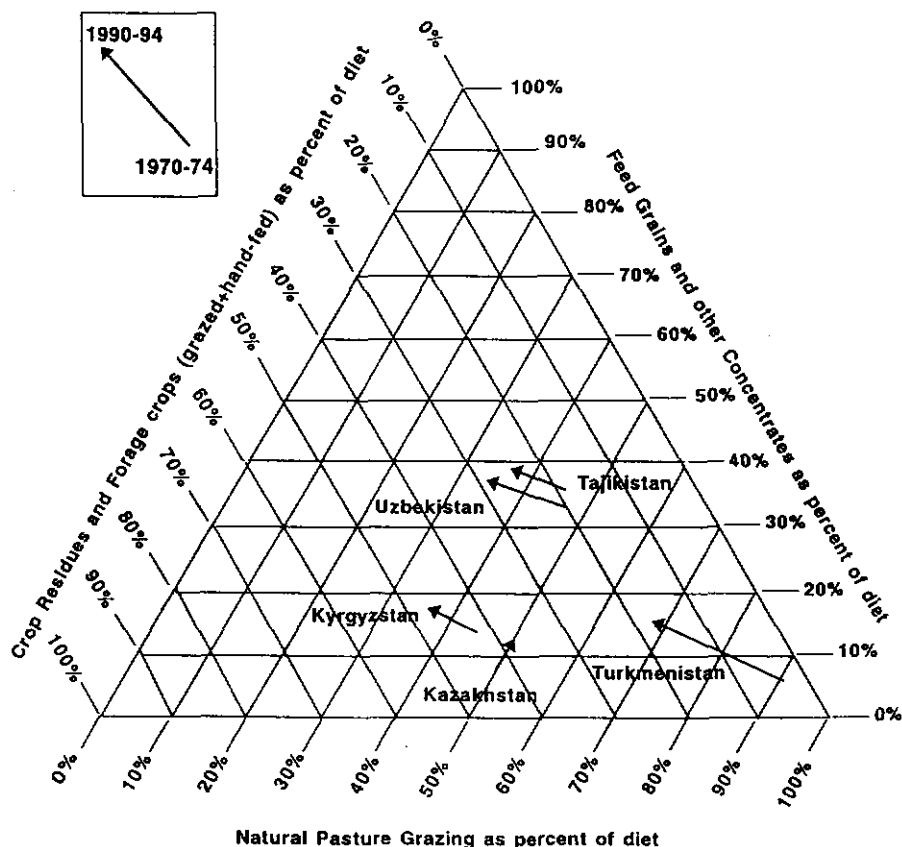
The diet shares lost by rangelands have been accounted for by increased dependence on crop residues and feed grains. The general trend toward greater use of feed grains and concentrates can be expected to continue in the future. Much of this will be to supplement diets based primarily on crop residues and range grazing. Rising amounts, however,

will be profitably used in expanded feeding operations for dairy, poultry and intensive meat production.

Domestic feed production in most of Central Asia is likely to expand with developments in crop and sown pasture production. Quantities of both domestic crop residues and feed grains should increase with better management of cereal production in rotations including forage and food legume crops. As we see below, however, domestic feed production is unlikely to keep up with demand in three of the five republics.

Assuming that increases in crop production will be associated with proportionate increases in crop residue, forage crop and feed grain production allows us to make simple projections of the numbers of TLUs supportable by domestic feed sources alone in the future. The

Figure 2. Compositions of livestock diets, by feed category: 20-year trends (1970-74 to 1994) for Central Asian Republics.



following analysis further assumes that range grazing sources will continue to provide 1990-94 levels of feed off-take (200 kg/ha, although this may be optimistic). As with the projections of grain production for Table 4, our projections of total domestic feed supplies, given 1%, 2% and 3% annual rates of increase in crop production, allow us to bracket a plausible range of possibilities for each republic. To calculate total domestic feed, we subtracted imported grain from (or added exported grain to) total feed use. And to calculate these exports and imports of grain, we multiplied the differences between per capita production and consumption in Table 3 by the 1990 population in Table 1.

Dividing each republic's total domestic feed resources (five-year averages of 1990-1994 for crop residues, rangelands and home-grown feed grains) by 2.74 tons (3% of liveweight per day for our 250 kg **TLU**) gives an estimate of the number of **TLUs** supportable at that time with domestic feed alone.

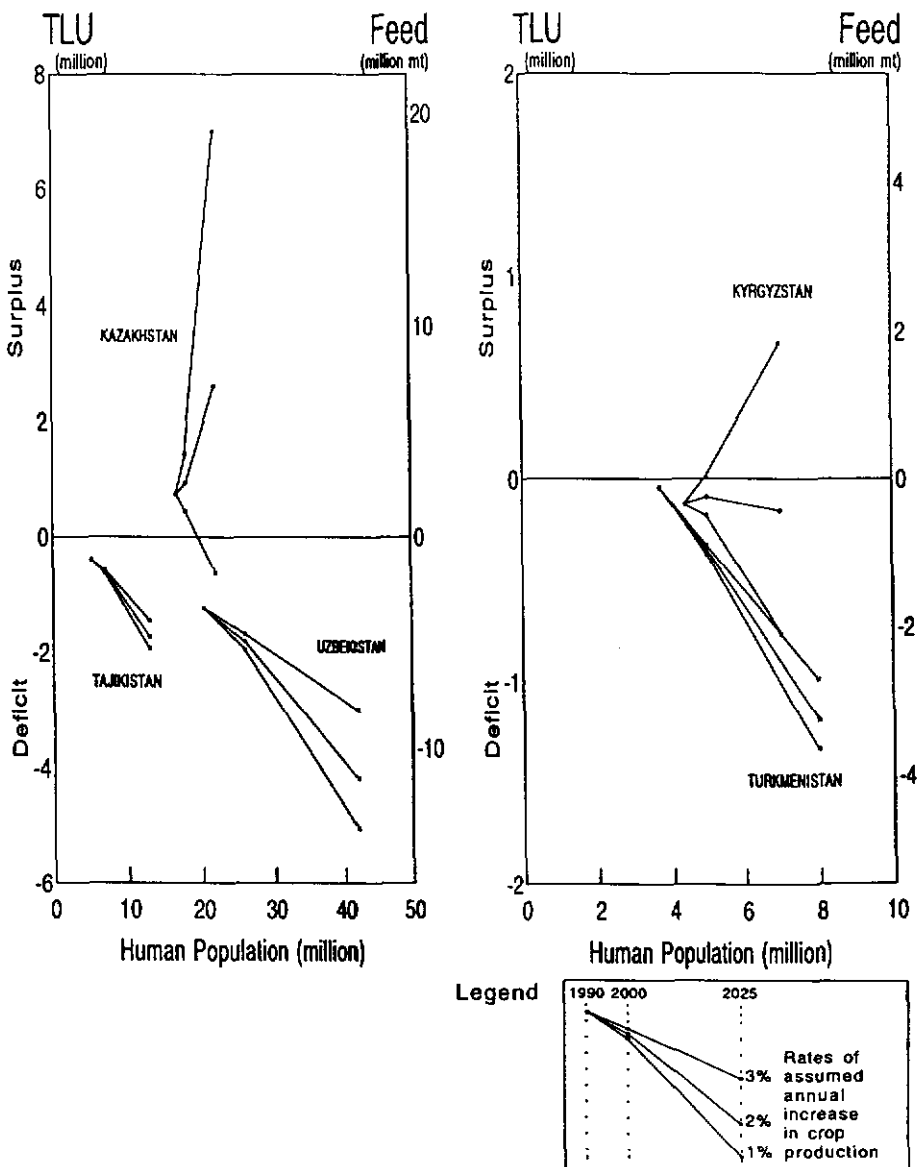
In Table 8, and Figure 3, we consider that a deficit in **TLUs** may be satisfied by imports of either livestock products or of feeds at the rate of 2.74 metric tons dry matter per **TLU**. Seasonal movement of livestock to neighboring republics with surplus feed is another possibility which was exploited in the past, in the time of the Soviet Union (according to speakers in this workshop). Clearly some such deficits may simply remain unsatisfied, and some surpluses unused until intra-regional trade arrangements can be worked out.

*Table 8. Projected surpluses (+) and deficits (-) in feeds given estimated domestic feed production in 1990-94 and annual increase in crop production of 1, 2 and 3% to years 2000 and 2025 assuming demand supports the constant current **TLU** per capita in each Central Asian Republics (feed, in million metric tons).*

COUNTRY	2000				2025		
	90-94	1%	2%	3%	1%	2%	3%
KAZAKHSTAN	2.00	1.21	2.54	3.95	-1.72	7.15	19.17
KYRGYZSTAN	-0.34	-0.49	-0.24	0.02	-2.10	-0.43	1.84
TAJIKISTAN	-1.10	-1.73	-1.65	-1.56	-5.30	-4.74	-3.98
TURKMENISTAN	-0.12	-1.02	-0.96	-0.90	-3.64	-3.24	-2.70
UZBEKISTAN	-3.39	-5.36	-4.99	-4.61	-13.88	-11.47	-8.21

Note: The per capita **TLU** level assumed constant at 1990-94 levels, represents the standing national herd of livestock, not the annual offtake of meat, milk and eggs.

Figure 3. Projected surpluses and deficits in Tropical Livestock Units (TLU) or feeds assuming constant demand of current TLU per capita, with population projections for 2000 and 2025 and annual increase in crop production of 1, 2, and 3% for the Central Asian Republics



Greater integration with world markets will become more essential; investments in human capital, natural resource management, research and technological development, likewise. Each of the Central Asian republics will benefit by developing its agriculture to the extent consistent with its particular comparative advantages. Becoming a large importer of food and feed grains is not a fearful catastrophe for a

country, provided it develops stable means for financing the imports through service industries, manufacturing and advantageous non-agricultural and agricultural exports.

Though spanning Mediterranean and temperate dry climates, the agro-ecological similarities across the vast "steppe" zones stretching from Morocco to Mongolia are matched by similarities in mixed farming systems: the predominance of small ruminants and the highly seasonal use of rangelands and crop residues in animal diets. Increasing human populations and the associated rise in demand for animal products has brought the rangelands of these regions under increasing pressure: more animals than ever graze shrinking areas of range for shorter periods of the year (Nordblom *et al.* 1996; Jones and Darkenwald 1967, Kerven *et al.* 1995), however, report what appears to be a recent reversal of this trend in Kazakhstan, Kyrgyzstan and Turkmenistan where pastoralists are lengthening their migratory cycles to make greater use of rangelands in order to reduce dependence on now-expensive cultivated fodder.

The presence of ICARDA's headquarters near the geographic center of the steppes of North Africa, and West and Central Asia, a region with common cultural roots and agro-ecological challenges, raises the possibilities of more intense collaboration in research and development across the greater region.

Strengths in rangeland ecology research in Central Asia, for example, could be used with advantage in WANA. Indeed, Central Asian range scientists have already made many contributions in WANA, particularly in Libya, Algeria and Syria.

The social, economic, policy and property-right developments for rangelands of Central Asia, on the other hand, may benefit from experiences in WANA that build upon traditional social structures and customs shared across the regions. A collaborative project joining ICARDA, IFPRI (International Food Policy Research Institute, Washington, D.C.) and national social and technical scientists of eight WANA countries (Morocco, Algeria, Tunisia, Libya, Lebanon, Iraq, Jordan and Syria), for example, is expected to result in practical and methodological lessons of wider applicability for dryland farming and rangeland management policy and property rights research.

RESEARCH NEEDS

With regard to the question of comparative advantages in meeting the projected livestock/feed deficits with feed imports, countries may choose instead to import live animals as well as frozen or processed livestock products, instead of feeds. Policies favoring imports of feeds and livestock products at prices below domestic production costs (if and where possible) could benefit consumer diets but damage the position of domestic livestock growers and feed producers. In some cases, however, this could have favorable environmental impacts in terms of, say, discouraging risky barley cultivation and overgrazing in the rangelands through lowered price incentives. Because all partners in trade stand to benefit where they have differences in comparative advantages, this is a policy topic worthy of further study.

Given the fact that we have not counted some potentially important crop residues and forage crops (e.g., cotton leaves and alfalfa) in this preliminary analysis, an element of uncertainty must remain in our calculations of feed balances and deficits until this study can be revised in partnership with local experts in Central Asia. Similarly, our blanket-estimates of rangeland productivity in the region are unrefined and would benefit from collaborative research.

There are several points where human capital (including institutions) need strengthening in Central Asia: rangeland tenure and farmer-level decision making need attention; where pastoralists and farmers are insecure tenants, they cannot be expected to take a long-run view of sustaining the natural resources they use (Young, 1992; Behnke *et al.* 1993; Bromley and Cernea, 1989; Schultz, 1981, 1993). Large economic gains appear feasible also through devolving property rights and decision taking from state bodies to individual farmers or well organized small groups. These questions deserve strategic research support.

Public goods for the region, and the world, will continue to be generated by international institutions working in partnership with national agricultural research systems (NARS) on conservation and enhancement of plant genetic resources (those particularly of wheat, barley, lentil, chickpea, faba bean, forage crops and pasture species whose centers of origin and wild relatives are found in Central Asia). Already, ICARDA and the five Central Asian Republics have concluded collaborative research agreements covering crop improvement, protection of plant genetic resources and on-farm water management.

Conservation and evaluation of the genetic resources of small-ruminants may also be the subject of global interest: for example, the hardy lean sheep species with fat-tails, found from Tunisia through Central Asia, and prized for milk and meat production. Better management of the animal nutrition/health complex is also a subject very much worthy of study.

Informal seed sectors provide services which could be enhanced considerably with support of strategic research on methods, followed up with well-informed extension. Production and efficient use of pasture seed holds particular challenges which are beginning to be tackled by ICARDA with NARS of WANA (Christiansen et al, 1994). This work will clearly benefit from further partnerships in Central Asia. For the formal seed sectors and the main crops they serve, a proposal to expand ICARDA's "WANA Seed Network" to include Central Asia is already being formulated.

Fertilizers are often under-exploited in dryland farming; with these, and better locally-tuned crop rotations and with regard for weather risks and world prices, large economic gains are possible. Strategic research is needed on methods for determining best (economically and environmentally) sustainable agronomic practices and for facilitating their adoption (Ryan 1996).

Increased attention is justified toward enhancing farm-level livestock management (including nutrition) where, as in many cases in WANA, animals produce at levels well below their genetic potentials resulting in wasted feed. Research on livestock management should be brought into economic balance with the current emphasis on national veterinary and animal breeding investments in both WANA and Central Asia. Development of suitable methods of nutritive diagnosis and testing are needed.

CONCLUSIONS

It is no coincidence that ICARDA's mandate is focused on the above areas of need for strategic research aimed at yielding "public goods information" (including genetic information) and human capital for the sustained benefit of mankind. Partnership with NARS of WANA and Central Asia is as much a key to ICARDA's success in the region as

our focus on rehabilitating natural resources and enhancing the welfare of resource users and consumers. Partnerships with other CGIAR centers, and non-CG centers of excellence (as represented by the Small Ruminant CRSP of USAID, and Britain's Overseas Development Institute), are also essential to bring critical masses of research skill to bear on these issues.

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ECOLOGY OF RANGELANDS OF CENTRAL ASIA AND MODELING OF THEIR PRIMARY PRODUCTIVITY

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1. GENERAL FEATURES OF THE GEOGRAPHICAL AND PRODUCTION ECOLOGY OF THE RANGELANDS OF CENTRAL ASIA

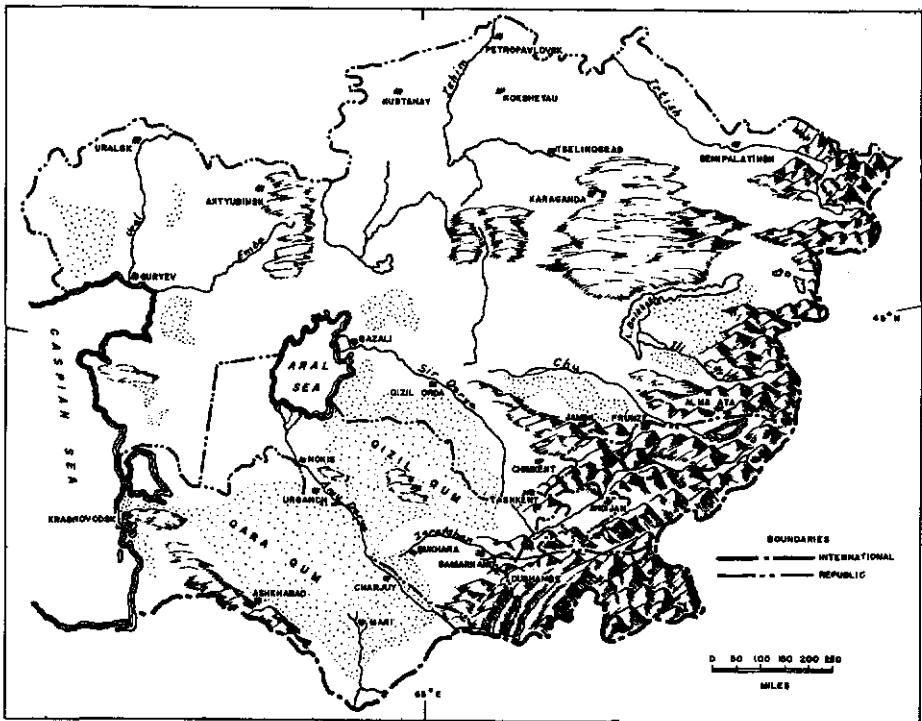
As described in detail by a number of Russian and Central Asian scientists, a great variety of landscape and ecosystem types exist in Central Asia, designated as the territory of the former USSR which belonged to the republics of Middle Asia (Turkmenistan, Uzbekistan, Kyrgyzstan, and Tajikistan and Kazakhstan). Two main factors determine the ecosystem distribution in the area:

- (1) latitudinal zonality, which is clearly demonstrated on the plains areas by consecutive changes from meadow to typical dry steppes in southern Russia and northern Kazakhstan to desert-steppes/semideserts, northern deserts, southern deserts and subtropical deserts in the most southern parts of Central Asia, and
- (2) altitudinal zonality explaining transition from deserts on the plains to the foothill semideserts, desert steppes, steppes, shrublands, woodlands, forests and meadows of Kopetdag, Pamir and Tyan-Shan mountains.

Combined with the global/continental regularities of atmospheric circulation, these macro-geographical features (Figure 1) result in a characteristic pattern of precipitation and temperature distribution in Central Asia (Fig 2, a, b, c).

Since most of the non-mountainous territory is characterized by less than 300 mm per year precipitation (and the predominant part even <200 mm/yr), and summer temperatures in the range of 28 to 32 °C, the region obviously belongs to the arid zone. At the same time low winter temperatures especially in the northern parts of the region (>43°N) appreciably limit the length of the growing season and cause substantial difficulties for livestock overwintering.

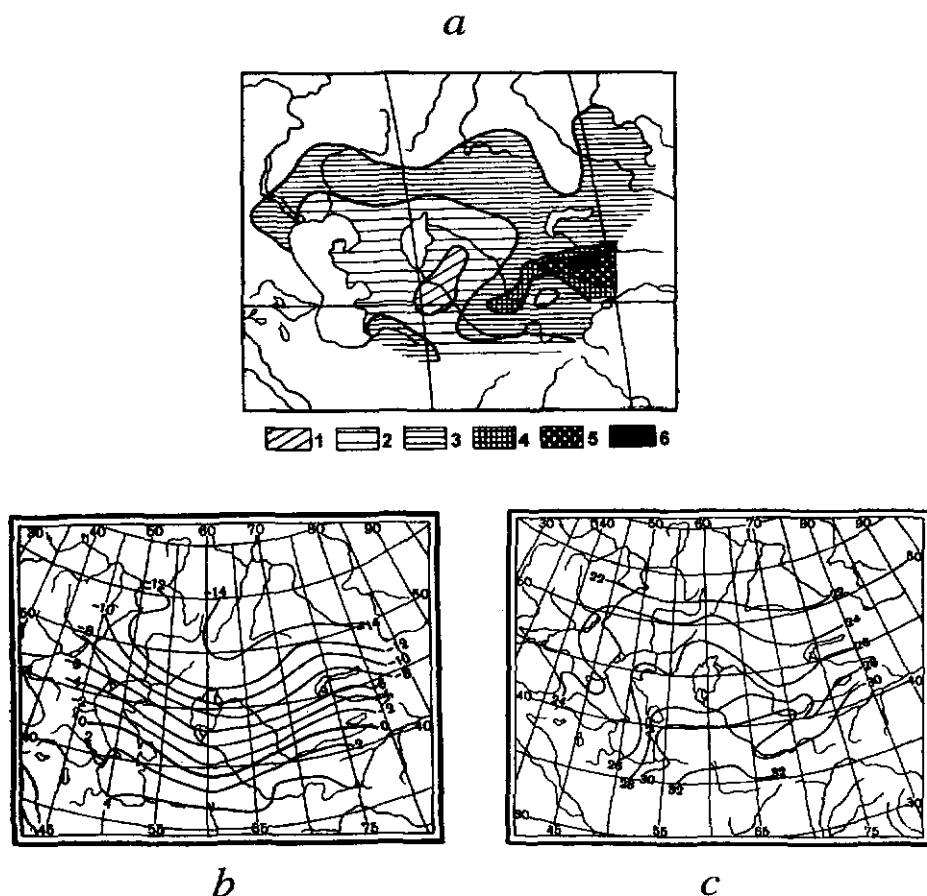
Figure. 1. Principal relief forms of Central Asia (after Matley, 1967).



With the total rangeland area of 262 MM ha and the present population of more than 50 M humans (nearly 20 persons per 1 km² of rangelands), Central Asia remains highly dependent on livestock production from natural rangelands, though during the past 30 years the significance of farm livestock husbandry and animal feed production on cultivated fields has continuously increased.

With a history of pastoralism in Eurasian Steppe being traced back at least to the fourth millennium BC (Tsalkin 1970), Central Asia belongs to the most ancient regions of human use of rangelands in the world. At the beginning of the first millennium BC nomadic cattle breeding emerged as an evolutionary stable life system for tribal nomads, probably as an adaptation to the dry climatic period at the turn of the second and first millennia BC (Khazanov 1994). During the following three millennia a number of nomadic civilizations were sustained in the rangelands of Eurasia due to the relative "homeostasis" of their life style with the steppe/desert rangelands, occasionally enriching the world

Figure. 2. Macroclimatic patterns in Central Asia: (a) Distribution of annual atmospheric precipitation: 1 - < 100 mm; 2 - 100-200 mm; 3 - 200-300 mm; 4 - 300-400 mm; 5 - 400-500 mm; 6 - >500 mm; (b) average January air temperature and (c) average July air temperature adjusted to the sea level elevation (after Kuvshinova and Chubukov, 1958).



history by such remarkable outbursts of activity of ethnogenesis as the great invasions of Scythians, Sarmats, Huns and Mongols which left their impact on civilization (Gumilev 1989).

Archaeological and historical data on the population density of nomads of the "Great Steppe" are scanty. Nevertheless combined ethnological and ecological analysis leads to the conclusion that the population density of the nomad societies on Eurasian rangelands was probably rather low. We may get an idea of the order of magnitude of

the "preindustrial" population density using the data for predominantly nomadic populations of Kazakhstan and Mongolia available for the 19th century. The population of Kazakhstan in 1830 was estimated as 1.3 M (Khazanov 1995), and the population of Mongolia in 1855 as less than 0.5 M (Bawden 1989). Using the contemporary estimates of the rangeland areas of Kazakhstan and Mongolia (1.80 and 1.32 M km² respectively) we come up with population densities of 0.7 and 0.4 persons per 1 km² of rangeland area. The higher value for Kazakhstan fairly reflects somewhat more favorable ecological conditions on its plains compared to ultracontinental and elevated rangelands of Mongolia.

The 20th century brought drastic changes to the life of nomadic peoples of Eurasia, and Middle Asia, and Kazakhstan in particular. Socialist revolution in Russia in 1917, formation of the USSR in 1922, and Mongolian revolution of 1921-24 had radically changed the life of peoples of the region. The comprehensive assessment of those transformations still belongs to the future, but the fact is that they inspired a steady and accelerating growth of human and livestock population in the republics of Central Asia. In addition to powerful social forces, there were rich natural resources of rangelands with sufficient primary productivity potential that made such a growth possible for finite period of time. It is an interesting learning experience - to understand, how and at what cost it was possible to increase the human population density from ~0.5 to nearly 20 persons per 1 km² of rangeland area.

Table 1. Rangeland area (M ha) of republics of Central Asia (Tsentral'noe Statisticheskoe Upravlenie 1991; Shend 1995; FAO 1995)

<i>Republic</i>	<i>Total area</i>	<i>Rangelands</i>
Kazakhstan	272	186.5
Kyrgyzstan	19.8	9.1
Tajikistan	14.5	3.5
Turkmenistan	49.5	39.6
Uzbekistan	45.2	23.4
<i>Total</i>	401	262.1

Total rangeland area of the republics of Central Asia available from the general statistical sources amounts to 262 M ha (Table 1). This large grazing resource became the basis for speculations of high livestock production potential. Indeed, considering the data on the growth of livestock numbers in the republics of Central Asia during the post-war period, one can see the nearly perfect exponential increase of livestock numbers with average growth rate of 4.4% per year (Figure 3).

These observations along with real examples of extremely high livestock productivity in selected range experimental stations, and collective and state farms in early 1960-s led certain scientists and administrators to the conclusion that further large increases in livestock production on soviet rangelands were possible (Esaulov 1963, Nikolaev et al. 1977). Assumptions of the permanent increase of productivity of animal husbandry in the USSR may be found in every soviet official 5-year plan up to the late 1980-s.

Figure 3. Growth of livestock numbers N (M Animal Units) in the republics of Central Asia during the post war period. Points: statistical data (Tsentrāl'nnmoe Statisticheskoe Upravlenie, 1959-1965); fitting line: $N = 11.1 \exp(0.044(t-1954))$; $R^2 = 0.94$.

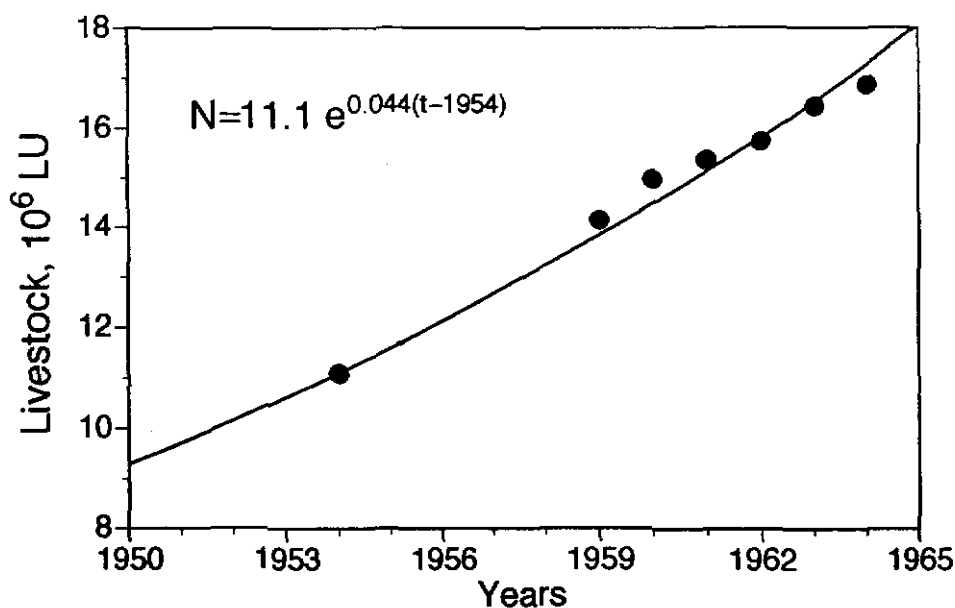
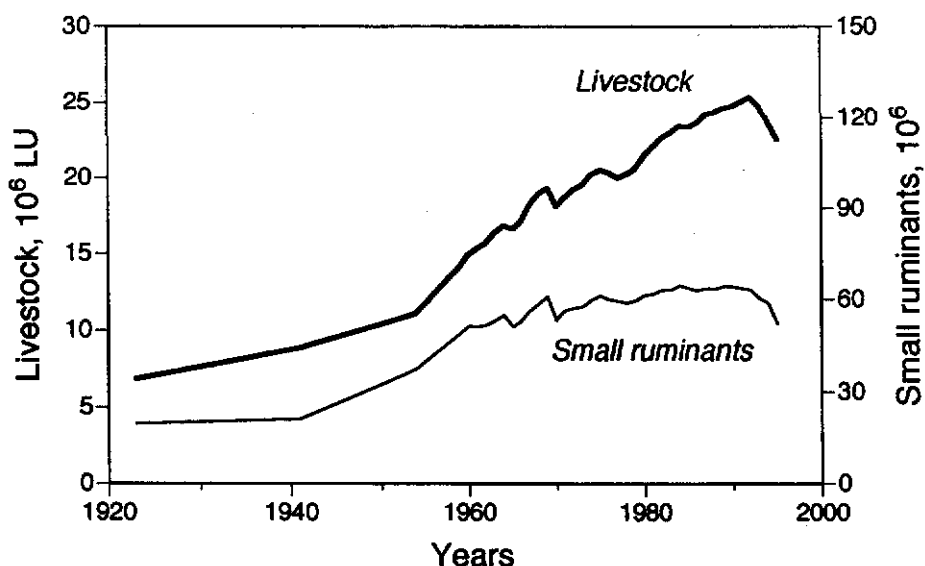


Figure 4. Dynamics of the total numbers of livestock and small ruminants in Central Asia (data sources: Tsentral'noe Statisticheskoe Upravlenie 1959-1989, Shend 1993, FAO 1995).



At the same time other scientists, e.g. prominent Soviet range-ecologist, N.T. Nechaeva, had already come to the conclusion that the carrying capacity of most of natural rangelands of the USSR in 1960's had already been reached further increases in range productivity were impossible without drastic improvements in the utilization of new scientifically based methods of range management coupled with substantial investments (Nechaeva and Pelt 1963; Gaevskaya 1963).

As can be seen from the more complete data (Figure 4), these cautious scientists proved to be correct. Since the mid-1960's the growth of the sheep population in the Central Asia, which is most directly related to the natural rangelands, had practically stopped, indicating that the carrying capacity was attained. The continuation of growth of livestock numbers (primarily cattle) until the mid-1980's could be maintained only at the expense of the progressive increase in the proportion of concentrates and silage in the diet of livestock (Gilmanov 1996, Nordblom et al. 1997).

Obviously, it is difficult to use these general figures in any detailed considerations of forage and livestock productivity because of the qualitative heterogeneity of rangelands in different geographical regions of Central Asia. There were a number of attempts to construct

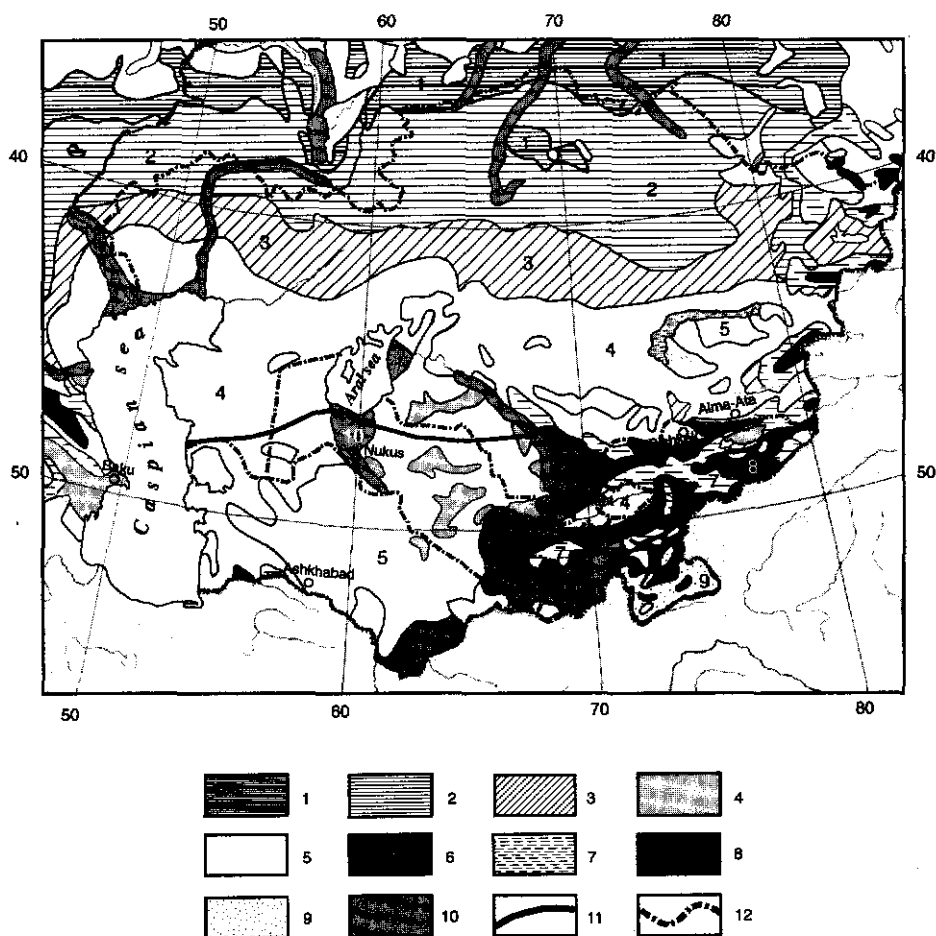
classifications and maps of the vegetation, soils, ecosystems and landscapes of Central Asia in general, and of the rangelands of the regions in particular (Korovin 1934, Lavrenko 1954, 1965, The map of vegetation of Central Asia 1957, Gvozdetsky 1960, Petrov 1964, Nikolaev et al. 1977, Skatershchikov et al. 1982, Lobova and Khabarov 1983, Makulbekova 1992). But when it comes to quantitative characterization of the areas occupied by different rangeland types, the data remain rather scanty and contradictory. Therefore, following Larin (1963) and Bazilevich et al. (1986) we adopted a simple classification of rangelands according to the principal biome types (or natural plant-soil formations) distinguished in Central Asia (Table 2). This simple classification and its schematic graphical representation (Figure 5) will be used as an ecological basis for estimation of the forage production potential of the Central Asian rangelands. In applying this simple classification it is necessary to consider the texture (sand, loam, clay, etc.) and salinity/alkalinity of the soils, and deeper surface geological layers. These factors greatly influence the structure and function of ecosystems of the region (cf. Petrov 1964)

Table 2. Rangeland areas in different biome types of Central Asia.

Zone	M ha	Per cent
Meadow steppes	1.8	0.7
Typical steppes	10	3.8
Dry steppes	26.3	10.0
Semidesert	80	30.5
Northern deserts	53	20.2
Southern deserts	57	21.8
Ephemeroïdal deserts	11	4.2
Mountains	23	8.8
Total	262.1	100.0

One of the reasons for contradictory opinions regarding livestock production capacity of the rangelands was the absence of adequate estimates of the aboveground net primary productivity (*ANPP*) of the rangelands of different landscape zones (measured, for example, in $t\ ha^{-1}\ yr^{-1}$ of dry organic matter). Most previous estimates of rangeland forage resources were based on peak seasonal aboveground phytomass (*G_{max}*). Although positively correlated with production, this measure does not completely characterize the production potential of the ecosystem, especially with regards to its seasonal dynamics.

Figure 5. Schematic map of major ecological zones of Central Asia: 1 - meadow steppes; 2 - typical steppes; 3 - dry (desertified) steppes; 4 - sagebrush-saltwort-ephemeral deserts (mostly northern); 5 - saksaul and shrub, often sandy deserts (mostly southern); 6 - ephemeroidal desert/semidesert (on foothill serozem soils); 7 - mountain steppes; 8 - alpine/subalpine meadows and mountain forests; 9 - high mountain deserts/semideserts; 10 - floodplains and other alluvial ecosystems; 11 - conditional border between "northern" and "southern" deserts; 12 - state boundaries.



In the present study we made the first attempt to obtain direct estimates of the potential aboveground primary productivity ($ANPP$) of rangelands of Central Asia. These estimates were based on the results of quantitative analysis of the published estimates of $ANPP$ of terrestrial ecosystems obtained during the last 25 years in all principal vegetation zones of the region. A large group of terrestrial ecologists and range scientists from Central Asian republics, Russia, and other republics of the former USSR have contributed to this work. On this occasion publications by Larin (1936, 1956; 1963), Rodin and Bazilevich (1967),

Bykov et al. (1974); Rodin (1975, 1979, 1984), Nechaeva (1963, 1968, 1980, 1981, 1985), Nechaeva et al. (1977, 1979), and Titlyanova (1977, 1979); Titlyanova and Nurmedov (1982), Titlyanova et al. (1988), Titlyanova and Mamedkuliev, (1992) should be mentioned as fundamentally important. Especially useful for the purpose of present study were the publications and personal consultations with Natalia I. Bazilevich whose pioneering spirit and enlightened personality greatly inspired the author of this work (Bazilevich 1975, Bazilevich, Grebenshchikov and Tishkov 1986, Bazilevich 1992, 1994).

To synthesize and quantitatively analyze all the available data on phytomass and productivity of rangelands of Central Asia relative to climatic and soil conditions, the data were organized into a "Climate/ Soil/Productivity Database of Rangeland Ecosystems of Central Asia and other regions of the former USSR". As can be seen from Table 3, representing ecosystems of different landscape zones, the total number of records in the database amounts to 627, of which 482 describe plain (grassland) territories and 145 records describe mountainous ecosystems. Along with geographically referenced estimates of above- and below ground plant phytomass, and aboveground net primary production, the database contains a number of climatic (temperature, precipitation, growing period, solar radiation) and soil characteristics (profile morphology, texture, humus and nutrients reserves, etc.) that are most relevant to the range production capacity.

Analysis of the information in this database has made possible estimates of the forage production potential of the Central Asian rangelands based on objective ecological characteristics, such as aboveground net primary productivity ($ANPP$, $t\ ha^{-1}\ yr^{-1}$) of different ecosystem types, rather than the traditionally used estimates of "forage productivity". To perform this analysis we used two sets of productivity figures. The first set, represented by column 3 in Table 4 below, contains the estimates of the productivity of zonal (dominant) ecosystems in each biome, while the second set provides the estimates of $ANPP$ of the zone aggregated at the landscape level (column 5, Table 4). These later values account not only for productivity of the dominant zonal ecosystem type, but also for the productivity of other ecosystem types occurring in the landscapes of the zone, such as ecosystems on sandy substrates, alluvial ecosystems, saline ecosystems, etc. Since productivity of these intrazonal and azonal types is usually higher than of the zonal dominants, the second estimate of the total annual $ANPP$

Table 3. Representation of different landscape zones in the "Climate/Soil/Productivity Database" of rangelands of the Former Soviet Union

Landscape zones/subzones	Records in a database
<i>Plain territories</i>	482
Meadows in forest zone	20
Meadow steppe	51
Typical steppe	116
Dry steppe	102
Desert steppe	86
Northern subboreal desert	19
Southern subboreal desert	38
Ephemeroidal desert	50
<i>Mountain territories</i>	145
Meadows	9
Meadow-steppe	18
Steppe	97
Desert steppe	8
Desert	10
High mountain desert	3
<i>Total number of records</i>	627

Table 4. Estimates of the aboveground primary production of the rangeland areas of Central Asia based on zonal (ANPPzon) and landscape-aggregated (ANPPagr) figures for average productivity of different biomes

Zone	Area	ANPPzon		ANPPagr	
	10 ⁶ ha	t ha ⁻¹ yr ⁻¹	10 ⁶ t yr ⁻¹	t ha ⁻¹ yr ⁻¹	10 ⁶ t yr ⁻¹
Meadow steppe	1.8	5.47	9.85	5.22	9.4
Typical steppe	10	2.66	26.6	2.65	26.5
Dry steppe	26.2	1.88	49.26	1.89	49.5
Semidesert	80	1.31	104.8	1.65	132
Northern desert	53	1.79	94.9	1.95	103.3
Southern desert	57	0.46	26.2	1.16	66.1
Foothill desert/semidesert	11	1.06	11.7	1.06	11.7
Mountains	23	2.92	67.2	2.92	67.2
Total	262		390.4		465.7

resource - 466 M t DM yr⁻¹, is higher than the value based on zonal estimates only - 390 M t DM yr⁻¹.

How do these estimates compare to the available data on livestock numbers in Central Asia? As shown on Fig. 4, the livestock numbers in Central Asia peaked in 1992 at the level of 25.4 M livestock units (LU). Using the recommended annual food consumption of a standard livestock unit equal to $C_{LU} = 4.38$ t DM yr⁻¹ we may try to estimate the number of livestock that may be supported by the *ANPP* reserves presented in Table 4.

To do such calculations two additional parameters are needed: the coefficient of utilization of *ANPP* by livestock - k_u , and the proportion of supplemental feeds (hay, silage, concentrates, etc.) in the ration of livestock - p . Denoting the number of livestock units by the letter N we may equate the amount of forage consumed on natural rangelands

$C_{LU} N(1-p)$ to the k_u -th part of the *ANPP*, obtaining an equation:

$$C_{LU} N (1-p) = k_u ANPP \quad (1)$$

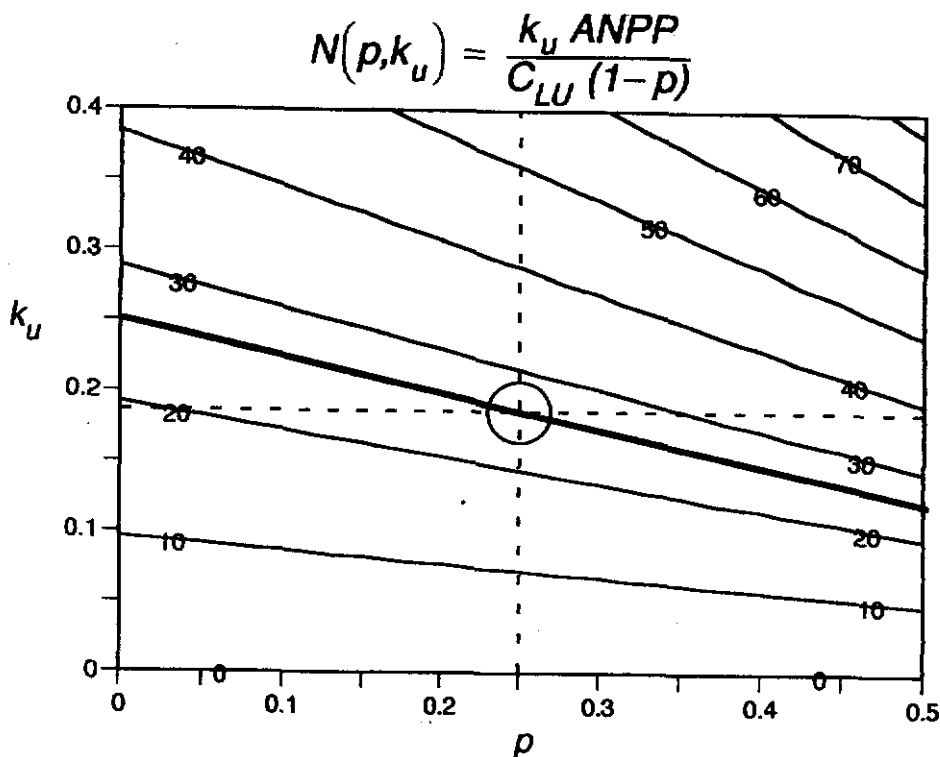
From which it follows that the supported number of livestock units N is equal to:

$$N = \frac{k_u ANPP}{C_{LU} (1 - p)} \quad (2)$$

Figure 6 shows the contour graph of the function $N = N(p, k_u)$, quantifying the obvious expectation that the number of supported animals will increase with an increasing proportion of supplemented feed (p) and an increasing range utilization (k_u). According to the most recent review by Nordblom et al. (1997, this volume), in years with normal forage supply on the range the proportion of supplemental feeds in the livestock diet in various republics of Central Asia is in the range 11 to 39 %. Assuming the average estimate $p = 25\%$ we may use the graph on Fig. 6 to estimate the rangeland *ANPP* utilization coefficient corresponding to livestock population $N = 26$ M LU. As we see, the corresponding estimate is $k_u = 0.18$.

Even adopting the rounded value $k_u = 0.20$ at first glance this estimate seems to be somewhat low. For example, for "healthy"

Figure 6. Contour lines of the function $N = N(p, k_u)$, quantifying equilibrium number of supported animals N for the Central Asian region depending on the proportion of supplemented feed (p) and range utilization coefficient (k_u) according to eq. (2), assuming $ANPP = 466 \text{ M t DM yr}^{-1}$ and $C_{LU} = 4.38 \text{ t DM yr}^{-1}$.



(predominantly grassland) rangelands of North America values as high as 0.55 were recommended (Looman, 1977). In this connection at least three remarks should be made.

First, in the formula (2) we operate with the estimate of $ANPP$, while most range scientists relate their utilization coefficient k_u to the more ambiguous value of estimated "forage production", which is only a part of the $ANPP$. On most of the Central Asian rangelands, shrubs and dwarf shrubs constitute considerable, sometimes predominant, part of $ANPP$. Since they usually contain a greater proportion of less palatable woody and lignified phytomass compared to grasses and forbs, this will result in lower values of k_u .

Secondly, it should be taken into account that the estimate of $ANPP = 466 \text{ M t yr}^{-1}$ used in formula (2) is related to the whole rangeland area. The resulting average value of $k_u = 0.2$ may hide the fact that

one third of the rangeland territory is heavily overgrazed having $k_u > 0.3$, the second has the k_u close to the average, and the last third is underexploited with $k_u < 0.1$.

Thirdly, the estimate $k_u = 0.2$ corresponds to the “normal” rangeland yield conditions. Since k_u is inversely related to *ANPP*, in years with inadequate rangeland yield to support a given livestock population, a higher production utilization coefficient is needed. Obviously, in unfavorable years the proportion of supplemental feeds is increased (e.g. Nordblom et al. 1997, estimate $p = 21$ to 54% for Central Asian states when forage yield is only $0.25 \text{ t DM ha}^{-1}$), but it is not sufficient to prevent the increasing of k_u . Assuming $p = 37\%$ and $ANPP = 233 \text{ M t yr}^{-1}$ we obtain $k_u = 0.30$.

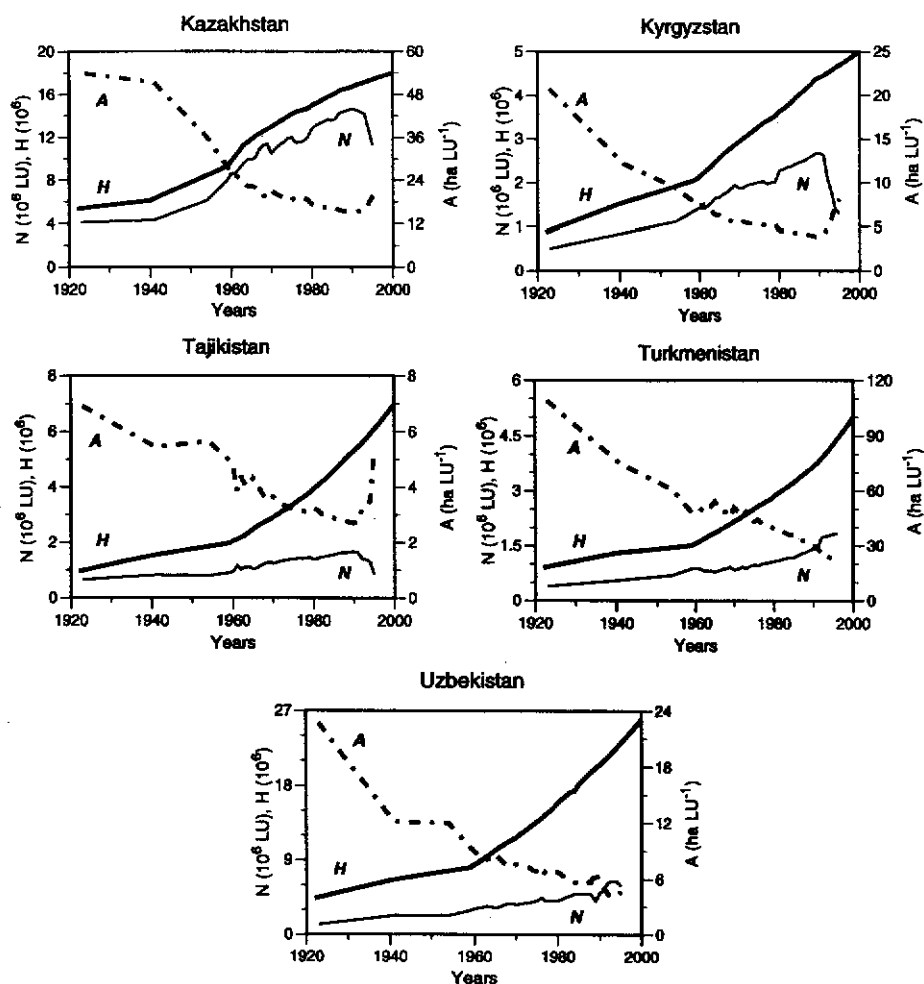
As preliminary and rough as they are, these considerations evidently support the conclusion that the natural carrying capacity of most of the rangelands of Central Asia, represented by the available estimates of their aboveground net primary production, probably is not capable of supporting considerably larger livestock population than the present level of approximately 25 M LU without a corresponding increase in the proportion of supplemental feed (increasing p) and increasing the grazing load on rangelands (increasing k_u). Unfortunately, this conclusion is in sharp contradiction with the implications of the current trends in human population growth (Figure 7).

Apparently, except Kazakhstan, the growth of livestock numbers in the past 50 years remained far behind the growth of human population, the “scissors” being especially evident in most densely populated Tajikistan and Uzbekistan that are also characterized by the lowest area of agricultural land per livestock unit ($3\text{--}4 \text{ ha LU}^{-1}$). These data indicate the highly strained situation on the rangelands of Central Asia requiring application of new methods for their management.

2. ECOSYSTEM THEORY [BIOGEOCOENOLOGY] AS A THEORETICAL BASIS FOR RANGE MANAGEMENT

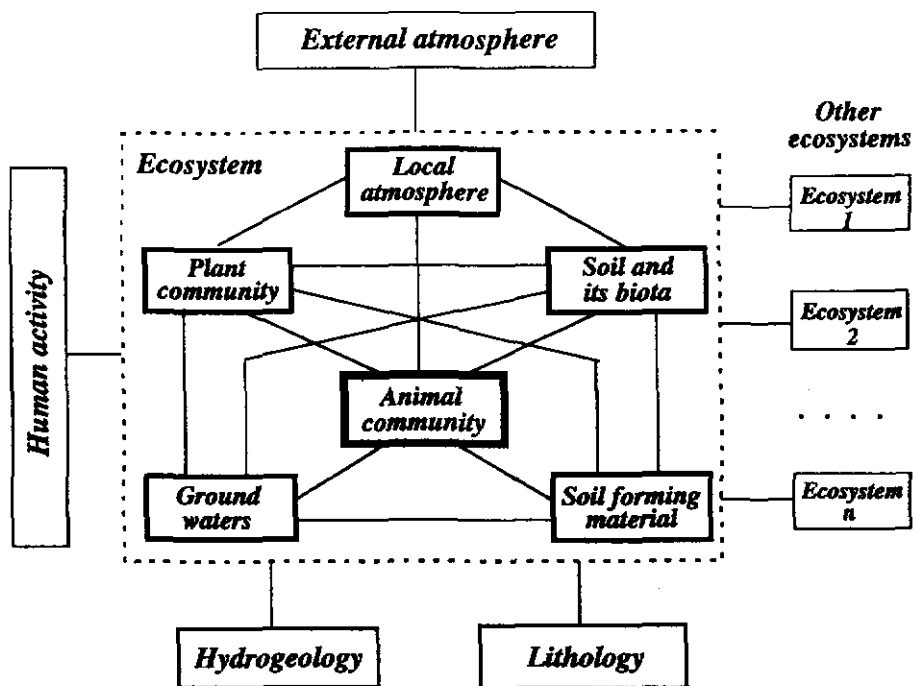
While the ecosystem concept of range management in the west is a widely vocalized but predominantly heuristic device with limited applicability (Nickolson 1988), the Soviet tradition of range science and its applications to arid and semiarid rangelands at the outset was heavily built on the fundamental principles of ecology and

Figure 7. Dynamics of human population H (M.), livestock numbers N (M LU), and agricultural area per livestock unit A (ha LU⁻¹) in the republics of Central Asia according to available statistical data (Tsentrāl'noe Statisticheskoe Upravlenie 1959-1989, Shend 1993, 1995, FAO 1995).



biogeocoenology. To give a few examples, the first Russian textbooks on general and animal ecology published in 1930s by D.N. Kashkarov (1933, 1936, 1938), based on the results of his studies on the rangelands of Central Asia, emphasized concepts of biotic communities, their successional development and interrelations with abiotic environment and human management. Though the theory of the biogeocoenosis was derived by V.N. Sukachev mainly from his studies in forests and grasslands of the moderate climatic zones (Sukachev 1964), it was systematically applied to arid and semiarid rangelands by Larin (1969), Rodin (1975), Lavrenko (1961, 1971), Rode (1974), Nechaeva et al. (1979), and other authors.

Figure 8. Conceptual diagram of the composition and structure of an abstract terrestrial ecosystem (dashed box) and its interactions with external systems. Boxes denote subsystems of the ecosystem and the systems in its environment; lines between boxes generalize relationships (interactions) between corresponding subsystems and/or systems (after Gilmanov 1977, 1992, modified).



The diagram in Figure 8 presents the animal-centered perspective of the ecosystem concept. The animal community was placed in the center of the diagram contrary to the common case where the "atmosphere-plant-soil" component is the center of most energy flow based ecosystem schemes. The six compartments encircled by the dashed rectangle in the central part of the diagram designate the main subsystems traditionally distinguished in any terrestrial ecosystem: local atmosphere, plant community, animal community, soil (with microbial community inseparable from it), subsoil (parent rock), and ground waters. These subsystems are closely linked together by a multitude of relationships, which are schematically represented by the lines connecting the compartments. As a whole, the ecosystem is affected by and feeds back to, external atmosphere, other ecosystems of the local landscape, with local hydrogeology and lithology, and, last but not least, to various forms of human activity.

The need to consider an ecosystem as dynamic complex of interrelated subsystems interacting with its abiotic, biotic and human environment is presently considered as a truism by many ecologists and environmental practitioners. But it will remain an academic slogan until these mentioned interrelations and feedbacks are incorporated into dynamic mathematical models and efficiently incorporated into validated computer programs.

Grassland and range ecology has its own history of failed attempts to implement the concept of hierarchically constructed and mechanistically based ecosystem models. This approach is perhaps best exemplified by the saga of the US/IBP Ecosystem Level Model (ELM) (e.g., Innis 1978). On the other hand, the experience available in rangeland modelling provides the basis to delineate the most relevant and effective directions of modelling which are likely to bring desired results in a reasonable time.

Probably one of the most straightforward ways to illustrate the need of ecosystem approach to range management is provided by considering primary production of rangelands which is the basis for their livestock productivity and sustainability under changing climatic and management controls.

3. MODELING PRIMARY PRODUCTIVITY OF RANGELANDS AS THE BASIS OF LIVESTOCK PRODUCTIVITY

The instability of range forage supply in arid and semi-arid rangelands of Eurasia in different years is well established (as can be seen from Figures 14-15 below presenting results of some of the most long-term observations on phytomass dynamics on permanent study sites). But with all the uncertainties of meteorology, the task of mathematical modeling of primary productivity of rangelands was found to be feasible because of the strong dependence of arid/semi-arid plant production on atmospheric precipitation. Since the early publication by H. Walter (1939) it is assumed that the productivity of arid and semi-arid ecosystems may be described as a linear function of precipitation. While the data from our database show this assumption is quite reasonable, for the whole range of precipitation variability a more subtle S-shaped relationship is more appropriate (Figure 9):

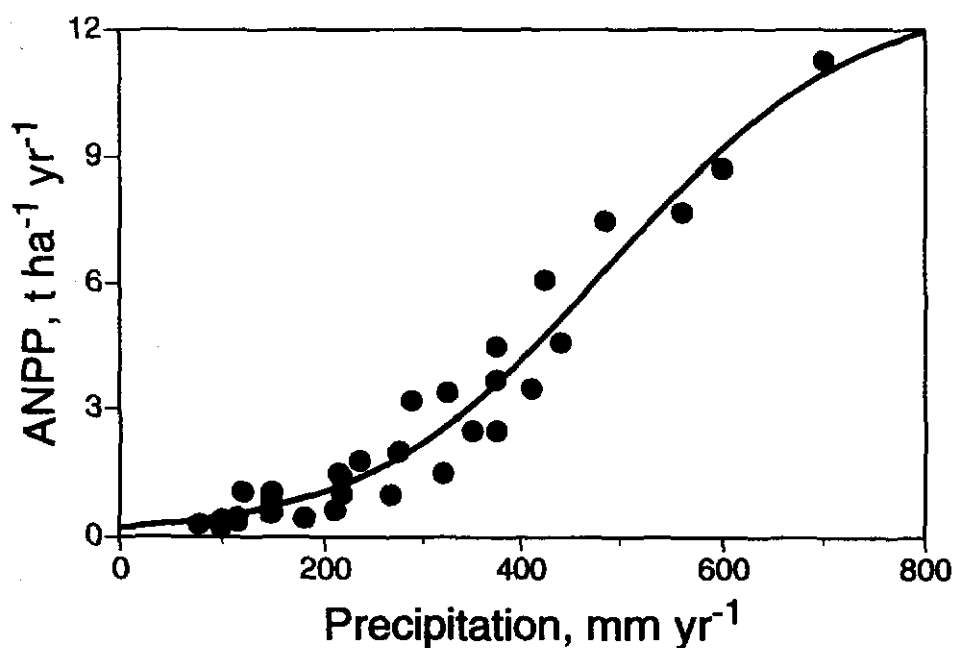
$$ANPP = \frac{12.88}{(1.0 + \exp (-0.0083 \text{ Prc}))} \quad (n = 32; R^2 = 0.97) \quad (3)$$

where $ANPP$ is measured in $\text{t ha}^{-1} \text{ yr}^{-1}$, and annual precipitation Prc in mm yr^{-1} .

The scatter of the data points around the regression curve reflects the fact that not only the total precipitation amount, but other factors such as seasonal rainfall distribution, soil texture and fertility (to name only few) contribute to the control of ecosystem productivity. Nevertheless comparatively small deviations of the points from the fitting curve indicate how significant precipitation is in determining productivity of arid rangelands.

Figure 9. Aboveground net primary production of zonal (autonomous) steppe, desert-steppe and desert ecosystems $ANPP$ ($\text{t ha}^{-1} \text{ yr}^{-1}$) in relation to annual atmospheric precipitation Prc (mm yr^{-1}). Points designate representative records from the "Climate/Soil/Productivity Database" and approximating S-shaped curve is described by the equation

$$ANPP = \frac{12.88}{(1.0 + \exp (-0.0083 \text{ Prc}))} \quad (n=32; R^2 = 0.95).$$



Using the information from the database for plain and mountainous rangelands of the arid and semi-arid zones of the Former USSR the means and standard deviations of the *ANPP* were calculated (Figures 10 - 11). Since the records in the database represent mostly ungrazed and lightly grazed ecosystems, corresponding numerical estimates should be considered as characterizing the potential ecosystem productivity.

4. CARBON FLUX STUDIES IN RANGELAND ECOSYSTEMS CONTRIBUTE TO RANGELAND PRODUCTIVITY ESTIMATES

Beyond the phenomenological models of rangeland productivity exemplified by equation (3) or those based on traditional productivity measurements using the clipping techniques with the site-specific parameters, a new opportunity to develop rangeland productivity models is now available from the on-going direct measurements of carbon flux studies in different types of rangeland ecosystems (e.g. Svejcar et al.

Figure 10. *Estimated potential ANPP (means $\pm$ s.d.) of zonal and intrazonal ecosystems of the subzones of the desert zone of the Former Soviet Union based on information from the "Climate/Soil/Productivity Database".*

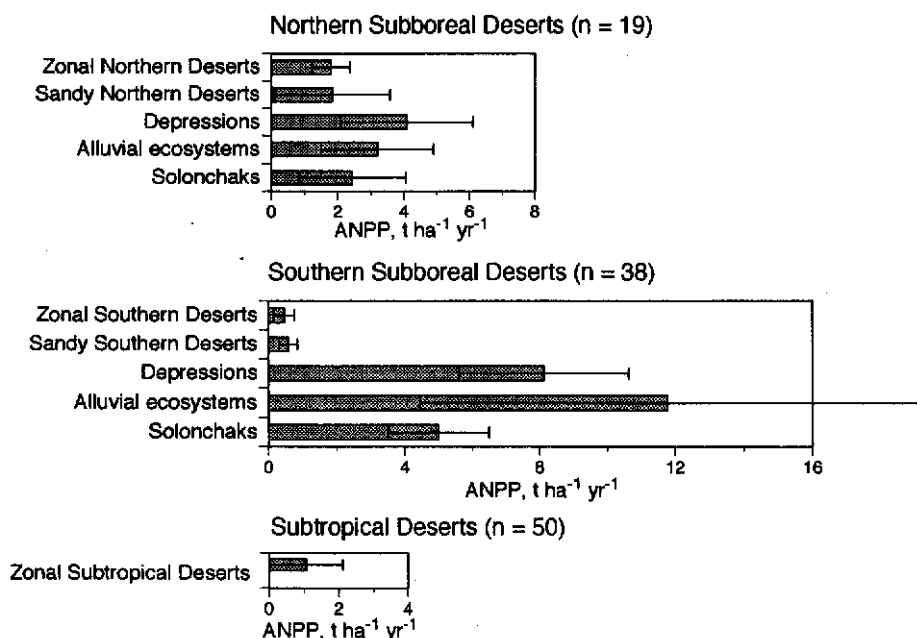
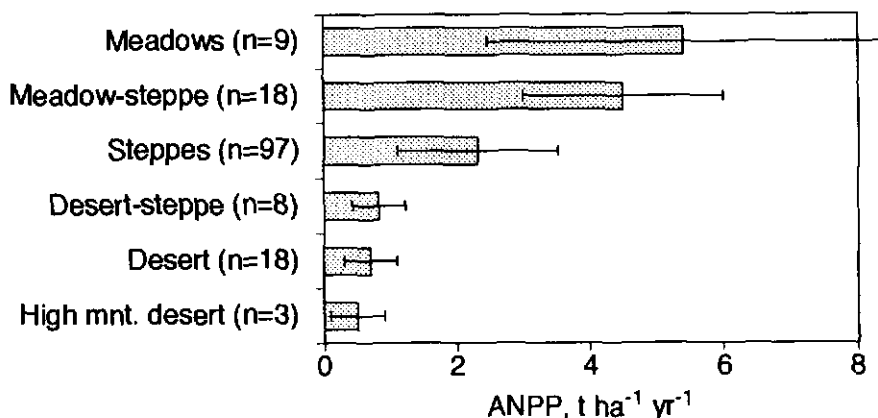


Figure 11. Estimated potential ANPP (means $\pm$ s.d.) of ecosystems of different altitudinal zones in mountainous regions the Former Soviet Union based on information from the "Climate/Soil/Productivity Database".

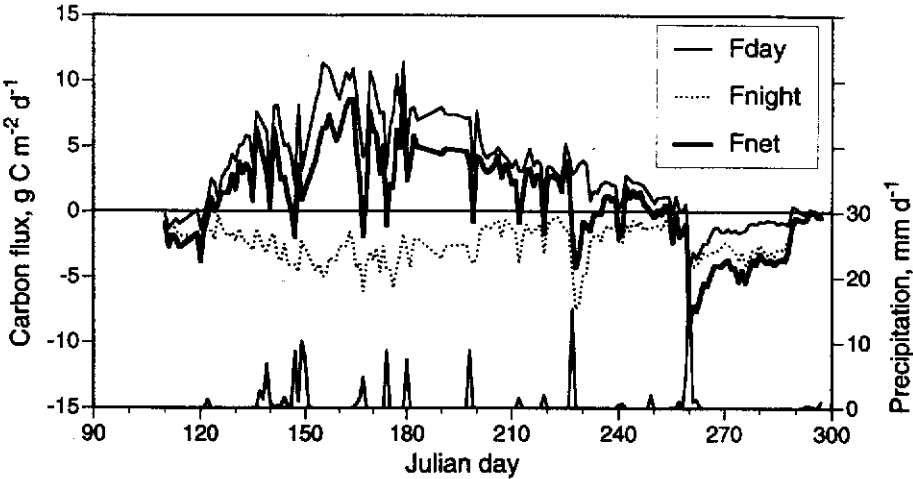


1997). In general, three different techniques are presently used for measuring carbon flux in non-forest terrestrial ecosystems: (i) chamber measurements, (ii) eddy-correlation tower measurements, and (iii) Bowen-ratio/energy balance tower measurements (e.g.: Baldocchi et al. 1988, Verma 1990, Held et al. 1990, Vourlitis et al. 1993, Dugas 1993). Of the many advantages of these measurement techniques over the traditional clipping methods of productivity studies, three are especially significant for rangeland productivity studies.

First, these methods (especially the Bowen-ratio towers, which may operate in a quasi-autonomous manner) may provide near continuous productivity measurements during the whole growing season, as illustrated by data of flux measurements (Figure 12) in a sagebrush steppe ecosystem. Station in Duboise, Idaho.

Secondly, combined with the corresponding environmental and vegetational data, flux measurements datasets make it possible to identify quantitative relationships of the carbon flux rates to certain environmental factors. For example, Figure 13 presents the graph of the experimental measurements of the rate of carbon exchange ($\text{mg C m}^{-2} \text{ s}^{-1}$) between the atmosphere and the sagebrush ecosystem during the period June 3 - 7, characterized by the highest photosynthetic activity of the sagebrush community. Multivariate numerical analysis revealed that 81% of the data dispersion is explained by the simple two-factorial six parametric model:

Figure 12. Seasonal dynamics of the day-time carbon flux integrals F_{day} , night-time carbon flux integrals F_{night} and the net daily carbon exchange F_{net} ($g\ C\ m^{-2}\ d^{-1}$) in the sagebrush steppe ecosystem at the U.S. Sheep Experimental Station in Dubois, Idaho during the 1996 growing season (based on unpublished measurements by J. Walker, D. Johnson and N.Saliendra).



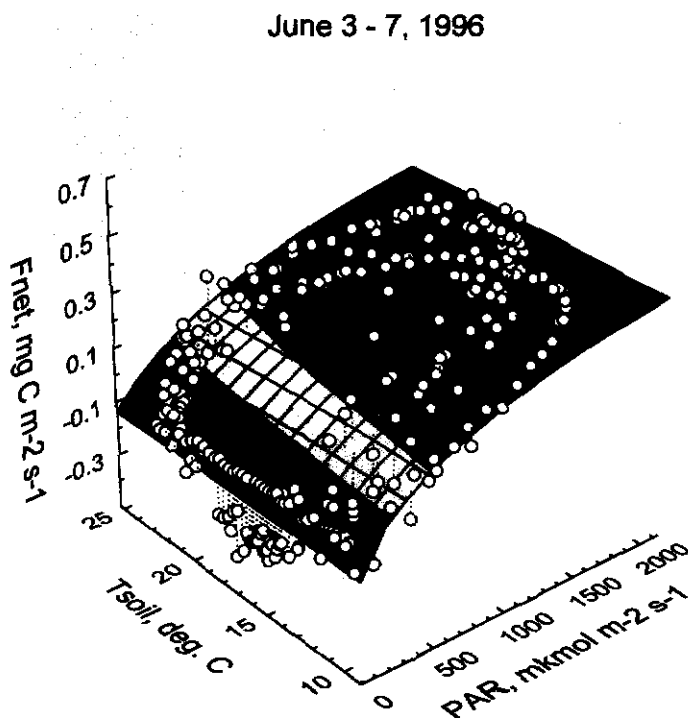
$$F_{net} = (PAR > 0) \left[\frac{a_1 PAR a_2}{a_1 PAR + a_2} - a_3 \exp(a_4 T_{soil}) \right] - (PAR \leq 0) a_5 \exp(a_6 T_{soil}) \quad (4)$$

where PAR is the intensity of photosynthetically active radiation ($mkmol\ m^{-2}\ s^{-1}$) and T_{soil} is the soil temperature (deg. C). Interestingly enough, with appropriate parameters $\{a_i\}$ the same equation (4) works reasonably well for the other periods of the growing season, with the R^2 values in the range 0.72 to 0.86 (Table 5).

Table 5. Parameters of the model (4) for estimation of the net carbon flux in a sagebrush ecosystem in relation to PAR and T_{soil} for different periods during the growing season.

Dates	a_1	a_2	a_3	a_4	a_5	a_6	R_2	n_{obs}
May 4-8	0.0003	0.3384	0.0413	0.0624	0.0097	0.1772	0.80	262
June 3-7	0.0007	0.6467	0.0412	0.0480	0.1221	0.0049	0.81	267
July 13-17	0.0011	0.4242	0.2138	-0.0488	0.0969	0.0043	0.84	156
August 2-6	0.0006	0.1625	0.0162	0.0254	0.0097	0.0557	0.86	279
August 17-21	0.0011	0.2992	0.1166	0.0092	0.0691	0.0332	0.72	314

Figure 13. Response of the net carbon exchange rate of a sagebrush steppe ecosystem at Dubois (Idaho) on PAR and soil temperature based on Bowen-tower measurements during the period June 3 - 7, 1996. Parameters of eq. (4) (Table. 5) were estimated using unpublished data by J. Walker, D. Johnson and N. Saliendra, 1996.



To further improve the R^2 of the C-flux models, additional factors-predictors should be taken into account. One such factor should be some characteristic of the moisture regime of the ecosystem, since, as can be seen on the graph on Figure 12, oscillations of the flux are closely correlated with rainfall events. Other potentially significant flux predictors should be sought among the vegetational characteristics such as green aboveground biomass, per cent cover, leaf area index, or remotely sensed indices related to these variables (e.g., *NDVI*).

The third advantage is the prospect of using C-flux models to scale up locally identified equations to estimate productivity of larger geographical areas. Regional dynamic meteorological models, providing estimates of needed environmental driving varieties (radiation, temperature, soil moisture), combined from remotely sensed vegetation indices (*NDVI*, etc.), create a solid basis for the geographical extrapolation of C-flux models derived on a limited number of rangeland polygons.

5. ECOSYSTEM-LEVEL MODELS OF RANGELAND PRODUCTIVITY

Obviously, the problem of rangeland productivity modeling can not be reduced to the application of phenomenological equations like eq. (3-4). The alternative approach (which has its own advantages and drawbacks) consists of the application of ecosystem-level models of grasslands. To take into account a wider array of environmental and management factors, and their interactions as described by the diagram on Figure 8, more comprehensive models were developed, for example the SPUR model (Simulation of Production and Utilization of Rangelands, Ross et al. 1987). A comprehensive survey of the subject was presented by Agren et al. (1991). One of the presently available models applicable to the task is the CENTURY model, constructed by W. Parton and co-authors at the Natural Resource Ecology Laboratory, Colorado State University (Parton et al. 1987, 1992, 1993). In addition to precipitation input *per se*, the CENTURY model takes into account its seasonal distribution and influence on soil moisture status, accompanied by description of soil temperature and nutrient availability, and management parameters (fire, grazing level).

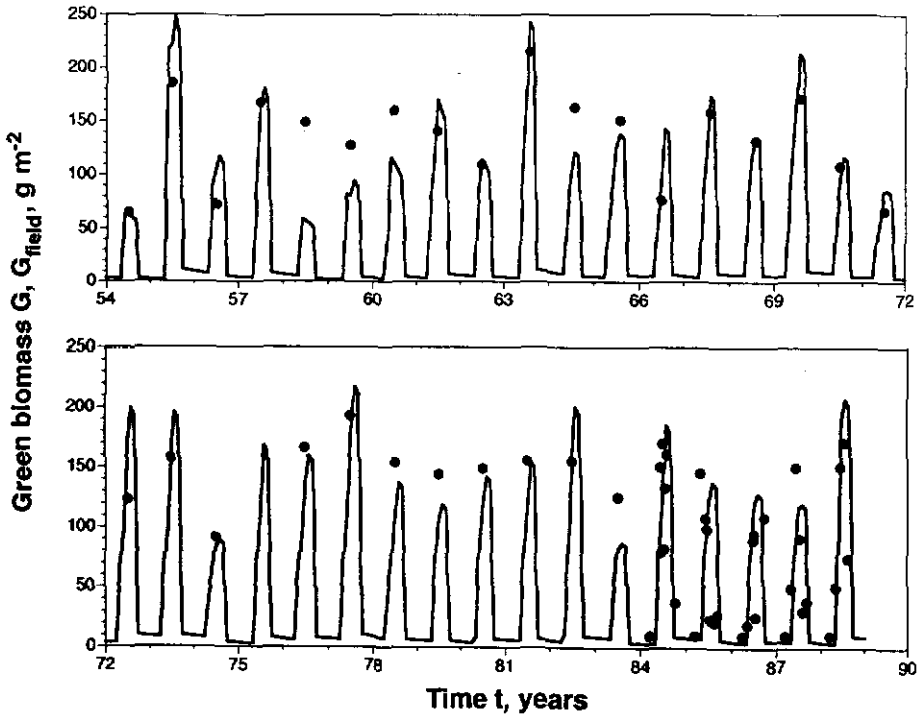
Application of the CENTURY model to a number of grassland sites in the Former USSR (including sites in Kazakhstan and Central Asia) demonstrated its ability to simulate reasonably well seasonal and year-to-year dynamics of primary productivity of arid and semi-arid grasslands (Figures 14-15).

6. REGIONAL-SCALE ASSESSMENT OF PRODUCTIVITY TRENDS ON RANGELANDS OF CENTRAL ASIA

In the light of the above-presented materials the following approach to the problem of regional-scale estimation and prediction of trends of rangeland production in Central Asia is emerging.

1. Based on the detailed and geographically referenced information of various components of the rangeland ecosystems available for Central Asia, a geographical information systems (GIS) for rangeland resources of the region should be constructed. The layers describing distribution of meteorological parameters (radiation, precipitation, temperature, etc.), soil and vegetation types, would be combined in the GIS with livestock management information (stocking densities, water availability, supplemental

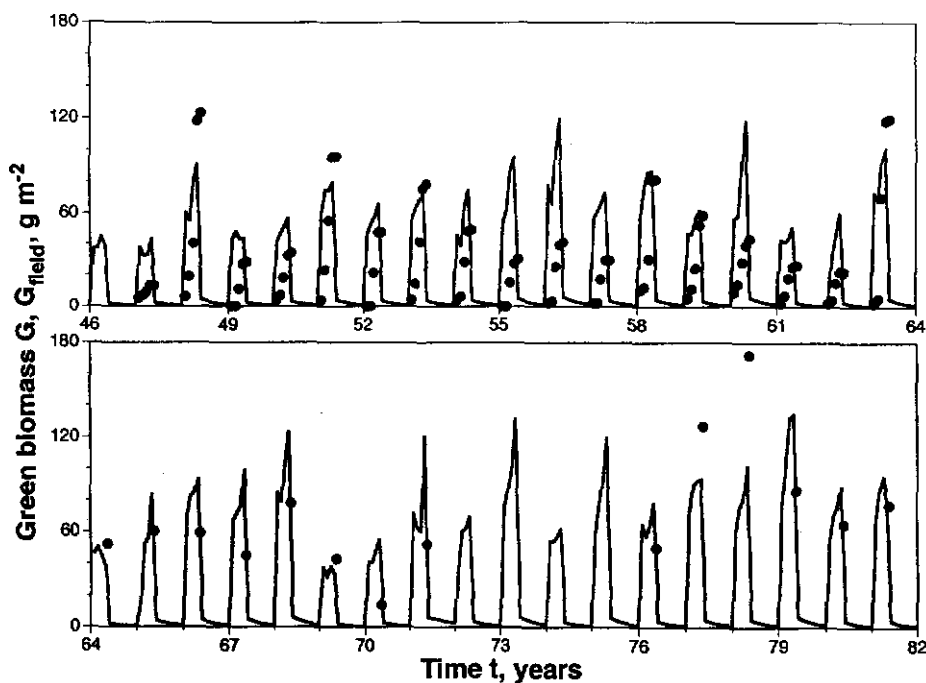
Figure 14. The long-term dynamics of the aboveground live phytomass G (g m^{-2}) in the semi-desert grassland ecosystem of the Dzhanibek Research Station during 1954-1989 period. Points - field data after Gordeeva and Larin (1965), Olovyannikova (1976, pers. communication); Gilmanov and Ivaschchenko (1990); curve - CENTURY simulation results using the real meteorological data for the same period. Mean absolute deviation between model and data equal to 36.2 g m^{-2} (after Gilmanov, Parton and Ojima 1996).



feeding resources, etc.) with the GIS grid size not larger than 10 geographical minutes.

2. A number of mathematical models of different complexity for calculation of the net primary productivity of the different rangeland ecosystem types and its utilization by livestock under different climatic and management scenarios would be linked to the GIS. This approach would allow computer experiments with the system resulting in dynamic analysis and prediction(s) of the temporal dynamics and geographical pattern of rangeland productivity of the region.
3. A special programming shell to coordinate the interaction of the GIS and models will be built to provide a user-friendly tool for regional range managers and decision-makers.

Figure 15. The long-term dynamics of the aboveground live phytomass G (g m^{-2}) in the ephemeral desert ecosystem of the Badkhyz Research Station during 1946-1982 period. Points - field data after Nechaeva, Prikhod'ko and Shuravin 1971, Artykov 1975, Gannibal 1989; curve - CENTURY simulation results using the real meteorological data for the same period. Mean absolute deviation between model and data equal to 38.6 g m^{-2} after Gilmanov, Parton and Ojima 1996.



As the step to the implementation of the above approach, the first assessment stage, a project "GIS/modeling tools for international donors and local policy makers to understand and predict regional trends of rangeland production in Central Asia," has been recently supported by the Small Ruminant Collaborative Research Support Program (SR-CRSP) of the US Agency of International Development (Laca, 1996). The full scale development of this project will provide an adequate scientific, organizational and financial framework for coordination of efforts of the range scientists from the United States (SR-CRSP participants), Central Asian republics and from other countries and international organizations in the studying of the problem of rangeland production in Central Asia.

CONCLUSIONS

1. Available field data on the net primary production of the ungrazed and lightly grazed rangeland ecosystems of Central Asia give the estimate of the total average potential aboveground net primary production of 466 M t DM yr⁻¹. Compared with data on current livestock population numbers and proportion of supplemental feeds, this figure leads to the estimate of the range utilization coefficient $k_u = 0.2$.
2. Combined with the available data on the accelerated growth of human population and significantly slower growth of livestock numbers in most of the republics of Central Asia (except Kazakhstan to a certain extent), these estimates lead to the conclusion that under present management regime the natural carrying capacity of most of the rangelands has already been reached and in many cases surpassed. New methods of range management, based on the latest achievements of ecological theory and new field and measurement methodologies, are urgently needed.
3. Mathematical modeling of rangeland ecosystems and their productivity enhances the effectiveness of these new methods. Both phenomenological and mechanistic simulation models are available to describe dynamics of rangeland ecosystem productivity under variable climatic and management regimes. Further tuning of the structure and parameters of these models using the available and newly collected data is required for more effective application to the rangelands of Central Asia.
4. New methods of measurement of the net carbon exchange and primary productivity of rangelands using the micrometeorological techniques were quite promising under the conditions of semi-arid and arid rangelands. They provide new ways to incorporate remote sensing information about the factors controlling rangeland production and to scale up the results of local studies on selected research polygons to the larger geographical areas.
5. The GIS methodology is the only available way to integrate the vast amounts of available data on Central Asian rangelands with new modeling and experimental techniques to provide the range

managers and decision-makers at the local and regional scales an adequate tool to increase the productivity and ensure the sustainability of rangelands to satisfy the needs of the human population of the region.

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APPENDIX



Appendix A

AGENDA

Tuesday, February 27, 1996

Chairperson: Acad. S. Usmanov

9:00 – 9:30	Opening Session	
	Statement	Acad. Usmanov, UAAS
	Statement	Dr. Gintzbarger, ICARDA
	Vote of Thanks	Dr. Beniwal, ICARDA
9:30 – 10:30	Introduction	Prof. M. Demment Program Director SR-CRSP
10:30 – 11:00	<i>Break</i>	

Country Presentations

Chairperson: Acad. R. Khusanov
Cochairperson: Prof. M. Demment

11:00 - 11:40	Kirgizstan	Prof. I. Botbaev Animal Research Inst.
11:40 - 12:00	Discussion	
12:00 - 12:40	Kazakhstan	Acad. S. Abdraimov Res.Inst. of Karakul Sheep Breeding
12:40 - 13:40	Discussion	
13:00 - 14:00	<i>Lunch Break</i>	

Country Presentations(continued)

Chairperson: Acad. S.Abdraimov

Cochairperson: Dr. E. Thompson

14:00 - 14:40	Turkmenistan	Prof. Khodjakov Inst. of Livestock and Veterinary
14:40 - 15:00	Discussion	
15:00 - 16:15	Tajikistan	Dr. Eshanov Agricultural Institute Prof. A. Karakulov Inst. of Livestock Production
16:15 - 16:30	Discussion	
16:30 - 16:45	<i>Break</i>	
16:45 - 18:00	Uzbekistan	Prof. U. Nasirov Inst. of Livestock Dr. U. Aripov Res.Int.of Karakul Breeding
18:00 - 18:15	Discussion	

Wednesday, February 28, 1996

Resource Presentations:

Chairperson: Prof. O. Khodjakov

Cochairperson: Dr. T. Gilmanov

8:30 - 9:30	Carol Kerven and Roy Behnke, Overseas Development Institute "Impacts of Decollectivization on Rangelands and Livestock Marketing in Central Asia"
9:30 - 9:45	Discussion

9:45 - 10:00	<i>Break</i>
10:00 - 11:00	Thomas L. Nordblom, ICARDA "Food and Feed Prospects for Resources in Central Asia"
11:00 - 11:15	Discussion
11:15 - 12:15	Tagir Gilmanov, San Diego State University "Ecology and Range Systems in Central Asia"
12:00 - 12:30	Discussion
12:30 - 13:30	<i>Lunch Break</i>

Resource Presentations(continued)

Chairperson: Dr. K. Tinalyev
 Cochairperson: Dr. T. Nordblom

13:30 - 14:30	Tjaart Schillhorn Van Veen, World Bank "New Changes For the Livestock Sector in Central Asia"
14:30 - 14:45	Discussion
19:00 - 21:30	Workshop Reception Dinner

Thursday, February 29, 1996

8:00 - 8:30	Dr. M. Demment	Instructions to Thematic Groups
8:30 - 11:30	<u>Thematic Work Groups</u> Livestock/Environment Economic Growth/Policy	<u>Group Leaders:</u> Gilmanov/Thomson Schillhorn/Khodjakov
11:30 - 12:00	<i>Break</i>	
12:00 - 13:00	Full Group Discussion	

<i>13:00 – 14:00</i>	<i>Lunch Break</i>
<i>14:00 – 16:00</i>	Thematic Work Groups Regional Integration and Prioritizing
<i>16:00 – 16:30</i>	<i>Break</i>
<i>16:30 – 18:00</i>	Reporting and Discussion (Full Group)

Friday, March 1, 1996

<i>8:30 – 9:30</i>	Thematic Groups Revision and Discussion (Full Group)
<i>9:30 – 10:00</i>	<i>Break</i>

Plenary Session

Chairperson: Prof. M. Demment
 Cochairperson: Prof. U. Nasirov
 Dr. G. Gintzburger

<i>10:00 – 12:00</i>	Final Reporting and Regional Priority Setting
<i>12:00 – 13:00</i>	Meeting of Central Asia Country Participants for Network and Regional Association
<i>14:00 – 14:30</i>	Concluding Session
<i>14:30 – 17:00</i>	Visit to Animal Research Institute, Tashkent

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Appendix C

SOURCE: Summary Report, Meeting of
SRCRSP Advisory Panel, October 19-20, 1995

SR-CRSP PROGRAM GOAL AND OBJECTIVES

Goal Statement. After a review of statements related to previous activities, the Advisory Panel Agreed on the following:

Improve food security and quality of life in developing countries through collaborative partnerships with US land-grant institutions and national and international agencies (government, NGO, private sector) for research leading to sustainable improvements in animal agriculture.

Strategic Objectives. Discussion first focused on a review of USAID's statement of strategic objectives: To reach an international consensus on indicators of food availability, access and natural resource accounting through: (1) adequate quantities and qualities of food that become consistently available for target populations; (2) adequate access of food by poor households (via self-productions or purchasing power); (3) agricultural practices that enhance the long-term conservation of natural resources.

The discussion led to setting fourth the strategic objectives for the proposed new phase of the SR-CRSP:

- To strengthen ability of institutions to identify problems and constraints and develop appropriate solutions in production systems in which livestock play a role.
- To support decision makers in developing more effective policies and technologies to improve livestock production, marketing 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.
- To enhance the nutritional status o targeted populations through consumption of livestock products.

- To increase employment and incomes among livestock producers and associated value-added agribusinesses.

Program Themes. Review of the strategic objectives led to a revision of the themes for work for the proposed new phase of the SR-CRSP and areas in which it would undertake technical and policy research with respect to:

- Impact of livestock on the environment.
- Conservation of biodiversity
- Human nutrition.
- Economic growth.
- Nutrient recycling.

Appendix D

CENTRAL ASIAN REGIONAL LIVESTOCK ASSESSMENT WORKSHOP THEMATIC GROUPS

Goal: To produce a set of prioritized constraints (problem models) related to livestock production that are the assessment and description of the underlying processes responsible or connected to the identified problem model in your theme. Identify and characterize potential partners for US Land Grant Universities with the capabilities of addressing the problem model.

Suggestions

1. Please survey your group, determine if there are critical perspectives not represented by the expertise in the membership, and if so, communicate that to Susan Johnson and we will attempt to make adjustments in group composition. Please insure that someone in the group takes good notes of the discussions and the issues raised. The results of your discussion will be presented to the entire workshop for discussion.
2. Establish a list of issues raised by the presentations of the country representatives and resource people that are related to your theme. Add additional topics which group members feel are important but not raised in the presentations. The topics should be researchable issues. For example, CRSPs do not provide tractors or fertilizer, but they might well analyze why policies that affect their supply may be constraints.
3. Organize this list of issues by either linking them functionally or grouping them by subject matter area. Then distill each grouping not an integrated problem description (Problem Model).
4. Use the expertise of the group to develop a detailed description of the problem. Most problems are, at the surface, the domain of a single discipline or area of interest. For example, trypanosomiasis has often been the domain of animal disease and veterinarian medicine. However, the surface problems are likely aggregated phenomena generated by a number of interacting lower level processes outside this domain. Trypanosomiasis infection is more than a problem of vaccine development. The constraints on its control are the product of macro

and micro policies that control everything from land use patterns to the economics of vaccine development. At a minimum the disease's impact is a function of the ecology of host and vector, their genetics, and the management of livestock and wildlife populations. Furthermore the strategy for successful control is likely to be multifaceted approach that combines vaccine development with the genetics of disease resistance and comprehensive land and animal management strategies.

5. Determine how regional the problem model is and identify the countries where this problem is particularly important.

6. Make a list of institutions in the region, including international institutions not located in the region but active in the relevant area of research, that could be potential partners with US. Land Grant universities for each of the problem model is identified. Provide a description of their capabilities and their comparative advantages relative to other institutions who might work on the problem model. Keep in mind the continuum from research to technology development to extension of a product. Consider NARs, national universities, research institutions. IARCs, NGOs, women's groups, private sector businesses, farmers' organizations, and others.

7. Make a list of active projects in the region or globally that address or are related to the problem model. Provide a brief description of the project, including if possible the collaborating institutions, the funding sources and a contact to allow SR-SRSP to gather information on the project.