Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia

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Grant Completion Report

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Abbreviations

ASDP	Agency Support Development Processing
BVDP	Barani Village Development Project
CMT	California Mastitis Test
DM	Dry matter
F	Farm
FRI	Fodder Research Institute
GDP	Gross Domestic Product
HH	Household
HQ	Headquarter
ICARDA	International Center Agricultural Research in Dry Areas
IFAD	International Fund for Agricultural Development
INTA	National Institute for Agricultural Technology. Argentina
KGS	Kyrgyz Som
NARC	National Agricultural Research Center
NARs	National Agricultural Research Systems
NGO	Non Governmental Organizations
NRSP	National Rural Support Programme
PARC	Pakistan Agricultural Research Council
PI	Principal Investigator
PO	Professional Officer
SWRC	South Western Research Center
T	Treatment
TAG	Technical Assistance Grant
TJS	Tajik Somoni

Executive Summary

In Central Asia and Pakistan, livestock plays an important role in the agricultural economies. In Central Asia livestock does not only contribute to the livelihoods of the most vulnerable rural sector, particularly in isolated regions and highlands, such as in Tajikistan and Kyrgyzstan, but also played a critical role in the period of transition when other sources of income were substantially reduced. However, livestock production has been severely affected by the economic transition, which resulted in the disruption of the Soviet markets for traditional products such as wool and pelts, fragmentation of large production units into small and unproductive flocks/herds, the collapse of production support services and animal health control, a lack of technology transfer services and disruption of livestock research in Pakistan the livestock sector provides up to a third of household income for small and landless farmers, contributes more than a tenth to GDP higher than the contribution of crops and has tremendous and recognized potential in any strategy aimed at poverty reduction. The productivity of the rural livestock industry however is still low due to poor feeding management, inadequate housing, animal diseases, poor market access, and lack of policy support. In particular in the months of May to June and November to January feed deficits are high and severely limit milk and meat production.

Funded by the International Fund of Agricultural Development (IFAD), on 15 June 2006 the International Center for Agricultural Research in the Dry Areas (ICARDA) in collaboration with National Research and Development Organizations, Universities and NGOs in Central Asia and Pakistan, started the Grant Project 816 "Community Action in Integrated and Market-oriented Feed Livestock Production in Central and South Asia". The Programme aimed to capitalize on the lessons learned and to transfer the knowledge gained during TAG ICARDA-425[1] to neighboring countries with similar agroecologies and production constraints, and included Pakistan for interregional learning and knowledge exchange.

The Programme goal was to improve the livelihoods of rural communities in Central and South Asia. Its purpose was to develop and promote community-based actions to support productive and sustainable livestock systems, access to market opportunities, and sustainable management of the natural resource base in the region.
The project activities were structured according to four themes, three themes related to technology development and a cross cutting theme on capacity building and knowledge sharing:

- Theme 1: Socioeconomics
- Theme 2: Range and forage productivity
- Theme 3: Improvement of livestock productivity
- Theme 4: Capacity Building and Knowledge sharing

To initiate community based actions and test promising technologies to increase livestock productivity the program targeted one to two communities at strategically selected research sites in each country. In Central Asia potential research sites representing specific production systems were discussed and agreed with the national partners during a scoping mission in May 2006. In Pakistan research areas were selected at the inception workshop in September 2006 and the villages selected through rapid rural appraisal. In South West Kazakhstan the team chose Akdala village in the Arys district which is located at 90 km from the City of Shymkent. In Kyrgyzstan two sites in the same production system were selected both at a distance of about 100 km from Bishkek: Ak-Beket in Kemin district and Kenesh (Onberjylgy) in Chu district. For Tajikistan it was originally planned to focus on the Mohair goat rangeland production system in Sogd Province in Northern Tajikistan. The Jamoat area of Bobojon Gafurov district at about 32 km of the city of Khujand was selected. However, upon request of the Tajik Academy of Sciences a second research site in Dusti village in Vakhdat district in Central Tajikistan (at 35 km from Dushanbe) was included representing Gissar sheep meat production. In Pakistan, two research sites representing rainfed and irrigated crop-livestock systems were selected in Punjab Province. At the rainfed site the project was implemented in Lodhay village in Gujar Khan Tehsil in Rawalpindi District, and at the irrigated site in the villages Chak No. 74/SB and 105/SB in

[1] Technical Assistance Grant ICARDA-425 "Integrated Feed-Livestock Production in the Steppes of Central Asia", which was conducted from 1999 to 2003.

Sarghoda district. This allowed testing different ways to include forages into the crop rotation and was supposed to allow a wider applicability of results in Pakistan.

The activities and related results from the program were numerous and only the most relevant ones and main conclusions are mentioned below:

Theme 1: Socioeconomics

In the first project year a **livelihood analysis** was conducted at the **four research sites** in **Central Asia** including an assessment of poverty levels and the resource situation of households. Although household farms are the major producers and suppliers of meat, milk, eggs, and honey, they practice an extensive small scale production mainly to satisfy the needs of family members. Mainly women and children are involved in keeping and feeding of animals in household and small farms. The highest share of income in sheep production is generated from selling live animals, little income is generated from selling other products like wool and only a very small percentage of produced products are processed at household level. The household farms have limited access to croplands and to remote summer rangelands in mountainous area and the weakly developed forage and feed base (especially in the winter period) is a major problem for all livestock producers. The forage deficit is a consequence of decreased forage cropland area, cessation of subsidies and shift from forage crops to commercially more profitable cereals in irrigated arable land areas. Existing constraints including limited access to forage/feed, rangelands, water and veterinary services; underdeveloped rural infrastructure prevent a more intensive and efficient livestock production and exacerbate degradation of pasture areas around the villages. The level of farmers' and households' knowledge on livestock production and in particular feeding and breeding practices as well as rangeland management need to be improved.

As there was a general lack of information and analytical data on **sheep markets in Kazakhstan, Kyrgyzstan and Central Tajikistan** and market prices, the project collected price data from the different markets and the share of different market agents in the retail price. Livestock markets are mainly located around cities, in the district centers, and in big villages. They operate separately from food markets. In most livestock markets a number of different agents are active including producers, middlemen, fattener, wholesale buyers, butchers, exporters and consumers creating different market channels. The value added share of producers in the retail price was estimated at 52% in Kazakhstan and in Kyrgyzstan at 58% which indicates a scope for increasing producers' shares through organized collective marketing. In all countries a high number of animals are sold at the farm gate to middlemen without prior fattening. Fattening operations are mainly undertaken by specialized fatteners. Middlemen have developed a good livestock procurement system from households at their farm gates and thus link small livestock producers with few animals in remote areas to the livestock markets. They also act as a source of price information for smallholders. The markets are open for many traders; there was no concentration of few traders which ensures competitive prices.

The **Mohair market** in the Soghd province in **Northern Tajikistan** is unstable and depends heavily on the wholesale customers from Russia. Mohair producers with a subsistence income level cannot wait for more favorable prices as they need the cash for daily expenses. As a result, middlemen with more financial resources and storage facilities benefit from low mohair purchasing prices in the spring season and high selling prices in fall. Value addition activities as sorting, packaging, and washing of mohair are mainly undertaken by wholesale procurers who are interested in selling big volumes of mohair to customers at markets located in Sogd province or to CIS countries. Mohair prices depend on the season, distance between the local markets and central markets and marketing costs. Lack of information, shortage of financial resources, and inability to efficiently market mohair put the small producers at a disadvantage and lowers their net income.

In **Pakistan** the socioeconomic research focused on **socioeconomic evaluation** and **assessing** the **impact** of the project interventions. A baseline study was conducted in 2007 and repeated in 2009. The study included participating farmers and as a control non-participating farmers in the project villages and farmers from neighboring villages. It documented the resource situation of the farmers and the performance levels and practices before the project was initiated, and informed the selection of interventions to be tested or demonstrated.

The socio-economists also assessed the **economic viability** of various interventions such as green fodder selling enterprises, seed production and supplementation, and guided the scientists to modify their interventions. Because of the importance of providing easy access to adequate supplements for dairy animals, the project supported two entrepreneurs invested in installing small scale feed mills. The investment appraisal for the feed mills showed that keeping the sales at around 0.6 tons per day (50% of the capacity), the net present value was positive and the internal rate of investment was also very high with 205% for the unit at the irrigated site and 225% at the rainfed site. These two factors provided a good justification for the investment. The breakeven analysis demonstrated that the enterprises have to sell about 1.8 tons of feed in a given month in order to breakeven at the rainfed unit and 2.04 tons of feed at the irrigated site. At both sites the feed sales in October 2009 exceeded this level with 4.18 tonnes per month at the irrigated site and 17.76 tonnes at the rainfed site. However, as the feed entrepreneurs are facing competition from large players in the market and the recommended rations have to be continuously adjusted as the prices of the available feed ingredients change overtime which means that they need to be supported by research institutes that should also control the quality to maintain the confidence of the smallholders.

In addition to the formal impact assessment the socioeconomic team in **Pakistan** prepared a standard questionnaire to capture the **farmers' evaluation** and perception on the interventions. This assessment of technologies provides valuable information to the researchers, extensionists and policy makers to identify reasons of slow adoption and diffusion. The results are mentioned for each intervention below.

Theme 2: Range and forage productivity

A survey to assess **the current status of forage production and feeding practices** of household farms was started in **Kazakhstan, Kyrgyzstan**, and **Tajikistan** in October 2007 and completed in June 2008 with a total of 314 respondents. The survey showed that maize (*Zea mays* L. ssp.) and alfalfa (*Medicago sativa* L.) were the most common and popular forage crops; in some villages sainfoin (*Onobrychis viciifolia* Scop.) and sorghum (*Sorghum bicolor* (L.) Moench) were grown. Relatively large differences in alfalfa biomass and maize grain yields between households and villages were reported but overall the yield levels were low which indicates the use of poor agronomic practices and the lack of access to improved varieties. In all countries a large proportion of the pasture areas has not (yet) been permanently allocated to households or dekhan farms but instead is still owned by the state and being used as communal pastures.

The project assessed the potential for **introducing new species and improved varieties of forage crops**. In **Kyrgyzstan** and **Central Tajikistan** mungbean (*Vigna radiata* (L.) Wilczek) was tested as a summer crop after the harvest of winter wheat under irrigated conditions. In the climatic conditions of Central Tajikistan early maturing varieties have to be chosen because in some years early frost can decrease grain yields. Overall, mungbean seems to be a promising crop for both countries to diversify the cropping system as it can improve soil fertility and decrease farmer's economic risk from climatic variability or changing commodity crop prices.
In Kyrgyzstan and Northern Tajikistan pearl millet (*Pennisetum glaucum* (L.) R.Br.) varieties that had been recommended by ICRISAT for the agroecological zone were tested as an alternative to maize as a summer crop after winter wheat. The pearl millet varieties showed excellent growth and tillering capacities but were rather late maturing, they are suitable for green forage production when used as summer crop after winter wheat. To harvest the grains, pearl millets would have to be cultivated as main crop in spring. It is known from other studies that pearl millet shows excellent re-growth after the first cut, therefore multiple cutting should be tested in the future. In Northern Kyrgyzstan pearl millet provided more stable fodder yields than maize which produced much higher yields under favorable weather conditions but produced very low yields under adverse conditions.

Optimizing agronomic practices is very important to ensure high forage production. Seeding rates and planting dates for hybrid maize were tested in **Kazakhstan** and in **Tajikistan**, and the effect of ammophos application to alfalfa in the first growing year in Central Tajikistan and South Kazakhstan. The on-farm experiments led to distinct recommendations for each site. In general the cost-benefit analyses revealed that moderate seed rates and applications of fertilizer proved to be most

advantageous. More long-term on-farm research and demonstrations are required to develop best practices for household farms considering productivity and profitability.

Another research area in the project was to develop practical measures for **rehabilitating rangelands**. An exploratory vegetation study compared two sites each in Central **Tajikistan** and **Kyrgyzstan** that differed in aspect (north versus south facing). Aspect had a profound effect on species composition, the number of plants, on the proportion of litter and bare ground and on dry matter biomass production. This means aspect should be considered when selecting sites for rehabilitation measures.
In **Kazakhstan** and in Northern **Tajikistan** oversowing with indigenous species was tested in order to rehabilitate degraded rangeland areas. Due to the dry spring and summer the experiment failed in 2008 and was repeated in 2009. Hence only preliminary results are available that showed that the germination and early establishment of the species in the pastures worked well and that in combination with controlled grazing management – adequate resting periods – this low cost measure could help to speed up the recovery of degraded rangelands. At present this would be only applicable to private rangelands.

One measure to decrease the gap in winter feeds could be to increase the **productivity of hayfields** which are designated areas in the communal or private rangelands to be harvested in late summer for winter feeding. The project tested the effect of oversowing with sainfoin and nitrogen fertilization on hayfield productivity on a medium scale farm in **Kyrgyzstan** and on community hayfields in **Central Tajikistan**. The results showed that the productivity of hayfields in both countries could be indeed increased by both oversowing and fertilization. However, the yield response varied considerably between 2008, a very dry year and 2009, a year with favorable rainfall. Thus, moderate input levels are recommended to decrease the economic risk as net benefits depend on the market price of hay that may decrease considerably in good rainfall years when it is abundantly available on the markets. Practices to increase hayfield productivity are considered to be more widely applicable and more promising than rangeland rehabilitation measures as the access to hayfields is more controlled than to other communal grazing areas.

In **Pakistan** the project focused on **forage production** as the communal pastures were of little importance for feed supply and the potential for sustainable improvement was considered very limited.

The on-farm experiments at the **rainfed site** showed that the highest yields in winter fodder were achieved with oats-vetch combination and in summer fodder with a mixed cultivation of maize, millet, sorghum with guar. The oat-vetch combination was liked by the farmers as green fodder due to its high palatability, which was also the case for maize-guar mix in summer.
The production of oat plus vetch hay introduced by the project proved very successful and popular with the farmers, especially for milking buffaloes and cows, when compared with wheat straw, the roughage traditionally used in the lean period and the majority of farmers stated that they will adopt hay making and continue on their own although there was some concern about high labor requirement for hay making.
Where irrigation was available from dug wells multiple planting of maize followed by multicut sorghum-sudan grass hybrid showed high yields and were assessed as the best options for green fodder production for sale. This provides a good income opportunity but labor and transportation costs makes it difficult for the small land holders to fetch the higher prices on the main market therefore they prefer selling to neighboring farmers.
As the farmers appreciated the use of improved varieties in terms of quantity, quality, market value and improved livestock productivity, seed production for fodder crops at farmer's fields proved to be a viable enterprise while ensuring availability of seed of improved varieties to the local community.

At the **irrigated site** in Pakistan the yield difference between improved and local varieties in case of sorghum, millet, oat and berseem was significant; the improved varieties could also be harvested over a longer period (higher number of green fodder days) and thus helped to shorten the lean period. Given the higher yields and better palatability the farmers expressed their high interest to adopt these varieties. The main problem highlighted by the farmers was that they could not produce seeds of the improved millet and sorghum varieties due to bird attack and late maturity. Berseem and oat mixtures proved the best fodder crops for winter fodder production. Oat was considered the best option for making hay that could be used in lean periods of May-June after the harvest of wheat. It had a higher

nutritive value than wheat straw that is traditionally used and was found almost equal to green fodder. However, only farmers with larger land holdings can adopt hay making as many have very small farm sizes and even smaller areas allocated to fodder crops as that there is little surplus fodder to be conserved.

Theme 3: Improvement of livestock productivity

In **Kazakhstan** the research focused on two promising technologies tested with good success in the previous IFAD project – **early lambing** and **early weaning.** The results from testing early lambing in two seasons under different resource situations clearly revealed the advantages and disadvantages: in average years it can be an interesting strategy to obtain cash income in a critical time of the year and to spread the sales of lambs; in years with very cold winter the risk of loosing lambs is high. It requires good management practices and facilities and should not be recommended to resource-poor households. Early weaning is technically feasible but does not provide obvious economic benefits as long as it is not linked to an intensive fattening program or to milking of the ewes. An expected advantage from both practices is higher ewe fertility because early lambing leads to a better feeding situation of the ewes after weaning and early weaning allows ewes a prolonged recovery period. However this effect could not be measured in the experimental design.
In addition the **Kazakh** project team worked on options for **value addition** applicable in small households as there is a good potential to generate additional income because of the demand for high-value milk products in the regional markets. Processing methods for households were developed and trainings conducted for preparing dairy products such as brynza, chechil, rennet, cheese, yogurt, homemade kvas and kurut with cherry as well as homemade sausage.

In **Kyrgyzstan** and **Northern Tajikistan** the project implemented a combination of **improved husbandry and breeding strategies** at community level to improve sheep and goat productivity. The improved husbandry practices were similar in the two countries and included a preventive health program, optimizing flock structures by culling unproductive ewes and castrates, better hygiene and strategic supplementation. In Northern Tajikistan a mineral briquette from locally available material was developed and in Kyrgyzstan chopping of forages and crop residues was facilitated through the purchase of a chopping machine for the community. The implementation was accompanied by intensive training of farmers, and the development of extension brochures.

Despite the short implementation period of the **breeding program** in Akbeket/**Kyrgyzstan** the outcome and the response of farmers can be regarded as positive: the farmers worked well together as a group in sharing rams, organizing mating and keeping birth and liveweight records as planned with them. The first offspring showed higher weight gains after weaning and achieved good market prices. At the end of the project more farmers were interested in sharing Aikol rams. The sustainability of the breeding program is questionable as intense technical support would be needed for a number of years from the NARS scientists but the institutes lack the operational funds to continue intensive field work.
In Khujand/**Northern Tajikistan** the **breeding program** led to a common agreement and good understanding of selection traits for Angora goats and record keeping was established during the project duration. The inclusion of fiber fineness into the breeding objectives was agreed and its importance for the market value of the fiber is now recognized. The latter was also an outcome of creating a demand for fine fiber by women processors in the neighborhood. The farmers applied the agreed selection strategies within their flocks but they were less interested in sharing or exchanging bucks and in joint performance testing.

In **Northern Tajikistan** women processor groups in eight settlements were formed, intensively trained and provided with equipment and direct feed back from the consumes to produce **handspun mohair yarn** for export. Yarn samples were successfully test-marketed in a US yarn store which showed that there is a viable export market for luxury mohair yarns. It is expected that an export market for luxury knitted apparel, woven products and hand-made carpets can be developed. Exporting yarn can provide very good earning opportunities for women spinners and knitters. By switching from yarn produced for the local and the Russian market ($10 per kg) to high-priced yarns for the US ($70 per kg), women spinners will be able to earn approximately $240 per month as opposed to their current income of $24 per month. The yarn export market will benefit Angora goat

farmers by increasing the price of undervalued kid and super kid mohair from the current price of $3-4 per kg to $9 per kg. Moreover, quality, kemp-free adult mohair can be used to make woven blankets and hand-knotted carpets for the US and European market. It is expected that eventually, a high market price for kemp-free, quality mohair will be established region-wide.

In **Kyrgyzstan** the project demonstrated that **sheep milk production** with Awassi crossbred sheep and processing the milk to Ayran is technically feasible in the Tokmok highlands with similar meat production levels as the local coarse wool fat tail sheep. However, to become a viable production option for the farmers in the region a clear business model would be required as there the old tradition of milking sheep was abandoned in the Soviet times and consumers are no longer used to buy sheep dairy products.

In **Central Tajikistan** the project team demonstrated to the farmers through performance recording and economic analysis that **grazing** Gissar flocks on the remote summer pastures was clearly superior in animal performance and economic return than keeping the animals all year around on pastures around the villages. Based on these results the owners of small flocks were encouraged to form groups to send their animals to summer pastures which will also help to restore the productivity of the village rangelands. In addition supplemental feeding with concentrates during mating and late gestation was demonstrated and can be recommended. Early weaning of lambs combined with grazing on good quality summer pastures resulted in good weight gains and rapid increases in the liveweights of their ewes and allows milking of ewes which has a good income potential when processed into traditional dairy products.

In **Pakistan** a number of on-farm **feeding experiments** were carried out at both research sites in the winter and summer season testing the hay produced under Theme 2 in balanced rations for milk and meat production. In dairy cows and buffalos feeding balanced rations from legume-cereal hay and concentrates (mixed from various industrial by-products) led to significantly improved milk yield, body condition of the animals and generated cash income through the sale of additional milk. The cost-benefit analysis showed that using the improved fodders and concentrates proved to be economically beneficial for milk production. The experimental results were strongly confirmed by the observations of the participating and neighboring farmers who rated this intervention very highly.
In the fattening experiments with cattle and buffalo calves the balanced rations resulted in higher weight gains but the performance was not high enough to make it economically viable but at the rainfed site there were also some doubts if the farmers used the concentrates only for the experimental group.
The livestock scales installed at the project sites for the experiments helped the farmers in marketing of livestock as well as controlling the quantity of purchased inputs such as feeds, fodders and agricultural inputs.

To ensure the sustainability of the use of balanced feed two small scale **feed mills** were installed on a shared cost basis between the project and the entrepreneurs, one at the **rainfed site** and one in one village at the **irrigated site**. The installation of the feed mills improved the access of small farmers to concentrates with regard to saving time and money (no or little transport charges and comparatively cheaper than on the market), confidence in the ingredients used and having the possibility to get concentrates on loan to be paid back at the time of crop harvest.

The farmers at the **rainfed site** understood the importance of **hygienic milking** and adopted the use of teat sprays or dips and CMT to control mastitis in dairy animals as it resulted in better bargaining power with middlemen that were prepared to pay higher prices for the higher quality milk. Improved **milk processing** methods were welcomed by the women groups at **both sites**, in particular introducing improved dairy products at village level was adopted for home consumption and raised the quality standards and shelf life. Unfortunately the quality dairy products could not be marketed due to the required of governmental registration and taxation which is not easily affordable for small farmers. At the rainfed site there was also little economic incentive for commercial dairy processing as the price of the raw mail was quite high and showed an increasing trend. However, products such as flavored yogurt, flavored milk, peanut butter and whey healthier were adopted at household level by the community and the skills of the local women were enhanced.

Theme 4: Capacity building

The project provided different avenues for knowledge exchange such as specific training of staff and farmers, farmers' meetings, field days to demonstrate results and discuss project findings, specific scientific workshops and the annual national and regional project workshops. These opportunities proved useful for the capacity building of farmers, students and participating scientists.

On-farm experimentation and targeted training of farmers on various aspects of their farming systems increased their knowledge and their confidence in the scientists' ability of understanding their conditions. The project teams produced extension material which was directly linked to the project interventions and was informed by the interaction with the farmers during the field work and training sessions. Moreover, working on-farm and in close interaction with the farmers allowed the scientists to continuously adjust the proposed practices to the farmers' reality and to evaluate technical and socioeconomic performance under realistic conditions.

Involving students by using project activities for their theses supported reliable data collection and analysis and exposed the Central Asian and Pakistani students to an international scientific environment. It also helped to convince the involved academic institutions, e.g. NARC in Pakistan that the project was not a development project.

Lessons learned

The project findings in **Central Asia** indicate a number of technically and economically interesting practices that should now be taken up by more specialized development oriented projects at a larger scale. In Kyrgyzstan and Tajikistan this will require external investments supported by NGOs as the countries lack the organizational infrastructure in the public and private sector.

The project cannot claim that the tested interventions in Central Asia will be sustainable in the real sense of the term. Nevertheless it is expected that the households and farms that were directly involved will continue the practices that proved technically and economically beneficial. Furthermore, a considerable number of extension brochures were developed that can be used for farmer trainings even outside the project target sites and build a good basis for the institutes for their future work. However, without additional investments the project findings will largely remain 'on the shelf'.

Thanks to the continued support of IFAD the follow-up Grant 1107 on developing fiber value chains allows the continuation of the promising model of combining breeding, value addition and marketing in Northern Tajikistan in order to create a sustainable value chain. Furthermore, an IFAD investment project planned in Central Tajikistan will work on improved rangeland management (reestablishing mobility through collective action) and on improved husbandry and marketing of Gissar sheep.

Probably the longest lasting effect of the project will be the capacity building and knowledge exchange and change in attitude of the Central Asian NARS partners that this project has achieved. Conducting community based research and development is still a novel approach in Central Asia. However, during the duration of the project all research teams fully embraced the focus on household farms and started to develop the required skills and experience. Not only the researchers were interacting closely with the households but also the medium-scale farmers in Kyrgyzstan and Kazakhstan took an active interest and supported the activities on household farms. Trainings and meetings were conducted jointly often using the facilities of the medium scale farmers for demonstrations.

In **Pakistan** the project created awareness in the farming community on the importance of improved fodder varieties and good agronomic practices, of nutritional value of different feeds and of clean milk production for a better bargaining power with middlemen. This was clearly shown in the socioeconomic evaluation. Farmers a**t the rainfed site** expressed their determination to continue preparing sorghum and guar hay for winter use and maize-guar mix as green fodder in kharif season. The farmers at **the irrigated site** will continue to use the introduced fodder varieties of both summer (sorghum and millet) and winter fodders (oats and berseem).

To ensure the continuity and sustainability of disseminating improved fodder crops/varieties, the establishment of village based seed production that are well linked to fodder research institutes is crucial. Fodder seed production as an enterprise is not well developed. Although a number of farmers expressed their intention to produce seeds of improved oats, maize, guar and sorghum varieties, this

component will require longer-term training and strong efforts in building the required market channels for the seed producers.

To ensure the sustainability of the use of balanced feed two feed mills were installed and the socioeconomic evaluation showed that they are economically viable but the entrepreneurs will require some technical backup from animal nutritionists and socioeconomists. The project team felt that the majority of the feed-livestock interventions have a high potential for becoming sustainable and strongly recommend their further support and up-scaling in a follow-up development project.

Furthermore, the project provided a platform for mutually beneficial interaction between farmers and scientists and for multi-disciplinary research. The involved stakeholders with different professional backgrounds followed a common overall goal and worked together on one research platform rather than working in separation. Through the project scientists got the chance to work with small livestock farmers and directly observe the economic viability of the technologies/interventions that they recommended to improve feed resources and livestock productivity.

1 Introduction

Livestock play an important role in the Central Asian agricultural economies. Livestock not only contribute to the livelihoods of the most vulnerable rural sector, particularly in isolated regions and highlands, such as in Tajikistan and Kyrgyzstan, but also played a critical role in the period of transition when other sources of income were substantially reduced. However, livestock production has been severely affected by the economic transition, which resulted in the disruption of the Soviet markets for traditional products such as wool and pelts, fragmentation of large production units into small and unproductive flocks/herds, the collapse of production support services and animal health control, a lack of technology transfer services and disruption of livestock research.

The smallholder farmers that have emerged from the transition process face severe shortages of feed particularly in the critical period of winter feeding that coincides with pregnancy. Feed supplies have been disrupted, there is inadequate access to rangelands and production and conservation of forages is limited. The disaggregation of large herds into small herds and the inability of farmers to practice seasonal grazing have led to overgrazing of areas near villages and the undergrazing of remote ranges, increasing the reliance on cultivated fodder, which is limited or only available at a high cost. The lack of feed, together with the need to generate income for subsistence purposes, led to forced sales and slaughter by smallholders, resulting in a tremendous decrease in animal population stocks in most countries after independence. The sheep population was more than halved in the 10 years following independence, with stocks being reduced by 75% and 65% in Kazakhstan and Kyrgyzstan respectively. In recent years, animal populations have stabilized, and in some Central Asian countries are increasing, however farmers are still facing severe fodder shortages for critical periods such as winter feeding.

Because of the lack of information on production constraints and market trends, and the loss of production support services, mechanisms and support to bridge the productivity gaps are not available. Research has been disconnected from the "new" on-farm environment. This has hindered the identification and application of appropriate technologies to improve productivity and to target market opportunities, the rational use of resources, and the design of appropriate policies.

In 1999, ICARDA initiated a technical assistance programme – Technical Assistance Grant (TAG) 425 Integrated Feed-Livestock Production in the Steppes of Central Asia – that was implemented in Kazakhstan, Kyrgyzstan, Turkmenistan and Uzbekistan and ended in 2003. The program created an integrated adaptive research framework with the active participation of farmers and the direct involvement of NARS.The lessons learned from TAG 425 led to the identification of new priorities for further action, including: the need for a community-based approach; collective resource management (such as joint grazing) and technology testing and adaptation; fuller analysis of rural livelihoods; identification of avenues for production diversification; and community action for sustainable rangeland management.

To widen the regional scope of the planned follow-up program to TAG 425 IFAD suggested to include Pakistan in the new program proposal. The importance of the livestock sector in Pakistan is huge – it provides up to a third of household income for small and landless farmers, contributes more than a tenth to GDP and has tremendous and recognized potential in any strategy aimed at poverty reduction. The increasing population in Pakistan – it is expected to reach 217 million by 2020 – combined with higher household incomes is expected to generate an increase in the annual demand for livestock, milk and meat products by more than 50%. For the sub-sector national and provincial policy aims to improve; (i) credit flow to the rural and livestock dependent poor, (ii) genetic resources, (iii) feed and fodder resources, (iv) milk and meat productivity, (v) animal health services and marketing and (vi) investment in mills, milk and meat processing. Thus, constraints faced by the small scale farmers in both regions show similarities, in particular feed shortages during critical production stages are common. In both Central Asia and Pakistan, for livestock production to increase and to address increasing demand and for the rural poor to benefit from the process, there must be progress in the development of the livestock sector.

The new Programme aimed to capitalize on the lessons learned and to transfer the experiences gained during TAG ICARDA-425 to neighbouring countries with similar agroecologies and production constraints, including highland Pakistan. On 28 May 2006, IFAD and ICARDA signed the new Technical Assistance Grant Agreement for implementing the research programme "Community Action in Integrated and Market-oriented Feed Livestock Production in Central and South Asia" (TAG 816) for a total amount of US$ 1,200,000. The project was approved by IFAD Executive Board on 13 December 2005, became effective on 15th June 2006 with a project completion date of 30th June 2009. On 4 March 2009 ICARDA asked for a no cost extension until 31 December 2009 which was approved by IFAD on 17 June 2009.

2 Grant Description and Implementation Arrangements

2.1 Grant goal, objectives, components, and target groups

2.1.1 Grant goal and objective

The Programme goal was to improve the livelihoods of rural communities in Central and South Asia.

The Programme purpose was to develop and promote community-based actions to support productive and sustainable livestock systems, access to market opportunities, and sustainable management of the natural resource base in the region.

The specific objectives of the programme were to:

(a) consolidating research on promising options in Kazakhstan and Kyrgyzstan in Central Asia and expanding activities to Tajikistan;

(b) initiating a new programme of research in Pakistan and developing knowledge sharing with other countries in South Asia ;

(c) strengthening national research institutions and linking with key development projects for more rapid achievement of goals;

(d) developing productivity enhancing and market oriented technologies and community-based strategies for the management of integrated crop (fodder)/rangeland/livestock production systems that can be utilized by IFAD's community development and agricultural support services projects; and

(e) testing available technologies and production options together with farmers, livestock producers and national program scientists, evaluating their impact on farmers' livelihoods, and assessing the need for support services and institutions, including those governing common property (rangeland) access and management, to support the adoption of these technologies.

2.1.2 Programme approach and components

The Programme focused on activities at community level with the full participation of livestock producers in combination with field experiments with selected farmers. It tested available technologies and production options together with farmers, evaluate their impact on farmers' livelihoods, and assessed the need for support services and institutions, including those governing common property (rangeland) access and management, to support the adoption of these technologies.

In order to develop market oriented technologies and community-based strategies for the management of integrated fodder/rangeland/livestock production, the project activities were structured according to four themes, three themes related to technology development and a cross cutting theme on Capacity building and knowledge sharing:

- Theme 1: Socioeconomics
- Theme 2: Range and forage productivity
- Theme 3: Improvement of livestock productivity
- Theme 4: Capacity Building and Knowledge sharing

2.1.3 Target group and beneficiaries

For technology testing, the program targeted one to two communities at strategically selected research sites in each country and individual farmers within these communities for a specific on farm experiments. A description of the research sites and project villages is provided in Annex 1.
The selection of target areas in Kazakhstan and Kyrgyzstan was based on criteria that enabled the project to address best the priorities identified through TAG-425, including (a) the development of integrated production systems that include fodder crops, rangeland and livestock; (b) interactions among different farm types; (c) community action for sustainable rangeland management; (d) identification of opportunities for production diversification and marketing enterprises.
During a scoping mission research sites representing specific production systems were discussed and agreed with the national partners. were selected by collaborating partners.
For Tajikistan originally it was agreed to implement the project in Sogd Province focusing on the Mohair goat rangeland production system and the first workplan only included activities in Sogd Province. However, upon request of the Tajik Academy of Sciences and the national coordinator a second research site in Dusti community in Central Tajikistan was included and a workplan developed. This research site focused on meat production from the famous Gissar sheep breed. In Dusti community keeping Gissar sheep is the main base for producing high quality meat and there is a high market demand for their meat but also for breeding animls as the Gissar sheep is a highly productive breed. Furthermore, the site presented a typical case where summer and winter pasture rotations are no longer fully functional causing degradation of winter pastures.

In Pakistan, two research sites representing two different farming systems, rainfed and irrigated crop-livestock systems, were selected. This allowed testing different ways to include forages into the crop rotation and was supposed to allow a wider applicability of results in Pakistan. Data collection for the selection of project villages was organized as informal rapid rural appraisals. The specific approach differed between the two research sites. In the rainfed area in Punjab the Barani village development project had been conducted and the National Rural Support Programme (NRSP) is very active, therefore the Assistant Director Barani Village Development Project (Gujar Khan) and Professionals of NRSP were consulted and the activities of the project were discussed with them in detail. Four villages were proposed to select the project village from. The main criteria for the selection of project village were:

- Concentration of livestock (small and large)
- Fodder Production in the village
- Availability of farmland in the village
- Farmers' intentions and interest in project activities

After visiting the four proposed villages, Lodhay village was selected because of the "entrepreneurial" attitude of the community.
In Sarghoda district thirty-five villages were visited, out of which two villages Chak No. 74/SB and 105/SB were selected based on the following criteria.

- Small landholdings/ smaller herd size
- Dairy and meat production
- Presence of large and small ruminants
- Low income of the farmers
- Farmers' willingness to adopt technologies in crop-livestock systems
- Willingness of women to participate in the project
- Accessibility to market

In both sites village profiles and basic information on marketing was collected during the selection process. The data from the two villages in Sarghoda were used for a PhD study at the University Goettingen.

The number of target households/farmers and direct beneficiaries in both regions varied with the nature of the activity.

2.2 Grant Implementation Arrangements

ICARDA has been responsible for managing and coordinating the Programme, including financial management and donor reporting. Technical support was provided by ICARDA and collaborating institutions. The Programme was first led by ICARDA's senior livestock research scientist, Dr. Luis Iñiguez till 31 December 2006 and then taken over by Dr Barbara Rischkowsky till the end of the project. The project implementation was facilitated by ICARDA's regional office in Tashkent and its country office in Pakistan.

Annual national work plans and budgets were developed, discussed and agreed in Annual National Coordination Meetings. The results of the annual coordination meetings were then presented at regional coordination meeting, where the workplans were presented, discussed and harmonized. A Programme Steering Committee was created comprising National Coordinators, ICARDA's Regional Coordinator, and representatives from ICARDA, collaborators and the donor agencies. The Steering Committee will meet once a year to review, amend and approve the annual work plans and budgets developed during the national and regional meetings.

2.2.1 Central Asia

In each Central Asian country a principal partner institute and a national project coordinator were selected in agreement with the National Focal Points in the countries, ICARDA's regional coordinator at Tashkent office and the project coordinator. The partner institutes were:

- Kazakhstan: South-Western Center of Agriculture
- Tajikistan: Tajik Scientific Research Institute of Livestock Breeding (Dushanbe and Sogd branch)
- Kyrgyzstan: Kyrgyz Institute of Livestock, Veterinary and Rangelands

Originally it had been foreseen to establish a Project Technical Coordinator (PTC) position in Tashkent and three National Project Officer (NPO) positions in Kazakhstan, Kyrgyzstan and Tajikistan. After interviewing candidates for the PTC and NPO positions in September 2007, Drs Suleimenov, Iñiguez, Larbi, Aw-Hassan and Piggin felt that the candidates for the NPO positions would not add resources or expertise as they were already involved in the project. It was then decided that the funding foreseen for the country NPO positions would be used to support three Professional Officers (PO), one each for socioeconomics, rangeland and forage and livestock production to be based at Tashkent office. It was agreed that the POs would work under the direct scientific supervision of ICARDA's principal investigators for each theme and under administrative guidance of Mekhlis Suleimenov for the first year of project implementation and later under ICARDA's regional coordinator (Table 1).

The national project coordinators in the three countries selected principal investigators for each theme and built teams of researchers involving other institutes where additional expertise was required. For example, for theme 1 additional partner institutes are the South Kazakh State University, the Kyrgyz Agrarian University and the Khujand Technological University.

Table 1. Principal Investigators (PI) at ICARDA HQ and in the countries and Professional Officers (PO) in Tashkent by research theme

Themes	Programme manager and PIs at HQ	PO	National coordinators and PIs in Countries
Project coordination	L. Iñiguez (till Dec. 2006) B. Rischkowsky (1 Jan. 2007-31 Dec. 2009)	M. Suleimenov (till 06/2007)	Kazakhstan: A. Ombaev Kyrgyzstan: R. Nurgaziev Tajikistan: A. Karakulov
1: Socioeconomics	A. Aw-Hassan	N. Nishanov (1 Oct. 2006-1 Dec. 2009)	Kazakhstan: N. Alibaev. Kyrgyzstan: J. Isakov and U. Osmonaliev Tajikistan (Site 1): S. Makhmudov Tajikistan (Site 2): G. Safaraliev
2: Range & Forage Productivity	A. Larbi M.Louhaichi (Oct. 2008-Dec. 2009)	A. Nurbekov (1 April 2007-31 Dec. 2009)	Kazakhstan: S. Abdraimov Kyrgyzstan: K. Joldoshev & I. Ponomarenko Tajikistan (Site 1): M. Bokiev Tajikistan (Site 2): A.A. Madaminov
3: Livestock productivity	B. Rischkowsky L. Iñiguez (till Sept. 2008)	A. Atakurbanov (15 April-15 May 2007) H. Hamdamov (1 Oct. 2007-31 Dec. 2009)	Kazakhstan: M. Tuekbasov Kyrgyzstan: A. Ajibekov Tajikistan (Site 1): M. Kasimov Tajikistan (Site 2): F.M. Ikromov

The implementation in Central Asia was supported by frequent visits of the POs at strategic times in all three countries. Each trip was reported and the reports shared among all team members. The POs were supervised and backstopped by the respective ICARDA scientists who also visited the project sites and attended the regional coordination meetings when possible .

In addition to the ICARDA scientists Liba Brent from Madison University worked closely with the Tajik scientists at Khujand on the market analysis and value addition for Mohair goats. Joaquín Mueller from INTA backstopped the community based breeding activities in Khujand/Tajikistan and in Kyrgyzstan. He supervised data collection and developed detailed workplans jointly with scientists and farmers.

2.2.2 Pakistan

In Pakistan it was agreed to implement the programme under rainfed and irrigated conditions in the Punjab province. Accordingly two research sites were selected during the inception workshop by the team under guidance of Asamoah Larbi and ICARDA's country office in Islamabad. The two main partner institutes were the National Agricultural Research Centre (NARC) in Islamabad and the Fodder Research Institute (FRI) in Sarghoda. The latter is the only fodder research institute in Pakistan. Two multi-disciplinary teams were formed for each of the selected research sites and team leaders selected. Sartaj Khan, the national forage coordinator of NARC, for the rainfed site and Dr. Aktar Ali the director of FRI, for the irrigated site. Sartaj Khan also agreed to act as National Coordinator for Pakistan. In the latter function he was supported by Dr. Abdul Majid, the coordinator of ICARDA's country office. Dr. Azeem Khan, a former staff member of ICARDA's country office, and currently a leading socioeconomist at the Pakistan Agricultural Research Council (PARC), coordinated Theme 1 in Pakistan in collaboration with Dr Aden Aw-Hassan.

Monthly meetings of the research team were conducted at ICARDA's office in Islamabad to exchange experiences and plan the future activities. Over time a network of collaborators from various

agricultural institutions/organizations working on fodder crops, livestock and dairy processing in Pakistan was developed for each site.

Coordination:
National Project Coordinator:
Sartaj Khan, Forage Specialist, NARC, Islamabad (till 1 Oct. 2008)
Dr Muhammad Ansar, Fodder Agronomist, Pir Mehr Ali Shah-Arid Agriculture University, Rawalpindi-Pakistan (1 Oct. 2008-31 Dec. 2009)
Coordinator Theme 1:
Dr. Muhammad Azeem, Chief Scientific Officer, Social Science Division, PARC, Islamabad.

Project Research Team (Rainfed Site)

1. Team leader (s): Sartaj Khan, Forage Specialist, NARC, Islamabad (till 1 October 2008)
2. Team leader: Dr Muhammad Ansar, Fodder Agronomist, Pir Mehr Ali Shah- Arid Agriculture University, Rawalpindi-Pakistan (1 Oct. -31 Dec. 2009)
3. Mr. M. Zubair Anwar, Senior Scientific Officer, Social Sciences Institute, NARC, Islamabad.
4. Mr. Syed Hussnain Sha, Senior Scientific Officer, Social Sciences Institute, NARC, Islamabad.
5. Mr. Abid Hussain, Scientific Officer, PARC, Islamabad.
6. Mr Ashiq Husasain, Principal Scientific Officer, Fodder Program, NARC, Islamabad.
7. Dr. Imdad Hussain Mirza, Animal Nutritionist / Director, PRMC, NARC, Islamabad.
8. Mr. Tariq Aziz, Dairy Technologist, NARC, Islamabad.

Project Research Team (Irrigated Site)

1. Team leader: Dr Akhtar Ali, Director Fodder Research Institute, Sargodha (till ... 2008)
2. Dr Muhammad Siddique, Agri. Economist, University of Agriculture, Faisalabad.
3. Dr Ghulam Mohy Ud Din, Plant Scientist, Fodder Research institute, Sargodha.
4. Dr Qurban Ali. Animal Nutritionist, Livestock department, Sargodha.
5. Dr Nuzhat Huma, Dairy Technologist, University of Agriculture, Faisalabad.

2.3 Changes in grant implementation context, grant design, and outreach occurred throughout grant life

No changes in the implementation context and grant design occurred during the project duration. The project followed the four themes and implemented associated main research activities defined in the original workplans for each country designed in the inception meetings in 2006. It was conducted in the research sites suggested by the scoping mission and discussed and agreed upon in the inception workshops and was active in all sites throughtout the lifetime of the project. During the first project year some adjustments were made in the types of farms and target beneficiaries to be included in the research program to ensure a mix of medium scale and household farms.
Some changes occurred in the research teams in the countries due to staff changes in the institutes. The ICARDA scientist team was expanded in October 2008 by including Dr. Mounir Louhaichi, a range management and ecology scientist who joined ICARDA in June 2008.

3 Review of Performance and Achievements

3.1 Theme 1: Socioeconomics

3.1.1 Analysis of rural livelihoods

3.1.1.1 Baseline survey of small ruminant producers in Kazakhstan

The villages Akdala, Akbulak, and Junek were selected for the producers' survey. Akbulak and Junek villages are located closer to the main cities, Shymkent and Turkistan, respectively, while Akdala village is farther from Shymkent. A total of 150 households were interviewed (Table 2).

Akdala village is located in the Arys district, South Kazakhstan province, at 9 km from the district center, Arys town, and at 90 km from the provincial center, Shymkent city. The village population of 4,776 people lives in 462 households. Although smallholders keep most of the livestock population, each household has a small number of animals. The village occupies 133,760 ha of land including 90,800 ha used for agriculture. Rangelands cover most of the area (76,800 ha) and a small portion is under hayfields (3,000 ha) and cultivated forages (3,000 ha), while other croplands occupy 8,000 ha.

Akbulak village is located in Ordabas district, South Kazakhstan province, at 20 km from Shymkent city and at 30 km from the district center, Temirlan village. The closest railway station is Badam station. Population of this village is 1,200 people. In the village, there are 40,000 ha of rainfed lands, 3,000 ha of irrigated land, and 50,000 ha of rangelands. Water is pumped from wells and partially obtained from the Arys and Syrdarya rivers. Main source of water for cattle are mineshafts 5 to 56 m deep. Water in these shafts varies from low-saline to bitter. The village is accessible from Shymkent by paved roads. Farmers are connected by dirt roads difficult to be used during winter and spring. The need to identify forages that will provide adequate dry matter yield in the winter months is of major importance for the livestock producers in Arys district. The livestock market in Badam station is the closest market to Akbulak village.

Junek village is located in Turkistan district at 20 km from the district center, Turkistan city, and at 200 km from Shymkent city. Population of this district is 9,452 people living in 620 households. Livestock kept by 1,737 families consists of 4,045 cattle, 17,556 sheep, 410 horses, and 5,730 chickens. The closest to Junek village livestock market is located in Turkistan city. Inclusion of Junek village is explained by the proximity to the big livestock market in Turkistan as well as by the fact that the most of local residents are involved in rearing of small ruminants.

Table 2. Information on the selected villages

Village	Population	Total number of HHs	Selected sample, HHs	Distance to the main city
Akdala	4,776	462	60	90 km (Shymkent)
Akbulak	1,200	127	51	20 km (Shymkent)
Junek	9,452	620	39	20 km (Turkistan)

Analysis of rural household incomes

Average household income break-up by sources indicated that the highest income is obtained from intraregional off-farm employment (47%), sheep production (25%) and income from state jobs including pensions (17%). Data on the per capita income distribution show that 29% of the selected 150 households live below the USD 2 a day poverty line, and the income of 8% of people is below USD 1 a day (Figure 1).

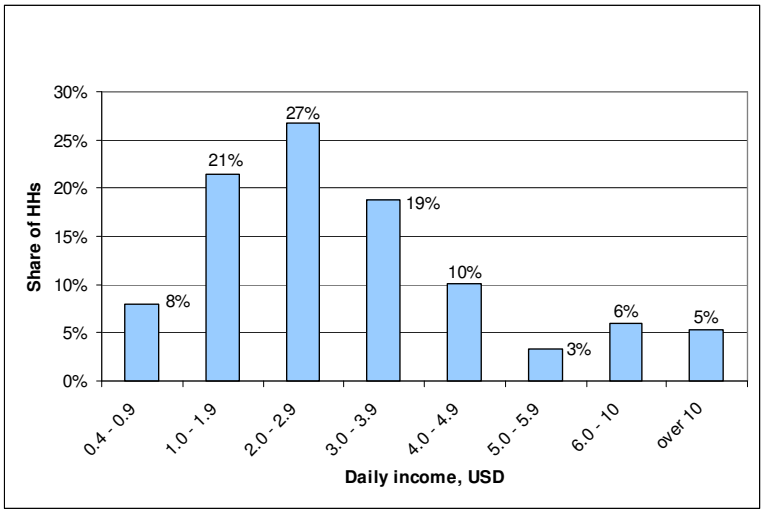


Figure 1. Per Capita Income Distribution

Analysis of access of smallholders to natural resources

Cropland owned and rented by smallholders was studied, and the land area distribution among households was analyzed. Data on cropland area distribution show that 50% of the interviewed households have or rent less than 1 ha of cropland, and 22% of all interviewed households have only 0.15 ha of cropland (Figure 2).

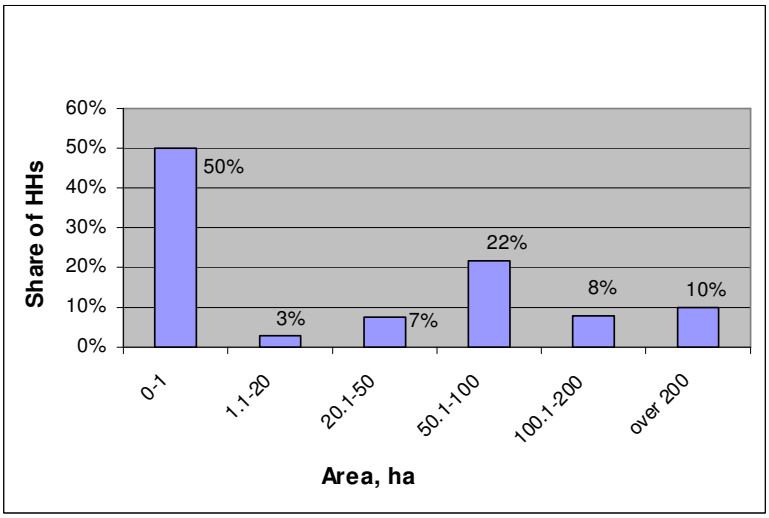


Figure 2. Cropland Area Distribution

The analysis of the data from the producers' survey reveals that the production systems can be described by the extent of rangeland resources' utilization for rearing small ruminants. The data show that the most frequent livestock production system among households (45%) is jointly herded flocks grazing in nearby common rangelands at distances where they can return to the homestead in the evening, each householder grazes the combined flock on a rotational basis.

Short description of production systems and proportion of 144 households applying the system

Type 1: Jointly herded flocks grazing in nearby common rangelands at distances where they can return to the homestead in the evening, each householder grazes the combined flock on a rotational basis (45%).

Type 2: Same as type 1, the difference is that HHs hire a shepherd for grazing the flock (35%).

Type 3: Animals are kept on rangelands from spring to autumn and each HH for the winter season moves their animals for stall-feeding (1%).

Type 4: Animals are kept on remote rangelands with the required infrastructure (sheep-fold, etc.) throughout a year (18%).

Analysis of households' livestock flock size dynamics for last 3 years

Data on the livestock kept by households shows that, in average, each producer keeps 126 sheep, 8 cattle, 1 horse, 3 indigenous goats, and 3 hens Table 3). Percentage of households in the sample keeping sheep and cattle dominate (92% and 90%, respectively) over the other livestock kept. At the same time, a share of households keeping horses (28%) is also high.

Table 3. Livestock flock size

	Sheep	Goats	Cattle	Horses	Poultry
Average flock size for 150 HHs	126	3	8	1	3
No. of HH keeping livestock	138	23	135	42	24
Share of HHs keeping livestock	92%	15%	90%	28%	16%

Household sheep flocks have been mainly increasing and showed an average 34% growth in 2006 compared to 2005 and 38% increase in 2007 compared to 2006. Negative flock size dynamics have been recorded only in 4 households keeping less than 30 sheep.

3.1.1.2 Baseline survey of small ruminant producers in Kyrgyzstan

The villages Ak-Beket, Progress, and Komsomolsky were selected for the survey (Table 4). They represent two categories of villages: smallholders in Ak-Beket and Progress villages located farther from main cities have access to the summer rangelands, while population of Komsomolsky village nearby Bishkek has no access to the summer rangelands.

Table 4. Information on the selected villages

Village	Households	Population	Distance from Bishkek	Distance from Tokmok
Ak-Beket	178	694	93	29
Progress	402	1,950	83	13
Komsomolsky	460	2,247	15	75

The main income source of population in the newly selected **Komsomolsky** village is neither crop, nor livestock production. Most of the residents work in Bishkek and at Manas airport. One of the main reasons for selection of this village was to see how proximity to Bishkek city affected livestock production practices of local householders in comparison with the farther located villages. Proximity of Komsomolskiy village to the livestock markets in Bishkek and, at the same time, insignificant share of agricultural production in livelihoods make this village a good site for comparison.

In **Ak-Beket** village, Kemin district, households graze their livestock on the nearby pastures or stubble-fields located at 3-7 km from the village. In summer, smallholders hire a shepherd to send their flocks to the summer rangelands at 35-40 km. (Depending on the age of a sheep households pay 15 to 35 Kyrgyz Som per head to shepherd for grazing).

In **Progress** village, Chuy district, smallholders have similar grazing practices as in Ak-Beket village. To graze their flocks, producers in Komsomolskiy village, Sokuluk district, use the forest belt located close to the village along the highway Bishkek-Airport (in the summer time), and the rest of the time they graze their animals on the nearby pastures or stubble-fields located at 1 to 5 km from the village. Smallholders graze their pooled livestock on a rotational basis without hiring a shepherd. In this village, there are no summer rangelands.

Analysis of rural household incomes

The analysis of the household income structure showed that the highest share of income is obtained from jobs in state institutions (27%). Income from cattle products is the second highest (18%), while income generated from sheep production forms 13%. Data on the per capita income distribution show that people in the 39% out of the 150 selected households live below the USD 1 a day poverty line, while the daily income of 76% of people in the interviewed households is less than USD 2 (Figure 3).

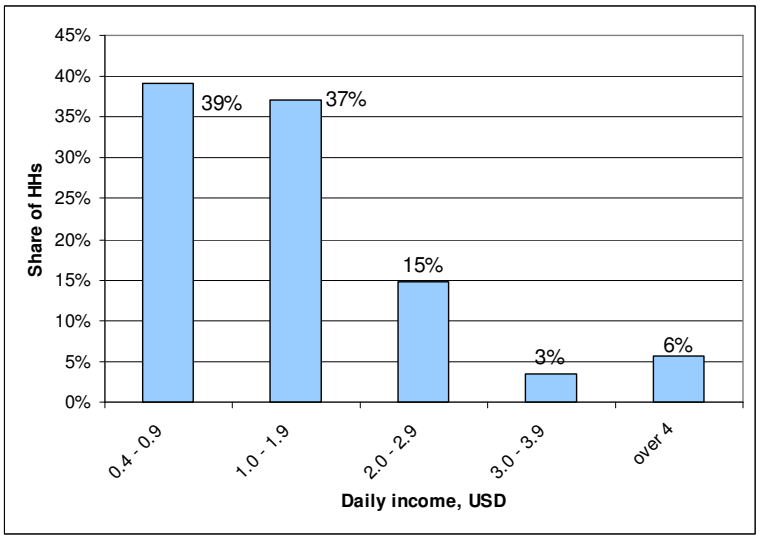


Figure 3. Per Capita Income Distribution

Analysis of access of smallholders to natural resources

As for Kazakhstan the livestock production systems can be best differentiated by the extent of rangeland utilization for feeding small ruminants. The responses of livestock producers indicated that most of them (39%) prefer the formation of a joint community flock to be grazed during the day and returned to the household each evening.

Short description of production systems and proportion of 97 households applying the system

Type 1:	Jointly herded flocks grazing in nearby common rangelands at a distance where they can return to the homestead in the evening, each householder grazes the combined flock on a rotational basis (39%).
Type 2:	Same as type 1, the difference is that HHs hire a shepherd for grazing the flock (21%).
Type 3:	Animals are kept on rangelands from spring to autumn and each HH is stall-feeding its animals during the winter season (10%).
Type 4:	Animals are kept on remote rangelands with the required infrastructure (sheep-fold, etc.) throughout the year (8%).
Type 5:	Stall-fed by the household throughout the year (22%).

Analysis of households' livestock flock size dynamics for last 3 years

On average each smallholder keeps 23 sheep, 4 cattle, 1 horse, and 2 goats (Table 5). Percentage of households in the sample keeping sheep and cattle dominate (85% and 84%, respectively) over the other livestock kept.

Table 5. Livestock flock size

	Sheep	**Goats**	**Cattle**	**Horses**	**Camels**	**Poultry**	**Other**
Average flock size (calculated for 150 HHs)	23	2	4	1	0.02	9	0.09
No. of HHs keeping certain livestock	127	41	126	56	1	68	5
Share of HHs keeping certain livestock	85%	27%	84%	37%	1%	45%	3%

There was a controversial dynamics of households' sheep flocks from 2005 to 2007. In 2006, compared to 2005, the number of animals increased in 13% of the interviewed farmers, in 67% of farms flock size remained the same, and in 20% of households it declined. In 2007, compared to 2005, flock size increase of 20 to 100% was recorded by 17% of smallholders, it remained unchanged in 57% of farms, while 7 to 75% decrease of sheep quantity was faced by 25% of producers.

3.1.1.3 Baseline survey of small ruminant producers at Khujand site, Sogd Province in Tajikistan

The villages Apon, Karajingil, Takli, Okbulok and Uyas were selected for formal socioeconomic survey. The five villages can be stratified according to the altitude as well as small ruminant production technology. **Apon** village was in the first group (at the highest altitude), goats dominate in these HHs. The second group (at medium altitude in the foothill area) consisted of three villages, **Karajingil, Takli, and Okbulok**. Share of goats and sheep is almost equal in these villages. **Uyas** village belongs to a third group (at the lowest altitude in the plain area). In these HHs, there are fewer goats and more sheep. Table 6 summarizes some basic population data of the villages.

The total number of households in the sample formed 150 including 40 HHs from Group 1, 50 HHs from Group 2, and 60 HHs from Group 3. The newly selected Apon village is located in the mountainous area at a higher altitude than the other villages. This village was selected to represent the households in the highland zone. Three big mohair markets are located close to this village in Koramozor and Dulona villages and Adrasman town. This makes Apon village a good option for conducting not only the producers' but also the traders' survey.

Table 6. Households and population in the selected villages in Ismoil Jamoat, B. Gafurov district

Name of the village	**No of HHs 2006**	**Population 2006**	**Including: Male**	**Including: Female**	**Population (under 14 years old)**	**Note**
			for 2004 only			
Apon	121	664	321	341	215	Group 1
Karajingil	163	1,090	571	606	383	Group 2
Takli	9	69	33	35	22	Group 2
Okbulok	5	28	13	14	9	Group 2
Uyas	715	4,220	1,999	2,122	1,339	Group 3
Total	**1,013**	**6,071**	**2,937**	**3,118**	**1,968**	

Analysis of rural household incomes

Analyses of the weighted average household income structure shows that the highest share of income (51%) comes from remittances. This is the highest indicator recorded for remittances among four project sites. These are followed by mohair goat production (17%) and income from the state job (10%). Sheep production provides 7% of the average household income. In general, about 36% of income is obtained from agricultural production. Data on the per capita income distribution show that people in the 75% out of the 150 selected households live below the USD 1 a day poverty line, and the daily income of 93% of people in the interviewed households is less than USD 2 (Figure 4).

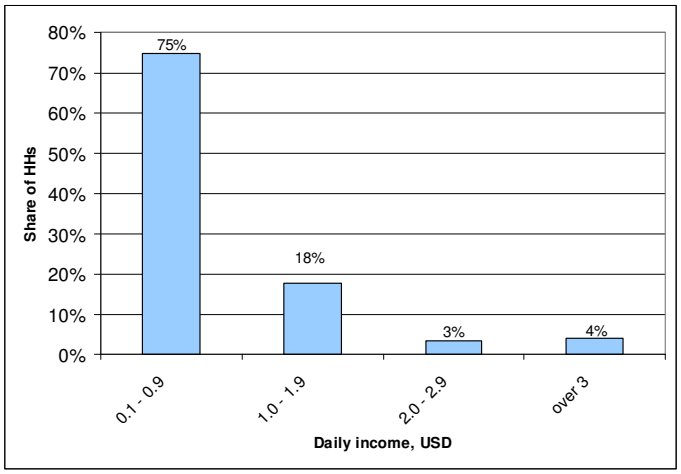


Figure 4. Per Capita Income Distribution

Analysis of access of smallholders to natural resources

Cropland owned and rented by smallholders was studied, and the land area distribution among households was analyzed. Analysis of the livestock production systems producers revealed that all the production systems can be differentiated into five production systems according to the extent of rangeland resources' utilization for rearing small ruminants. Responses of livestock producers on sheep and goat production system used by them indicate that most of them (35%) prefer grazing of their flocks on rangelands except for the winter season when sheep are brought back to household.

Short description of the production systems and proportion of households applying the system

Type 1: Joint flock of HHs sent for grazing in the morning and returned to the HHs in the evening, each householder grazes this flock on a rotational basis (33%)

Type 2: same like type 1, the difference is that HHs hire a shepherd for grazing the flock (6%)

Type 3: Animals are kept on rangelands from spring to autumn and each HH for the winter season moves their animals for stall-feeding (35%)

Type 4: Animals are kept on remote rangelands with the required infrastructure (sheep-fold, etc.) throughout a year (8%)

Type 5: Livestock producer working in an agricultural cooperative uses his position to graze his own flock with the cooperative's flock (5%)

Type 6: stall-fed mixed with grazing on nearby pastures around village, each household grazes its flock separately from other households by sending its family member (13%)

Analysis of households' livestock flock size dynamics for the last 3 years

Data on the livestock kept by households shows that in average each smallholder keeps 19 mohair goats, 12 sheep, 1 cattle, 1 indigenous goat, and 2 hens (Table 7). Percentage of households in the

sample keeping sheep and mohair goats dominate (85% and 81%, respectively) over the other livestock kept. However, nearly half of the households also keep cattle (45%).

Table 7. Livestock flock size

	Sheep	Mohair goats	Dairy goats	Other goats	Cattle	Horses	Donkeys	Poultry	Other
Average flock size for 150 HHs	12	19	0.2	1	1	0.02	0.5	2	0.05
No. of HH keeping certain livestock	127	122	9	12	67	3	53	43	2
Share of HHs keeping certain livestock	85%	81%	6%	8%	45%	2%	35%	29%	1%

Comparing the sheep and goat flock sizes in 2005 and 2007, the proportion of households that increased or decreased their flock size of goats was nearly the same, while more households had decreased than increased their sheep flock size (Table 8).

Table 8. Flock size dynamics in 2005-2007

Livestock	Change from 2005 to 2006			Change from 2005 to 2007		
	increase	same	decrease	increase	same	decrease
Mohair goats	in 47% of HHS	in 21% of HHS	in 32% of HHS	in 39% of HHS	in 19% of HHS	in 42% of HHS
Sheep	in 36% of HHS	in 37% of HHS	in 27% of HHS	in 34% of HHS	in 20% of HHS	in 45% of HHS

3.1.1.4 Baseline survey of small ruminant producers at Dushanbe site, Vahdat district in Tajikistan

Nine villages were selected for conducting the formal socioeconomic survey of livestock producers. Detailed information on the number of households, population, and livestock in the selected villages is provided in Table 9. The selected villages were divided into three strata according to altitude and livestock production systems:

Group 1: Households of Buzbid, Karsang, and Vakhdatobod villages located in the plain area at 36 km to the east from Dushanbe and at 10 km from the Vakhdat district center at the altitude of 750-860 m above sea level. Relief of this area is a floodplain terrace. The climate is characterized by low humidity with hot summer and mild winter. Major forage crops cultivated by households include cereals mainly wheat, leguminous plants, alfalfa for green forage and hay, maize for silage and green forage, and straw for forage. Livestock production is mainly stall-fed over the year. Distance to the rural livestock markets is 3-5 km to Vakhdat market and 12-17 km to Rudaki market. Distance to the semi-urban livestock markets is 35-40 km to Sharora market and 40-45 km to Chorbogh market.
The total number of livestock producing households in this stratum was 94. Out of these, 50 households were randomly selected for the survey.

Group 2: Households of Muminobodi bolo, Muminobodi poyon, and Nematobod are located in the flat and foothill areas at 45–50 km to the north-east from Dushanbe, at 15–20 km to the north-east from Vakhdat, and at 7-12 km from Dusti jamoat at the altitude of 860-900 m above sea level. Relief of the area can be described as uneven highland. The climate and crops do not differ much from group 1. Livestock production is mainly stall-fed mixed with grazing. The distance to Vakhdat and Rudaki

livestock markets is 5-7 km and 15-18 km, respectively, while from Sharora and Chorbog markets it is 38-43 km and 45-48 km, correspondingly.
Total number of livestock producing households in this stratum is 89, from which 50 households were randomly selected for the survey.

Group 3: Households Kosataroshi-bolo, Kosataroshi-poyon, and Chorvador are located in "Luchob" jamoat, Varzob district, at 30-50 km to the north-west from Dushanbe at the altitude of 1000-1200 m. Relief of this area is rugged terrain. Climate in this area is characterized by moderate precipitation, hot summer and moderate winter. Major forage crops cultivated by households include cereals (wheat, barley, and oats), alfalfa for hay, annual grasses for hay, and straw of cereal crops. Livestock production is mainly 1) stall-fed mixed with grazing at nearby pastures or 2) grazing on the outrun rangelands. The distance to Gissar rural livestock market is 12-25 km and from Sharora and Chorbog markets it is 15-22 km and 7-12 km, respectively.
Total number of livestock producing households in this stratum is 67 from which 50 households were randomly selected for the survey.

In total, 150 households were selected from 250 households rearing small ruminants in the mentioned nine villages.

Table 9. Information on stratified sampling

Villages	Total number of HHs	Selected sample, HHs	Altitude (m)	Dominating sheep production system	Distance to Dushanbe, km	Distance to local livestock markets, km
Group 1	925	50	750-850	stall-fed over the year	35-40	3-17
Group 2	358	50	860-900	stall-fed mixed with grazing	45-50	5-18
Group 3	439	50	1,000-1,200	1) stall-fed mixed with grazing at nearby pastures or 2) grazing on the outrun rangelands	30–50	12-25

Analysis of rural household incomes

Average household income structure indicates that the highest share of income (24%) comes from remittances. These are followed by sheep and cattle production where 16% and 14% of income are generated, respectively. In general, like in Kyrgyzstan, about a half of the average household income is obtained from agricultural production.
Data on the per capita income distribution show that people in the 33% of the selected 150 households live below the USD 1 a day poverty line, and the daily income of 84% of people in these households is less than USD 2 (Figure 5).

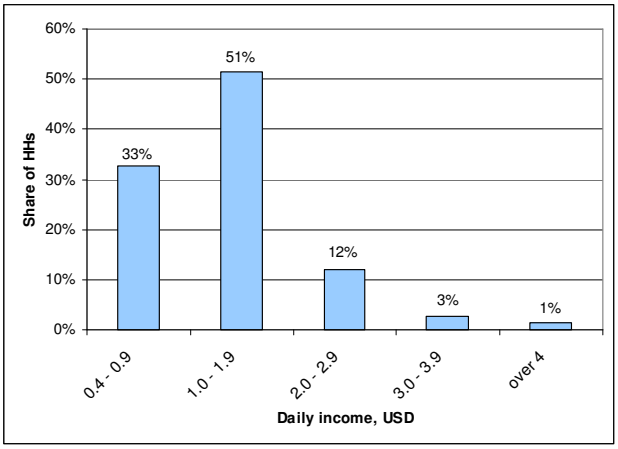


Figure 5. Per Capita Income Distribution

Analysis of access of smallholders to natural resources

Cropland owned and rented by smallholders was studied, and the land area distribution among households was analyzed. Analysis of the livestock production systems producers revealed that all the production systems can be differentiated into five production systems according to the extent of rangeland resources' utilization for rearing small ruminants. Responses of livestock producers on sheep production system used by them indicate that most of them (51%) prefer formation of a joint flock to be grazed during the day and returned to the household each evening.

Description of the production types and proportion of 148 households applying the system

Type 1: Jointly herded flocks grazing in nearby common rangelands at distances where they can return to the homestead in the evening, each householder grazes the combined flock on a rotational basis (51%).

Type 2: Same as type 1, the difference is that HHs hire a shepherd for grazing the flock (4%).

Type 3: Animals are kept on rangelands from spring to autumn and each HH for the winter season moves their animals for stall-feeding (28%).

Type 4: Animals are kept on remote rangelands with the required infrastructure (sheep-fold, etc.) throughout the year (15%).

Type 5: Stall-fed throughout the year by the household (1%).

Analysis of households' flock size dynamics for last 3 years

Analysis of the livestock kept by the households shows that in average each smallholder keeps 19 sheep, 4 cattle, 11 goats, and 8 hens (Table 10). Percentage of households in the sample keeping sheep and cattle dominate (99% and 97%, respectively) over the other livestock kept although the shares of households in the sample keeping goats (79%) and hens (62%) are also high.

Table 10. Livestock flock size

	Sheep	**Goats**	**Cattle**	**Horses**	**Poultry**	**Others**
Average flock size for 150 HHs	19	11	4	0.3	8	1
The no. of HH keeping certain livestock	149	118	145	33	93	21
Share of HHs keeping certain livestock	99%	79%	97%	22%	62%	14%

From 2005 to 2007, the number of Gissar sheep had increased in more than half of the households (Table 11). For the same period, the proportion of households that had increased and that had decreased their goat flock size was the same.

Table 11. Flock size dynamics in 2005-2007

Livestock	Change from 2005 to 2006			Change from 2005 to 2007		
	increase	**same**	**decrease**	**increase**	**same**	**decrease**
Local goats	in 48% of HHS	in 16% of HHS	in 36% of HHS	in 42% of HHS	in 16% of HHS	in 43% of HHS
Gissar sheep	in 52% of HHS	in 14% of HHS	in 35% of HHS	in 66% of HHS	in 5% of HHS	in 29% of HHS

3.1.2 Market analysis

3.1.2.1 Market analysis in Kazakhstan

Analysis of marketing strategies of rural households based on the producer survey

Completed analysis indicates that before selling their sheep and goats all sheep and goat producers limit feeding to natural grazing, and none of them feeds animals with concentrates. Majority of livestock producers (83%) prefer postponing sales of animals, if there is a price decline on a livestock market. All producers prefer selling their animals without pre-arranged agreement, and make immediate settlements in cash.

Information channels used by smallholders to find out the latest livestock prices were also studied to reveal that friends are the most frequently used source of price information for smallholders.

Lack of space for selling livestock at the markets was the major concern mentioned by smallholders impeding their free market access.

Studying price fluctuations for staple food, forage and livestock products

Data for 2009 show that the inflation rate was moderate; most of the staple food prices increased by up to 10% within one year. Average live lamb price followed the seasonal trend: the price hike recorded before the Navruz holiday in March was followed by price decline in the second half of August upon return of flocks from summer grazing. Forage prices did not change significantly.

Table 12. Livestock, staple food and forage prices

Item	Unit	Jan. 2009	Dec. 2009	Price change
Live lamb	1 head	5,500	6,000	9%
Lamb	1 kg	600	650	8%
Milk	1 L	70	75	7%
Apple	1 kg	35	40	14%
Aprikot	1 kg	100	110	10%
Grapes	1 kg	50	53	6%
Garlik	1 kg	65	65	0%
Beet	1 kg	10	11	10%
Hay	1 kg	5	5,3	6%

Analysis of market integration

The collection of weekly livestock prices at two rural (Arys and Badam) and two urban (Turkistan and Shymkent) livestock markets started in May 2008 and was completed in June 2009. All weekly data were entered into the electronic database.

The analysis of the data to study market integration has been initiated. Analysis of transactions at the four livestock markets shows that the highest sales are recorded in Shymkent and Turkistan cities,

while the number of deals at Arys and Badam rural markets is significantly smaller compared to that of the urban markets.
An analysis of the animals sold at the livestock markets by livestock species and sheep breeds was also conducted. Results show that Kazakh fat-tailed sheep dominate over the other sheep breeds and over other livestock species at all four studied livestock markets.

3.1.2.2 Analysis of lamb and mutton market in Kyrgyzstan

Analysis of marketing strategies of rural households based on the producer survey

Survey results show that most of the livestock producers in Ak-Beket and Progress villages (93.3%) prefer selling their animals at Tokmok market. And the majority of smallholders in Komsomolskiy village usually sell their livestock in Bishkek or in Sokuluk district. Conducted analysis indicates that before marketing their sheep a significant part of producers (91%) feed animals by concentrated feeds, while the others limit feeding by natural grazing.
When producers were asked what they would do, if there was a sheep price decline, 75% of respondents said they would sell animals anyway, while the other households would postpone sales.
Majority of producers (97%) prefer selling their animals without pre-arranged agreement. Almost all smallholders make immediate settlements in cash. Most of the households (97%) sort their animals before marketing. The survey results revealed that the majority of smallholders (80%) obtain price information from livestock markets.
Middlemen and unsuitable market infrastructure are considered major obstacles for free access to the livestock markets by 45% and 39% of households, correspondingly.

Analysis of monthly price fluctuations for staple food, forage and livestock products to be completed

Prices for staple food were unstable. Sugar price has been almost regularly increasing to end up with a 56% higher level by the end of 2009 (Figure 6). Rice price hiked in April by nearly 15%, and the December level recorded a 12% annual increase. Flour price has gone through less fluctuations but still showed an 8% growth per annum. Prices of straw and barley showed a deflationary trend, and both decreased by the end of the year by 18 and 39% compared to the January levels, correspondingly. Maize was about 20% cheaper in May but eventually finished the year at the 67% higher price than in January. Petrol was about 15% cheaper in April, however, by December it has grown by 30% compared to the price recorded in the beginning of 2009.

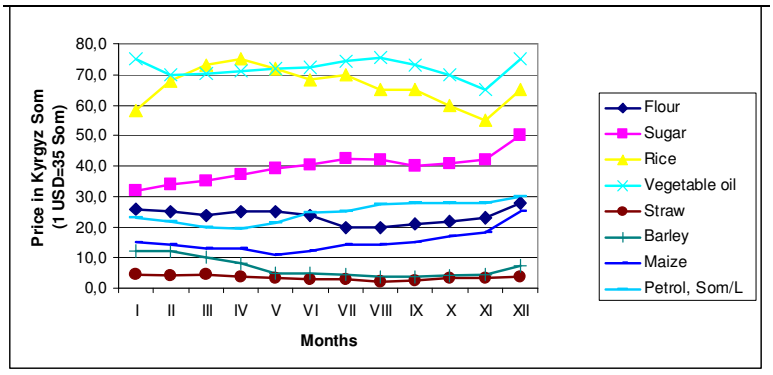


Figure 6. Prices for staple food, forages, and fuel in 2009

Analysis of market integration

The weekly collection of prices at three livestock markets, one in Tokmok town (rural) and two in Bishkek (Old Tolchok and Bayat, urban), started in June 2008 and was completed in June 2009. All weekly data were entered into the electronic database.

Initial weekly data analysis was started for development of the market integration study. The livestock market in Tokmok is actually the market supplying both Bishkek markets. Analysis of the Tokmok livestock market shows that more than 2,000 sheep and goats, about 420 heads of cattle, and nearly 300 horses are sold on every market day. More than a half of small ruminants is purchased by the middlemen regularly working at this market. Animals sold at Tokmok market are mostly not fattened and brought from rangelands. In contrast, animals sold at both Old Tolchok and Bayat markets are selected and well fattened.
Analysis of sheep at livestock markets by gender and age groups indicates that the highest average price was recorded for adult rams (5,500 KGS) in July. For the other sheep categories price change was not so significant (from 50 to 200 KGS per head per month). Old ewes were sold at the lowest price (2,500 KGS per animal). In general Kyrgyz coarse wool fat-tailed sheep dominate at all three studied livestock markets with the share of transactions exceeding 60%. The highest share of goats compared to the other two livestock markets and no cattle were recorded in the smallest Bayat market.

3.1.2.3 Potential for a sheep milk market in Kyrgyzstan

First the socioeconomic report from the from the first IFAD funded project TAG ICARDA-425 was reviewed. The report emphasizes a very low awareness of the population about the sheep dairy products. The report also included results from a survey on the potential for marketing sheep milk in Kyrgyzstan. Apparently many respondents were very interested to see sheep milk derivatives in the shops.
An opinion survey was conducted in September-October 2009 including the farmers who had been involved in the dairy sheep breeding program, their neighbors and others in the community. Thirty-five farmers participated in the survey. Most of them (88%) had heard about sheep milk products. None of them has practiced milking sheep for consumption or selling of sheep milk and dairy products. However, 91% of farmers stated that they were interested to see these products in local shops, as they were perceived as very healthy.
In addition a brief opinion poll of local consumers on their views of sheep dairy products was conducted in the same period. Forty men and women were interviewed. Most of them (68%) did not have any idea about products made from sheep milk. At the same time, the majority of consumers (75%) would like to see sheep dairy products in the shops.
A quick survey of the retail stores in Kemin, Chuy and Sokuluk districts as well as the retail stores in Bishkek in September-October 2009 completed the studies on the potential for sheep milk marketing. It was investigated if the owners of the retail stores were selling any dairy sheep products (even if imported), their prices and consumer preferences. Twenty nine traders were included in the survey. Although 55% of traders were aware of these products, none of them sold sheep dairy products.

3.1.2.4 Analysis of mohair market at Khujand site, Sogd Province in Tajikistan

Analysis of marketing strategies of rural households based on the producer survey

Survey results show that a significant part of producers (88%) feed their goats before selling them only by natural grazing, while 11% of farmers provide purchased concentrated feeds in addition to grazing, and only one household feeds animals with concentrated feeds without grazing.

To the question on the producers' behavior to a rapid mohair price decline, 74% of respondents said they would sell animals anyway, while 17% of households would postpone sales. Some households (8%) would either sell or postpone the sales depending on the circumstances. And three smallholders think that they would keep the mohair for processing.
To the question on the information channel smallholders use to find out the latest livestock prices, most of them (91%) mentioned livestock markets, while less households clarify prices from farmers (64%) and traders (57%). Friends (51%) and social gatherings in a village (28%) also help them to get the current price info.

Farmers were also asked to list major obstacles for accessing livestock markets. Around 70% of households stated that remoteness of markets is the main problem for market access.

Analysis of monthly price fluctuations for staple food, forage and livestock products

The Mohair price increased by 79% in 2009, while price for mohair yarn gained 36% for the same period (Figure 7). Lamb meat has not changed throughout the whole year, but the goat meat price increased by 17%. In contrast, there was a 46% and 25% decline recorded for barley and straw prices, correspondingly.

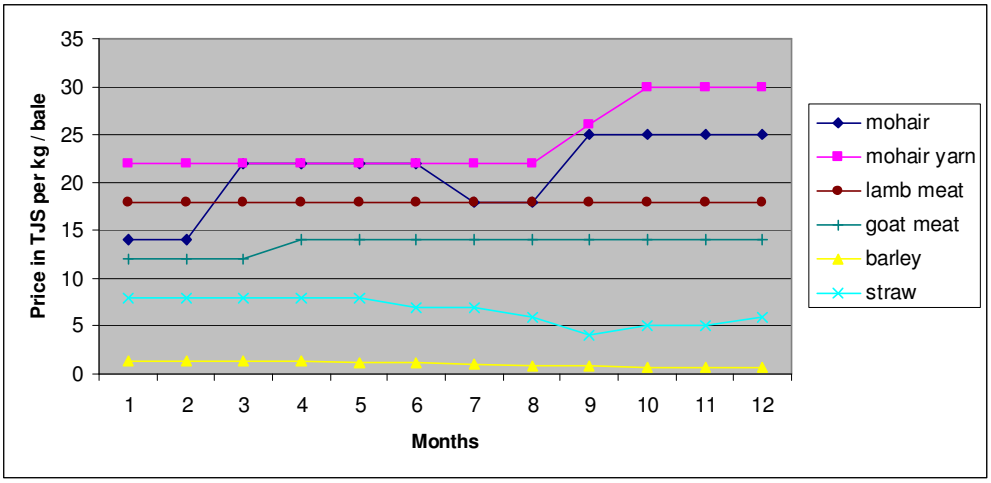


Figure 7. Livestock product and forage prices in 2009

Following price hikes in mid-2009 cotton seed oil and rice prices showed 5% and 20% annual decline, respectively (Figure 8). Flour price decreased by 3%, while sugar price jumped up by 26% in 2009.

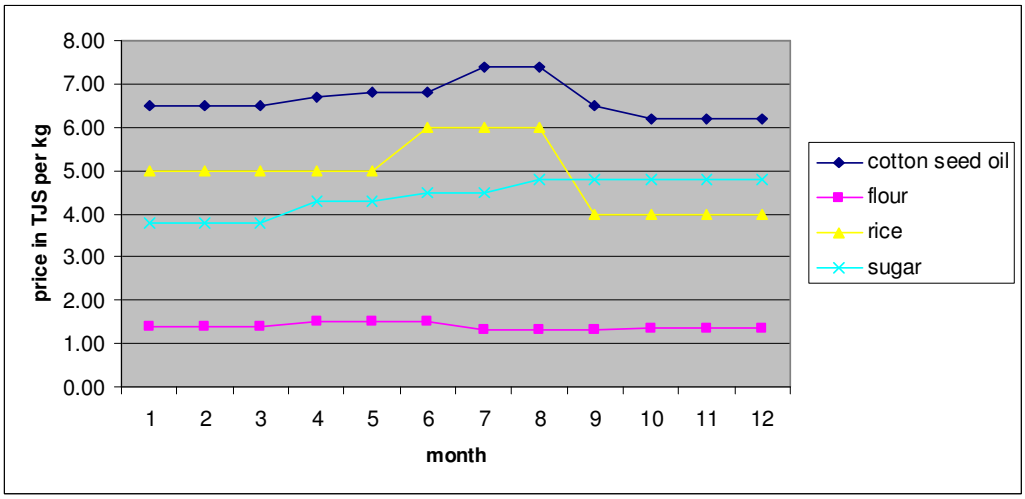


Figure 8. Staple food prices in 2009

Analysis of market integration

In Khujand site, the weekly price monitoring was not conducted due to a very little change in mohair price recorded during the monthly price analysis, and more attention was paid to the traders survey instead. Thus, the market integration analysis will be based on the descriptive information and monthly price data collected so far.

Mohair traders' survey – continued value chain analysis

Seven mohair markets (including Juma-Bazar, Dusti, Taboshar, Adrasman, Koramozor, Apon, and Bulok) were selected for the survey by March 2008. Traders' questionnaire was adapted and tested for local conditions by May 2008. Enumerators and researchers were trained by May 2008. One hundred mohair traders participated in the survey. First 50 traders were interviewed by November 2008, while another 50 traders provided their answers by March 2009. This survey started in early September 2008 and was completed in March 2009 rather than end of 2008, as many traders were expected to return from Russia to Tajikistan in winter. Data entry was finalized by June 2009.

According to the survey results the amount of time spent for production of mohair yarn indicates that yarn production is still a labor intensive process for processors, and most of them spend more than 3 days to make a kilo of yarn (see Figure 9). Lack of knowledge and old tools/equipment are the major factors contributing to the low productivity of yarn in households.

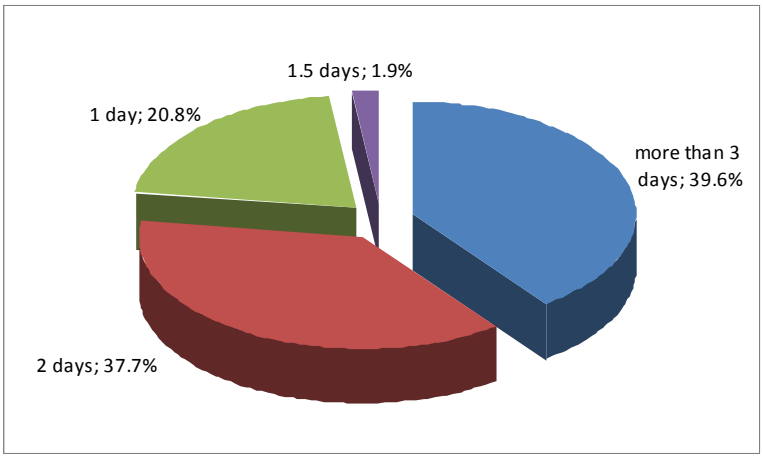


Figure 9. Time spent by mohair processors to produce 1 kg of yarn

To the question on the main limitations facing yarn producers in order to develop yarn making capacity responses distributed as shown in Figure 10. Results show that mostly fiber processors refrain from procurement of electric equipment for yarn production due to unstable electricity supply, while half of the smallholders think that it is difficult to find such equipment on local markets.

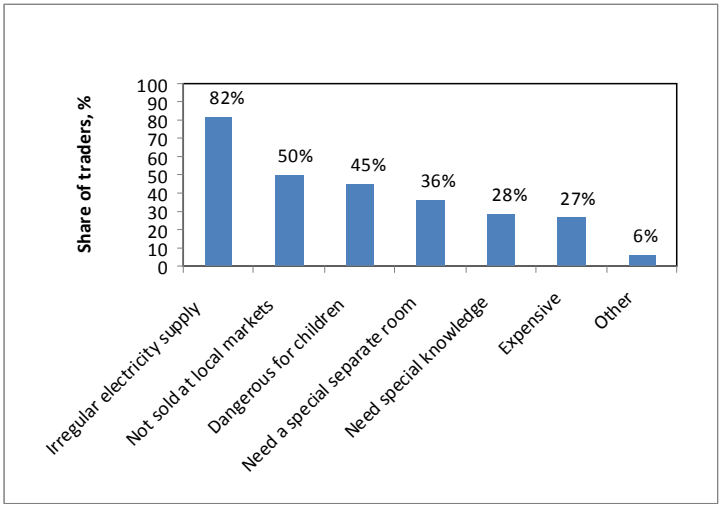


Figure 10. Constraints for procurement of yarn producing equipment

Traders listed the fiber characteristics that they usually look for during procurement. Figure 11 shows that most importantly mohair should be clean, not washed, and lustrous. Most of the respondents advised that meeting these three characteristics would increase the fiber price up to 30%.

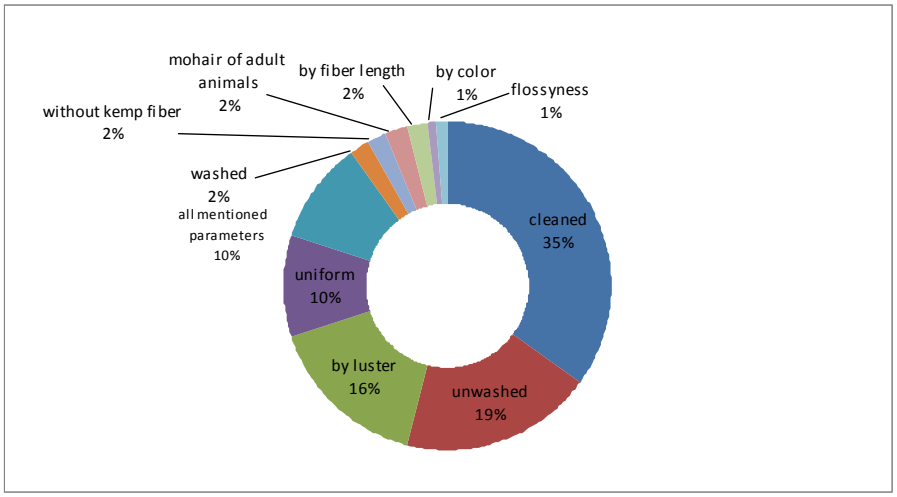


Figure 11. Good mohair characteristics considered by major buyers

At the same time traders shared a list of factors they try to avoid when they buy mohair. As indicated in Figure 12 the fiber basically should not contain dandruff, should not be dirty and washed. Most of traders think that, if the fiber has some of the indicated unfavorable characteristics, the price of mohair could fall down by more than 50%.

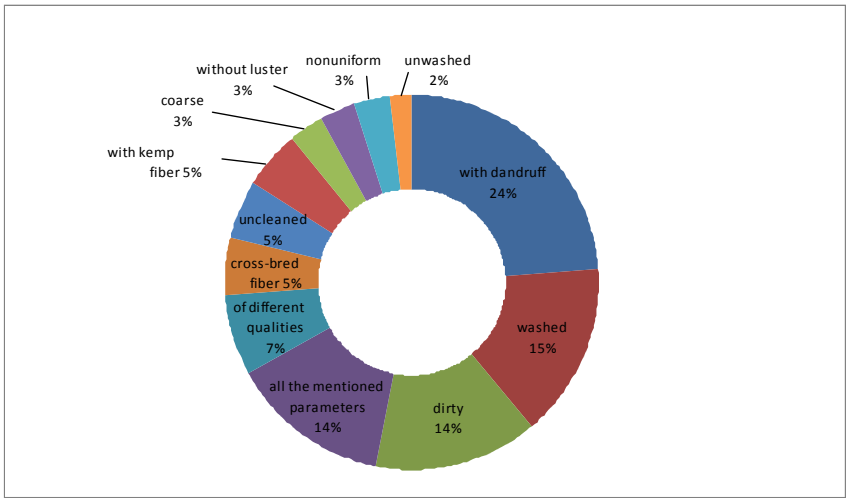


Figure 12. Mohair characteristics avoided by major buyers

On the local mohair markets, there is no established standardization system. Mohair quality is determined by buyers based on the visual assessment. Immediate supply and on the spot settlement are mainly practiced at these markets. Market relations are underdeveloped as there is no certain firms or entrepreneurs involved in regular mohair trading and exporting it abroad, although most of the produced fiber is sent through different channels (mainly smuggling) to Russia in a spontaneous way.
The volume of sold mohair varies by seasons. To resell, middlemen (exporters) procure and store nearly 30% of the total volume of produced mohair during the goat shearing period on farms. Active mohair sales are observed during departure of labor migrants to Russia (March, April, May). To cover travel costs these workers procure small portions of raw mohair and mohair products for further reselling in Russia.

According to the traders' perceptions the best quality mohair is usually sold by producers with smaller flocks. This fact shows that smallholders keeping a few animals pay more attention to initial fiber sorting/processing.
Average mohair trader's costs are given in Table 11.

Table 11. Transport and other marketing costs

Costs	Per kg (in TJS)	Per month (in TJS)
Transport costs	0.33	57.95
Marketing costs:		
- cleaning	0.14	23.85
- sorting	0.13	29.49
- packing	0.86	18.50
- market fee	0.27	5.29
- storing	0.47	8.04
Middleman's commission	0.85	2.41

3.1.2.5 Market analysis at Dushanbe site, Vahdat district in Tajikistan

Analysis of the marketing strategies of rural households based on the producer survey

Before selling their sheep a significant part of producers (58%) limit feeding by natural grazing, while every third farmer (28%) in addition to grazing provides purchased concentrated feeds, and fewer households (14%) feed animals by concentrated feeds without grazing.

To the question on the producers' reaction to a rapid sheep price decline, 48% of respondents said they would sell animals anyway, while 50% of households would postpone sales. The majority of producers (98%) prefer selling their animals without pre-arranged agreement. Many smallholders (96%) make immediate settlements in cash. When farmers were asked about the source they get the price information from, majority of smallholders (82%) mentioned livestock markets. More than 45% of households stated that they have no problem for market access. At the same time, low prices for agricultural products were mentioned as the main problem to access markets by more than 35% of households.

Analysis of monthly price fluctuations for staple food, forage and livestock products

Deflationary trend was recorded for all feeds and forage in 2009. For example, barley, maize, straw, and concentrated feed prices showed an annual decline of 45%, 50%, 63%, and 25%, respectively (Figure 13).

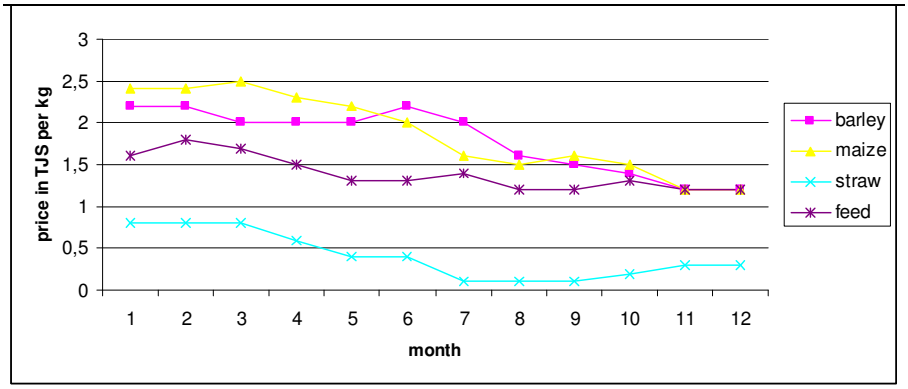


Figure 13. Forage prices in 2009

In contrast, the price of lambs was relatively stable and gained 11% by the end of the year. Prices for the vegetable oil, rice and sugar increased significantly, while the flour price went down by 27% for the same period (Figure 14).

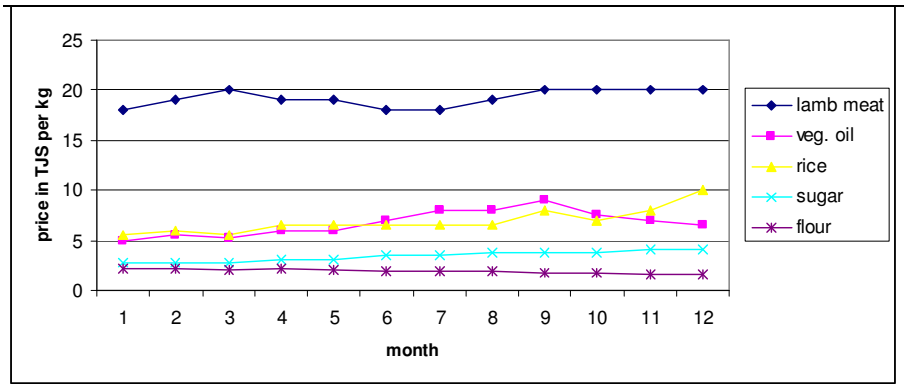


Figure 14. Staple food prices in 2009

Analysis of market integration

Weekly livestock price data collection was undertaken at two urban livestock markets, Sharora (in Gissar district, at 8 km from Dushanbe) and Chorbogh (in Varzob district, at 2.5 km from Dushanbe), and two rural livestock markets, Sangob (in Vakhdat district, 25 km from Dushanbe) and Eski Bozor (in Rudaki district, 8 km from Dushanbe).

Preliminary results of analysis of collected weekly livestock prices and market transactions at urban and rural markets show that the highest number of livestock is sold at Rudaki market located nearby Dushanbe city limits.

3.2 Theme 2: Technical interventions for increasing range and forage productivity

3.2.1 Assessment of current status of forage production and feeding practices

A survey on forage production and feeding strategies of households was launched in Kazakhstan, Kyrgyzstan, and Tajikistan in October 2007 and was completed in June 2008 with a total of 314 respondents. The survey was conducted in three villages at each research site in the project village(s) and neighboring villages (Annextable 2). Between nineteen and thirty farms and households were interviewed in each village.

Land use

The privatization of state controlled land has been initiated in most Central Asian countries after independence in 1991. This process has advanced at different pace in the countries and did not include all agricultural land; often large rangeland areas were excluded. This resulted in complex ownership patterns and huge differences in ownership of private land between the countries. Annextable 3 shows private and rented land per household in the survey villages for irrigated, rainfed cropland and pasture areas. In all countries most pasture land has not yet been permanently allocated to household or dekhan farm; instead large areas that were allocated to individual sovkhoz or kolkhoz during the Soviet time are still owned by the state and being used as communal pastures. In Kazakhstan some pastures have been fully privatized.

Pasture conditions

Responses of interviewees on pasture conditions differed across the villages and countries and between seasons (Figure 15). For example the respondents from Northern Tajikistan perceived a higher percentage of their spring, summer and autumn pastures in good condition compared to the other three countries which came as a surprise. Next best were the summer pastures in Kyrgyzstan being judged by 28.8% in good, by 54.9 % in medium and by 6.3 % in poor condition. The winter pastures were most frequently perceived as either in poor shape (Central Tajikistan and Kazakhstan) or in medium condition (Northern Tajikistan and Kyrgyzstan). It should be noted that these differences between the countries are linked to differences in the frequency of use: pastures around the settlements in Central Tajikistan are used as main forage resource all year round while in Northern Kyrgyzstan they are used only during the winter period of the year.

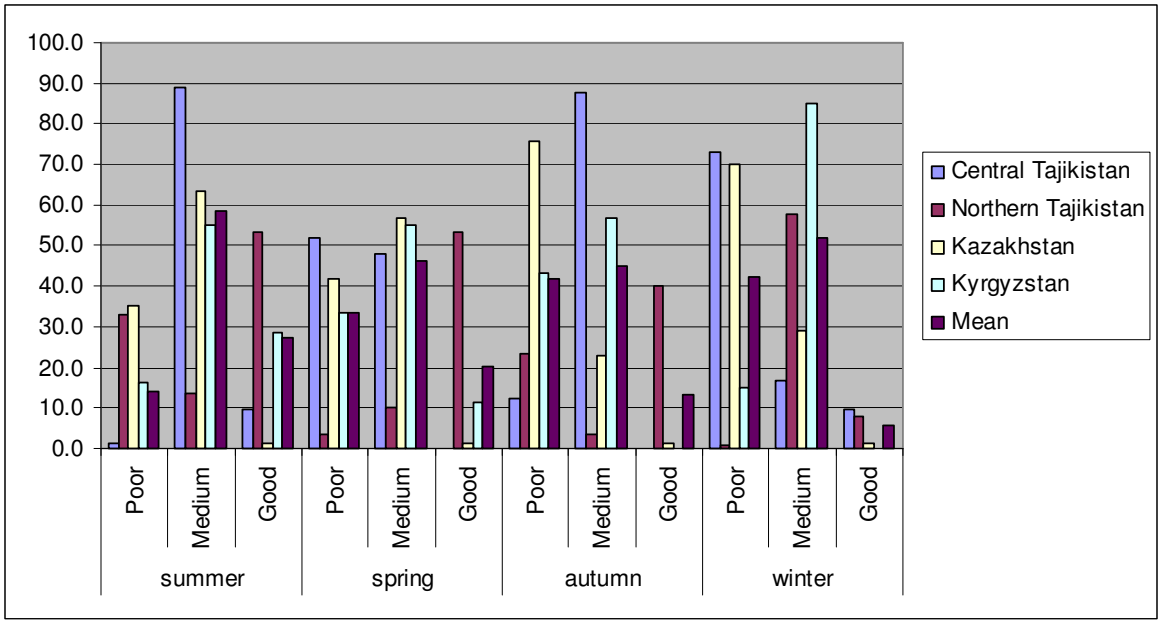


Figure 15. Conditions of pastures as reported by the interviewed farmers and households at the four project sites (percentage of respondents stating a certain pasture condition)

Crop and forage production

Winter wheat and barley crops are the most common cereals in all interviewed villages while alfalfa and maize crops are the most important forage crops. In Central and Northern Tajikistan forages are mainly grown on irrigated land and are the main source for livestock feeds while the main sources of feeds in Kazakhstan and Kyrgyzstan are rangelands, open grazing land and then cropland.

Households and farmers in the selected villages are growing old varieties of all agricultural crops especially maize, barley, and alfalfa. They indicated that they did not have access to improved varieties. Low yielding varieties in combination with poor agronomic practices (fertilization, seeding rates, and mono-cropping) explain the relatively low productivity of irrigated forage crops. Nevertheless, dry matter yield of Alfalfa significantly differed across the countries and villages; the lowest yield (1.3 t/ha) was recorded in Kipchok village in Northern Tajikistan while the highest yield was reported in Uyas village also in Northern Tajikistan (Table 12). Maize yields also differed between the interviewed villages and countries. For instance the highest maize grain yield was recorded (5.1 t/ha) in Akbulak village in Kazakhstan and the lowest yield was observed (1.6 t/ha) in Progress village in Kyrgyzstan.

Table 12. Forage crops (share of household in %, area, yield) in the selected villages

Village	Al-falfa	Sain-foin	Maize	Sorg-hum	Village	Al-falfa	Sain-foin	Maize	Sorg-hum
KAZAKHSTAN					**DUSHANBE, TAJIKISTAN**				
Ak-bulak					**Buzbit**				
Households, %	92.5	0	81.5	0	Households, %	40.0	0	28	0
Area	61.5		51.5		Area	5.1		3.55	
Yield, t/ha	6.6		5.1		Yield, t/ha	7.2		2.6	
Akdala					**Nematabat**				
Households, %	14.3	0	10.7	0	Households, %	47.8	0	21.7	0
Area	56.0		22		Area	7.0		3.0	
Yield, t/ha	1.0		2.3		Yield, t/ha	3.7		3.8	
Dermene					**Karsang**				
Households, %	52.6	0	47.3	0	Households, %	37	0	22.2	0
Area	72.6		47.8		Area	5.6		3.9	
Yield, t/ha	3.2		3.6		Yield, t/ha	3.4		4.5	
KYRGYZTAN					**KHUJAND, TAJIKISTAN**				
Akbeket					**Kipchok**				
Households, %	55.5	3.7	37	0	Households, %	60.0	0	50.0	16.6
Area	42.9	1.0	20		Area	7.5		7.6	2.0
Yield, t/ha	3.2	2.4	2.2		Yield, t/ha	1.3		3.8	6.3
Ak-Zhol					**Michurin**				
Households, %	45.4	4.5	36.3	0	Households, %	0	0	70.0	83.3
Area	25.5	1.0	14.0		Area			2.2	3.2
Yield, t/ha	3.8	1.7	3.3		Yield, t/ha			2.0	2.3
Progress					**Uyas**				
Households, %	50.0	0	42.3	0	Households, %	36.6	0	26.6	43.3
Area	33.1		1.7		Area	5.6		3.6	3.4
Yield, t/ha	3.2		1.6		Yield, t/ha	9.9		3.7	1.3

Interviewed households in Nematabat village (69 %), Buzbit village (92 %), Karsang village (100 %) in Central Tajikistan, households and farmers of Kipchok village (60 %) and Uyas village (36 %) in

Northern Tajikistan and Akbulak village in Kazakhstan (51 %) also grow vegetables as cash crops while this is not the case in the other villages in Northern Tajikistan and Kazakhstan and in all villages in Kyrgyzstan.
There are no farmers or households specialized on forage production and it is very rare that households and farmers sell forages at the local market. They grow forage crops only for feeding their own livestock.

Animal numbers
The highest number of goats per household was recorded in Uyas village(142.0) followed by Kipchok village (54.3) in Northern Tajikistan, while the lowest number of goats per household was observed (2.5) in Michurin village also in Northern Tajikistan (Figure 16). This can be explained by the fact that the households of Michurin village do not have access to pastures or hayfields for grazing their goats and thus have to rear their goats by tethering in the backyards.
The highest number of sheep per household was recorded in the villages in Kazakhstan, namely Akbulak (101.6), Akdala (100.3) and Dermene (87.2) village while the lowest number of sheep per household was recorded in Michurin (10.7) in Nothern Tajikistan, and in Nematbat (16.2) and Karsang village (16.9) in Central Tajikistan.
The livestock numbers have to be treated with caution as interviewees stated different livestock numbers for the same household when asked about the livestock numbers of others. Households were afraid that their answers would be reported to the official state tax organization.

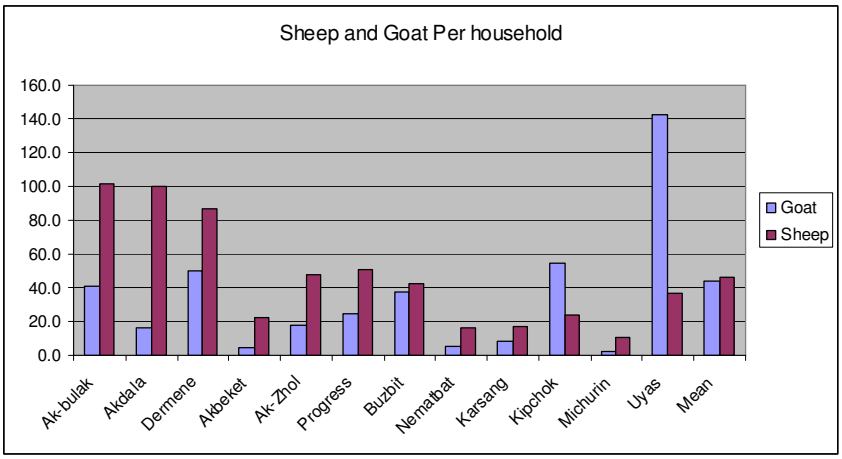


Figure 16. Sheep and Goat numbers by interviewed households in the selected villages

Perceived major constraints for livestock production
For 45% of respondents in Central Tajikistan and 63% in Michurin village in Northern Tajikistan the main limiting factor for livestock development was lack of winter fodder due to lack of irrigated land and insufficient pasture areas to graze their livestock. There was also a relatively high percentage of farmers in Akdala village in Kazakhstan that mentioned that winter fodder was a major problem. These were farmers that grazed their animals on winter pastures, and experienced high losses in the winter 2007/2008.
The most important constraint for livestock production named by the interviewees in the two other villages in Kazakhstan was the abandonment of the traditional rotational grazing management system which has resulted in winter pastures around villages and pastures near roads being overused and becoming severely degraded, and in summer pastures being underused. The major constraints for livestock production in the selected villages in Kyrgyzstan were lack of capital (40.1 %), knowledge (27.1 %) and improved forage varieties (17.2%). Twenty-eight percent of the interviewees in Kazakhstan, 34% in Kyrgyzstan and 52 % in the two other villages in Northern Tajikistan mentioned that the cost of fuel, seed and fertilizer were the major limiting factor for forage production.

Main conclusions

- In all countries most pasture land has not yet been permanently allocated to households or dekhan farms. Instead large areas that were allocated to individual sovkhoz or kolkhoz during the Soviet time are still owned by the state and being used as communal pastures.
- The analysis indicates that summer and spring pasture's conditions are perceived to be relatively better than autumn and winter pastures.
- The most common and popular forage crops, among households and farmers in the survey villages are maize and alfalfa.
- Alfalfa and maize grain yield significantly differ between countries and villages. Households and farmers indicated that they do not have access to improved varieties of maize and alfalfa and that the productivity of irrigated forage crops are low due to the use of poor agronomic practices.
- In the villages where goats are very important as in the hilly villages without irrigation in Northern Tajikistan and one village in Central Tajikistan, sheep numbers are low and vice-versa. In Kazakhstan and Kyrgyzstan sheep production clearly dominates.
- Main limiting factors for livestock production are lack of winter fodder, the non-functioning of the traditional rotational grazing management system and the absence of support for foage production.

3.2.2 Introducing new species and improved varieties of forage crops

3.2.2.1 Testing early, medium and late maturing and three different seed rates of mungbean after winter wheat in central Tajikistan

Research methods

Experiment 1: Early (*Tajikskiy 2*), medium (*Tajikskiy 1*=control) and late (*Serhosil*) maturing varieties of mungbean were tested as summer crop after winter wheat. The experiment was conducted on irrigated plots of two households in Dusti community for three cropping seasons from 2007-2009. Days to maturity, grain yield, biomass yield and profitability were studied in the experiment.

Experiment 2: Three different seed rates of mungbean (16, 20 and 24 kg ha^{-1}) were tested after winter wheat harvest. Days to maturity, grain yield, biomass yield and profitability were studied.

Results

Experiment 1: Testing different mungbean varieties

Days to maturity differed between varieties and years and ranged from 85 to 107 days. Maximum days to maturity (107) were recorded in the late maturing variety in 2009 while minimum days to maturity (85) were observed for the early maturing variety in 2009.

The weather conditions in 2009 were not conducive for high grain yields as the air temperature during autumn was lower than in 2008 and 2007 and therefore the mungbean seeds did not mature properly. Consequently, grain yields decreased by more than half compared to 2008 and 2007 (Table 13). However, biomass yields were significantly higher in 2009 than in 2007 and 2008.

Biomass and grain yields were also significantly affected by varieties and farms. The medium maturing variety (*Tadjikiskiy 1*) showed the highest biomass yields in 2007 and 2008 across farms but in 2009 the maximum biomass yield was recorded with the late maturing variety *Serhosil* in farm 1 (5.34 t ha^{-1}). The early maturing variety gave consistently the highest grain yields across years and farms.

Table 13. Biomass and Grain yield of three mungbean varieties

Farmers	Treatments	Mean biomass yield, t ha^{-1}				Mean grain yield, t ha^{-1}			
		2007	2008	2009	Mean	2007	2008	2009	Mean
F1	Tajikskiy 1= control	2.16	1.96	4.62	2.91	1.66	2.10	0.28	1.35
	Tajikskiy 2	1.96	1.89	4.73	2.86	2.05	2.16	0.72	1.64
	Serhosil	1.75	1.91	5.34	3.00	1.81	2.10	0.49	1.47
F2	Tajikskiy 1= control	1.90	1.09	4.93	2.64	1.52	1.05	0.30	0.96
	Tajikskiy 2	1.78	1.03	4.88	2.56	1.84	1.20	0.65	1.23
	Serhosil	1.61	0.95	4.84	2.47	1.68	1.15	0.48	1.10
	Year		<.001				<.001		
	Farmer		<.001				<.001		
	Varieties		<.001				<.001		

Highest net income (891 somoni ha$^{-1)}$ was obtained from the early maturing variety Tajikiskiy 2 while the other two varieties achieved the same net benefit (Table 14).

Table 14. Cost-benefit analysis (TJ somoni ha^{-1}) for early, medium and late maturing mungbean varieties

Cost items (TJ somoni[1] ha^{-1})	**Tajikiskiy 1**	**Tajikiskiy 2**	**Serhosil**
Gross income	**1680**	**1760**	**1680**
Seed cost	60	60	60
Labor	60	60	60
Machinery fuel, oil, repair	60	60	60
Lubrication	20	20	20
Transportation	100	100	100
Other costs	439	439	439
Land rent and taxes	130	130	130
Total costs	**869**	**869**	**869**
Net income	**811**	**891**	**811**
Profitability rate, %	93.3	102.5	93.3

[1] 1 USD=4.45 TJ somoni, August 2009

Experiment 2: Testing mungbean seed rates

The same effect of year 2009 on days to maturity, biomass and grain yields was observed as in experiment 1.

Higher seed rates tended to lengthen the days to maturity particularly under adverse climatic conditions as in 2009. The biomass yields differed significantly between seed rates and farms. With a seed rate of 20 kg ha^{-1} maximum biomass yield (1.97 t ha^{-1}) was achieved in 2008 while in 2009 the maximum biomass yield (6.81 t ha^{-1}) was recorded with a seed rate of 24 kg ha^{-1} (Table 15).

Seed rates had a significant effect on grain yield. Farm 1 achieved highest grain yields with a seed rate 16 kg ha^{-1} in both years, while this was the case for farm 2 only in 2009. In 2008 farm 2 obtained highest grain yields with a seed rate of 20 kg ha^{-1}.

Table 15. Biomass and grain yield of mungbean crop as affected by different seeding rates

Farmers	Seed rate	Biomass yield, t ha^{-1}		Grain yield, t ha^{-1}	
		2008	2009	2008	2009
F1	20 kg ha^{-1} - Control	1.97	6.57	1.86	0.87
	16 kg ha^{-1}	1.51	6.43	2.27	1.11
	24 kg ha^{-1}	1.89	6.81	1.73	0.80
F2	20 kg ha^{-1} - Control	0.72	5.04	1.21	0.76
	16 kg ha^{-1}	0.62	5.29	1.03	1.01
	24 kg ha^{-1}	0.74	5.17	0.94	0.68

Conclusions

Days to maturity is a key parameter in the climatic conditions of Central Tajikistan because in some years early frost can decrease grain yields. Thus, growing early maturing varieties after the winter wheat harvest ensures to harvest at least some grains besides the forage biomass. The cost benefit analysis using averages from three year observations confirmed the advantage of growing early maturing varieties achieving a higher net income of 18 USD per hectare.

The effect of seed rates was not conclusive as the effect differed between farms. However, overall a seed rate of 16 kg ha^{-1} showed good results. Higher seed rates seem to increase the number of days to maturity and the risk of depressed grain yields in favor of higher biomass yields.

3.2.2.2 Introducing mungbean (Vigna radiata (L.) Wilczek) as a summer crop after winter wheat in Kyrgyzstan

In Northern Kyrgyzstan mungbeans have occasionally been used for sheep forage, but they are not common. A pilot experiment was conducted at the central experimental farm of the Kyrgyz Research Institute of Livestock and Pasture near Bishkek city to test the feasibility of introducing mungbean into the cropping systems. Mungbean seeds were taken from Southern Kyrgyzstan and planted at two seed rates, namely 16 and 20 kg ha-1

Results

If planted in mid June, mungbeans are usually ready to be harvested in early to mid-September in Southern Kyrgyzstan. Our experiment showed that in the conditions of Northern Kyrgyzstan the crop will be ready to be harvested one month later in early October.

The 2008 and 2009 growing conditions for mungbean in North Kyrgyzstan were, in general, favorable with near (2008) and above average (2009) rainfall, cool temperatures, and low disease pressure, resulting in good grain yield.

Days to maturity (DTM) were mainly affected by the year; in 2009 it took 11.8 and 9.8 days longer to reach maturity at seed rates of 16 kg ha^{-1} and for 20 kg ha^{-1}, respectively. Increasing the seed rate and thereby plant density was positively related to yield and plant height and negatively related to flowering, number of primary branches per plant and thousand-grain weight. Grain yield was significantly affected by seed rate and year. The maximum grain yield of 1.72 t ha^{-1} was recorded in 2008 at a seed rate of 20 kg ha^{-1} while the minimum grain yield (1.22 t ha^{-1}) was recorded in 2009 at a seed rate of 16 kg ha^{-1}. Mungbeans planted in 2009 produced significantly higher forage yields due to good growing and weather conditions. The maximum forage yield of 2.67 t ha^{-1} was achieved at a seed rate of 20 kg ha^{-1} in 2009 while the minimum forage yield (2.25 t ha^{-1}) was recorded in the plots with a 16 kg ha^{-1} seed rate in 2008.

Conclusions

A seed rate of 20 kg ha^{-1} showed good results in the conditions of Chuy province. Overall, mungbeans seem to be a promising crop to diversify the cropping system in Northern Kyrgyzstan. It can improve soil fertility and decrease farmer's economic risk from climatic variability or commodity crop prices. Additional research is needed in this area.

3.2.2.3 Introducing pearl millet varieties to replace maize as summer crop after winter wheat in Kyrgyzstan

Research methods

Three dual-propose varieties of pearl millet originating from ICRISAT were tested against local maize variety as control (farmers' practice). The evaluation of these accessions was conducted on irrigated fields in two consecutive years (2008 and 2009) at the Research Institute of Veterinary, Livestock and Pastures, one household in Kyrgyzstan and two households in Northern Tajikistan. Pearl millet accessions were sown in early July at a rate of 15 kg ha^{-1} while maize seed was sown at 40 kg ha^{-1}. The preceding crop in both years was winter wheat.

Results

The mean vegetation period was 107 days; it was for all crops shorter in 2009 than in 2008. The shortest number of days to maturity was recorded (87 days) for the early maturing pearl millet variety ICMV 221 in Northern Tajikistan in 2009, while the longest vegetation period was recorded (125 days) for maize in Kyrgyzstan in 2008.

The two pearl millet varieties HHVBC and ICMV 221 outperformed maize in green fodder yield with the exception of farm 2 in Kyrgyzstan, where ICMV 221 showed lower yields than maize (Figure 17). The green fodder yield of maize crop, which was used as control treatment, ranged from 15.6 to 28.8 t ha^{-1}.

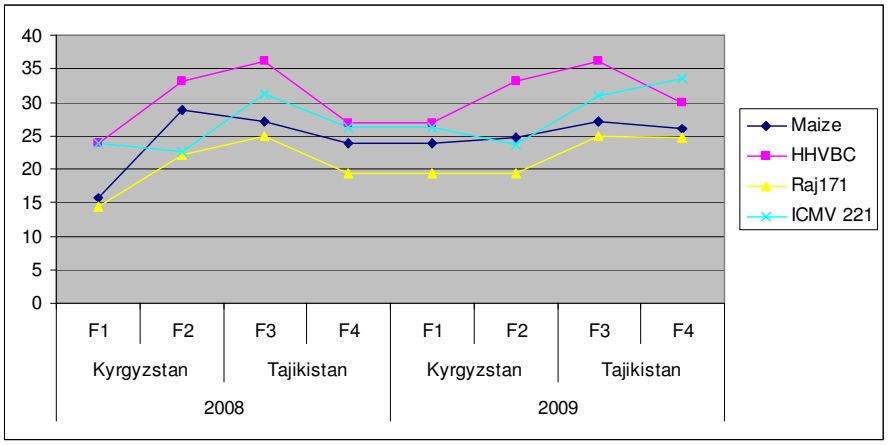


Figure 17. Green fodder yields (tonnes per hectare) in maize and pearl millet dual-propose varieties

The cost benefit analysis of the experiment shows that two of the three dual-propose pearl millet varieties (HHVBC, ICMV 22) were more profitable than maize in both countries (Table 16).

Table 16. Cost benefit analysis of the experiments in Kyrgyzstan and Northern Tajikistan

Cost items	**Crops**			
	Maize	**HHVBC**	**Raj 171**	**ICMV 221**
Kyrgyzstan				
Feed unit yield, t ha^{-1}	3.5	4.8	3.1	4.0
Feed unit, som* t^{-1}	3450	3050	3050	3050
Total benefits, KRG som ha^{-1}	12075	14640	9455	12200
Total costs, KRG Som ha^{-1}	6224	5904	5904	5904
Net benefits, KRG Som ha^{-1}	5851	8736	3551	6296
Profitability rate, %	94.0	148.0	60.1	106.6

Cost items	Crops			
	Maize	HHVBC	Raj 171	ICMV 221
Northern Tajikistan				
Feed unit yield, t ha^{-1}	4.6	6.5	5.2	6.4
Feed unit, TJ somoni** t^{-1}	369	342	342	342
Total income, TJ somoni ha^{-1}	1713	2253	1808	2209
Total costs TJ somoni ha^{-1}	940	892	892	892
Net benefit	773	1361	916	1317
Profitability rate, %[2]	82.2	152.6	102.7	147.6

*1 USD = 46 Kyrgyz som; **1 USD=4.45 Tajik somoni

Conclusions

As the pearl millet varieties showed excellent growth and tillering capacities but were rather late maturing, they are suitable for green forage production when used as summer crop after winter wheat. To harvest the grains, pearl millets have to be cultivated as main crop in spring. It is known from other studies that pearl millet shows excellent re-growth after the first cut, therefore multiple cutting should be tested in the future.

Two pearl millet dual propose varieties had a higher profitability rate than control variant maize crop. The results have to be considered as preliminary. More detailed studies of the nutritional value and other factors likely to influence farmers' choices and preferences are required.

Forage production from summer crops after winter wheat - pearl millet or maize - was profitable in both countries despite recent increases in fuel and fertilizer price.

3.2.2.4 Comparing pearl millet, sorghum and maize as summer crops after winter wheat in Northern Tajikistan

Research methods

Pearl millet, sorghum and maize were evaluated on a farmer's field for demonstration purposes over two cropping seasons in 2008-2009. The experiment was planted in early July after the harvest of winter wheat. Nitrogen 250 kg ha-1, ammophos 200 kg ha-1, and potassium 120 kg ha-1, were applied before planting.

Results

Green forage yield across two years of the experiment were significantly different between maize, pearl millet and sorghum crops. While the green forage yield of sorghum was almost similar in the two years of the experiment, maize yields differed greatly: in 2008 maize achieved the highest green fodder (43.9 t ha^{-1}) and in 2009 the lowest (7.4 t ha^{-1}) of all crops (Figure 18). In contrast pearl millet showed higher yields in 2009 than in 2008 (32.5 and 22.2 t ha^{-1} in 2009 and 2008, respectively).

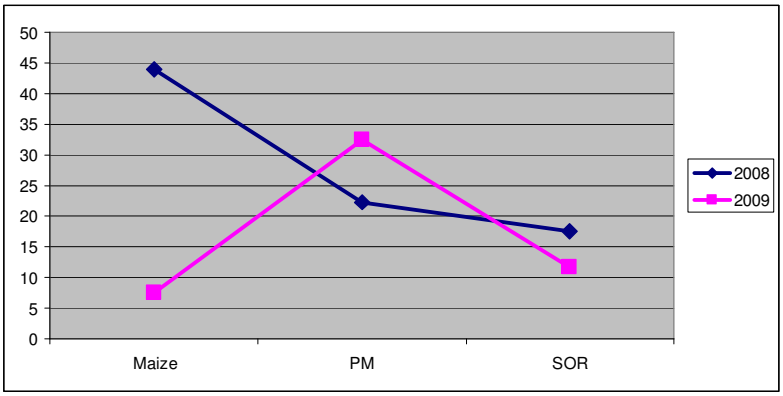


Figure 18. Green fodder yield of studied crops in Northern Tajikistan

[2] **Profitability rate was calculated as PR=net benefit/cost*100.**

The cost benefit analysis (Table 17) based on mean yields for the two years showed good internal rate of returns for pearl millet (310%) and maize (275%) and a comparatively lower value for sorghum (127%).

Table 17. Cost benefit analysis of summer fodder crops in Northern Tajikistan

Cost items	Maize	Sorghum	Pearl Millet
Dry matter yield, t ha^{-1}	9.8	5.8	10.5
Crop price, TJ somoni* t^{-1}	1000	1000	1000
Total benefits, TJ somoni	9800	5800	10500
Total costs, TJ somoni	2613	2559	2559
Total net benefits	7187	3241	7941
Profitability Rate, %	275%	127%	310%

*1 USD=4.45 Tajik somoni

Conclusions

The results confirmed the findings from the experiment testing different pearl millet varieties in Kyrgyzstan (see 3.2.2.3) that pearl millet is indeed a promising summer crop after winter wheat. It provided more stable fodder yields than maize which under favorable weather conditions produced much higher yields but under adverse conditions yields dropped to a very low value.

The introduction of pearl millet in the wheat-based cropping system could help to resolve to some extent the wheat nematode problem. This beneficial aspect of summer forage crops should be further investigated in the Central Asian region.

3.2.3 Improving agronomic practices in forage production

3.2.3.1 Testing seeding rates and planting dates for hybrid maize (Zea mays L. *ssp.) in Kazakhstan*

Research methods

Maize hybrid seeds from Uzbekistan were planted under irrigated conditions on two household fields in 2008 and 2009. In the first experiment four planting dates – 15 April, 30 April, 15 May and 30 May – were tested. In the second two seed rates 25 and 35 kg ha^{-1} were evaluated.

Results

The 2008 and 2009 rainfall in South Kazakhstan was, in general, favorable with near (2008) and above average (2009) rainfall.

In the first experiment the plants grew higher in 2009, but excessive precipitation in May and June 2009 reduced grain and biomass yields due to disease pressure, particularly corn smut. No difference in germination rates was found between the four planting dates. The best sowing date with regard to biomass and grain yields across years was 30 April but with little difference to 15 May; in two cases even a small advantage of 15 May over 30 April was observed (Table 18).

Table 18. Biomass and grain yield of maize (2008-2009)

Farms	Treatment	Biomass yield, t/ha			Grain Yield, t/ha		
		2008	2009	Mean	2008	2009	Mean
Farm 1	15-April	11.8	8.3	10.0	4.4	3.9	4.2
	30-April	15.6	11.5	13.5	7.4	4.9	6.2
	15-May	14.5	12.4	13.5	6.0	5.0	5.5
	30-May	12.9	7.4	10.2	5.7	4.8	5.2
Farm 2	15-April	9.5	7.3	8.4	4.7	3.6	4.1
	30-April	12.5	10.3	11.4	6.8	4.6	5.7
	15-May	12.8	9.4	11.1	5.1	4.7	4.9
	30-May	11.8	6.4	9.1	4.1	3.3	3.7
ANOVA	Farm		<.001			<.001	
	Year		<.001			<.001	
	T		<.001			<.001	

In the second experiment germination rates were significantly higer with the lower seed rate of 25 kg ha^{-1} (78.9 %) compared to 35 kg ha^{-1} (74.6%) but the biomass yields were significantly higher with a seed rate of 35 kg ha^{-1} (Table 19) . The results for grain yields were less conclusive, only on farm 1 a significantly higher rain yield was achieved with the higher seed rate while on farm 2 there was no difference across the two years.

Table 19. Effect of corn seed rate on biomass and grain yields

Farms	Treatments	Biomass yield, t ha^{-1}			Grain yield, t ha^{-1}		
		2008	2009	Average	2008	2009	Average
Farm 1	25	11.2	12.1	11.6	4.3	4.0	4.2
	35	14.1	13.2	13.6	5.0	4.8	4.9
Farm 2	25	11.9	12.2	12.1	4.9	3.6	4.2
	35	13.4	13.1	13.2	4.1	4.3	4.2
l.s.d.	T		0.4			0.2	
	Y/T		0.6			0.3	
	Y/F/T		0.9			0.4	

The cost benefit analysis showed an 11% higher profitability rate of the higher seed rate (Table 20). This analysis has to be treated with caution because the maize grain yields were only higher in farm 1. However, considering also the significantly higher biomass achieved, a seed rate of 35 kg ha^{-1} for maize seems to favorable under the conditions in South Kazakhstan.

Table 20. Cost-benefit analysis of two seed rates in maize

Cost items	Maize seed rate, kg ha^{-1}	
	25	35
Yield, t ha^{-1}	4.2	4.6
Crop price, KZ tenge* t^{-1}	50,000	50,000
Total benefits, KZ Tenge	210,000	230,000
Total costs, KZ Tenge	120,653	123,853
Net benefit, KZ Tenge	89,347	106,147
Profitability rate, %	74.1	85.7

*1 USD=150 Kazakh tenge

Conclusions

Only preliminary conclusions can be drawn from this experiment. However, a planting date of 30 April to 15 May seems to be reasonably safe to achieve good maize yields. Considering maize biomass and grain yield a seed rate of 35 kg ha^{-1} can be recommended. The profitability of maize

cultivation in spring was relatively low due to the recent increases in fuel and fertilizer prices in Kazakhstan.

3.2.3.2 Testing planting dates for hybrid maize in Tajikistan

Research methods

A similar experiment for testing optimum planting date in hybrid maize as described was conducted on four irrigated farmer fields in 2008 and 2009. Two households (farmer 1 and 3) in Karajingil village and two (farmer 2 and 4) in Uyas participated.

Results

In 2009 the climatic conditions in Northern Tajikistan were more favorable than in 2008 year where severe warm winds at flowering stage decreased the grain yields.

Plant height and biomass yield increased with later planting dates (15 May and 30 May). The maximum biomass yield (48.3 t ha-1) was obtained by farmer 2 in 2009 and the minimum yield (9.9 t ha-1) was obtained by farmer 1 in 2008 (Figure 19).

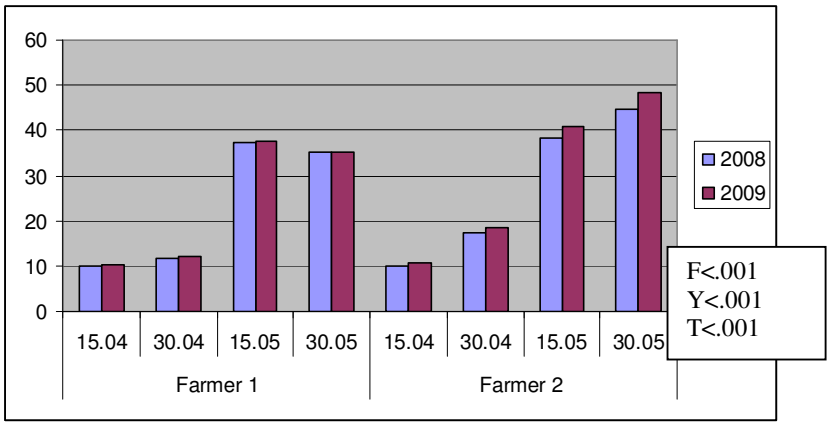


Figure 19. Biomass yield of maize crop as affected planting date

Maize planted on 15 and 30 May also outyielded maize planted on 15 and 30 April in both years in grain yields (Figure 20) .

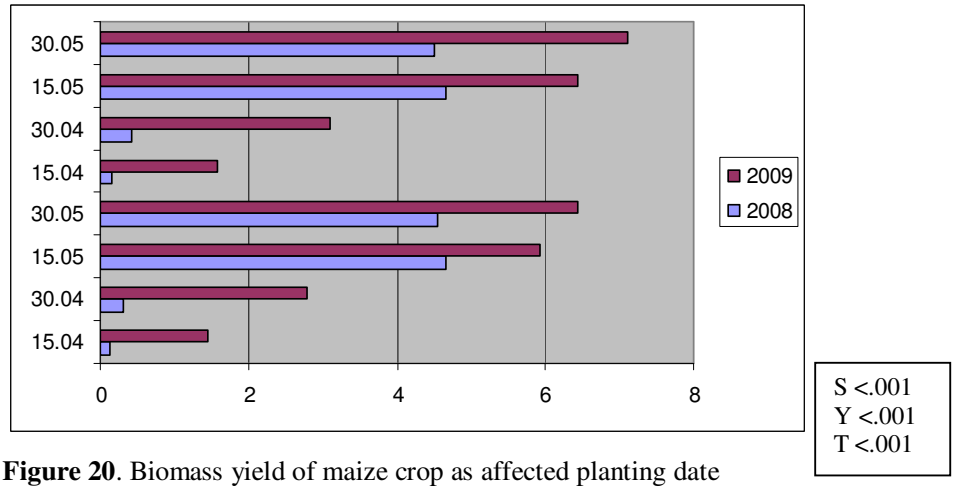


Figure 20. Biomass yield of maize crop as affected planting date

Conclusion

In Tajikistan early planting in April proved to be more risky than planting in May as under unfavorable conditions biomass and grain yields can be significantly reduced.

3.2.3.3 Fertilizer application to alfalfa (Medicago sativa) in the first growing year in Central Tajikistan and South Kazakhstan

Research methods

In Central Tajikistan and South Kazakhstan, alfalafa is an important forage crop on irrigated fields. It is common practice to not apply fertilizer in the first year of plantation, which results in relatively yields. Thus, we tested for both coutries whether it would be economically interesting to apply fertilizer.

In **Central Tajikistan** four fertilizer applications were tested on six farms: 1) no fertilizer=control, 2) 40 kg ammophous ha^{-1}, 3) 60 kg ammophous ha-1, and 4) 80 kg ammophous ha^{-1}. The first cut was done on 27 April at a plant height between 75 and 80 cm at the beginning of flowering. During the vegetation period (spring-summer-autumn) alfalfa was cut 5 times.

In **Southern Kazakhstan** three fertilizer treatments were tested on four farms: 1) no fertilizer=control, 2) 40 kg ammophous ha^{-1}, and 3) 60 kg ammophous ha^{-1}. Alfalfa was cut four times during the vegetation period.

Results

In Central Tajikistan plant heights increased with increasing fertilizer application rates except for a rate of 80 kg ammophos ha^{-1}, for which plant heights started to decrease. Green forage yields of alfalfa ranged from 13.9 t ha^{-1} to 30.9 t ha^{-1} (Table 21). The yields for 40 and 60 kg ammophos ha^{-1} were significantly higher than for the non-fertilized control in both years except on farm 6 but there was nearly no difference between the application rates of 40 and 60 kg ammophos ha^{-1}. 80 kg ammophos ha^{-1} did not lead to increased yields. Dry matter forage yields showed the same trends (Annextable 4).

Table 21. Green forage yield of Alfalfa as influenced by different ammophous application rates and farms

Farms	Treat-ment	Green forage yield, t ha^{-1}			Farms	Treat-ment	Green forage yield, t ha^{-1}		
		2008	2009	Mean			2008	2009	Mean
F1	AC	16.4	14.4	15.4	F4	AC	19.7	13.9	16.8
	A40	24.4	19.6	22.0		A40	22.6	16.3	19.4
	A60	26.0	18.4	22.2		A60	22.3	15.5	18.9
	A80	17.8	17.8	17.8		A80	14.5	14.5	14.4
F2	AC	24.0	16.8	20.4	F5	AC	11.4	15.4	13.4
	A40	31.0	18.7	24.9		A40	16.3	15.0	15.6
	A60	28.6	16.7	22.6		A60	14.7	17.7	16.2
	A80	15.5	15.5	15.5		A80	17.2	17.2	17.2
F3	AC	19.7	16.4	18.0	F6	AC	14.9	17.2	16.1
	A40	21.3	20.0	20.7		A40	14.7	17.9	16.3
	A60	22.0	18.9	20.4		A60	15.2	17.1	16.1
	A80	18.3	18.3	18.3		A80	15.1	15.1	15.1
T	<.001				T	<.001			
T.F	<.001				T.F	<.001			
T.F.Y	<.001				T.F.Y	<.001			

Applying 40 kg ammophos ha^{-1} nearly doubled the total costs of alfalfa production and decreased the profitability rate (Table 22). However, the net benefits increased by 540 TJ somoni (121 USD) ha^{-1}. A further increase of the fertilizer rate did not increase net benefits.

Table 22. Cost-benefit analysis for three ammophos fertilizer rates as compared to the control

Cost items (TJ somoni ha^{-1})	Control	40 kg ha^{-1}	60 kg ha^{-1}	80 kg ha^{-1}
Benefits	**3900**	**5400**	**5600**	**4500**
Fertilizer	0	960	1440	1920
Seed price	320	320	320	320
Labor	80	80	80	80
Machinery fuel, oil, repair	50	50	50	50
Lubrication	5	5	5	5
Transportation	100	100	100	100
Miscellaneous (Irrigation)	250	250	250	250
Depreciation costs (8%)	114	114	114	114
Land rent	130	130	130	130
Total costs	**1049**	**2009**	**2489**	**2969**
Net benefits	**2851**	**3391**	**3241**	**1661**
Profitability rate (%)	271.8	168.8	130.2	55.9

In **Kazakhstan** the height of Alfalfa plants increased with higher ammophos fertilization rates as in Central Tajikistan. Green fodder yields increased with higher ammophos application rates, from 26.3 t ha^{-1} in the control, to 27.4 and 29.2 t ha^{-1} with application rates of 40 and 60 kg ha^{-1}, respectively. The difference between treatments was less pronounced in farms 3 and 4 than in other two farms. The dry fodder yields followed the same patterns (Table 23).

Table 23. Green and dry fodder yields of Alfalfa as affected by different ammophos application rates and farms

Farms	Treatments	Green fodder yield, t ha^{-1}			Dry fodder yield, t ha^{-1}		
		2008	**2009**	**Mean**	**2008**	**2009**	**Mean**
F1	AC	25.8	27.2	26.5	7.4	7.3	7.3
	A40	29.6	26.8	28.2	8.5	8.2	8.3
	A60	32.4	31.4	31.9	9.1	9.0	9.0
F2	AC	26.6	25.1	25.8	7.3	6.3	6.8
	A40	28.7	27.2	28.0	8.2	6.7	7.5
	A60	31.4	28.0	29.7	9.0	7.0	8.0
F3	AC	25.9	23.5	24.7	6.5	5.6	6.0
	A40	27.1	24.1	25.6	6.6	5.8	6.2
	A60	28.0	25.1	26.5	7.0	6.2	6.6
F4	AC	29.5	26.7	28.1	6.4	6.9	6.6
	A40	28.8	27.2	28.0	6.8	7.3	7.0
	A60	29.6	28.0	28.8	7.0	7.5	7.2
	T	<.001			<.001		
	T.F	<.001			<.001		
	T.F.Y	0.005			<.001		

Even though the fuel, oil and fertilizer prices are higher in Kazakhstan than in the neighboring countries Tajikistan and Kyrgyzstan, the results of the economic analysis from the first harvest year showed that with both fertilizer rates net benefits increased compared to the control where no fertilizer was applied (Table 24). However the profitability rate decreased considerably with the application of 40 and 60 kg ha^{-1} fertilizer..

Table 24. Cost-benefit analysis for two ammophos fertilizer rates as compared to the control

Cost items, KZ tenge ha^{-1}	Fertilizer rates, kg ha^{-1}		
	0	**40**	**60**
Total income	**248200**	**278800**	**302600**
Fertilizer	0	22000	36000
Labor	14324	14324	14324
Machinery fuel, oil, repair	1000	1500	1500
Lubrication	500	500	500
Transportation	6000	6000	6000
Miscellaneous (Irrigation)	10000	10000	10000
Depreciation costs (8%)	11923	11923	11923
Total costs	**45747**	**68247**	**82247**
Net benefits	**202453**	**210553**	**220353**
Profitability rate (%)	442.5	308.5	267.9

Conclusions

In both countries net benefits increased with moderate applications (40 and 60 kg ha^{-1}) of ammophos fertilizer. Although the profitability rate was higher in the control, an ammophos application of 40 kg ha^{-1} can be recommended to increase forage biomass in the first growing year.

3.2.4 Assessing rangeland productivity

3.2.4.1 Effect of protection from grazing (cages) and fertilizer application on rangeland productivity in Northern Tajikistan

Research methods

This study was conducted near Takli village in Sogd Province in Northern Tajikistan. The experiment was conducted in an overgrazed open rangeland with a vegetation composed of mainly *Artemisia, Ziziphora* and *Ceratocephalus falcatus* plants. Protection from grazing (with cages) and protection plus an application of 50 kg ha^{-1} nitrogen fertilizer in March were compared to open rangeland as control. During the month of May 2009 plants were cut at 5 cm above ground when they had reached 26-28 cm.

Results

Nitrogen fertilization and protection from grazing increased the fresh and dry biomass production significantly. Fresh biomass yield was 165 g m^{-2} in the open rangeland, increased to 274 g m^{-2} in the protected plots and further to 460 g m^{-2} in the fertilized and protected plots. Dry biomass yield were also significantly increased by protection from grazing and protection plus nitrogen fertilizer application (Figure 21).

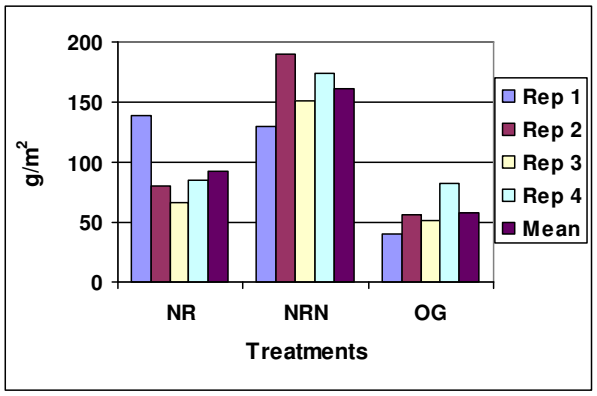


Figure 21. The effect of protection from grazing (NR), protection and nitrogen fertilization (NRN) on dry biomass yields compared to open rangelands

Averaged over four replications the total dry matter yield increased by 187% in the fertilized and protected plots compared to the control.
Table 25 shows the net benefits generated in the three treatments.

Table 25. Economics of nitogene application on rangelands in Northern Tajikistan

Costs and benefits per ha	Control	Protection from grazing	50 kg N ha^{-1}
Yield, t	1.6	2.7	4.6
Fodder price, TJ somoni* t^{-1}	90	90	90
Benefits, TJ somoni	**144**	**243**	**414**
Fertilizer cost, TJ somoni	0	0	350
Labor, TJ somoni	20	20	20
Lubrication, TJ somoni	0	0	10
Transportation, TJ somoni	2	2	2
Miscellaneous, TJ somoni	20	20	20
Total costs TJ somoni	**42**	**42**	**402**
Net benefits	**102**	**201**	**12**
Profitability, %	242.9	478.6	3.0

*1 USD = 4.45 Tajik somoni

Conclusions
As expected protection from grazing increased dry biomass yield considerably ; an additional application of nitrogen more than doubles the yield. The economic analysis shows that protection doubles the net benefits while nitrogen fertilization is economically not interesting as no netincome is generated. However, the results greatly depend on rainfall.

3.2.4.2 Influence of geo-morphological landscape patterns on vegetation characteristics in Central Tajikistan and Kyrgyzstan

Research methods
The study was conducted at two sites in Central Tajikistan (Oqjar and Karsang) and Kyrgyzstan (Jelariq 1 and 2) Treatments included location (site), season (winter and summer pastures), and aspect (north versus south). The vegetation sampling took place in summer and fall of 2009. Vegetation characteristics were assessed using the line intercept method for plant cover and species composition and quadrat sampling for biomass production.

Results
Site, season and aspect had significant impact on the species composition, cover, and biomass production ($P<0.001$). For instance in Tajikistan at Oqjar site *Malcolmia turkestanica* was the dominant species on the north facing slopes while *Astragalus rytlobus* dominated on the south facing slopes. In Kyrgyzstan *Carex turkestanica* and *Artemisia Tianschanica Krasch. Ex Poljak* were dominant species on the north facing slopes while *Festuca Sulcata* and *Carex turkestanica* were dominant species on the south aspect. The number of green plants on the northern slopes was nearly 2 times higher than the number of green plants on the south slopes.
The percentage bare ground was also greatly affected by aspect (Figure 22). For example percentage bare ground at Karsang site in Tajikistan on the northern aspect (42%) was higher than at the southern aspect (7%). Similar differences were observed at the other sites across the countries.

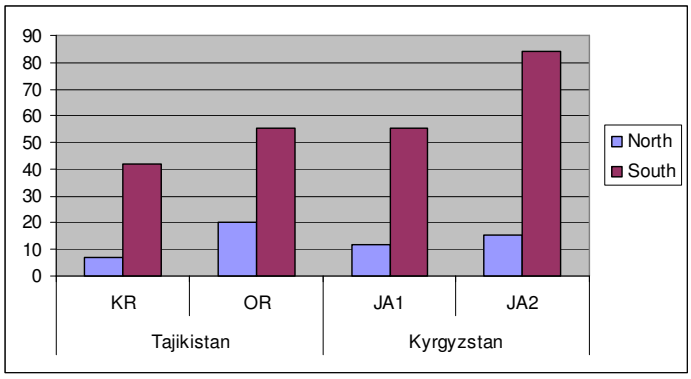


Figure 22. Bare ground based on LIT (point sampling) for North and South facing slopes

North and South facing slopes also differd significantly in biomass production. Among the north facing slopes the highest biomass production was recorded (179 g m^{-2}) at Karsang site in Tajikistan and the lowest biomass yield was recorded (28.1 g m^{-2}) at Oqjar site also in Tajikistan (Figure 23).

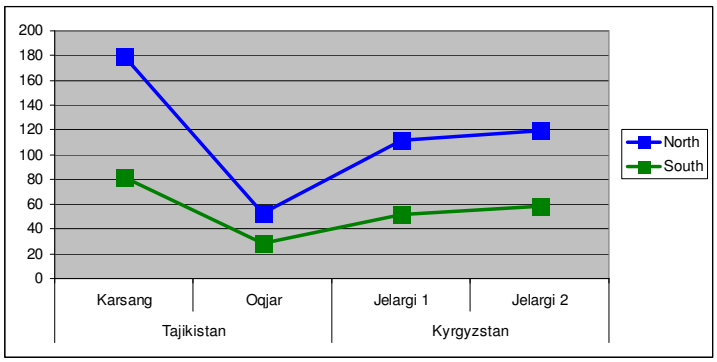


Figure 23. Biomass Production (DM g m^{-2}) based on quadratic sampling

Conclusions

The study showed that aspect has a profound effect on species composition, the number of plants and rocks, on litter and bare ground and on dry matter biomass production. On the basis of these findings it can be concluded that the aspect is an important factor in determining rangeland productivity in Central Asia. The findings also emphasizes the strong relationship between vegetation coverage and surface temperature (potential direct incident radiation). Thus, this parameter needs to be taken into account when considering options for rehabilitation and restoration measures of degraded rangelands.

3.2.5 Rehabilitating rangelands

3.2.5.1 Effect of oversowing with Kochia on rangeland productivity in Kazakhstan

Research methods

A degraded rangeland site near the settlements was oversown with seeds of Kochia, an indigenous well adapted shrub species in early December 2008. A mild winter and favorable rainfall in spring promoted good growth conditions and rangeland species emerged that had not been observed for the last 19-20 years.

Results

At the end of May 2009 the number of plants per square meter was with 217 and 226 not significantly different among grazed and non grazed plots, respectively (Table 26). In the treatments with different seed rates of Kochia the number of plants differed significantly. The highest number of plants was recorded at a seed rate of 4 kg ha^{-1} while the lowest was recorded at a seed rate of 3 kg ha^{-1}. Biomass production was only determined for grazed and ungrazed plots as the Kochia aplnts were still too

small. Fresh and dry matter biomass production was significantly higher in the ungrazed than grazed natural rangeland.

Table 26. Number of plants per m^2, green biomass and dry matter production as affected by different Kochia seed rates and grazing management

Treatment	Number of plants m^{-2}	Biomass production, g m^{-2}	Dry matter, g m^{-2}
Grazed Natural Rangeland	217	283	104
Natural Rangeland protected from grazing	226	373	141
Kochia 3 kg ha^{-1}	12	0	0
Kochia 4 kg ha^{-1}	44	0	0
Kochia 5 kg ha^{-1}	33	0	0

3.2.5.2 Effect of oversowing with saltwort, persian clover and their mixture on rangeland productivity in Northern Tajikistan

Research methods

This study was conducted near Takli village in Sogd Province at the same site as the nitrogen fertilizer treatment. The natural rangeland plot was oversown the first time in March 2008 and a second time in early December 2008 with Saltwort (*Batis maritime*) and Persian clover (*Trifolium resupinatum*) and their mixture using a strip planting method. The plots remained ungrazed during the study period.

Results

Poor rainfall during spring 2008 (total precipitation amounted to only 23 mm) led to a low number of seedlings (Table 27) and very poor plant growth and eventual death of the seedlings. Number of seedlings and dry matter yield varied significantly between treatments and years. Under good rainfall conditions oversowing led to significantly higher dry matter yields than the yield from the untreated rangeland plots with little differences between the plots oversown with Saltwort, Persian clover and the mixture.

Table 27. Number of seedlings and dry matter yields on natural rangeland as affected by oversowing with different rangeland species

Year	Seedlings, number m^{-2}			DM, t ha^{-1}		
	2008	2009	Mean	2008	2009	Mean
Natural rangeland (control)	57	279	169	0.11	1.22	0.67
Saltwort	72	285	179	0.24	1.65	0.95
Persian Clover	11	273	142	0.16	1.58	0.87
Saltwort+Persian Clover	75	257	166	0.21	1.69	0.95
Year		<.001			<.001	
Treatment		0.006			<.001	
Year x Treatment		0.004			<.001	

Conclusions from oversowing experiments in Kazakhstan and northern Tajikistan

Due to the unusual weather conditions in 2008 in Kazakhstan and in Northern Tajikistan no final conclusions can be drawn from the oversowing experiments in the two countries. Under favourable rainfall conditions the establishment of indigenous rangeland species by oversowing seems to be relatively easy. However, a much longer observation period under controlled grazing conditions is required to evaluate the benefits from the tested treatments.

3.2.6 Increasing the productivity of hayfields

*3.2.6.1 Effect of oversowing with sainfoin (***Onobrychis viciifolia***) and nitrogen fertilization on hayfield productivity in Kyrgyzstan*

Research methods

Hayfield experiments were conducted on the medium scale farm Alimseyit in Kemin district in Northern Tajikistan for two years (2008-2009). In separate experiments two tillage methods for reseeding of sainfoin, namely plowing and minimal tillage (disking), two seed rates of sainfoin (50 and 70 kg ha^{-1}) and three application rates of ammonium nitrate (30, 40 and 50 kg ha^{-1}) were tested in comparison to untreated (control) plots.

Results

1. Testing land preparation methods for reseeding

Plant height, density and biomass production were significantly affected by tillage methods and years. Year 2009 in contrast to 2008 was characterized by favorable weather conditions and therefore resulted in higher values for all three traits. In both treatments plant height and density were higher in both years than in the natural hayfield (Table 28). Tillage and oversowing with sainfoin also significantly increased dry matter biomass production in both years. Full tillage (ploughing) resulted in higher dry matter productivity compared to minimum tillage; the difference between the methods was more pronounced under the favorable conditions of 2009.

Table 28. Effect of tillage methods for reseeding with sainfoin on plant height and density and dry matter productivity of natural hayfields

Tillage methods	**Plant density (no m^{-2})**		**Plant height (cm)**		**Dry matter biomass (t ha^{-1})**	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**
Control (Natural hayfield)	19.5	63.5	9.5	64.5	0.42	1.28
Minimum tillage (Disking)	81.0	123.2	28.2	80.7	0.70	2.37
Tillage	93.8	154.2	26.0	84.3	0.78	3.39
Year	<.001		<.001		<.001	
Treatment	<.001		<.001		<.001	

Net benefits from both treatments are higher than from the natural hayfield but profitability is only higher in the case of full tillage while minimum tillage shows a lower profitability than the natural hayfield (Table 29).

Table 29. Variable and fixed cost estimates per hectare in Kyrgyz som

Cost items in KRG som*	**Control**	**Disking**	**Tillage**
Total benefits	**3840**	**7110**	**10170**
Fertilizer	1400	1400	1400
Seed costs	0	2506	2506
Other costs	1200	1320	1440
Total costs	**2600**	**5226**	**5346**
Net benefits	**1220**	**1884**	**4824**
Profitability (%)	46.9	36.1	90.2

1 USD= 46 KRG som in August 2009

2. Testing different seed rates of sainfoin

Plant density was higher in hayfields oversown with sainfoin than in the natural hayfields while plant height was lower in 2008 and higher in 2009 (Table 30). Dry matter biomass was in general low in 2008 and overseeding showed no advantage over the natural hayfield. In contrast to 2008 overseeding with sainfoin nearly doubled the biomass yields in 2009; the seed rate of 70 kg ha^{-1} sainfoin yielded a slightly higher biomass than the seed rate of 50 kg ha^{-1}.

Table 30. Effect of oversowing on plant height and density and yield productivity of natural hayfields under different seeding rate

Treatments	Plant density (no m^{-2})		Plant height (cm)		Dry matter biomass (t ha^{-1})	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**
Control (natural hayfield)	19.0	56.5	24.5	74.5	0.42	1.34
50 kg ha^{-1} sainfoin seeds	71.3	95.1	12.8	86.1	0.35	2.29
70 kg ha^{-1} sainfoin seeds	89.5	115.3	14.2	109	0.40	2.44
Year	<.001		<.001		<.001	
Treatment	<.001		<.001		<.001	

3. Testing nitrogen application rates

Plant density and plant cover were significantly increased by all three ammonium nitrate application rates in both years; however increasing nitrogen fertilizer rates to more than 30 kg ha^{-1} did not lead to further increases in these traits instead even decreased values were observed (Table 31). In 2008 dry matter biomass was highest with 30 kg ha^{-1}; while 40 ha^{-1} resulted in nearly the same yield and 50 kg ha^{-1} led to a yield at the level of the natural hayfield. In 2009 the biomass production increased with higher annominum nitrate fertilization rates.

Table 31. Effect of ammonium nitrate application rate on plant height, cover and biomass production

Treatments	Plant height (cm)		Plant cover (%)		Dry matter biomass (t ha^{-1})	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**
Control	15.5	49.1	32.5	50.0	0.37	1.36
Nitrogen 30 kg ha^{-1}	25.8	81.5	45.3	69.5	0.54	1.81
Nitrogen 40 kg ha^{-1}	24.3	96.3	39.0	64.5	0.51	2.32
Nitrogen 50 kg ha^{-1}	25.8	98.3	41.0	65.0	0.36	2.63
Year	<.001		<.001		<.001	
Treatment	<.001		<.001		<.001	

An ammonium nitrate application rate of 40 kg ha^{-1} increased the net benefits considerably and was more profitable than a lower and a higher fertilization rate (Table 32).

Table 32. Cost and benefits for three ammonium nitrate application rates in hayfields

Cost items, KRG som* ha^{-1}	Control	30 kg ha^{-1}	40 kg ha^{-1}	50 kg ha^{-1}
Total Benefits	**4080**	**5430**	**6960**	**7890**
Fertilizer	0	1428	1904	2380
Other costs	1290	1360	1510	1580
Total costs	**1290**	**2788**	**3414**	**3960**
Net benefits	**2790**	**2642**	**3546**	**3930**
Profitability (%)	216.3	94.8	103.9	100.8

*1 USD= 46 KRG som in August 2009

Conclusions

In a dry year like 2008 the treatments tested in Kyrgyzstan failed to increase biomass production from hayfields. In 2009 – a year with favorable rainfall –oversowing with sainfoin after full tillage led to a considerable increase in biomass production and was more advantageous than preparing the land with minimum tillage. Oversowing with a moderate seed rate of sainfoin without prior land preparation or nitrogen fertilization of the natural hayfield led to nearly the same net benefits requiring less inputs. Given the climatic uncertainty oversowing with a moderate seed rate of sainfoin or a low level of nitrogen fertilization can be recommended to increase biomass production.

3.2.6.2 Effect of oversowing with sainfoin at different seed rates and nitrogen-phosphorous fertilization on productivity of hayfields in Central Tajikistan

Research methods

Two experiments were conducted in the hayfields of two households in Central Tajikistan. Oversowing of natural hayfields with two seed rates (60 kg and 80 kg ha^{-1}) of sainfoin was tested and compared to a natural hayfield as control. In the second experiment different fertilizer rates were compared to an unfertilized natural hay field: 45 kg ha^{-1} nitrogen as ammonium nitrate (N45), 45 kg ha^{-1} N as urea (N45U) and 45 kg ha^{-1} N plus 30 kg ha^{-1} phosporous (N45 P30).

Dr. A. Madaminov in front of a hayfield oversown with sainfoin in May 2008

Results

1. Testing seed rates of sainfoin

Plant heights on the hayfields increased with a higher sainfoin seed rates on both farms and in both years. Plant heights and biomass production were consistantly higher in 2009 than in 2008 and on oversown hayfields than on natural hayfields across both years and farms (Figure 24). The highest mean biomass yield (3.94 t ha^{-1}) across the two years was achieved with a sainfoin seed rate of 80 kg ha^{-1}.

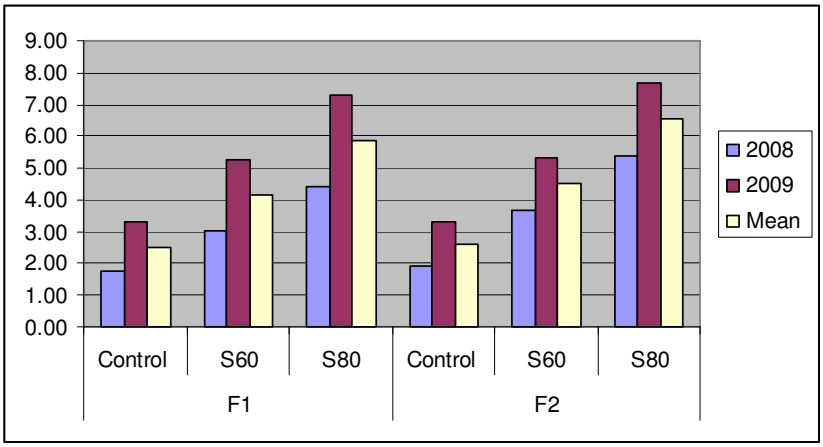


Figure 24. Effect of different seed rates on productivity of hayfield

The highest net benefits (497 TJ somoni ha^{-1}) were obtained with a sainfoin seed rate of 80 kg ha^{-1} followed by seed rate of 60 kg ha^{-1}; the control treatment achieved the lowest net benefits (Table 33). However, profitability was highest for the natural hayfield qnd lowest for a seed arte of 80 kg ha^{-1}.

Table 33. Costs and benefits per hectare of different sainfoin seed rates

Cost items, Tajik somoni* ha^{-1}	Control	60 kg ha^{-1}	80 kg ha^{-1}
Benefits	**450**	**1110**	**1290**
Seed price		480	640
Transportation	40	40	40
Miscellaneous	60	60	60
Labor	50	50	50
Total costs	**150**	**630**	**790**
Net benefits	**298**	**478**	**497**
Profitability, %	198.7	75.9	62.9

*1 USD= 4.45 TJ somoni in August 2009

2. Testing different fertilizer applications

The same significant differences between the year 2008 and 2009 for all traits were observed as described above. Plant height and plant cover on the hayfields increased with nitrogen application and increased further when applying nitrogen and phosphorous; the type of nitrogen fertilizer - as urea or ammonium nitrate - made little difference in plant cover and heights. The combined application of nitrogen and phosphorus also produced the greatest yield response which was significantly different from the other treatments; the highest yield of 7.69 t ha^{-1} was measured in 2009 (Figure 25).

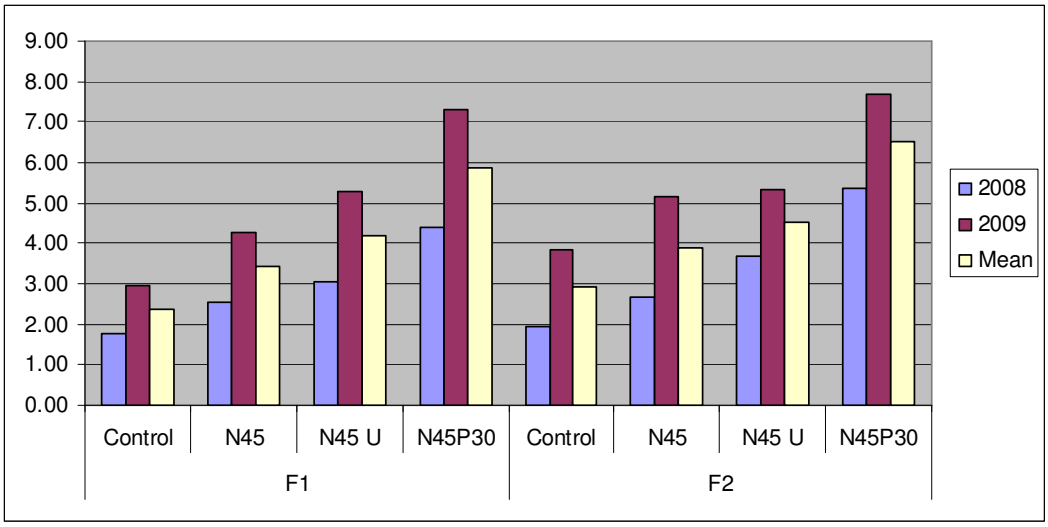


Figure 25. Effect of nitrogen (ammonium nitrate = N45 and urea N45 U) and nitrogen phosphorous fertilization on hayfield biomass yield

Net benefits were highest for combined nitrogen phosphorous fertilization followed by applying urea and ammonium nitrate fertilizer (Table 34). The profitability was highest for natural hayfields and for nitrogen fertilization in the form of urea.

Table 34. Cost benefits (TJ somoni* ha^{-1}) for different fertilizer applications for hayfields in Central Tajikistan

Cost items	Control	N45	N45U	N45 P30
Benefits**	**1450**	**2150**	**2650**	**3650**
Fertilizer (kg ha^{-1})	0	149	100	160
Fertilizer, price TJ Somoni kg^{-1}	0	1.2	2.1	5.6
Fertilizer costs	0	178.8	210	896
Other costs	220	220	220	220
Total costs	**220**	**398**	**430**	**1116**
Net benefit	**1230**	**1751.2**	**2220**	**2534**
Profitability, %	559.0	440.0	516.3	227.1

*1 USD = 4.45 TJ somoni in August 2009; ** hay price = 0.5 TJ somoni kg^{-1}

Conclusions from the hayfield experiments in Central Tajikistan

The results show that the productivity of hayfields in Central Tajikistan can be increased by oversowing with sainfoin and applying fertilizers. However, as the yield response varies considerably between the years depending on the rainfall, moderate input levels should be used: a sainfoin seed rate of 60 kg ha^{-1} and urea fertilizer at a rate of 45 kg ha^{-1}or maybe even lower. Furthermore, the net benefits heavily depend on the market price of hay that can decrease considerably in good rainfall years when hay becomes more abundantly available on the markets.

3.3 Theme 3: Livestock productivity

3.3.1 Improving sheep production in South-West region in Kazakhstan

3.3.1.1 Background

Sheep production is one of the oldest branches of agriculture in Kazakhstan. Sheep are highly valued by local people for their valuable products – mutton, pelts, wool and milk. Households and farms in the South-West region are engaged in keeping fat-tailed and Karakul sheep. However, sheep breeding in Kazakhstan is facing a crisis. In the past sheep production, in particular Karakul sheep, has been focused mainly on production of pelts and wool; nowadays Karakul pelts are no longer fashionable and the cost of shearing is much higher than the selling price of wool. Sheep meat, however, is in high demand but not affordable for the poor rural population. Thus, improving the economics of lamb production could help to provide mutton at lower cost.

3.3.1.2 Early lambing for targeting lamb sale during Navruz (March) involving a genotype comparison in household flocks

Background

The rural credit system is not easily accessible to farmers and individual households; banks offer loans with an interest rate of 16%, but the farmers must prove their creditworthiness. If they have difficulties in doing so, the bank raises the interest rate even higher to 25-30% per annum. Thus, the main source of cash income for smaller households is selling lambs which are ready for sale in the month of August after weaning from their ewes. In the case that farmers and households need urgent cash before this date, they have to sell part of their productive flock (even pregnant ewes) in winter or spring, which leads to a reduction in flock size and lost benefits. Furthermore, there are two public holidays on 22 March (Navruz, New Year) and the May Days from 1-9 May, which are traditionally celebrated in Kazakhstan with slaughtering sheep in order to prepare national dishes like beshbarmak and kaurdak. Richer people prefer to buy young lambs for these occasions; as in the traditional system lambs are mainly born in March, the market price for lambs is high during the Navruz due to the

limited supply of young animals. Thus, early lambing was suggested as an interesting management option in order to allow the farmers to obtain cash income earlier and to take advantage of the seasonal price differences for lambs due to the festivities.
Early lambing compared with the traditional spring lambing was expected to have also other advantages: with early lambing lambs would be 2 to 2.5 months old at the start of grazing and be able to effectively use the highly nutritional grass on spring pastures. By fall early lambed lambs would reach higher liveweights, and should therefore be better prepared for their first winter.
Thus, the main objective was to test impact of early lambing on performance of ewes and lambs and on farm economics

Methods
In the **season 2007-2008** one farm and three households were selected for the experiment in order to represent different resource situations, namely the medium scale farm "Kasymbay", in the household farm "Abdukarim", representing a more specialized and more knowledgable sheep farmer with a larger flock size keeping only fat-tailed sheep, and in the households "Andas" and "Ergesh" resource-poor households with small mixed flocks of Karakul and Kazakh fat-tailed sheep. The ewes in each farm/household were divided into two groups: experimental group, in which ewes were mated in August and control (traditional) group, in which ewes were mated in October 2007 (Table 35). Accordingly the lambing of experimental group occurred in December 2007, and of the control group in March 2008. In total 130 Karakul and 170 fat-tailed ewes were included. The farmer and households were trained on feeding of rams during mating and winter feeding of the ewes during gestation and suckling. The feeding was optimized according to the feed resources available and therefore differed between the flocks: in Kasymbay's farm the daily ration consisted of 1.5 kg of hay and 0.3 kg of crushed barley in the first 60 days and 0.5 kg of crushed barley in the next 60 days (Annextable 5); in the household Abdukarim 2.0 kg hay, 0.5 kg of crushed corn in the first and 0.7 kg in the second period were fed (Annextable 6) while in the households Ergesh and Andas the ration included 2.0 kg hay, 0.2 kg and 0.4 kg of crushed barley, respectively (Annextable 7).

The winter of 2007-2008 was exceptionally cold and long with snow from end of November until March and was followed by heavy rainfall and frost, which caused flood and destruction of houses and farm buildings in the village Akdala, also affecting the households Andas and Ergesh. Thus, as a result of the difficult natural conditions and the high mortality the households Andas and Ergesh could not participate further in the project activities in the **2008-2009 season.** They were replaced by two new households, "Abish" and "Bahytjan" located 27 km from Arys, the regional center. These two households sold their lambs on the markets of Shymkent city, while the others sold in Arys. Like Abdukarim both keep only fat-tailed sheep. In total 146 Kazakh fat-tailed ewes and 41 Karakul ewes were included in the experiment in the second year. Winter feeding was the same in Kasymbay's farm and in the households Abdukarim and Abish: the daily ration per ewe was 2.0 kg hay and 0.5 kg concentrates (Annextable 8). The household Bahytjhan only offered 1.5 kg hay and 0.3 kg of concentrates in order to save money (Annextable 9). Accordingly, feed costs in the households Kasymbay, Abdukarim, and Abish with early lambing was 2250 tenge and in the household Bahytjan 1539 tenge per ewe. For traditional lambing feed costs (3000 tenge per ewe) were the same in all households.

Results
While the conception rate and fertility did not differ between early and traditional lambing in the **season of 2007-2008**, there were large differences in the survival of lambs between early and traditional lambing, in particular in the resource-poor households (Table 35). The highest lamb mortality was observed in the early lambing group of Karakul in the household Ergesh (75%); followed by 67% for Karakul lambs in Andas household and for fat-tailed lambs in Ergesh and Andas. In contrast the lamb mortality for traditional lambing in the two households was only around 25%. The differences between early and traditional lambing were less drastic in Karakul (27% versus 7%) and fat-tailed lambs in Kasymbay farm (26% versus 5%) and much smaller in fat-tailed lambs in Abdukarim's flock (16% versus 4%).

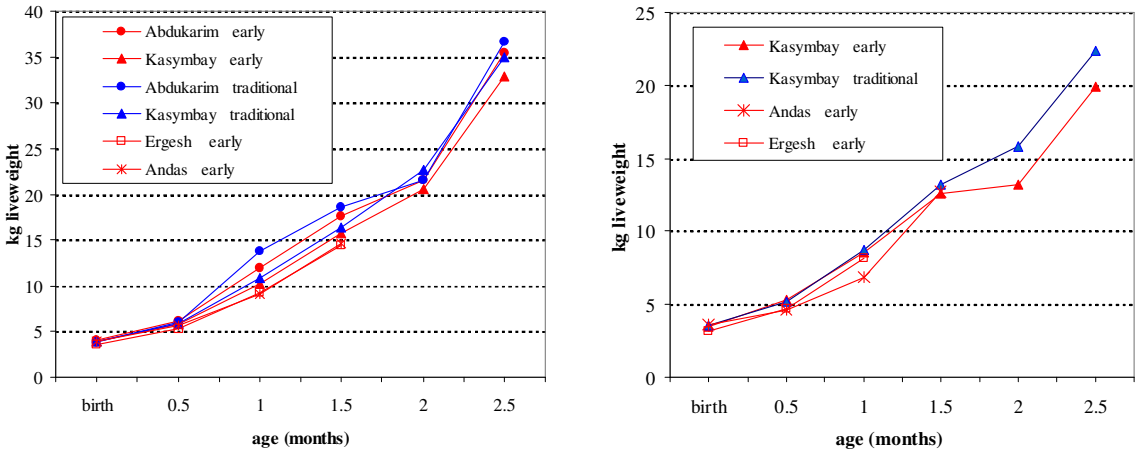
Early lambing in the household flocks in Akdala village (February 2008)

Table 35. Comparison of ewe fertility and lamb survival between early and traditional lambing in the lambing season 2007-2008

Farmer/ household	Genotype	Lambing practice	Ewes mated	Concep-tion rate of ewes, %	Fertility of ewes, %	Lambs died at Navruz, heads (%)	Lambs died at weaning (August), heads (%)
Kasymbay	Karakul	early	43	95.3	109.8	12 (26.6%)	-
	Karakul	traditional	57	100	107.0	-	4 (6.5%)
	fat-tailed	early	48	93.7	113.3	13 (25.5%)	-
	fat-tailed	traditional	52	100	109.6	-	3 (5.3%)
Abdukarim	fat-tailed	early	17	100	111.8	3 (15.8%)	-
	fat-tailed	traditional	23	100	117.4	-	1 (3.7%)
Andas	Karakul	early	9	88.9	100	6 (66.6%)	-
	Karakul	traditional	11	100	90.9	-	2 (20.0%)
	fat-tailed	early	6	100	100	4 (66.7%)	-
	fat-tailed	traditional	4	100	100	-	1 (25.0%)
Ergesh	Karakul	early	4	100	100	3 (75.0%)	-
	Karakul	traditional	6	100	116.7	-	2 (28.6%)
	fat-tailed	early	8	100	112.5	6 (66.7%)	-
	fat-tailed	traditional	12	100	100	-	3 (25.0%)

There were several reasons for the high mortality of lambs: 1. a severe and prolonged winter followed by flood and destruction of houses and farm buildings in Akdala; 2. lack of preparation in the households Andas and Ergesh for the severe and prolonged winter (insufficient storage of fodders and lack of shelters); 3. small number of ewes in the household flocks, e.g. in household Ergesh there were 4 Karakul lambs only in the early lambing group, so each death changed the rate drastically.

As Andas and Ergesh discontinued their participation in March 2008, the liveweight changes of lambs in the traditional group could only be observed in Kasymbay's and Abdukarim's flocks. The comparison of the liveweight of fat-tailed lambs from birth to the age of 2.5 months showed that were only minor differences in favor of the traditional lambing (Figure 26a). In Karakul lambs a significant difference in the lamb liveweights at 2 and 2.5 months between early and traditional lambing was observed and in general smaller liveweights than in fat-tailed lambs (Figure 26b).



Figures 26. Changes in lamb liveweights (kg) for early and traditional lambing in the season 2007-2008 by participating farmer/household; a) left: fat-tailed lambs, b) right: Karakul lambs

For the cost-benefit analysis only feed costs were considered in the costs per ewe to simplify the analysis. Also it is well known that feeding accounts for the highest proportion of the costs of sheep production in farms and households. Feed costs per ewe amounted to 2,232 tenge for early lambing and 2,952 tenge for traditional lambing for the farm Kasymbay, 3,168 tenge and 4,152 tenge in the household Abdukarim (Table 36) and 1,656 tenge and 2,784 tenge in households Ergesh and Andas, respectively. During Navruz holiday household Abdukarim sold his fat-tailed lambs for an average of 5460 tenge and Kasymbay sold the fat-tailed lambs for 5060 tenge, and the Karakul lambs for 2879 tenge (Table 36). In August the price of fat-tailed lambs from traditional lambing was 9678 tenge for Abdukarim, and 8719 tenge for Kasymbay, for Kaymbay's Karakul lambs it was 3497 tenge.
The analysis showed that the average profit for Kasymbay farm from selling Karakul lambs during Navruz holidays (647 tenge), was higher than in August (545 tenge). In contrast, even though selling fat-tailed lambs from early lambing during Navruz was profitable, the profits were more than double for traditional lambing and selling in August in Kasymbay farm and Abdukarim household (Table 36). However, the highest profits were achieved by Kasymbay farm for fat-tailed lambs from early lambing.

Table 36. Cost-benefit comparison (tenge) per ewe for early and traditional lambing in the season 2007-2008

Items	**Kasymbay**				**Abdukarim**	
	Early		**Traditional**		**Early**	**Traditional**
	Karakul	Fat-tailed	Karakul	Fat-tailed	Fat-tailed	
Feed costs for 1 ewe	2232	2232	2952	2952	3168	4152
Average selling price of 1 lamb	2879	5060	-	-	5460	-
Live weight of lambs	19.9	32.9	-	-	35.4	-
Price for 1 kg of live weight	144.0	153.8	-	-	154.2	-
Profit in Navruz	**647**	**2828**	**-**	**-**	**2292**	**-**
Average selling price of 1 lamb in August	5000	10500	3497	8719	-	9678
Live weight of lambs in August, kg	35.4	47.2	31.4	42.3	-	43.7
Price for 1 kg of live weight	141.2	222.4	111.4	206.1	-	221.4
Profit in August	**2768**	**8268**	**545**	**5767**	**-**	**5526**

*1 USD=150 Kazakh tenge

As in the previous year conception and fertility rates did not differ between early and traditional lambing in the **season of 2008-2009.** In contrast to the preceeding season also the lamb mortality was similar and in fact quite low (Table 37).

Table 37. Comparison of ewe fertility and lamb survival between early and traditional lambing in the lambing season 2008-2009

Farmer/ household	Genotype	Lambing practice	Ewes mated	Concep-tion rate of ewes, (%)	Fertility of ewes, (%)	Lambs died, heads (%)	Lamb survival, heads (%)
Kasymbay	Karakul	early	21	95.2	110	-	22 (100)
Kasymbay	Karakul	traditional	20	100	105	1 (4.7)	20 (95.3)
Kasymbay	fat-tailed	early	25	100	116	1 (3.4)	28 (96.6)
Kasymbay	fat-tailed	traditional	25	100	112	-	28 (100)
Abdukarim	fat-tailed	early	15	100	133	-	17 (100)
Abdukarim	fat-tailed	traditional	20	100	115	1 (4.3)	22 (95.7)
Abish	fat-tailed	early	14	100	114	-	16 (100)
Abish	fat-tailed	traditional	15	100	107	-	16 (100)
Bahytjan	fat-tailed	early	15	100	107	1 (6.2)	15 (93.8)
Bahytjan	fat-tailed	traditional	17	100	106	1 (5.5)	17 (94.5)

No differences in liveweights of Karakul lambs were observed from birth to the age of three months between early and traditional lambing (Table 38).

Table 38. Changes in liveweights (kg) of Karakul lambs on Kasymbay's farm for early and traditional lambing in the season 2008-2009

Age of lambs	Early lambing			Traditional lambing		
	Liveweight, kg	Weight gain		Liveweight, kg	Weight gain	
		total, kg	daily, g		total, kg	daily, g
3 days	3.8	-	-	3.9	-	-
1 month	9.9	6.1	204	9.9	6.1	201
2 month	14.8	4.9	162	15.0	5.1	170
3 month	20.9	6.1	203	21.3	6.3	208

The same result as for Karakul lambs – no difference in the liveweights between early and traditional lambing –was obtained for fat-tailed lambs in all farms with exception of a difference of 2.9 kg and 1.1 kg in favour of traditional lambing in the 3 month liveweights in the households Bahytjan and Abish, respectively (Table 39).

Table 39. Changes in liveweights (kg) of fat-tailed lambs for early and traditional lambing in the season 2008-2009

Age of lambs	Early lambing			Traditional lambing		
	Liveweight, kg	Weight gain		Liveweight, kg	Weight gain	
		total, kg	daily, g		total, kg	daily, g
			Abdukarim			
3 days	5.1	-	-	5.2	-	-
1 month	13.9	8.8	292	14.9	9.7	324
2 month	23.5	9.6	319	23.9	9.0	300
3 month	36.1	12.6	420	36.8	12.9	428

Age of lambs	Early lambing			Traditional lambing		
	Liveweight, kg	Weight gain		Liveweight, kg	Weight gain	
		total, kg	daily, g		total, kg	daily, g
			Kasymbay			
3 days	4.8	-	-	4.9	-	-
1 month	13.2	8.41	280	14.0	9.1	303
2 month	23.1	9.95	331	23.9	10.0	332
3 month	36.0	12.83	427	36.1	12.1	404
			Bahytjan			
3 days	4.5	-	-	4.8	-	-
1 month	13.1	8.7	288	14.1	9.2	307
2 month	22.5	9.4	312	23.2	9.2	305
3 month	32.1	9.6	3.2	35.0	11.8	3.9
			Abish			
3 days	4.9	-	-	5.0	-	-
1 month	13.9	9.1	302	14.4	9.4	317
2 month	23.3	9.4	312	23.7	9.3	310
3 month	35.4	12.1	403	36.5	12.8	428

The average price of fat-tailed lambs sold in August 2009 was higher than in spring; overall the prices achieved for lambs from early lambing were higher in 2009 than in 2008 (Table 40). The market location – Arys in the case of Kasymbay and Abdukarim and Shymkent for Bahytjan and Abish– did not affect the price much.

The cost-benefit analysis showed that the average profit per ewe was between 188 and 520 Tenge higher for early than for traditional lambing except for the household Bahytjan that lost 1191 Tenge per ewe with early lambing (Table 40). The reason was that Bahytjan achieved a relatively low price for the lambs from early lambing because of the lower liveweight of the lambs (32 kg) compared to the lambs of the same age in the other flocks. Two factors may explain the low average liveweight, namely the use of sires of low genetic value and the inadequate level of feeding in an attempt to save feed costs. The highest profit per ewe was achieved by Abdukarim with early lambing.

Table 40. Cost-benefit comparison (in tenge) per fat-tailed ewe for early and traditional lambing in the season 2008-2009

Items	Abdukarim		Kasymbay		Abish		Bahytjan	
	early	**trad.**	**early**	**trad.**	**early**	**trad.**	**early**	**trad.**
Price of lambs at Navruz	8220	-	8125	-	8000	-	5548	-
Price of lambs with traditional lambing	-	8450	-	8400	-	8562	-	8200
Costs of fodder	2250	3000	2250	3000	2250	3000	1539	3000
Profit	**5970**	**5450**	**5875**	**5400**	**5750**	**5562**	**4009**	**5200**
Difference	+520		+475		+188		-1191	

In addition to the cost-benefit analysis monthly market prices were observed for fat-tailed lambs from early and traditional lambing in Kasymbay farm and Abdukarim household in 2009 (Table 41). From the age of 5 month onwards the price for early lambed lambs was consistently higher than for lambs from traditional lambing at the same age. Due to the age difference and the related higher liveweights early lambed lambs achieved considerably higher prices than lambs from traditional lambing in the same calendar month.

Table 41. Market prices (tenge) of fat-tailed lambs from early and traditional lamb by age group and calendar month in 2009

Age of lamb	Early lambing		Traditional lambing	
	Month	Price	Month	Price
		Abdukarim		
3 month	March	8220	June	8450
4 month	April	8600	July	8680
5 month	May	9500	August	8200
6 month	June	10300	September	9200
7 month	July	11200	October	10400
8 month	August	11800	November	10900
		Kasymbay		
3 month	March	8125	June	8400
4 month	April	8550	July	8600
5 month	May	9400	August	8200
6 month	June	10100	September	9100
7 month	July	11000	October	10200
8 month	August	11600	November	11000

Conclusion

The study showed that in contrast to the expectation at the start of the experiment the average selling price for lambs at 3 month age was higher for traditional lambing (in August) than for early lambing (Navruz and spring) in both years.

In the first year which represented an exceptionally cold winter with consecutive floods in spring early lambing resulted in high lamb mortality, in particular in the two resource poorer households but also in the other two flocks. Even without considering the higher lamb mortality the comparison of the profits per ewe showed that early lambing was less profitable than traditional lambing when selling lambs at the age of 2.5 months except for Karakul lambs in the farm Kasymbay. However, when lambs from early lambing were sold in August like the lambs from traditional lambing, considerably higher profits per ewe were achieved. In the second year early lambing was fully profitable for the farm and households that could afford a reasonable management standard, including adequate levels of winter feeding; i.e. a daily ration per ewe of 2.0 kg hay and 0.5 kg of concentrates. The full advantage of early lambing was realized when selling at the age of 5 months and onwards. However, early lambing and selling the lambs in spring provide the additional benefit of providing cash for field work as alternative to expensive bank loans with 25-30% interest rates or to selling pregnent ewes. Furthermore, in autumn early lambed lambs have higher liveweight, are well-fed and therefore better equipped to get through their first winter.

Concluding, early lambing can be an interesting management option for well managed flocks but includes the risk of higher lamb mortality in years with harsh winters. Thus, it cannot be recommended for resource poor households.

3.3.1.3 Early weaning of lambs and milking of early weaned ewes for value addition in household flocks

Background

During September-October in Kazakhstan the market is promising for selling weaned lambs. This can be targeted by early weaning of lambs (at 60 days) and then raising lambs in the summer ranges (following the "Nagul" system) best in combination with extra feeding for sustaining a rapid growth. It is expected that by September and October the lambs will reach marketable weights. Furthermore, early weaning of lambs will lengthen the recovery period of ewes until the next mating which is expected to have a positive effect on reproductive performance of the ewes. It would also allow milking of the early weaned ewes and thus open a source of additional income to farmers or improve

the diet of the family. According to other studies early weaning can be done between 30 to 60 days after lambing.
The main objective of this activity was to test the effect of weaning at 75 days instead of 120 days on lamb growth, and on liveweights gains and milk production of ewes.

Methods
Experiments were conducted in two lambing seasons 2008 and 2009 in Kasymbay, households Abdukarim, Bahytjan and Abish of South-Kazakhstan region of Kazakhstan. The experimental ewes were artificially inseminated in the period from 25 October to 15 November.
In 2007 113 Karakul and 104 fat-tailed ewes in the farm Kasymbay and 44 fat-tailed ewes in the household Abdukarim were artificially inseminated (Table 42). In 2008 40 Karakul and 40 fat-tailed ewes in the farm Kasymbay and 20 fat-tailed ewes each in the households Abdukarim, Bahytjan and Abish were artificially inseminated (Table 43).
In the experimental group weaning was done 75 days after lambing and in the traditional groups at 4 month age. The early weaned lambs were grazed on good pastures and supplemented with 0.2 kg crushed barley. In order to compensate for the lack of essential amino acids in their rations the early weaned lambs received methionine (at the start a dose of 0.5 g daily, which was increased to 0.75 g after 7 days and to 1 g daily per lamb after 10 days).
In 2009 in addition to lamb growth and liveweight changes in the ewes milk production associated with early and traditional weaning of lambs was studied in the farm Kasymbay. Milking of ewes in the early weaning group started on 15 May and in the traditional weaning group on 3 July and was continued until 28 July; daily milk yield was recorded every five days.

Table 42. Ewes inseminated in 2007

Farm/ households	Karakul		Fat-tailed	
	early	traditional	early	traditional
Kasymbay	50	63	54	50
Abdukarim	-	-	24	20

Table 43. Ewes inseminated in 2008

Farm/ households	Karakul		Fat-tailed	
	early	traditional	early	traditional
Kasymbay	20	20	20	20
Abdukarim	-	-	10	10
Bahytjan	-	-	10	10
Abish	-	-	10	10

Conception rate in all groups was 100% in both years. In 2008 a higher mortality of both Karakul and fat-tailed lambs was observed in the early weaning group and thus a lower number of lambs entered the experimental group (Table 44); in 2009 there were nearly no differences (Table 45).

Table 44. Comparison of ewe fertility and lamb survival between the early and traditional weaning groups in the lambing season 2007-2008

Parameters	Farm/households					
	Kasymbay				Abdukarim	
	Karakul		Fat-tailed		Karakul	
	early	trad.	early	trad.	early	trad.
Ewes inseminated	50	63	54	50	21	23
Conception rate, %	100	100	100	100	100	100
Lambs born	50	63	54	50	21	23
Lambs survived till weaning	41 (82%)	57 (90%)	44 (81%)	48 (96%)	19 (91%)	20 (87%)

Table 45. Comparison of ewe fertility and lamb survival between the early and traditional weaning groups in the lambing season 2008-2009

Parameters	Farm/households									
	Kasymbay				Abdukarim		Bahytjan		Abish	
	Karakul		Fat-tailed		Fat-tailed		Fat-tailed		Fat-tailed	
	early	trad.	early	trad.	early	trad.	early	trad.	early	trad.
Ewes inseminated	20	20	20	20	10	10	10	10	10	10
Conception rate, %	100	100	100	100	100	100	100	100	100	100
Lambs born	20	20	22	21	11	11	10	11	11	11
Lambs survived till weaning	19	19	21	21	11	11	10	10	10	11

Results

Four months after lambing at the time of traditional weaning the ewes in the early weaned group were between 2.1 to 5.8 kg heavier than the ewes in the traditional group in 2008; this difference decreased to 0.5 to 1.3 kg seven months after lambing (Annextable 10). In 2009 there was little difference in the liveweight of ewes four months after lambing and six months after lambing the ewes in the early weaning group were by 1.0 to 3.8 kg heavier (Annextable 11).

At the time of traditional weaning in 2008 the early weaned lambs were by 1.2 kg (Karakul) and 5.8 kg (fat-tailed) in the farm Kasymbay and 2.6 kg lighter (fat-tailed) in the household Abdukarim than the traditionally weaned lambs (Table 46). At six months the difference in the farm had decreased to 0.4 and 3.4 kg, respectively but remained about the same (2.9 kg) in the household. At an age of 195 days the liveweights of the lambs in the two groups were nearly similar and with 210 days the early weaned lambs were about 2 kg heavier than the lambs in the other group.

Table 46. Changes in liveweights (kg) of early and traditionally weaned Karakul and fat-tailed lambs in Kasymbay farm and household Abdukarim in 2008

Age of lambs	Kasymbay				Abdukarim	
	Karakul		Fat-tailed		Fat-tailed	
	early	trad.	early	trad.	early	trad.
Birth	3.96	3.95	3.98	4.03	4.17	4.14
15 day	5.75	5.73	5.89	5.96	6.89	6.93
30 day	10.13	10.06	10.23	10.26	12.92	12.98
45 day	13.78	13.78	16.33	16.42	17.54	17.60
60 day	14.12	15.95	16.66	22.79	22.44	22.54
75 day	15.68	16.56	17.98	23.92	24.73	24.83
90 day	17.29	18.88	19.43	25.72	25.13	27.75
105 day	18.67	20.59	21.13	27.63	26.74	29.33
120 day	20.43	21.67	23.01	28.76	28.67	31.28
135 day	24.65	25.04	26.64	33.24	32.43	35.24
150 day	27.28	28.56	34.38	37.76	35.70	38.56
165 day	30.26	31.47	38.08	41.40	39.24	42.06
180 day	33.87	34.23	41.52	44.96	43.66	46.55
195 day	35.91	35.45	45.21	45.18	47.36	47.42
210 day	37.87	35.88	47.54	45.76	49.91	47.68

In 2009 similar trends were observed as in 2008: at the age of 120 days the traditionally weaned lambs were heavier than the early weaned ones; at the age of six months there was still a difference between the two groups which was smaller in the farm than in the three households (Table 47).

Table 47. Changes in liveweights (kg) of early and traditionally weaned Karakul and fat-tailed lambs in Kasymbay farm and three households in 2009

Age of lambs	Kasymbay				Abdukarim		Bahytjan		Abish	
	Karakul		Fat-tailed		Fat-tailed		Fat-tailed		Fat-tailed	
	early	trad.	early	trad.	early	trad.	early	trad.	early	trad.
Birth	3.98	4.00	4.07	4.09	4.19	4.20	4.16	4.12	4.10	4.16
15 day	5.78	5.83	6.03	6.28	6.83	6.94	6.68	6.54	6.72	6.80
30 day	9.70	9.96	10.14	10.12	10.58	10.73	10.24	10.20	10.43	10.53
45 day	13.03	13.20	13.44	13.66	15.28	15.53	14.03	13.98	14.20	14.28
60 day	13.58	15.13	13.89	15.22	16.83	18.40	14.53	17.56	14.87	17.44
75 day	14.63	17.43	15.07	19.10	19.26	20.27	15.74	19.86	15.66	19.63
90 day	16.28	19.29	16.80	21.03	20.64	22.86	17.50	21.74	17.36	21.46
105 day	17.84	21.03	18.54	22.90	22.10	24.38	19.12	23.54	19.10	23.19
120 day	19.28	22.16	20.33	23.84	24.14	26.16	20.90	24.77	20.77	24.43
135 day	23.58	25.26	23.85	26.58	27.50	29.54	24.46	27.46	24.18	27.09
150 day	26.44	28.84	27.34	29.69	30.14	32.06	28.59	30.04	28.46	29.74
165 day	30.16	31.46	31.28	32.50	33.46	35.58	31.24	33.36	31.40	32.66
180 day	33.26	34.10	34.20	35.73	36.89	39.17	33.66	36.74	33.78	35.90

In 2008 lambs of both groups were sold at an age of 210 days (in October) and in 2009 at an age of 180 days (at the beginning of September). In 2008 the prices did not differ much; the early weaned lambs received a slightly higher price (Table 48) in accordance with their slightly higher liveweights. In 2009, when the lambs were sold one month earlier, the traditionally weaned lambs fetched higher prices which was related to their higher liveweights at that age.

Table 48. Selling price (tenge) of early and traditionally weaned Karakul and fat-tailed lambs in 2008 and 2009

Farm/Households	Karakul		Fat-tailed	
	Early	Traditional	Early	Traditional
2008				
Kasymbay	10,855	10,625	12,950	12,750
Abdukarim	-	-	13,860	13,540
2009				
Kasymbay	9,978	10,023	10,500	10,710
Abdukarim	-	-	11,067	11,750
Bahytjan	-	-	10,100	11,020
Abish	-	-	10,150	10,770

The milk production of fat-tailed and Karakul ewes did not differ much; the milk yield of both genotypes in the early weaning group was about 545 g at the start of milking (15 May 2009) and had decreased to about 340 g daily when milking of the ewes in traditional weaning group started on 3 July (Annextable 12). The daily milk yield of the ewes in the traditional weaning group at this time was much lower than in the early weaning group (on average 155 g). In both groups the milk yield decreased to about 100 g till 28 July when milking was stopped. From early weaning to the end of lactation the on average 26.8 l milk were produced per Karakul ewe and 28.5 l per fat-tailed ewe with a market value of about 1342 tenge (US$ 9) and 1275 tenge (US$ 8.5), respectively. The Karkul and fat-tailed ewes in the traditional weaning group produced 32 and 3.7 l respectively.

Conclusion

When selling lambs at 6 or 7 months of age only minor differences were found in the benefits from early and traditionally weaned lambs; with 6 months (2009) the difference was in favour of traditional weaning and with 7 months (2008) in favor of early weaning. Of course early weaning would open the opportunity for early stall fattening of lambs instead of grazing. There was also a favorable effect of early weaning on the liveweights of ewes but if this resulted in improved fertility in the subsequent lambing season was not recorded. Thus, the major advantage of early weaning lies in the option of

milking the ewes for about two months after weaning. An additional income of about US$ 9 per ewe can be achieved in addition to the average value of US$ 77 for the lamb. However, milking of ewes is labour intensive and the best way of marketing the milk would be by processing the milk in the households. Given that the costs of supplementation with barkey and methionin have not been calculated, it is doubtful that early weanin can be recommended for wider use.

3.3.1.4 Value addition: improving household processing of cow and sheep milk and making sausages

Background

A wide range of high-value milk products such as butter, cheese, sour cream, cottage cheese, brynza, kurt, etc are produced in the region mainly from cow 's milk. The project trained households in milk processing to fresh cheese and yogurt. This has the potential to generate additional income which are demanded in the markets. Currently almost all households in villages of Kazakhstan have cattle with a relatively low level of milk production (1200-1500 liters of milk per lactation). Given the high costs for maintaining dairy cows sheep milk production could be an alternative for resource-poor households in the future. The objective was to increase household' income through improved methods of milk processing (cow and sheep milk) and production of sausages.

The main activities included

- studying the seasonal chemical composition of cow and sheep milk in the households of South Kazakhstan region;
- development and improvement of methods for milk processing and sausage production under household conditions and training of households;
- assessing the benefits from processing selected dairy product and sausages.

Sheep milk yield and chemical composition

In 2007 fat-tailed and Karakul ewes were milked during the second half of their lactation (from June to September) and the milk composition analyzed. The total milk yield for 82 days per fat-tailed ewe was 24.6 kg with an average of 8.9% fat; average daily milk yield of fat-tailed sheep was 300 g (Table 49). Towards the end of the lactation the protein content increased from 5.0 to 7.2 per cent. Total solids, density (g/cm3) and acidity varied only slightly. Beginning of September daily milk yield was 100 g and it then decreased to 30 g. Thus, it is recommended to milk high producing fat-tailed ewes up to 16 August and low producing ewes up to 1 July. Further milking is economically not profitable.

Table 49. Milk yield and composition of fat-tailed sheep in the second half of lactation

Time of milking		Milk	Average content, %			Density,	Acidity, °т
Month	Days	yield, kg	Fat	Proteins	TS	g/cm^3	
June	10	3.8	8.1	5.0	19.5	1.0363	23.3
July	31	10.8	8.6	5.1	20.2	1.0363	22.3
August	31	8.8	9.5	6.0	21.3	1.0363	22.6
September	10	1.0	9.0	7.2	21.7	1.0365	22.5
Total/Average	82	24.6	8.8	5.8	20.7	1.0364	22.7

The average milk production of Karakul ewes under the same management conditions was with a total of 17.3 kg or 188 g daily lower than that of fat-tailed ewes (Table 50). Fat and protein content were also lower than for fat-tailed ewes. The highest daily milk yields were recorded in June, and then they started to decrease; in August the daily milk yield was already below 100 g. Therefore, milking of Karakul ewes can be recommended till about 15 July.

Table 50. Milk yield and composition of Karakul sheep in the second half of lactation

Time of milking		Milk yield, kg	Average content, %			Density, g/cm^3	Acidity, °т
Month	Days		Fat	Proteins	TS		
June	30	8.3	5.5	4.4	16.4	-	-
July	31	6.3	6.2	4.8	17.2	1.0365	23.4
August	31	2.7	6.9	5.0	18.2	1.0366	23.3
Total/Average	92	17.3	6.2	4.7	17.3	1.0365	23.3

The changes in milk composition have a practical relevance for e.g.the production of pickle brynza (kept in salt solution) as the fat and dry matter content with cow milk should be newly adjusted every decade (10 day period).

In addition the effect of additional feeding of Karakul ewes with concentrates on milk yield and composition in the second half of lactation was tested in Kasymbay farm in 2007. Three groups of ewes were formed with 15 animals each. The first group (control) was grazed, while the animals in the second and third group were fed in the mornings with additional 0.2 kg and 0.4 kg concentrates, respectively. The milk yield of ewes in the first group was 11.6 kg, in the second and third group 15.2 kg and 17.3 kg, respectively, which represents an increase by 31.0 and 49.1%, respectively.

Chemical composition of cow milk

In accordance with the current standard for good quality brynza, cow milk should contain 4-5.2% lactose, 3.2-4.0% fat, 2.7-3.6% protein and a total acidity by Turner of 16-19^0. As differences in the composition of cow's milk may require changes in the preparation or cause differences in the flavor of milk products, the composition of cow's milk was analyzed four times during the year at the times when feeding and climate change most drastically. The analysis showed only small seasonal changes which were related to the feeding in the different seasons. In autumn when cows are grazed around the village, the cow milk was richer in protein and fat than in the other seasons (Table 51). The protein content in the autumn milk was by 0.15 and 0.23% higher than in the spring and summer milk, respectively. Overall the milk composition was well in the range allowing good quality cheese production.

The cow milk was also tested for its bacteriological property by a reductase test which showed that the number of bacteria in the milk was within the norm.

Table 51. Seasonal chemical composition of cow's milk

	Chemical composition of cow's milk (%)				
	Winter	Spring	Summer	Autumn	Average
Protein	3.05	3.00	2.92	3.15	3.03
Fat	3.65	3.63	3.65	3.78	3.68
Total solids (TS)	11.70	11.81	11.90	11.94	11.84
TS non fat	8.09	8.30	8.35	8.19	8.23

Dairy processing and sausage production

Processing methods for milk products that are demanded on the local market were developed and further tested in the household Elan (G. Kuleeva) and at Kasimbay farm. Subsequently 25 households from Akdala village were trained. About 15 households decided to process milk in the future and four households are already producing chechil.

The following processing methods were developed and trainings for households conducted:

- preparing brynza
- preparing chechil
- preparing rennet
- preparing homemade cheese
- preparing yogurt

- preparing homemade kvas
- preparing kurut with cherry;
- preparing homemade sausage.

Presentation of improved dairy products at Kasymbay farm
(Center Commissioned External Review Mission, May 2008)

Brynza production
Brynza is a very popular cheese among the local population. The processing is relatively easy and does not require sophisticated equipment, so it is suitable for processing under household conditions. brynza Production is a good option for using skimmed milk. It can be ready for sale within 10-15 days if made from pasteurized milk. Production of 1 kg brynza requires 8-10 kg of cow milk or 4-5 kg of sheep milk.

Chechil production
From 10 litres of milk 1 kg of chechil, 1 litre of sour cream and 8 litres of milk serum were obtained. The required labour time recorded in the household G. Kuleeva was 2 hour for production of 1 kg of chechil. The costs and benefit analysis shows that it is profitable to produce chechil under household conditions (Table 52).

Table 52. Costs and benefits (tenge) of chechil production (household G. Kuleeva)

Costs and benefits	**Price, tenge**
Sheep (5 l) and cow (5 l) milk	800
Rennet ferment (100 ml)	100
Electricity	80
Natural gas	80
Total costs	**1060**
The price of 1 kg of chechil	1200
The price of 1 kg of sour cream	800
Net benefits	**940**

Homemade cheese production

Home made cheese refers to sour milk products from cow's milk consumed without ripening. It takes about two hours for obtaining 1 kg homemade cheese. A net benefit of 1410 tenge can be obtained from processing 10 liters of cow milk (Table 53).

Table 53. Costs and benefits (Tenge) of home made cheese production (household G. Kuleeva)

Costs and benefits	Price, tenge
Cow milk (10 l)	500
Rennet ferment, diluted 1: 10000 (100 ml)	100
Electricity	90
Total costs	**690**
Sour cream sold with 20% fat, 1 l	600
Homemade cheese, 1 kg	1500
Total benefits	2100
Net Benefits	**1410**

Homemade kvass production

Milk kvass with crushed white corn is thirst-quenching beverage which is consumed mainly in summer. From processing 5 litres of kvass U. Tolegeneva realized a net benefit of 625 tenge (Table 54).

Table 54. Costs and benefits (Tenge) of home made kvass production (household U. Tolegeneva)

Costs and benefits	Price, tenge
Crushed corn, 300 g	45
Ayran, 1 l	80
Milk serum, 3 l	30
Electricity	20
Total costs for 5 l	**175**
Kvass, 5 l	700
Net benefit	**625**

Totra production

Totra is the popular name of melted butter, which contains milk fat, water and sugar. In our test two methods of producing totra were used, namely from butter and sour cream with milk. For the production of 1 kg totra from butter 590 tenge were spent and net benefits were 110 tenge (Table 55).

Table 55. Costs and benefits (Tenge) of home made totra production from butter (household G. Kuleeva)

Costs and benefits	Price, tenge
Butter	500
Electricity	90
Total costs	**590**
Totra, 1 kg	700
Net Benefits	**110**

The production of totra from sour cream proved non profitable: 230 tenge were lost in producing 1 kg totra with this method (Table 56).

Table 56. Costs and benefits (Tenge) of home made totra production from sour cream (household G. Kuleeva)

Costs and benefits	Price, tenge
Sour cream	500
Milk	90
Electricity	90
Total costs	**680**
Price of 1 kg of totra sold	450
Net benefits	**-230**

Homemade sausage (asip) production

For the production of 1 kg asip 1 m of sheep caecum, 1 spleen, 200 g of lung, 2 kidneys, heart, 200 g of meat, 200 g camel hump, 1 onion, 1 cup of rice, 2 glasses of warm water, salt, 1 teaspoon of apple vinegar and pepper are required. It takes approximately two hours for obtaining 1 kg of homemade sausage. The price of 1 kg of Asip on the local market was 1200 tenge. Thus, a net benefit of 550 tenge was obtained (Table 57).

Table 57. Costs and benefits (Tenge) of home made sausage production (household A.Dauletiyarova)

Costs	Price, tenge
Guts	200
Meat and camel hump (400 g)	290
Electricity	90
Milk (200 ml)	20
Rice and spices	50
Total costs	**650**

3.3.2 Improving sheep production in Chuy and Kemin district in Kyrgyzstan

3.3.2.1 Background

In Soviet times wool and mutton were the prioritized products, thus, within the division of labor in the Soviet Union, sheep farming in Kyrgyzstan was focused on development of wool and meat oriented fine-wool sheep-breeding, which accounted for 92% in the sector, while the percentage of more meat oriented crossbred and wool sheep farming was about 7%, and only about 1% were focused on semi-coarse wool meat sheep. Wool accounted for 55% of the products from sheep farming, while lamb production accounted for 44% and skins for 1%. Sheep breeding was primarily focused on improvement of wool productivity and quality, and increased mutton production.

Thus, fine-wool production used to be a leading sector of livestock farming in Kyrgyzstan. In the transition period to the market economy and due to the reforms in the agricultural sector of Kyrgyzstan, the importance of fine-wool sheep declined leading to a reduction of the Kyrgyz Merino population by ¾ compared to 1990. The low prices for fine wool, lack of marketing channels and poor market infrastructure has been hindering the development of fine-wool sheep-breeding and led to the emergence of new production systems in the country and therefore to adjustments in the genetic composition of national sheep population. According to the agricultural census (2003), the proportion of the breeds in the sheep population were as follows:

- Kyrgyz fine-fleeced breed: 41.0%;
- Australian merino: 2.0%;
- Tian-Shian breed: 3.0%;
- Alay breed: 6.0%;
- Edilbaev breed: 3.0%;
- Gissarized: 6.0%;
- Local Kyrgyz: 38.0%;
- Others: 1.0%.

Almost all wool is sold through intermediaries at low prices (USD 0.8 to 1 per kg), while the price for mutton is relatively high (USD 4.1-5.1 per 1 kg). In response, the smaller sheep owners keep primarily coarse-wool fat-tailed sheep.

The economic reform in the rural areas has also drastically changed the composition of rural livestock producers in Kyrgyzstan. The main producers of livestock products are household farms, which account for 53.6% of meat, 55% of raw milk, 49.4% of eggs, and 48.7% of wool.

While the farms are legally registered, have land resources and production assets, opportunities to take a loan, and a sufficient number of sheep for selection within their flocks, household farms are often resource-poor and a, have small number of sheep. The average number of sheep per household ranges from 10-15 and on farms from 100-150 sheep depending on access to land resources. Often sheep owners have only limited knowledge of husbandry and breeding practices and no access to extension services. These farmers cannot afford to buy animals with known pedigree from breeding farms and there are no organized breeding programs in the villages. As the market price for pedigree animals does not cover the production cost and there is no support for organized breeding programs, the number of breeding animals has decreased and some breeding companies ceased to exist, while others lost their status as the centers of domestic breeding. As a result sheep productivity has been decreasing and it is estimated that the sheep farmers get 35-40% less income per sheep (in dollar terms) compared to the Soviet period.

The aim of the project was to improve the knowledge of sheep owners in households and medium-sized farms on husbandry and breeding practices through practical demonstration and direct implementation of improved methods in their flocks. Project activities were implemented on two medium-sized farms: “Alymseyit” in Kemin and “Kenesh” in Chuy rayon, and in household farms in Akbeket village in Kemin rayon and Progress village in Chuy rayon.

3.3.2.2 Improving productivity of fine-wool and coarse wool sheep on a medium scale farm

Background

Alymseyit farm located in Akbeket village of Kemin rayon of Chu oblast, 90 km from Bishkek, 23 km from Tokmok, and 5 km from Kemin rayon center. The farm has 310 ha pastures, 25 ha of natural

hayfields in the Jelkildek hole and 7 ha of planted perennial grass for making hay. The farm keeps fine-wool and fat-tailed coarse-wool sheep in two sheds with total area of 1,098 m^2. According to the technology in place, fine-wool and coarse-wool sheep are kept separately on the Jelargi winter pasture. The evaluation of the sheep and analysis of production conditions on Alymseyit farm revealed the following shortcomings:

- Feeding and maintenance do not conform with established requirements, particularly in the winter;
- hygienic conditions are sub-standard;
- mating practices are chaotic (i.e. in-breeding; no selection);
- Low liveweight, poor growth and development;
- Sheep bred in the farm do not meet the standards of Kyrgyz fine-wool breed (low quality inhomogeneous wool);
- Wool production and quality are low (length, fineness, density, homogeneity, proportion of pure wool, etc.).

In order to overcome these shortcomings, the project team Improved livestock technology includes:

- Optimal combination of sheep grazing with supplemental feeding in winter and early spring;
- Winter-feeding of animals with balanced rations;
- Monitoring of lambing; lambs' growth and development;
- Increased proportion of productive ewes in the flocks (culling of old ewes and castrated rams)
- Selection of best ewes and culling;
- Introduction of high quality breeding rams;
- Improving hygienic state of sheds
- Training on diagnostics, prevention and treatment of infectious, parasitic and non-contagious diseases of sheep.

The main objective was to increase the proportion of productive ewes in the flock, improve their body condition and growth rates based on improved feeding, particularly in the winter and improved husbandry practices, especially hygienic conditions and care of lambs, and improved breeding strategies.

Results

Fine wool sheep

To improve the fleece quality of the fine wool flock on recommendation of the project team the farmer bought eight fine-wool breeding rams with liveweights from 53.5 to 61 kg from the government-owned Orgochor breeding station in November 2007; first lambs were born in April 2008. Upon evaluation of the flock in autumn 2007, 53 ewes and 45 castrated rams born in 2006 were rejected and sold. Based on the recommendation from the researchers ewes with poor body condition were kept separately and received supplementary feed of 0.5 kg hay and 200 g concentrate per head. The monitoring of ewes' reproductive performance and growth of lambs enables the farmer to evaluate the outcome of measures taken to improve flock productivity, e.g. replacing low-productive breeding rams and culling of low-productive ewes, etc.). Farmer's training in basic skills in diagnostics, prevention and treatment of infectious, parasitic and non-contagious diseases of sheep prevents mortality, and facilitates higher productivity.

Lambing of fine-wool ewes takes place in March/April. In 2008 fertility of ewes was high (94%) and mortality of lambs (4%) low (Table 58).

Table 58. Reproductive performance of fine wool ewes in 2008

No of ewes mated	Lambs born alive		Twins	Lambs survived at weaning		Average live weight at weaning, kg
	no	%	%	no	%	
230	216	93.9	9.3	207	96	29.2

From 2007 to 2009 the average birth weight increased from 3.0 kg to 3.8 kg, the weight at 2 weeks from 5.9 kg to 7.1 kg and the weaning weight from 28.5 kg to 29.5 kg (Table 59). Also the weight of 1 year old ewes was in 2008 by 2.6 kg and in 2009 by 1.8 kg higher than in 2007 (Table 60). The weight

of breeding rams was much in 2009 by 40 kg higher than in 2007 due to the newly purchased rams, while the average weight of adult ewes was by 1.2 kg lower in 2009 than in 2007. The increases in liveweights of younger animals are assumed to result from the combination of rational nutrition, timely vaccination, and introduction of high quality breeding rams imported from Orgochor breeding station.

Table 59. Average liveweights of fine-wool female lambs by year

Years	Birth weight, kg	15 days, kg	At weaning, kg
2007	3.0	5.9	28.5
2008	3.5	6.6	29.2
2009	3.8	7.1	29.5

Table 60. Average liveweight of fine-wool sheep by age and sex group and year

Group	Age, years	Average live weight, kg		
		2007	2008	2009
Breeding rams	2.5-3.5	57.5	74.9	97.5
Ewes	2-7	53.9	51.5	52.7
Young ewes	1	41.1	43.7	42.9

Kyrgyz fine-wool ewes should produce 3.2-3.5 kg of pure wool. In 2007 the ewes produced only 3 kg, but in 2008 and 2009 their production met this standard (Table 61). Samples for testing wool quality were taken from the Orgochor breeding rams and from selected ewes and tested in the laboratory using an OFDA-2000 device. Substantial improvements occurred in the quantitative and qualitative wool characteristics, in particular fineness and wool length.

Table 61. Changes in wool quality of fine-wool young ewes from 2007 to 2009

Year	Output, %	Fineness, micron	Natural length, cm	Fleece weight, kg
2007	53.31	21.59	7.70	3.01
2008	59.23	21.82	7.81	3.30
2009	60.56	19.47	8.88	3.52

In fact the wool production in all age-sex classes except for young ewes increased from 2007 to 2009; the highest increase in fleece weight was observed for the breeding rams which was related to a substantial increase in liveweight (Table 62).

Table 62. Changes in wool yields obtained from fine-wool sheep from 2007 to 2009

Group	Fleece weights, kg								
	2007			2008			2009		
	n	average	total	n	average	total	n	average	total
Breeding rams	8	4.74	0.38	8	6.08	0.48	8	8.09	0.64
Ewes	160	2.96	4.73	216	3.51	7.58	380	3.57	13.57
Young ewes	70	2.68	1.87	73	2.12	1.54	74	2.37	1.93
Castrated rams	52	3.40	1.77	36	3.85	1.38	42	3.82	1.60
Average	**-**	**3.01**	**-**	**-**	**3.30**	**-**	**-**	**3.52**	**-**
Total	**290**	**-**	**875**	**333**	**-**	**1,100**	**504**	**-**	**1,774**

The farmer sold fine wool at the price of 40 soms or USD 1.03 in 2007, at a price of 80 soms or USD 2.02 per kg in 2008 and for 65 soms or USD 1.48 per kg in 2009. While in 2007 875 kg of fine wool were produced; the wool production at the farm increased to 1100 kg in 2008 and to 1774 kg in 2009. This increase was achieved by an increase in the total number of animals (from 290 to 504) and an increase in fleece weight per head. Accordingly the revenues from sales of fine-wool from one head

were on average 120 soms or USD 3.11 in 2007; in 2008 they increased to 264 soms or USD 6.69; while in 2009 the revenues slightly decreased to 229 soms or USD 5.22 per head (Table 63).

Table 63. Income from sales of the wool produced by fine-wool sheep from 2007 to 2009

Currency	Entire flock			Per 1 head		
	2007	2008	2009	2007	2008	2009
Som*	35,000	88,000	115,310	120	264	229
US$	804.5	2023	2650.8	3.11	6.06	5.25

*In 2007 1 USD=38.6 soms; in 2008 1USD=39.4 som; in 2009 1-USD=43.8 soms

Overall a growing demand and higher price for fine wool increased the profitability of Kyrgyz fine-wool sheep, which significantly affects the further development of fine-wool sheep breeding at this farm.

Coarse wool sheep

After evaluation of the coarse-wool sheep flock in May 2007, the farmers started to implement the recommendation of the researchers. 37 old ewes and 29 castrated rams were sold in September 2007. In October 2007 the farmer started mating with better quality rams bought at the local market. In the lambing period the owner and his assistants were trained how to take better care of the lambs and on disease prevention and treatment of lambs.

Coarse-wool ewes lamb in February. Fertility, twinning and mortality rate did not differ much between 2007 and 2008 and were lower than in fine-wool ewes (Table 64).

Table 64. Reproductive performance of fat-tailed coarse wool ewes in 2007 and 2008

Year	No of ewes mated	Lambs born alive (fertility)		Twin-ning	Lambs survived at weaning		Average live weight at weaning, kg
		no	%	%	no	%	
2007	103	98	95.1	7.6	84	87.8	31.5
2008	160	149	93.1	6.7	129	86.3	31.6

The average liveweight of lambs (at birth, at two weeks and at weaning) differed only slightly from 2007 to 2009 (Table 65). The weaning weight of coarse wool lambs was about 2 kg higher than in fine-wool lambs. Even though mating and lambing of coarse-wool sheep occurs about 1 month earlier than that of fine-wool sheep, which has the advantage of using summer pastures more effectively, the liveweights of the lambs at weaning were only by 2 kg higher than that of fine-wool lambs.

Table 65. Average live weight of coarse-wool young ewes by year

Years	Birth weight, kg	Weight at 15days, kg	Weight at weaning, kg
2007	4.2	7.4	31.5
2008	4.3	7.5	31.7
2009	4.4	7.9	31.6

While the liveweight of breeding rams was by 35 kg higher in 2009 than in 2007, the weight of young ewes differed only by 1.5 kg and the liveweight of adult ewes was 1.1 kg lower (Table 66).

Table 66. Average liveweight of coarse wool sheep by age and sex groups and year

Group	Age, year	Average live weight, kg		
		2007	2008	2009
Breeding rams	2-7	63.6	76.8	98.7
Ewes	2-7	54.6	52.4	53.5
Young ewes	1	44.2	46.8	45.7

Average fleece weights in all age-sex groups were higher in 2009 than in 2007; but the highest quantities were achieved in 2008 (Table 67). Ewes and rams produced nearly the same amount of wool, while female yearlings and castrated rams showed lower yields. The total yield increased from 296 kg in 2007 to 507 kg in 2009 due to the increase in fleece weights per head and an increased number of animals.

Table 67. Changes in wool production obtained from coarse-wool sheep from 2007 to 2009

Group	Fleece weight, kg								
	2007			2008			2009		
	n	average	total	n	average	total	n	average	total
Breeding rams	13	1.92	25	6	2.19	13	6	2.15	12
Ewes	91	1.54	140	150	2.20	330	189	2.07	391
Young ewes	59	1.19	70	35	1.30	45	43	1.23	52
Castrated rams	37	1.67	61	29	1.75	50	35	1.94	68
Average	**-**	**1.35**	**-**	**-**	**1.99**	**-**	**-**	**1.85**	**-**
Total	**200**	**-**	**296**	**220**	**-**	**438**	**273**	**-**	**507**

The price of coarse wool was 5 soms per kg and remained the same over the three years. Revenues from the sales of wool per head increased from 6.75 soms in 2007 to 9.95 soms in 2008 and to 9.25 soms in 2009 (Table 68), resulting in an increase in total revenues from wool production from 2007 to 2009. However as there is no market demand for coarse wool, the value of the wool hardly covers the shearing costs.

Table 68. Changes in the revenues from sales of coarse wool from 2007 to 2009

Currency	Entire Flock			Per 1 head		
	2007	2008	2009	2007	2008	2009
Som	1480	2190	2535	6.75	9.95	9.25
US$	34	50.3	58.2	0.15	0.22	0.21

All sheep from the farm were sold at Tokmok market at the price of 2,000 to 5,000 soms per head (USD 46-115). The average price of 1 kg of lamb was 230 soms (USD 5.3) regardless of the breed.

Conclusions

Clear improvements were achieved through the combination of high quality rams from Orgochor breeding station and improved management practices in the fine-wool flock of the farm, in particular higher fleece weights and wool quality were observed. Contrarily, no significant increases in liveweight development or reproductive performance could be observed in the coarse wool flock. The small increase in fleece weight was of no economic importance as there is practically no demand for coarse wool and the price is very low.

It was interesting to note that contrary to expectations the revenue per fine wool ewe was higher than for coarse wool ewes due to a relatively favorable wool price in 2008 and 2009 and the fact that the liveweights of the fine and coarse wool lambs differed very little and the market price for meat was the same.

3.3.2.3 Diversification of sheep production: potential for sheep milk production

Background

One option of increasing the profitability of sheep-farming given the low market prices for wool and relatively small number of animals could be diversifying the production through milk production. Sheep milk is rich in calories and protein and among the most nutritious foods.

Ewes were not milked in the cooperative farms in Kyrgyzstan during the Soviet time as the objective was to achieve maximum growth of the offspring. Hence, there are no specialized dairy sheep breeds. However, in the 1980s Kyrgyz sheep breeders selected within fine-wool and semi-fine-wool flocks for ewes with high milk yields. The aim was to increase the proportion of multiparous ewes using the high positive genetic correlation between milk production and multiparity in ewes. Thus, selection for high milk yields is not new in Kyrgyzstan.

However, the quickest way to increase milk production in sheep is crossing the local sheep with a milk-oriented sheep breed. As the local Kyrgyz sheep is a coarse wool fat-tailed genotype, Awassi sheep are seen as the most suitable exotic dairy breed.

The present study is the first attempt of the Kyrgyz scientists and farmers to create a breeding population of dairy sheep. Crossbreeding of local coarse-wool fat-tailed ewe with Awassi was started by Nurjan Abdymajitov on his farm "Kenesh" in 2002 with the import of one Awassi ram (ID 01068) from Kazakhstan. Nurjan Abdymajitov is a farmer and a livestock scientist at the Kyrgyz Livestock Institute and he used this experiment for his Phd thesis.

Methods of implementation

Kenesh farm is located in Onbirjilga village in Chu rayon in the Shamshi gorge at 1,800 meters above sea level at a distance of 18 km from Tokmak city, 75 km from Bishkek, and 10 km from Chuy (district center). The farm keeps 200 sheep, 9 cattle and 20 horses and has 200 hectares of pastures and 35 hectares of arable land.

In 2007 when the project started the farm kept 149 local coarse-wool sheep and a number of sheep with different proportion of Awassi genes – from 25% to 75% Awassi. The Awassi ram imported from Kazakhstan was 6 years old and had a liveweight of 85 kg. To increase the genetic pool two additional Awassi rams (ID 1058 and 01983) were bought from Kazakhstan and used for mating in autumn 2007.

As some neighboring household farmers perceived sheep milk production as an innovative and interesting idea, a community of 4 household farms in Progress village of Chuy rayon was formed with support from Kenesh farm (Nurjan Abdymajitov). The four households were Bakhtiyar Ashirov with 10 sheep, and Tolobek Esenaliev, Azimjan Tashbolotov and Altynbek Esenaliev with 15 sheep each.

Following activities were implemented by the project:

- Breed composition of sheep at Kenesh farm reviewed;
- Scheme for cross-breeding implemented;
- Phenotype and productive features of crossbred animals compared with the local breed;
- Milk production of crossbred and local ewes assessed;
- Sheep milk was converted to ayran and the ayran quality evaluated;
- Training of farmers and households trained on improved sheep management and selection of ewes for udder shapes.

Results

Kenesh farm

The breeding plan was based on further upgrading of the Awassi flock of Mr Nurjan Abdymajitov through the introduction of new Awassi rams. During the mating season in 2007 33 F1 Awassi crossbred (50%) and 26 local ewes were mated with the two new Awassi rams (no. 1058, 1983); 20 50% Awassi and 23 75% Awassi crossbred lambs were born in 2008. In the mating season 2008 80 ewes were mated and in 2009 21 50% Awassi crossbred and 17 75% Awassi lambs were born.

The liveweights of 50% and 75% Awassi lambs born in 2008 did not differ (Table 69). The local lambs born in 2009 had a smaller liveweight at birth than the crossbreds but from the age of 1 month onwards the local lambs were heavier than the crossbred lambs, except for 75% Awassi at the age of 84 and 148 days that had by 1.5 kg higher weights than the local (Table 70). That the local lambs

showed a similar growth to 75% Awassi lambs and that both grew better than 50% Awassi, means low or negative direct heterosis and/or low or negative additive Awassi effect. It also means high positive maternal heterosis and/or high or positive maternal additive effect. There are not enough genotypes to assess exactly the contribution of each genetic component but clearly Awassi honor their reputation for excellent maternal ability.

Table 69. Comparison of liveweights of Awassi crossbred lambs in 2008

Genotype	Sex	n	at birth	1 month
2008				
50 % Awassi	male	11	4.1	10.3
	female	9	3.8	9.9
75 % Awassi	male	11	4.0	10.2
	female	12	3.7	9.8

Table 70. Comparison of liveweights of local and Awassi crossbred lambs in 2009

Groups	n	Liveweights (kg) at age			
		birth	39 days	84 days	148 days
female	23	4.01	10.99	34.26	47.49
male	22	4.26	12.14	35.75	49.20
local	7	3.31	12.70	35.38	49.12
50 % Awassi	21	4.57	10.86	32.70	45.30
75 % Awassi	17	4.53	11.14	36.94	50.63

The 50% and 75 % Awassi crossbreds animals are clearly distinct by their physical appearance from local animals: with long legs and concave face profile, the typical white-brown color pattern and tail shape of Awassi sheep. Thus through upgrading the flock to Awassi the flock progressively takes the characteristics of Awassi (see Photo).

Awassi graded flock of Nurjan Abdymajitov: see ewes with typical Awassi features like yellow-white long stapled coat and light brown heads and extremities, "S" shaped tail and long ears.

No difference in liveweights in adult ewes was observed between 50% Awassi crossbred and local ewes in 2008 (Table 71).

Table 71. Live weights of crossbred sheep at Kenesh farm in 2008

Age and sex group of sheep	Genotype	n	Mean±se	CV,%
Ewes	50% Awassi	45	62.8±0.95	8.3
Ewes	local	29	62.1±1.62	11.7
6-month ewes	50% Awassi	3	36.3±0.67	3.2

The ewes were also evaluated with regards to udder shape. The visual observation showed that most of Awassi crossbred ewes had wide and long round-shaped udders with widely spread tits, but some also had loose round udder. In the mountains, too loose udders make it difficult for the sheep to move and may get damaged with subsequent emergence of mastitis. The local Kyrgyz coarse-wool ewes have round-shaped udder; some have hanging udders with big tits. The udders of the 50% Awassi ewes are 2-3 times larger than that of local ewes. It was recommended to the farmer to keep the Awassi crossbred ewes with convenient and distinct round-shaped udder with small conical tits close to its base. The udders should also be clearly separated into right and left halves.

To compare the milk production, lambs were separated from ewes on 10-15 July 2008 and milk yields of ewes recorded; ten 50% Awassi crossbred ewes and ten local ewes were hand-milked in the morning and in the evening. The average daily milk yield of 50% Awassi crossbred ewes was between 1.5-1.8 kg and of locals 0.9-1.3 kg in the 30 days of the experiment.

In the city of Tokmak within 18 km of the farm, there is a small dairy plant but its owner did not agree to process sheep milk because of small scale of production. Thus to increase farmer's income from sheep milk in implementation of the project, ayran was produced locally, and attempts were made to sell it in the market and to the tourists, and the guests of Shamshi spring, where in summer, especially on weekends, there are numerous guests. The farmer's assistant sold ayran at the price of 20 soms per liter, while the farmer sold it at 21 soms per liter in the city of Tokmak. The organoleptic test of ayran produced from sheep milk revealed that it is denser with less serum concentration and relatively higher fat content compared to ayran from cow-milk, and there is also no sour taste.

In order to directly compare the farmer's income from keeping crossbred Awassi and local sheep, in August 2009 the farmer sold 5 young 50% crossbred rams with an average live weight of 35 kg and 5 young local rams with average liveweight of 39 kg at the age of 3.5 months; the liveweight of the local ram was higher as the local ewe were not milked, and the lambs were still suckling. The carcass weight of the lambs was on average 16.8 kg (48%). The average price of 1 kg meat was 175 soms or USD 4.07in the bazaar of Tokmak city. The income from the sales of one crossbred lamb amounted to USD 68.37 and from ayran sales to USD 21.15 (1.5 l x 30days=45 liters x USD 0.47/l), in total USD 89.52 per ewe. The sale of one young local ram generated USD 76.1 (39 kg x 0.48=19.7 kg x USD 4.07/kg=USD 76.1). Potentially the farmer generated USD 13.42 or 577 soms more from Awassi ewes than from the local sheep.

Households in Progress village

The four neighbor smallholders started producing Awassi graded females for milking in the mating season 2007. They selected ewes based on reproduction traits and received the old Awassi ram provided by Kenesh farm. The households mated a total of 55 ewes and obtained 55 crossbred (50 % Awassi x local) lambs, of which 29 were female and 26 male (Table 72). The liveweights of the crossbred lambs at birth and at the age of 1 month were slightly lower in the households than at Kenesh farm.

In the mating season of 2008 the households in Progress village used selected Awassi crossbred rams from Kenesh farm to mate their ewes. All 55 ewes of the participating households that were mated produced live lambs. The growth of the lambs differed widely amongst flocks (Table 73), even at an early age. The lamb weights at 6 month age were not taken because the leader of the farmers participating in this Program (Esenaliev Tolobek) died in spring 2009.

Table 72. Liveweights of 50% crossbred Awassi lambs in the households in Progress village in 2008

Name of owner	No of ewes mated	Lambs sex	no	Liveweight, kg at birth	at 1 month
Bakhtiyar Ashirov	10	female	6	3.3	9.3
		male	4	3.6	9.6
Tolobek Esenaliev	15	female	7	3.2	9.2
		male	8	3.6	9.6
Azimjan Tashbolotov	15	female	8	3.2	9.2
		male	7	3.5	9.5
Altynbek Esenaliev	15	female	8	3.2	9.2
		male	7	3.6	9.6

Table 73. No of Awassi crossbred lambs born and their liveweight development in Progress village in 2009

Group	no	Liveweights (kg) of lambs* at birth	at 39 days	at 84 days
female	31	3.56	11.58	35.04
male	24	4.09	11.60	35.36
A Esanaliev	15	3.76	12.96	39.09
A Toshbolotov	15	3.87	10.41	31.71
B Ashirov	10	3.85	11.85	38.42
T Esanaliev	15	3.80	11.13	31.58

*Lambs obtained from mating of Awassi crossbred rams from Kenesh farm (ID 6299p, 6289p, 6234p) with local ewes.

Conclusions

The breeding plan and development of sheep dairy farming depended entirely on the Awassi crossbred flock established at Kenesh farm as the farm of took the role of a nucleus providing improved dairy rams to interested farmers. The experimental comparison of milk yields was useful in demonstrating the milk production potential of the Awassi crossbreds and thus the opportunity to start dairy sheep production to other farmers. However, milk production should be recorded systematically in the nucleus flock to allow selection for milk yields. This was economically not interesting for the farmer as he could not easily market the milk.

The participating households followed the agreed plan and mated selected ewes with the foundation Awassi ram in 2008 and again with selected Awassi crossbred rams in 2009. Indeed they obtained their first female 50% Awassi crossbreds in 2008, which lambed the first time in spring 2010. It is doubtful that the participants milked these ewes as additional skills in milking would have been required. More importantly farmers lack not only milking but also milk processing skills and obviously they also lack dairy product marketing experience. These aspects have not been fully considered by the participants and the technical team. Furthermore, as the leader of the households in Progress village died in spring 2009, this paralyzed much of the interest and work of the remaining farmers.

The difficulties of starting a sheep dairy business in Kyrgyzstan were underestimated by the Kyrgyz scientists. It turned out that the development of a market for sheep dairy products requires much more work as there is no tradition amongst sheep growers to milk their sheep and for consumers to buy sheep dairy products.

In summary the project proved that Awassi can be reared successfully in the Tokmok highlands and that sheep dairying is technically possible. However, to become a viable production option for the farmers in the region additional efforts and a clear business model would be required.

3.3.2.4 Community action to introduce improved management practices and a breeding program in Akbeket village

Background

Akbeket village is located in a zone of intensive irrigated farming in Chu valley. There are only small pastures areas around the village; the summer pastures are located in the distance of 50-150 km from the settlement. The flocks are grazed in early spring and autumn on the flood plain of the Chu river, on the borders of the water canals and on stubble fields, in the winter animals are stall-fed. Because of the limited fodder base, the household keep only small sheep flocks.

The project aimed at introducing a community approach to joint use of pastures around villages and summer pasture, genetic improvement of the flocks of local coarse-wool sheep and implementation of improved management practices. The recommended improved husbandry practices included:

- Organized grazing on the pastures around the village with strategic feeding in late autumn, winter and early spring periods;
- Preparation of sheds (mechanical cleaning, disinfection);
- Culling of unproductive ewes and optimization of flock structures;
- Monitoring of lambing;
- Monitoring of growth and development of lambs;
- Animal health control program.

Methods

Ten households agreed to follow the improved management scheme and they were encouraged to collaborate closely, in particular in the joint use of the remote pastures in summer, and in marketing. In autumn and winter the sheep were grazed on pastures around village and fed twice a day by a mixture of hay and straw. During the lambing period ewes were fed with concentrates following the recommendations of the scientists. A calendar of required veterinary measures for prevention of infectious and parasitic diseases over the 12 months of the year was developed and explained to the households. All households were provided with additional extension material.

In order to create the platform for access to genetically improved animals, household sheep farmers in Akbeket were encouraged to engage in a community breeding program. The design and implementation of the breeding plan with the aim to increase meat production started in October 2007. In order to produce offspring with higher liveweight and fast growth it was decided to use Aykol rams and mate them with the best available local ewes. The Aykol breed was developed from Kyrgyz local and pure-bred Gissar rams.

Originally all 10 households that implemented improved husbandry practices were also interested in the breeding scheme. But after farmers considered the risks involved by using a new breed and realizing the work involved, some declined to participate and others were excluded because of the low quality of their ewes. Finally five farmers were actively involved in the breeding plan:

1. Joldosh Mambetaliev: 3 ha irrigated cropland of alfalfa; 2 cows, 1 heifer, 3 calves, 6 sheep, 10 chicken;
2. Shaken Rysbekov: 5.1 hectares of irrigated cropland (esparsette and alfalfa); 26 sheep, 2 goats, 4 cows, 4 calves;
3. Keldybek Toktogonov: 3 ha cropland with alfalfa and barley; 25 sheep;
4. Erkin Toktogonov: 3 ha cropland with alfalfa, wheat and barley; 23 sheep;
5. Aman Omorov: 5 ha irrigated cropland with alfalfa; 26 sheep, 2 cows, 2 calves, 1 horse with colt.

Data were also taken from 3 control households in Akbeket village:

1. Talay Duysheev: 3 ha cropland with alfalfa and wheat; 27 sheep and 1 cow;
2. Talay Moldaliev: 1.5 ha cropland with alfalfa; 10 sheep, 1 horse;
3. Kalys Aydaraliev: 2 ha cropland with alfalfa and barley; 20 sheep, 1 cow, 1 calf.

In the control flocks rams and ewes were kept together for entire summer, thus, most ewes came back pregnant from pastures. The rams and ewes were of different colors and wool quality, with and without small fat tails.

Akbeket breeding plan participating farmers from left to right: Joldosh Mambetaliev, Shaken Rysbekov, Aman Omonov and Erkin Toktogonov (missing on the photo is participant Keldibek Toktogonov).

Two community members (Shaken Rysbekov and veterinarian Joldosh Mambetaliev) traveled with the scientists to the Aikol farm in the Tonsk district and selected 4 foundation rams. During the first year one ram died and another got lame. These two rams were replaced with two new rams (Numbers: 5890 and 5894). All rams performed very well in terms of quality of the progeny produced. . Average live weight and exterior indicators of imported ram-producers conformed to the requirements of breed standard. Their live weight at the time of procurement in October 2007 was on average 72 kg and increased to 79.5 kg in September 2008. As indicated by body measurements the Aykol rams were tall (76.3 cm height at withers) and large (75.3 cm body length and 97.8 cm chest girth) at the age of 1.5 years.

Results

The implementation of the plan commenced with selection of the best ewes in the 5 participating flocks for mating with the 4 Aikol rams. 83 ewes were selected visually and based on body weight (Table 74). The ewes in the control flocks were also weighed (Table 75). Mating started 17 November 2008 in individual household groups. There were 4 mating groups since the ewes of Joldosh Mambetaliev joined the ewes of Shaken Rysbekov for mating. The recording of mating dates was conducted by one of the farmers, Joldosh Mambetaliev. The total progeny obtained from the matings was 82, 49 females and 33 males.

Table 74. Liveweight(kg) of selected ewes in the mating program

Participating farmers	Nov. 2007		Sept. 2008	
	n	kg/head	n	kg/head
Rysbekov, Sh	19	54.3	19	53.8
Mambetaliev, J.	6	56.0	7	57.0
Toktogonov, E.	20	60.6	13	51.8
Omorov, A.	16	62.9	14	64.1
Toktogonov, K.	20	63.0	13	60.3
Total/Average	**83**	**60.0**	**66**	**57.7**

Table 75. Liveweight(kg) of ewes in the control flocks

Control farmers	Nov. 2007		Sept. 2008	
	n	kg/head	n	kg/head
Duysheev, T.	23	53.1	20	54.2
Moldaliev, T.	10	50.1	8	52.3
Aydaraliev, K.	16	52.4	17	53.3

Left: Joldosh Mambetaliev holds one of the Aykol sires; right: farmers explain merits of Aykol progeny.

Birth dates, birth type and weight were taken on the second day of birth and the lambs were ear-tagged in the experimental and the control flocks. All lambs were weighed at about one month of age and retained as inferior males will be castrated after the animals return from summer pastures. In 2008 this was on 10 September earlier than planned due to the intense drought. Thus, on 28 September all lambs were weighed again. The offspring of the Aykol rams showed higher liveweights at all three recording dates but this difference was only significant at 6 month (Table 76). The farmers perceived the offspring from Aikol as larger and more viable than the local offspring.

Table 76. Liveweight development of lambs from the breeding program and control flocks in 2008

Group	No	Liveweights (kg)		
		Birth weight	1 month	6 months
Breeding program				
Young ewes	49	3.3	9.3	36.7
Young rams	33	3.5	9.6	39.7
Control flocks				
Young ewes	27	3.1	8.9	35.1
Young rams	22	3.3	9.2	38.2

Ten six-month-old young rams with average live weights of 39.8 kg were selected for future use as breeding rams. (weights varied from 27.5-45.7 kg with a variation coefficient of 12.6%). In the winter and spring they will be fed well and maintained in good conditions. A final individual appraisal was done in May 2008 at the age of 12-13 months and they will be kept for replacement of producer rams. The other young male were recommended to be culled. Based on the same scheme 26 young ewes at the age of 6 months with an average body weight of 37.7 kg were selected (weights varied from 28-48 kg with a variation coefficient of 13.2%).
After return of the ewes from summer pastures before mating also adult and 18-month old ewes were examined and it was recommended to cull rejected ewes.

The second mating of ewes was conducted from 1-30 October 2008. 66 ewes kept by the five participating farmers were mated with 4 Aikol sires (5890, 5902, 5894 and 5901). Ewe fertility was 100%. It can be observed that at birth (mid March 2009), April and May there were no differences between the improved and control groups of flocks (Table 77 and 78). This is thought to be due to the severe drought which forced to feed the animals in-house on a fairly similar diet. Differences start to build at 5-months of age (25 August weighing) when animals were run on summer pastures. At about 7-months of age (27 October weighing) the difference between improved and control females and males were 2.7 and 2.1 kg, respectively, in favor of the improved group.

Table 77. Liveweight development of lambs (kg) in the Aikol breeding program in 2009

Groups	**n**	**Liveweight (kg)**				
		at birth	**15 April**	**9 May**	**25 Aug.**	**27 Oct.**
female	39	3.30	10.38	21.26	34.29	47.70
male	27	3.73	10.44	21.28	36.66	50.26
A Omorov	14	3.52	10.38	20.55	34.03	47.53
E Toktogonov	13	3.49	10.27	21.41	36.99	50.24
J Mambetaliev	7	3.45	10.17	22.08	34.44	48.20
K Toktogonov	13	3.52	10.66	21.24	35.54	49.02
S Rysbekov	19	3.60	10.56	21.09	36.36	49.89

Table 78. Liveweight development of lambs (kg) in the control flocks in 2009

Groups	**n**	**Liveweight (kg)**				
		at birth	**15 April**	**9 May**	**25 Aug.**	**27 Oct.**
female	29	3.30	10.17	21.88	31.26	45.04
male	16	3.56	10.30	22.52	34.24	48.14
K.Aydaraliev	17	3.38	10.24	22.33	33.33	47.16
T.Moldaliev	8	3.44	10.51	22.31	32.52	47.43
T Duysheev	20	3.46	9.96	21.96	32.40	45.18

It is important to note that the 5 farmers involved in the breeding program also implemented improved management strategies which include health, feeding, mating and culling techniques. Thus the experimental design does not allow isolation of genetic (introduction of the Aikol rams) and environmental effects (improved husbandry practices). Since the health calendar was applied to flocks of both groups and strategic feeding was limited due to the scarce feed available, it can be safely assumed that the stronger effect must have been the genetic effect.
An additional and very important result has been the price difference achieved by Aikol crossbred males as compared to regular males. Ten crossbred males were sold at 80-90 USD whereas the local males were sold at less than 60 USD. Members of the improved group acknowledged this monetary benefit from the sale of crossbred animals but also mentioned the opportunity to offer these animals as highly appreciated gifts on special occasions.

Conclusion

It is not be easy to provide conclusive results as intensity of data collection and the level of adopting recommended practices differed between the three groups of households in Akbeket village

("improved management and breeding", "improved management" and "traditional management"). The activities related to improved management were based on intensive training of farmers, the development of extension brochures and active implementation of an animal health control program. Unfortunately the Kyrgyz project team did not present any results from the comparison between the five improved flocks that did not participate in the breeding program and the control flocks to assess the effect of improved management on flock productivity. Furthermore, even though the number of control farmers in Akbeket village had been increased to five farmers in autumn 2008, no data from the farmers T. Ibraimov and M. Jumabekov were presented in the final report.

Nevertheless, the discussion of the results from the management and genetic improvement program with the ten community members and the owners of household farms serving as control group indicate that all of them are convinced that farmers groups as established by the project are a prerequisite to improve the productivity of their sheep flocks.

The implementation of the breeding plan advanced well. The present breeding plan required weighing at about 1-2 months of age (previous to summer pasture grazing) which allows the evaluation of milking ability of ewes if birth dates are available to adjust weight for age of lamb. In the usual management system the October weighing (at about 6 months of age) becomes important because at that stage male candidates are retained for winter feeding. The premise is to minimize recording needs given the restricted conditions of the farmers, but establishing a discipline that farmers could follow on a sustainable manner after the end of the project. Without recording, genetic progress is still possible but at a much lower rate and independence from an external ram source would become more difficult. However, the experience has been that data adjustment procedures and breeding value estimation is not yet evenly understood by all scientists involved.

Complete pedigree keeping is not obligatory but pedigree information tied to performance recording greatly improves selection accuracy and therefore genetic progress. Given the small numbers of animals involved, identification of the dam of a lamb is quite easy, and given the mating system (mating occurs in individual households) it is also easy to record the corresponding sire. The important point is to realize that it is important to only record factual data and, if there are doubts, it is preferable to consider it missing.

Even with the short implementation period of this program the outcome can be regarded as positive and more farmers are interested in introducing Aikol rams. But intense technical support would still be needed for a number of years but progressively the work has to be taken over by the participating farmers. For this to happen it is important that farmers can see the benefit of the breeding plan. This may happen in several ways, including a visual improvement of animal quality, an objective improvement in animal produce, the availability of home grown good rams, the income through sale of rams to other flocks, etc. It also will be important to progressively convey responsibilities to farmers and for this training is needed. Scientists will need to continue to explain the rationale behind the required activities. It was agreed that the Akbeket work will continue after the end of the project with the support of the Veterinary Institute.

3.3.3 Improving Mohair production in Khujand/Northern Tajikistan

3.3.3.1 Background

The Angora goat production in Sogd Province and the processing of Mohair fiber is of high socioeconomic significance for Tajikistan. Approximately 250,000-300,000 people are involved in production of Mohair primarily in the northern and some southern districts. Tens of thousands of residents (women) are involved in processing (yarn and finished products: mittens, socks, shawls, scarves, pullovers, etc.) and hundreds are involved in the sale of raw materials and semi-finished products.

In the past the Angora goat production has been supported by a governmental breeding program established during the Soviet period. Until recently, the majority of Angora goats have been produced on large state farms that had to follow governmental guidelines on breeding and fiber quality. Breeding was under the control of state research institutes such as the Livestock Institute in Khodzhand applied selection standards approved by the Ministry of Agriculture. These standards reflected the processing needs of Russian textile mills that produced mostly coarser, utilitarian clothing made from mohair and wool blends. As a result, priorities were placed on characteristics such as fleece weight and fiber length as opposed to fineness. Shepherds who raised their own animals together with the state flocks used breeding bucks produced by the state farms and did little of their own selection work. The Angora production survived the breakdown of the Soviet Union collapse of the Soviet union because the demand for raw mohair as well as yarn and knitted products produced by Tajik women has been relatively stable in Russia. Relying on old Soviet ties, Russian factories have been purchasing lower grade mohair to produce tops and cottage industry processors in the Caucasus region bought higher quality mohair to make scarves, pullovers and other clothing. Overall, 70-90% of Tajik mohair is exported to Russia each year and the remainder is sold to Kazakhstan, Kyrgyzstan and China.

A herd of Angora breeding bucks produced at a state farm, April 2008.

Based on the Russian market standards, the most expensive fleeces have been those of adult animals while fine, kid fleeces have been considerably underpriced – in 2008, kid mohair prices were $28/kg on the global market and $3-4/kg on the Tajik market. This can be explained by Russia's traditional mohair processing needs – coarse, adult fleeces can be processed into thick, brushed mohair products (scarves, shawls and pullovers) by the Russian cottage industry. Thus, the preference for male adult (i.e. coarse) mohair that has shaped mohair prices and breeding priorities in Tajikistan is unique to Russia. In contrast the global mohair markets show strong preference for fine kid mohair that is used in luxury clothing.

Market for mohair products that are exported to Russia, October 2008.

During the last decade the conditions that favored Angora goat production have started to change in ways that may threaten the long-term survival of the Tajik Angoras and the livelihoods of farmers and women who depend on mohair sales and processing. The state-run Angora goat farms are being privatized but the necessary support infrastructure for private producers (i.e. breeding programs, extension and marketing services) is not being developed. The lack of management skills and organized breeding leads to a decline of the quality of national Angora flock that is now mainly kept by a multitude of small farmers. The Russian mohair markets the Tajik producers depend on have been depressed since 2008 due to the global economic crisis that also impacted Russia. The mohair prices have plummeted from around $10 per kg in 2008 to $3 per kg in the spring of 2009. The recent decline in mohair prices has led some producers to start breeding their Angora goats to local meat goats. If used more widely, this strategy could threaten the survival of the Angora breed and jeopardize new sources of income from value-added mohair processing that are being developed by the ICARDA project. This would further limit the scarce earning opportunities of poor rural women many of whom depend on sales of mohair yarn and products for livelihood.

Private farmer Tuisumboi with black Angora kids, May 2009.

Thus, the main project objective in Khujand was to improve the productivity of Tajik Mohair goats and at the same time facilitate access of Mohair producers and processors to global markets to receive higher prices for fine, quality mohair yarns and other products.
Specific objectives included

- to increase the overall productivity and performance of the goats through testing a number of low-cost farming methods to improve flock productivity and farmers' income.
- to assess the quality of Tajik mohair through collection and analysis of mohair samples from multiple farms, and production and test-marketing samples of yarns and knitted products from different types of mohair
- to improve some of the main shortcoming of Tajik mohair such as the high percentage of kemp and medullated fibers and the high average fiber diametetr through an organized community based breeding program
- to improve the quality of value added products from Mohair goats in order to access international markets.

Main project activities included:

1. Improvement of the goat flock productivity through implementing affordable management practices
2. Development a new draft standard for classification of the Mohair based on international commercial requirements
3. Creation of a decentralized and joint plan for breeding for farmers' access to improved animals
4. Local processing of mohair by women to add value Angora mohair and market opportunities for processing.

3.3.3.2 Testing and implementing low-cost management practices to improve goat productivity

A number of acceptable and affordable management interventions were pilot-tested and implemented with the aim to improve flock productivity and overall management of Mohair goats.
Two groups of farmers were established for this purpose – an improved group and a traditional group. The most important criterion for the selection of the farmers was their willingness and commitment to participate in the project and in the case of the improved group to agree to implement the proposed management practices. The goat farmers were located in Karajingil and Takli at medium altitude in the foothill area and in Uyas village in the adjacent plain area (see 3.1.1.3 and Annex 1).
Table 79 gives an overview of the husbandry practices that were implemented in the "improved" flocks (five farmers) compared to the common practice in the "traditional" flocks. In 2007 13 traditional flocks were selected, but data collection became very demanding. Thus the number was reduced to only 7 control flocks with good information (about the same number as "improved" flocks). A first monitoring of the participating flocks showed that the flock size per households (min=25, max=190) as well as the composition of the flocks – the proportion of animals in certain sex and age groups – differed greatly between the farmers (Table 80). One farmer did not keep any breeding buck and borrowed from other farmers. Based on this first assessment the management practices to be introduced in the improved flocks were defined as strategic culling, improved feeding and animal health measures, recording of flock dynamics, tattooing and performance measurements of animal for their evaluation.

Table 79 Comparison between improved and traditional farmers

Experimental group:	**Traditional (control) group:**
Recording of changes in the flocks according to age and sex groups introduced (Flock rotation form)	No records taken
Optimization of flock structure	Optimization of flock structure not done
Recording of flock productivity - Number of kids born and their weights (at kidding, 1, 2, 6 month age); - kids survival rate till weaning; - Sheared fiber yield	Recording of flock productivity: some owners record total sheared fiber yields
Individual record keeping for nucleus animals and tattooing	Animal identification and Individual record keeping not common, was only used in state farms
Evaluation of fiber quality in spring	Evaluation of fiber quality not done
Evaluation and classification of all animals in the flocks and determining their purpose in autumn (pedigree, production and culling)	Classifying and culling animals is not done in a systematic way
Strategic and balanced feeding (taking into account requirements and available feeds)	Additional feeding in the winter period is only done in very harsh weather conditions without taking into account physiological condition of the animals
Well planned veterinary intervention with regard to prevention of infectious diseases and parasites	Veterinary treatments are only conducted in case of disease

Implementing recording of flock changes by age category and sex and optimization of flock structure

During the interaction with the farmers it became apparent that the owners of goats do not keep any records on their goats and do not calculate their benefits. This is even the case for larger-scale farms, with 200-300 of goats. Many only know the number of heads. For this purpose a simple recording format was developed in local language and distributed in a booklet to the participating farmers (Farmer's book). The main aim is to train farmers in recording and assessing their flock structure as a first step towards its optimization with regard to increasing the proportion of productive animals and thereby the economic output. The booklet also contains a monitoring form (Record 1) on herd dynamics (entries and offtake from the flocks per age category for a specific period) to initiate performance recording at the farms.

Every farmer in the improved group learned to periodically fill-in the forms in the handbook- at the beginning of the year, after the kidding, before the animals were taken to the summer pastures and after return from summer pastures and closer to the end of calendar year. This enables the farmers to control the flock structure throughout the year and to start an economic analysis.

As a result of the recording and the associated training the flock composition in the improved group was gradually optimized taking into account the availability of pastures, farmers' plans for the future flock size, required replacement animals and willingness to form a breeding nucleus. For instance, in the flocks of the improved group of farmers, the percentage of female goats increased from 36.1% to 45.2% at the expense of non-productive animals that were culled (Table 80). There was also an improvement in the traditional group – at the beginning of the project the percentage of female goats averaged 29.3% (27.5-36.0%) and at the end this value reached 38% (33.7-44.1%) – but even the increased percentage was still too low. In the improved group after a thorough evaluation the best

breeding bucks were kept, while low value ones were culled. Thus, the percentage of 1.9% bucks (1 breeding buck per 24 female goats) in 2009 now corresponds to the norm. In most flocks of the traditional group there is a surplus of bucks with an average of 1 buck for 7.3 does meaning that the number of bucks is about 4 times higher than required (Table 81).

Table 80. Changes in the Composition of Goat Herd in the improved Group

Farmer's name	Start of the project (April 2007)					End of the project (October, 2009)				
	Total	Reproductive group				Total	Reproductive group			
		Does		Bucks			Does		Bucks	
	head	head	%	head	%	head	head	%	head	%
Turgunboy Madaliev	160	50	31.1	6	3.8	181	93	51.4	4	2.2
Rakhmon Askarov	126	48	38.1	6	4.8	115	47	41.0	2	1.7
Abdunazar Matazimov	556	210	37.7	5	0.9	190	81	42.6	3	1.6
Sherali Tilloev	110	35	31.8	4	3.6	102	44	43.1	2	2
Sulaymon Umarov	146	53	36.3	3	2.1	136	62	45.6	3	2.2
Total	**1098**	**396**	**36.1**	**24**	**2.2**	**724**	**327**	**45.2**	**14**	**1.9**

Table 81. Changes in the Composition of Goats in the Traditional Group

Farmer's name	Start of the project (April 2007)					End of the project (October, 2009)				
	Total	Reproductive group				Total	Reproductive group			
		Does		Bucks			Does		Bucks	
	head	head	%	head	%	head	head	%	head	%
Abduvohid Mamatkulov	85	24	28.2	8	9.4	101	34	33.7	8	7.9
Abdurahmon Hayitmatov	40	11	27.5	3	7.5	48	19	39.9	3	6.2
Abdumalik Khanaev	90	23	32.8	4	4.4	68	23	33.8	4	5.9
Komil Mamatkulov	25	9	36.0	1	4.0	34	15	44.1	1	3.0
Ravshan Dushaboev	60	18	30.0	0	0	61	23	37.7	0	0
Abduvakhob Uskanov	70	21	30.0	5	8.3	45	19	42.2	5	11.1
Boir Parpiev	50	17	34.0	2	4.0	38	17	44.7	2	5.2
Total	**420**	**123**	**29.3**	**23**	**5.5**	**395**	**150**	**38.0**	**23**	**5.8**

Evaluation of individual animals for culling and breeding

In order to help farmers in the culling process, a simplified evaluation system was developed that considered the two main products from Angora goats – mohair and goat meat. Visual estimation of goats in the improved group was done in autumn when the majority of animals were in good (well-fed) condition. The aim was to select "best" animals and cull those that do not meet the standards. The goats were selected by visual appearance of wool quality (wool density, length, thickness, luster, winding of plaits) and size by age and sex. The best goats were marked with cutting of the hair of tail. For culling of goats following criteria were used:

- animal age; usually bucks and does using as reproductive part of flock up to 6-8 years, castrates up to 5 years for wool and meat. degree of the erasure of cutter teeth

- bad quality of wool: the large proportion of kemp in the wool, heterogeneous length on different parts of the body (for example, the difference between the length of wool on the thighs and the sides composes 3 cm or more)
- too small (size relative to their contemporaries in the herd).
- explicit defects (sick, blind and others).
- opinions of farmers (also the number of to be culled animals has to be adjusted to the flock size)

A simplified evaluation sheet for classifying (grading) was developed to facilitate the selection process by the farmers taking into account meat and fiber production (Table 82).
Wool productivity through the letter "W":

- "**-W**" – unproductive;
- "**W**" - normal;
- "**+W**" - good wool productivity.

Size of animal associated with liveweight (individual weighing carried out at two farms was used for developing the scale and train for the visual estimation. The liveweights of the female adult goats ranged from a minimum 24 kg to a maximum 33 kg, accordingly females with 28 kg were classified as "average") represented through the letter "S":

- "**-S**" - small animal;
- "**S**" - average;
- "**+S**" - large.

Condition ("fatness") designated by letter "F":

- "**-F**" - getting emaciated fatness;
- "**F**" - average fatness;
- "**+F**" - good fatness.

Aggregating the individual estimates, the animal is then classified as:

- "**N**" - pedigree (for nucleus);
- "**U**" - for user purposes;
- "**C**" – for culling.

Table 82. Recording sheet for individual estimation (grading, classification) of goats (example)

Animal Eartag	Age	Sex	Liveweight	Fatness	Wool productivity	General estimation
7	**1-1.5**	**f**	**+S**	**-F**	**W**	**U**
98	**4**	**m**	**+S**	**+F**	**+W**	**N**

Special attention was given to the selection of the replacement animals (2.5 years age and also 1.5 years old goats) with a good size were selected. The rejected goats were assigned to sales, fattening, more well-fat animals for slaughter (home consumption or for sale meat on the market). Systematic culling as an important management practice is new to the farmers and requires convincing as this idea is against the farmers' traditions who tend to preserve the number of animals in their flock and cull as little animals as possible. In addition to the improved group, also two farmers (Abdurahmon Khayitmatov, Boir Parpiev) in the control group carried out culling in theirs flocks.

Improved feeding with taking into account goats' requirements and local availability of feeds

The goats can meet their nutritional requirements only on the summer pastures from July to September. Consequently, critical shortages occur in late fall, winter, and early spring. In particular, during harsh winter days, when goats cannot graze on the pastures, they need to be hand-fed. Supplemental feed primarily consists of hay, which is produced by farmers in the summer or bought. Hay is produced from fodder crops like alfalfa and sorghum cultivated on homestead plots. Straws from cereals (wheat, barley, corn, beans, etc.) are also used. Some farmers produce hay from mountain pastures, which has a high dry matter content and good nutritional value. Farmers, able to do so, feed their goats with small amounts of concentrated feed in the later periods of pregnancy and kidding. Based on the actual situation observed by the researchers farmers were trained on basic principles of

strategic feeding of female goats in the last 1.5 months of pregnancy and beginning of lactation before the green feed in the pastures becomes again available.

The winter 2007/2008 in Tajikistan and in whole Central Asia was the longest and coldest for the last 40 years. It lasted from middle of December till February with temperatures up to -27ºC. Most of the winter the animals could not graze on the pastures. The feeds for the goats stored by farmers for the winter period were consumed much quicker than foreseen. The project supported supplemental feeding of pregnant and lactating does with oat grains (100 g per day per animal) for one month in the six improved farms.
The project also introduced mineral supplementation from local sources, namely bentonite clays. The basic components of bentonite clays are silicon (19.6%), aluminum (5.4%), calcium (10.4%), magnesium (3.0%), iron (1.2%) and phosphorus (0.5%), and others in the range from 0.001 to 0.1%. The mineral supplement promoted by the project is offered in the form of briquettes, composed of bentonite (35%), bone meal (4.7%), copper sulfate (0.2%), potassium iodide (0.1%), and common salt (60%). These briquettes were regularly offered to the goats in the improved group in the winter and spring at libido. After a short period of customization the goats ate the briquettes with great pleasure.

Preventive Animal Health measures
Infectious and parasitic goat diseases are among the main problems of successful development of goat farming in the region. Farmers practically do not use modern veterinary practices for prevention of animal diseases and their treatment. Thus, the project prepared and issued a short farmer's guide (see section 3.4.6.2) and trained the farmers. The Guide introduces the main diseases of mohair goats in the region, also indicating treatment and prophylactic methods. It contains a calendar of veterinary, sanitary, and prophylaxis activities for goat farms. According to the veterinary law of Tajikistan, especiallyepidemic diseases are controlled by state veterinary and service, that conduct prevention and eradication programs. Thus, these diseases were not included into the project activities..
According to the health plan, the farmers of the integrated group were trained in preventive activities, which were supposed to be conducted periodically. They were also provided essential veterinary drugs (neocydol, Ivermectinum, Alben, albendazolum, etc.). In September the farmers bathed their goats in the water solution of Neocidol against the parasites; in September-October all farmers in the integrated group and some farmers in the control group gave albendazolum (suspension or tablets) to their goats against helminthiasis. In the winter period some goats (especially young animals) suffer from lice. Because of the cold they cannot be bathed, so farmers sprinkle in the abdominal and inguinal region, where lice are most accumulated, with a solution of Neocidol. This method is not very effective. Therefore, it is recommended to the farmers use injection of ivermectinum instead which controls mange and other parasitic skin diseases and will greatly reduce loss of mohair and reduced quality.

Effects of improved management on animal performance
In spring 2008 the individual animals in the improved and traditional flocks were evaluated and compared (Table 83). Liveweight of bucks in the improved group was by 11.7% higher than in the control group. For does this difference was 6.4%. Fiber length of the animals in the improved group was greater than for animals of the same age in the control group. Fiber fineness of the goats of control group was less uniform than in the improved group. The highest fiber yield per head (2.95 kg) was obtained from bucks in the improved group, which exceeded the yield in the control group by 40.5%. Average sheared fiber yield from does in the improved group was 1.55 kg and 17.4% higher than in control group. The superiority of the improved group over the control can be explained through the introduction of the culling strategies and additional feeding (concentrates and mineral) but the flocks might have already differed at the start of the project.

Table 83. Results from individual classification of the adult goats in spring 2008

Groups	Sex	No.	No. of kids at birth (kidding %)	No. of kids at 6 month (survival rate %)	Animals' evaluation				
					Live weight autumn (kg)	Natural fiber length (cm)	Fine-ness (Bradf.)	Fiber yield (kg) total	Fiber yield (kg) per head
Experi-mental	m		-	-	52.2	21.5	48-46	71	2.95
	f	394	284 (72)	272 (96)	29.8	18.2	56-48	820	1.55
Control (Trad.)	m		-	-	44.5	19.0	56-48	65	2.10
	f	164	90 (55)	81(90)	28.1	17.5	58-48	363	1.32
Difference (exp. to control)	m		-	-	+7.7	+2.5	-	+5.8	+0.85
	f		+17 %	+6 %	+1.7	+0.7	-	+457	+0.23

Economic Analysis of the effects of improved management

To assess the cost effectiveness of the introduced improved management practices, a cost-benefit analysis was performed for three farmers each of the control and the experimental group. The goats in the improved group were heavier and related revenues were higher than in the control group. In the local market the price of 1 kg of mohair is within a wide range depending on its quality. More uniform hair without or with little kemp, with luster is valued far more than not uniform hair with a lot of kemp and low or dull luster. Goats of the experimental group were characterized by better quality mohair.

Table 84 shows that more profit was generated from the improved goats compared to the group of control goats. The profitability in the experimental group was with 279% slightly than in the control group (297%) but the difference is negligible given that the net benefits per goat were considerably higher in the experimental group.

Farmer Turgunboy Madaliev achieved by far the highest benefits from the sales of mohair per one goat. He sells it in Russia, where his son is employed.

Table 84. Average benefits and costs in goat-production by farmers in the experimental and control group for one Mohair goat (TJS)

Name	Total revenues	Including				Total expen-ses	Including				Net bene-fits
		weight gain	Mohair fleeces	sale of goats and meat	milk yield		feed costs	veterinary medicines	seasonal worker	pasture rent	
T. Madaliev (n=184)	**245**	45	105	55	40	**73**	55	2.5	8.5	6.5	**172**
S. Umarov (n=136)	**135**	32	35	30	38	**40**	37	2	0	0.8	**95**
K. Mamarasulov (n=107)	**173**	38	45	42	48	**33**	30	2	0	0.7	**140**
On average in exp. group	**184**	**38**	**62**	**42**	**42**	**49**	**41**	**2.2**	**2.8**	**2.6**	**135**
A. Hayitmatov (n=40)	**95**	23	25	15	32	**23**	21	2	0	0	**72**
R. Dushanboev (n=60)	**101**	25	38	18	20	**28**	27	0	0	1	**73**
A. Mamatkulov (n=112)	**129**	28	30	46	25	**31**	25	1.2	2	2.5	**98**
On average in control group	**108**	**25**	**31**	**26**	**26**	**27**	**24**	**1.1**	**0.7**	**1.2**	**81**

3.3.3.3 Assessing Mohair quality and developing a new draft standard for classification of the Mohair based on international commercial requirements

The following activities were conducted:

- collection of samples for laboratory analysis in Almaty;
- developing a draft new standard for classification of Tajik mohair taking into account international norms.
- conducting of training with farmers and scientists on international qualities standards;

Collection of fiber samples for Almaty laboratory analysis

To study the variation in Mohair quality samples were taken from Angora goats of different sex and age groups at the time of shearing in two consecutive years (2007 and 2008) from flocks of the improved and the control group, and from cooperative and state farms.

In 2007 89 samples were sent to Almaty wool laboratory (Table 85); in 2008 another 671 fiber samples were collected in spring and 69 samples in autumn (Table 86).

Table 85. Number of Mohair samples collected in 2007 from different age and sex groups of goats

Sex-age group		Total no of samples	Tests of samples undertaken in Almaty wool laboratory			
			Group I		Group II	
			white	colored	white	colored
Yearlings (1 year)	f	47	19	1	3	4
	m	17	6		-	2
2 year old animals	f	21	5	4	3	2
	m	12	5		1	1
Adults (3-5 years)	f	64	13	4	1	3
	m	22	10		-	2
Old animals (≥6 years)		17			-	-
Total		**200**	**58**	**9**	**8**	**14**

Table 86. Number and characteristics of samples collected in 2008

Age and sex groups		White		Colored		Total
		Number	Sample no	Number	Sample no.	Number
Autumn shearing						
Young animals, 6 months (super kid)		26	801-872	14	873-886	40
Adults (2-6 year)			887-915			29
Spring shearing						
Yearlings	f	86	001-099	61	C001-C061	147
(1 year)	m	41	101-161	15	C101-C115	56
2 year old	f	78	201-293	25	C201-C225	103
animals	m	93	301-393	13	C303-C315	106
Adults (3-	f	64	401-(499-13)	18	C401-C418	82
5 years)	m	80	501-(599-22)	25	C501-C525	105
Old animals (≥6 years)	f & m	67	601-667	5	C601-C605	72
Total		**509**		**162**		**740**

The results from the laboratory analysis in Almaty show that fiber fineness is clearly decreasing with age in both white and colored goats, while fiber length does not show a homogenous trend in relation to age (Tables 87 and 88). Colored goats have slightly shorter fibers than white ones and in some age classes the fiber was finer. The fiber from males is coarser than from females. These results indicate that grading by age and sex will be useful to achieve higher market prices for Angora fiber as soon as the farmers will have access to other market outlets that the Russian market.

Table 87. Results of fiber analysis from white Angora goats sampled in 2007 by age and sex (Almaty laboratory)

Age group	Sex	Average length, (mm)	Fiber diameter (µm)	Coefficient of variation (%)	Comfort factor (% fiber, thinness not less than 30 µm)	Average crimp (mm)
Yearlings (1 year)	f	186.3	26.4	28.37	73.3	16.0
	m	180.8	26.2	28.17	73.7	14.9
2 year old animals	f	199.9	27.8	28.25	66.1	16.3
	m	165.0	35.8	26.60	28.3	12.1
Adults (3-5 years)	f	195.1	31.0	32.75	53.6	14.5
	m	213.0	38.8	30.05	25.2	14.4
Old animals (≥6 years)*	f & m	192.5	42.1	33.06	-	-

*Analysis done in the laboratory of the Tajik Livestock Research Institute

Table 88. Results of fiber analysis from colored Angora goats sampled in 2007 by age and sex (Almaty lab)

Age group	Sex	Average length, (mm)	Fiber diameter (µm)	Coefficient of variation (%)	Comfort factor (% fiber, thinness not less than 30 µm)	Average crimp (mm)
Yearlings (1 year)	f	110.0	21.8	29.5	93.2	23.7
	m	183.0	26.8	33.0	69.0	19.7
2 year old animals	f	165.5	29.7	29.1	56.6	15.4
	m	157.0	30.6	29.0	56.9	14.4
Adults (3-5 years)	f	182.0	30.2	31.6	53.8	16.1
	m	190.4	34.5	32.9	37.2	17.1
Old animals (≥6 years)	f & m	174.1	39.4	32.1	26.8	14.8

The results of the larger number of Mohair samples tested in 2008 confirmed the results from the smaller sample in 2007 (Table 89). The difference in fiber fineness between white and colored animals became more evident and was observed in all age groups except for adults older than 6 years. Autumn shearing of young animsl led to considerable finer fiber compare to young white animals shorn in spring with 1 year while there was no difference to colored young animals of 1 year old. As expected autumn shearing reduced the fiber length by one third compared to spring shearing.

Table 89. Results of fiber analysis from white and colored Angora goats sample in 2008 by age and sex (Almaty lab)

Age group	Sex	Fiber diameter (µm)	Standard deviation (%)	Coefficient of variation (%)	Comfort factor (% fiber, thinness not less than 30 µm)	Average crimp (mm)	Average length, (mm)
Spring sampling: white animals							
Yearlings (1 year)	f	27.99 ±0.34	9.01	28.82	64.35	16.45	156.3
	m	30.04 ±0.59	8.89	29.73	55.86	15.45	168.1
2 year old animals	f	32.39 ±0.41	9.25	28.57	44.36	12.56	178.3
	m	34.11 ±0.37	9.60	28.36	37.64	11.57	167.6
Adults (3-5 years)	f	35.58 ±0.54	10.22	28.95	33.23	11.61	196.3
	m	37.24 ±0.52	10.55	28.46	29.41	10.94	189.1
Old animals (≥6 years)	f & m	38.42 ±0.62	11.06	28.93	28.11	11.04	180.0
Spring sampling: colored animals							
Yearlings (1 year)	f	24.31 ±0.33	8.00	32.71	80.16	23.58	113.1
	m	26.33 ±0.54	8.34	31.66	72.78	17.97	127.3
2 year old animals	f	28.81 ±0.69	9.15	31.81	59.83	18.87	147.3
	m	31.11 ±0.96	10.16	32.95	52.83	16.26	157.3
Adults (3-5 years)	f	31.83 ±0.63	9.75	30.77	48.51	13.89	174.8
	m	37.26 ±1.04	11.35	30.57	32.54	12.13	178.2
Old animals (≥6 years)	f & m	39.36 ±2.17	10.96	27.91	25.09	9.94	174.1
Autumn samples							
Young animals, 6 months (super kid)	f	24.74 ±0.44	7.87	31.79	80.86	16.40	98.4
	m	25.03 ±0.92	7.97	31.51	78.29	15.51	103.1
Adults (2-6 years)	f	39.71 ±2.30	12.40	31.44	31.83	9.28	108.7
	m	42.32 ±1.78	12.57	30.54	24.62	8.51	113.2

Developing a new national standard for classification of Tajik mohair

At international markets the demand for fine mohair is higher than for coarse mohair and the price for finer fiber is usually 3-5 times higher than for coarse fiber. The existing classification standard for unwashed Mohair (*Soviet standard GOST 2259-78: Goat mohair unwashed and classified*) does not meet international market requirements as it is lacking some important criteria, in particular the grading of fleeces by thinness.

A first step in developing a new standard for classification of Tajik Mohair was to study mohair classification systems of leading producer countries of Angora goats (South Africa, Australia, USA, Argentina, etc.) in comparison to the Soviet standard used in Tajikistan. The standards of mohair classification developed by these countries are mainly based on fineness, length, style and character and general appearance (absence of kemp, dirt etc.). Classification of mohair is performed when it is prepared for sale in accordance with industry standards and their requirements.
Secondly the results of the analysis of the Mohair samples zed in the Almaty wool laboratory (2007-2008) were used. The sample analyses indicated that in Tajik Angora goats there are large differences in fiber quality between sex and age groups. Fiber fineness and length increase with the age of goats and males produce coarser fiber than females.
On this basis the Sogd Branch of the Institute of Animal Breeding has developed a draft for a new standard for Tajik mohair (short description in the Annex).
The new standard provides also the basis for Mohair producers to grade their products to achieve higher prices. At present most farmers usually mix mohair from sex and age groups after shearing their goats and sell it unwashed without classification. Because of their lack of knowledge or interest in the quality differences they do not achieve the full benefits from their produce.

3.3.3.4 Developing a breeding program for Mohair goats based on international fiber standards

The breeding program was developed jointly by the Livestock Research Institute in Khujand, the communities and Joaquin Mueller. At the planning stage the team began to identify farmers who are well positioned to apply new breeding strategies and produce fine mohair suitable for luxury yarns production. Criteria considered for the selection of candidate farmers included experience, pasture conditions and fodder availability, and flock size (preference was given to the relatively larger flocks). The researchers met with farmers at the target sites, evaluated their animals and the condition of their flocks in terms of fiber quality and other characteristics, and assessed their potential to collaborate with the project on improving breeding and mohair quality. The assessment of the farmer's potential included the farmer's personal interest in improved breeding strategies with a focus on fine, kemp-free mohair as the supply of fine, kemp free mohair is essential for the spinners.

Tajik and ICARDA scientists and farmers examining Angora goats, October 2008.

Workshops were organized to discuss the establishment of nucleus groups from highly productive female goats and bucks with best quality mohair. The farmers concluded that the nucleus group should be created from best goats of participating farmers and that in the mating season the nucleus groups of female goats should be grazed seapartely with the best bucks and reunited with the main flock after completion of mating.

In September 2007 eight farmers were willing to participate in the development of the Angora goat breeding plan. However in the process of discussing details of the work, two farmers finally refused to participate. In 2008 five of the six farmers were still active and a new farmer was included at the beginning of 2009. The final number of participants in 2009 was 6 which given the difficulties to access the farms with large distances between them was considered a reasonable number to work with. However, two nucleus farmers are not very promising since they are facing several problems Table 90 summarizes the list of farmers with their involvement in the breeding plan.
A difficult hurdle to overcome was identification of goats to allow individual performance recording of at least every female goat in the nucleus. At first most households refused to tattoo their goats. During the soviet system 100% of the state animals were ear-tagged or tattooed. Private owners did not have an identification system for their animals. Therefore in the past many cases occurred, where the government confiscated animals with individual labeling (ear-tag, tattoo, etc) from households. Since there are still tattooed goats belonging to state farms in the region, the farmers are afraid to mark their animals. Thus, in 2007 tattooing was limited to the best does selected for the nucleus in two farms. The other farmers then agreed on tattooing their goats in spring 2008 before shearing.

Table 90. List of farmers and their involvement in the breeding plan

Farmer	Details
Abdufattoh Khanaev	Abandoned. First he was afraid of animal identification, and in autumn 2008 he decided to sell his animals.
Abdunazar Matazimov	Active nucleus
Rahmon Ascarov	Nucleus, had many losses and moves a lot
Sherali Tilloev	Nucleus, coarse goats and not very interested
Sulaymon Umarov	Active nucleus
Turgunboy Madaliev	Active nucleus
Khujan Mamarasulov	Observer in 2008, joined with new black nucleus in 2009

In the three years of project activities, farmers of nucleus groups have gained skills in breeding activities. As a result, in a relatively short period all farmers managed to increase the number of breeding animals in the nucleus group, e.g. Turgunboy Madaliev by 141%, and Sulaymon Umarov by 130% (Table 91).

Farmer Turgumboi produces quality white Angoras and collaborates with the project on setting up breeding nuclei, October 2008.

Table 91. Composition of nucleus flocks in 2006 and 2009

Farmer's name	Autumn 2006				Autumn 2009				
	Total	Does	Breeding bucks	Color	Total	Does	Breeding bucks	6-mo-old goats	Color
Turgunboy Madaliev	29 0	27 0	2 0	white colored	70	41	3	26	white
Sulaymon Umarov	23 5	22 4	1 1	white colored	53	30	3	20	white
Rahmon Askarov	12 9	11 8	1 1	white colored	27 19	16 11	1 1	10 7	white colored
Abdunazar Matazimov	16 9	15 8	1 1	white colored	29	17	1	11	white
Sherali Tilloev	10 17	9 16	1 1	white colored	32	16	1	15	colored
Abdufattoh Khonaev	19 0	18 0	1 0	white colored			*Left*		
Khujan Mamarasulov		*Joined*		colored	37	18	2	17	colored

Breeding structure

In terms of the breeding plan the six active participants are not an integrated group as such, since there are no breeding links between the flocks of the farms. Rather each farm has its own breeding plan based on a number of animals identified as nucleus animals. In addition each farm has its own bucks. This means that only the genetic variability within flocks is exploited and not the variability between flocks. Bucks which could be improvers in one farm but were born in another are not accessed.

This is a general situation in the region; most farmers are geographically isolated and largely not collectively organized. Therefore there is no community breeding structure, in fact in soviet times the cooperatives worked as a breeding structure, though other aspects made them inefficient. This is also the reason why proposing the establishment of collective breeding structures is difficult. Therefore, at least initially, the proposed breeding organization is within farm.

In the actively participating farms all animals, nucleus and base, are kept together during mating, only one farmer (Sulaimon Umarov) separates nucleus and base allowing mating of the best with the best as proposed. Another farmer (Turgunboi Madaliev) mates nucleus females with best bucks during peak of oestrus joining all animals afterwards, therefore increasing the probability of having nucleus females mated to best males. Other farmers mate the whole flock only with selected bucks. This procedure means that only part of the potential selection intensity is used.

Breeding for color

Another important point is that from what could be seen, white and colored animals were run together, even during mating. All six flocks had mixed color flocks. This is actually not bad as there is a market for fleeces of different uniform solid color in the cottage industry. However if mating across colors is allowed, non-solid color and non-uniform fleeces are produced. Mohair from such fleeces is difficult to process in high quality yarn and fabrics and is discarded by the industrial processors. In addition cross-color females maintained in the flock produce more variable offspring due to segregation.

Therefore it was suggested to use only solid color bucks in one mating flock, that is typically white or black. If complete separation is not possible farmers should try to separate colors at least during the peak of oestrus (eight days or so). This separation is of course even more important for nucleus females. If this is also not possible the option is to work on obtained progeny by culling non-solid colored animals. This needs reproduction to be high and for this to happen management must be

optimum. The success of introducing improved goat managemen practices is therefore crucial in this aspect.

Culling policy would be to discard mixed colored animals. If bucks are known (for example when only one buck is used or phenotypes are associated to a particular buck) and most progeny are mixed in color then farmers should replace the buck as he might be segregating the problem. If isolated kids are of mixed color then farmers should cull the kid and the dam (if culling margin allows to do so) or separate the dam from the nucleus.

Clearly the recommendation for the farmer is to establish nucleus of solid colored animals. The choice of color would typically be the most frequent in the flock. Some farmers have much more does of a particular color in the nucleus (for example Sulaimon Umarov has 22 white and 4 black does). In order to simplify the field work and to send a clear message to the farmer on what is expected we suggest concentrating on only one nucleus (color) per participating farmer. The technical team has identified at least two clear cases for excellent white and black Mohair nucleus amongst interested farmers (Photo 4).

As a result of the intensive discussions in the mating season in 2008 most farmers chose to keep a nucleus of only one color: white or colored. Turgunboy Madaliev, Sulaymon Umarov, Abdunazar Matazimov only white goats; and Sherali Tilloev and Khujan Mamarasulov – only colored goats. Only Rahmon Askarov preferred to keep both colors, which is undesirable from the perspective of breeding.

Largely white does in the nucleus of Sulaimon Umarov and Turgunboi Madaliev (top row) and largely black does in the nucleus of Khujan Mamarasulov (bottom left). Abdunazar Matazimov and his wife proudly show two excellent solid black Tajik Angoras.

Breeding objectives

Within a color, the original breeding objectives for all farms was to improve fleece weights and to improve mohair quality without loosing body weight and fitness. When discussing the breeding objectives in detail with the farmers their most important criteria for mohair quality were (listed by the degree of importance according to farmers' opinions):

- Fleece character (mohair cover, density of fiber);

- Softness (fiber should not feel coarse when touched) and the nature of crimp (crimp should not be small, but wave-like or corkscrew-like);
- Luster (chandelier-like luster not dull).

Thus, it was agreed that improvement of Mohair quality will include increasing staple length, reducing contamination (medullated fibers and kemp) and improving style, character and luster. Reduction in fiber diameter was strongly suggested by researchers but farmer's decision was left open since the present Russia-orientated market prefers strong fibers whereas international markets clearly prefer fine Mohair. This point was discussed in detail at the start of the breeding program and again in 2008 with farmers and within the technical team. It is clear that breeding objective changes will also be driven by market signals. Fiber processing for international markets will increase the local demand for fine Mohair as processing fine Mohair is far more profitable for the women than from the present coarse Mohair (see below). Clearly, to convince farmers to breed for finer Mohair will need various inputs: tangible market opportunities, interventions from women spinners, future market outlook information, objective data from the technical team, etc. In any case the process of reducing fiber diameter of Tajik Mohair will take time and in the meantime new markets and products are needed in order to improve income from all Mohair types produced.

The variability in fiber diameter between fleeces is very high and very fine, kemp-free fleeces are only available amongst kid fleeces, particularly if shorn early. Fiber contamination with kemp is another issue not considered in traditional selection practices. Kemp is a problem at all fiber diameter categories. High value Mohair should be free of kemp. However, this breeding objective has been more easily accepted by farmers. Improvement will take time since the amount of kemp observed is quite high in most animals. In Argentina this fault has been largely overcome by using imported Angora bucks or their semen. In about 10 years 90,000 Angoras of 900 farmers reduced kemp percentage from 6% to 1% using Australian Angora bucks in a large scale artificial insemination program. This improvement option needs appropriate skills and organization, not yet readily available in Tajikistan.

Selection

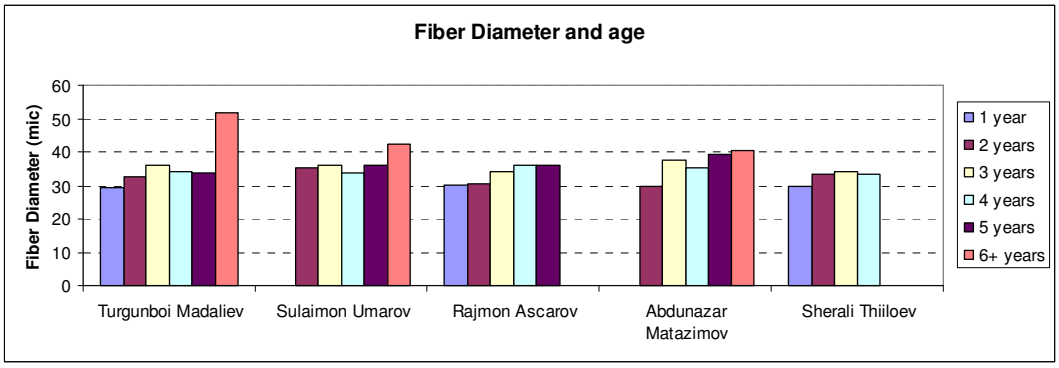
Although visual selection criteria, measurements and final decision criteria were clearly described, they were only partially applied. Furthermore, in autumn 2008 very few progeny (only 53 kids) was left from the116 nucleus does. There were several reasons for this low figure including bad climatic conditions (cold winter and dry summer 2008) which limited reproduction and survival but also heavy culling has taken place before performance data became available.

At first shearing in April 2009 the selection pressure on measured performance consequently was low.

It is of high importance that selection is based on objective performance such as liveweights and fleece sampling. Use of agreed selection criteria (measurements and visual) is essential for systematic selection, analysis of progress and for uniform extension work.

Fiber production and quality

Field records taken from the five active nucleus farms in 2008 included fleece weight, staple length (measured with a ruler) and visual fiber fineness (on the English Bradford scale). In addition fleece samples were taken from all animals and sent to the Alrun Wool Laboratory in Almaty, Kazakhstan for analyses. Averages for nucleus does per farm are shown in Table 92 and Figure 27.



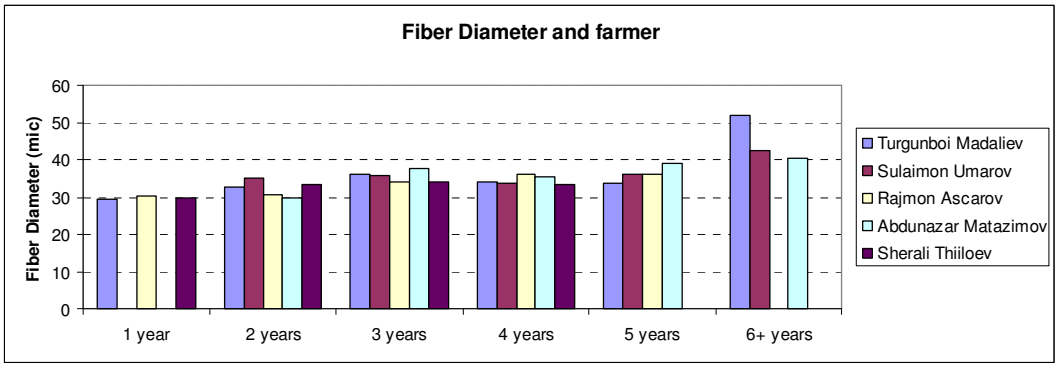


Figure 27. Average Mohair fiber diameter per age and farmer. See increase in diameter with age and see between farmer fiber diameter variability.

Table 92. Khojand Fiber sample analysis (Almaty Laboratory results, OFDA 4000)

Farmer	**Sex**	**Age (year)**	**n**	**Fleece sample analyses (OFDA 4000 - Almaty)**					**Staple length (mm)**
				Average fiber diameter (micron)	SD of fiber diameter (micron)	CV of Fiber diameter (%)	Comfort Factor (%)	Fiber length (mm)	
Turgunboi Madaliev	f	1	2	29.3	10.0	33.6	58.4	189.0	154.0
Turgunboi Madaliev	f	2	2	32.6	8.8	25.2	38.5	131.5	158.0
Turgunboi Madaliev	f	3	7	36.2	10.7	29.7	27.3	112.0	207.6
Turgunboi Madaliev	f	4	9	34.0	9.3	28.4	36.0	115.0	191.0
Turgunboi Madaliev	f	5	8	33.8	9.8	29.0	38.8	107.0	197.4
Turgunboi Madaliev	m	adult	1	51.8	14.9	28.7	9.6	93.0	178.6
Sulaimon Umarov	f& m	0.5	10	23.0	6.8	29.4	86.5	184.6	96.5
Sulaimon Umarov	f	2	6	35.1	9.5	26.9	35.7	109.0	192.1
Sulaimon Umarov	f	3	5	35.9	9.8	25.4	27.0	96.6	199.0
Sulaimon Umarov	f	4	4	33.7	10.5	31.1	39.3	118.0	205.3
Sulaimon Umarov	f	5	2	36.0	10.9	30.1	33.3	117.0	213.4
Sulaimon Umarov	f	6	2	42.4	9.9	23.2	11.9	94.5	229.5
Sulaimon Umarov	m	adult	1	43.4	10.8	24.9	9.0	101.0	173.5
Rajmon Ascarov	f	1	2	30.2	9.6	31.9	52.7	116.0	200.3
Rajmon Ascarov	f	2	4	30.6	10.8	35.2	55.9	135.0	170.0
Rajmon Ascarov	f	3	3	34.1	9.3	27.3	35.9	104.0	192.7
Rajmon Ascarov	f	4	5	36.1	9.5	26.5	29.6	102.0	192.7
Rajmon Ascarov	f	5	4	36.2	11.3	31.6	35.5	111.0	203.1
Rajmon Ascarov	m	adult	1	50.5	10.4	20.7	4.3	69.0	190.2
A. Matazimov	f	2	4	29.7	9.5	37.1	55.5	145.0	168.0
A. Matazimov	f	3	3	37.7	9.8	26.1	24.3	115.0	175.9
A. Matazimov	f	4	11	35.4	10.4	29.6	35.6	109.0	191.9
A. Matazimov	f	5	4	39.1	9.9	25.2	20.3	107.0	198.1
A. Matazimov	f	6	1	40.3	11.4	28.3	20.4	93.0	188.7
Sherali Thilloev	f	1	8	29.8	8.5	28.5	56.0	134.0	169.0
Sherali Thilloev	f	2	8	33.3	9.5	28.3	40.3	121.0	157.8
Sherali Thilloev	f	3	2	34.0	8.4	24.9	34.8	104.0	194.3
Sherali Thilloev	f	4	7	33.4	20.1	29.6	40.1	134.0	174.6
Sherali Thilloev	m	adult	1	51.1	8.6	16.9	1.6	68.0	197.3

Reproductive performance and kid survival in the nucleus flocks

The performance of does and kid survival differ greatly between the two seasons as the winter season in 2007/2008 was extremely difficult while the winter season 2008/2009 was the opposite and favorable rainfall in 2009 provided excellent pasture conditions in 2009. Thus while kidding percentage was between 39 and 59% in 2008 (Table 93), it was between 94 to 100% in 2009 (Table 94). No abortions and miscarriages were recorded in winter 2008-2009; however as not all does gave birth there may have been a few cases in four of the farms. The differences in kid survival at 6 months of age between the years were not as marked as the kidding percentage but also considerable (67 to 93% in 2008 and 94 to 100%).

Table 93. Reproductive performance of does and kid survival in the season 2007/2008

Parameters	**Turgunboy Madaliev**	**Sulaymon Umarov**	**Rahmon Askarov**	**Abdunazar Matazimov**	**Sherali Tilloev**
Number of mated does	32	28	20	23	29
Abortions (recorded)	3	2	1	5	4
Kids born in April (heads)	19	15	11	9	14
Kids born per mated does (%)	59.3	53.5	55.0	39.1	48.2
Survival of kids at 6 months (heads)	17	14	9	6	11
Survival of kids at 6 months (%)	89.5	93.3	81.8	66.7	78.5

Table 94. Reproductive performance of does and kid survival in the season 2008/2009

Indicators	**Turgunboy Madaliev**	**Sulaymon Umarov**	**Rakhmon Askarov**	**Abdunazar Matazimov**	**Sherali Tilloev**	**Khujan Mamarasulov**
Number of female goats	28	22	18	21	16	18
Kids born in April (heads)	27	21	18	20	16	17
Kids born per 100 females	96.4	95.4	100.0	95.2	100.0	94.4
Survival of kids at weaning, %	26	20	17	19	15	17
Survival of kids at weaning, %	96.3	95.2	94.4	95.0	93.7	100.0

Liveweight changes of kids in the nucleus flocks

Due to the bad weather conditions the daily weight gains were small in spring and summer of 2008 and there were nearly no difference among the farmers (Table 95). In comparison with the kids in the traditional flocks the nucleus kids w he as superior growth (Table 96).

Table 95. Changes in liveweight of kids (kg) in the nucleus flocks in 2008

Farmer	At kidding (April)		At 3 months (June)		At 6 months (Sept.)		Total weight gain (kg)	Daily weight gain (g)
	n	mean	n	mean	n	mean	mean	mean
Turgunboy Madaliev	19	2.5	17	5.6	17	15.5	13.0	72.1
Sulaymon Umarov	15	2.1	14	5.5	14	15.2	13.1	72.7
Rahmon Askarov	11	2.2	10	5.4	9	14.9	12.7	70.5
Abdunazar Matazimov	9	2.1	8	5.4	6	14.8	12.7	70.5
Sherali Tilloev	14	2.1	12	5.5	11	15.0	12.9	71.6

Table 96. Comparison evaluation of live weight (kg) of kids in the nucleus flocks and control group

Group	Liveweights (kg)						Daily weight gain (g)
	at kidding		at 3 months		at 6 months		
	n	mean	n	mean	n	mean	mean
Experimental (nucleus)	68	2.2	61	5.5	57	15.2	72
Control	35	2.1	35	5.1	35	13.9	66

Due to favorable natural conditions of pastures in the spring season of 2009, the condition of all goats was above average. The growth rates of the kids in spring 2009 were by far higher than in 2008. At 3 months of age they reached an average liveweight of 8.6 kg in 2009 compared to 5.5 kg in 2008 (Table 97). However, at the age of six months when they were separated from their does the average liveweight of the kids in both years was the same (15.1 kg). In 2009 there was more variation in growth performance between the flocks.

Table 97. Changes in liveweight of kids (kg) in the nucleus flocks in 2009

Farmer's		At birth		At 3 months		at 6 months	
name	Sex	n	mean	n	mean	n	mean
Turgunboy	f	14	2.4 ±0.04	14	8.9 ±0.27	14	14.9 ±0.42
Madaliev	m	13	2.3 ±0.09	12	9.8 ±0.18	12	16.4 ±0.35
Sulaymon	f	11	2.1 ±0.05	11	8.7 ±0.31	10	14.3 ±0.16
Umarov	m	10	2.0 ±0.05	10	10.1 ±0.28	10	16.3 ±0.24
Rakhmon	f	8	2.1 ±0.04	8	7.6 ±0.24	8	13.8 ±0.37
Askarov	m	10	2.2 ±0.11	10	8.9 ±0.19	9	15.5 ±0.61
Abdunazar	f	11	2.3 ±0.04	10	7.1 ±0.21	10	13.2 ±0.36
Matazimov	m	9	2.4 ±0.09	9	8.4 ±0.34	9	15.9 ±0.29
Sherali Tilloev	f	9	2.2 ±0.08	8	8.1 ±0.31	8	14.3 ±0.21
	m	7	2.4 ±0.05	7	9.2 ±0.26	7	16.3 ±0.35
Khujan	f	9	2.2 ±0.09	9	7.8 ±0.14	9	14.0 ±0.47
Mamarasulov	m	8	2.3 ±0.07	8	8.5 ±0.31	8	15.9 ±0.53
Total		**119**				**114**	

Assessment of performance and fiber quality of adult breeding animals

The liveweight of breeding bucks of nucleus groups of farmers was with 43 to 46 kg about average for the breed (Table 98). The lowest fleece weights produced by the bucks of Khujan Mamarasulov and Abdunazar Matazimov corresponded to about the minimum requirement according to the breed's standard. The best buck produced 15.9% heavier fleece than the worst. The bucks kept by Sulaymon Umarov had the longest mohair, and one of his bucks had a relatively fine fiber.

Table 98. Performance of breeding bucks in the nucleus flocks in 2009

Indicators		**Turgunboy Madaliev**	**Sulaymon Umarov**	**Rakhmon Askarov**	**Abdunazar Matazimov**	**Sherali Tilloev**	**Khujan Mamarasulov**
Number of animals		2	2	2	3	2	2
Liveweight, kg		45.5	44.3	45.0	43.0	46.0	43.0
Shear of unwashed mohair, kg		3.4	3.3	3.2	3.0	3.2	2.9
Mohair length, cm		20.5	21.6	19.0	18.6	19.75	18.6
Mohair fineness	48 (31.1-34.0)		1				1
	46 (34.1-37.0)	2	1	1	1	2	1
	44 (37.1-40.0)			1	1		
Mohair style	very good	2	2	2	2	2	2
	average						

It is visible in Table 99 that Sulaymon Umarov has maximum live weight of female goats (34.2 kg) and Khujan Mamarasulov has the minimum (31.2 kg), and that the difference is not significant. By the amount of shear, Rahmon Askarov's goats have the lowest indicator (1.41 kg) and does of Turgunboy Madaliev has the highest indicator (1.92 kg), exceeding by 36.2%. The goats of Turgunboy Madaliev and Sulaymon Umarov demonstrated the best style.

In autumn, based on visual examination and given individual evaluation in spring, old groups were partially culled and breeding groups of goats were replenished by the best 1.5-2.5-year-old young animals.

Table 99. Description of female adult nucleus goats in 2009

Indicators		Turgunboy Madaliev	Sulaymon Umarov	Rakhmon Askarov	Abdunazar Matazimov	Sherali Tilloev	Khujan Mamarasulov
Number of animals		28	22	18	21	16	18
Live weight, kg		33.6 ±0.58	34.2 ±0.25	33.5 ±0.48	32.7 ±0.34	34.1 ±0.56	31.2 ±0.72
Shear of unwashed mohair		1.92 ±0.13	1.90 ±0.28	1.41 ±0.08	1.74 ±0.05	1.55 ±0.08	1.46 ±0.09
Mohair length, cm.		19.2 ±0.24	18.6 ±0.38	17.2 ±0.13	17.8 ±0.20	17.9 ±0.12	17.5 ±0.03
Mohair fineness	56 (26.1-29.0)	4	2	4	3	5	3
	50 (29.1-31.0)	8	10	9	12	8	6
	48 (31.1-34.0)	16	10	5	6	3	9
Mohair style	very good	26	18	12	14	11	15
	average	2	4	6	7	5	3

3.3.3.5 Value added local processing of Mohair by women and assessing the potentials for its international marketing .

Identifying a Market for Value-added Mohair

The objective of activity has been to research the opportunity of increasing incomes of local women spinners and Angora goat producers through value-added local processing and export of mohair yarn and clothing. Most Tajik rural women in the mohair-producing region earn income by spinning coarse, cheap yarn for the Russian market and selling it for a low price of about $10 per kg. The project objective was to explore the development of an alternative market for value-added mohair products that would bring higher revenues for producers. The project identified the US market for luxury knitting yarns as an alternative, high-value market for Tajik mohair yarns. On this market, luxury mohair yarns sell for retail prices that range from $150 to over $500/kg. The researchers examined the assortment, prices and volume of sales of mohair yarns on the US market and established that fine yarns made from kid mohair were highly priced and preferred by knitters. The market has been booming in recent years as millions of American women started to knit as a hobby. The market research concluded that the Tajik women would greatly benefit from gaining access to this market by producing quality kid mohair yarns.

American yarn stores display imported luxury yarns from natural fibers, May 2007.

Training Women to Produce Yarn Samples for the US Market.

The researchers selected several groups of spinners and started training them to spin samples of fine kid mohair yarns that could compete with Australian, South African and Italian mohair yarns on the US market. The samples were taken for evaluation to professional American knitters who knitted swatches and provided individual feedback to the Tajik spinners.

American knitters with swatches knitted from samples of Tajik mohair, July 2007.

After two years of sample production, testing, feedback and training, the project developed a standard for handspun, kid mohair yarn that can successfully compete on the US market. Such yarn has to be fine, even, double-spun, with 3,000-4,000 meters per kg, packaged in skeins that weigh approximately 100 grams each. It can be spun from fine fleeces of yearling goats or six months old kids that have a low percentage of kemp fibers. Groups of women in eight settlements were trained in spinning this type of yarn and preparing it into skeins according to market standard. Women who are fully trained have been training their relatives and the number of spinners who can spin yarn according to the project standard has increased each year.

During the training sessions the women spinners first received information about the US market, samples of mohair yarns currently sold on the market, and instructions how to produce yarn samples according to market standard. After a spinner produced a yarn sample that is approved by the project, she is included in the project registration system and trained how to select mohair suitable for spinning Magic Mohair yarn. After she learns how to select fine kemp-free fiber or clean fine fleeces from kemp, the spinner can start spinning yarn for the project as long as she continues to maintain the established quality standard. Her yarn will be test-marketed on the US market under her name, the sales of her yarns will be registered and she will receive feedback on her yarn. In some cases her yarn can be processed into knitted products for export. This will help the women to understand the close correlation between high price and high quality and inspire them to compete for their niche on the global marketplace. Succeeding in this competition means substantial improvements in their income and livelihood. It also means an increase in their self-confidence and self-fulfillment through the appreciation of their craftsmanship by international buyers.

The researchers learned that most women who have experience spinning yarn for the Russian market could be trained to produce finer, more even yarns for the American market. However, not all women

will be able to reach the high standard established by the project. Those women who will not succeed in spinning can help with sorting and cleaning the raw fiber, carding it and preparing it for spinning. In some groups, such division of labor is already occurring.

Women at the Takeli settlement producing mohair yarn samples, September 2008.

Training Women to Select, Skirt and Clean Mohair Fleeces.

Yarn quality depends on the spinning technique and on the quality and preparation of the raw mohair. The researchers studied the effects of fleeces with different types of fibers on yarn quality and discovered that the best yarns can be spun from relatively fine, kemp-free, kid fleeces. The project team began training the women to sort and evaluate fleeces and select those that were most suitable for spinning quality yarn. Training sessions on fiber evaluation and sorting were organized for all spinning groups and individual spinners. The women were also trained how to skirt fleeces and separate kemp fibers from the rest of the fleece. As a result, the demand and price of fine, kemp-free mohair has increased dramatically in the spring and summer of 2009. The project team expects that this demand will have an effect on the farmers' breeding decisions in the 2009 season.

Matazim Kosimov training spinners to select and skirt mohair fleeces, May 2009.

Introducing New Technologies such as the Spinning Wheel.

The project team imported several New Zealand "Ashford" spinning wheels to Tajikistan and collaborated with a local craftsman to produce models on the basis of these prototypes. One craftsman successfully produced several different prototypes and nearly all women who were trained by the project switched from spindles to spinning wheels. Using a spinning wheel increases the spinner's productivity at least by one half and makes spinning easier without decreasing quality. The local production of spinning wheels, looms and other fiber processing tools is expected to expand and will also provide new earning opportunities for Tajik craftsmen.

Matluba Khanaeva became proficient at using a spinning wheel, September 2007.

Strategies to Increase Production of Quality Mohair

The main obstacle to scaling up the project is the shortage of fine, kemp-free mohair which is needed for the production of luxury yarns and products. The presence of kemp fibers in the majority of kid and adult fleeces makes them suitable for processing only after the kemp is separated from the fleece. The two short-term solutions to the problem of kemp identified by the project include separating kemp fiber from fleeces and shearing six months old kids that have little kemp. Simultaneously longer-term improvements through an organized Angora goat breeding program are being implemented.

Separating kemp fibers is a time-consuming work that requires additional training and lowers the efficiency of yarn production. The project has been working with the women spinners to develop methods of separating kemp from fleeces that have other desirable properties such as softness, length and luster. Currently these methods are being tested with several women's groups. One of the groups is already becoming skilled in kemp separation and has been able to produce soft, kemp-free yarn that can successfully compete with fine, Australian mohair. The project plans to focus on training other groups in using the same method.

Mohair fiber produced by six months old kids (so called "super kid mohair") is most highly valued on the world market for its softness, luster and lack of kemp and shearing six months old kids is common in many mohair-producing countries. In Tajikistan, fall shearing has been rarely performed because there was no demand for fine fiber. Only some farmers currently shear six months old kids to protect them from getting stuck and trapped on spiky brush in the mountains. The researchers tested super kid mohair in yarn spinning in 2008. The test had shown that fine, six months old kids with long fiber

could produce perfect mohair for spinning luxury yarns. The fall shearing in 2009 was organized with farmers under the project guidance to ensure that only kids with desirable fleeces are sheared and that they receive proper care after shearing.

Test-marketing Yarn Samples in an American Store.

The first samples of Tajik mohair yarn were successfully test-marketed in a US yarn store in February 2009. The yarns were sold for a price of comparable Australian kid mohair yarn for a wholesale price of $140/kg. Based on the project calculations, the Tajik spinners will be able to receive $70/kg for yarn and $70 will be used for export costs of the yarns. The Tajik yarn will be marketed under a trademark "Mohair Magic."

The test-marketing showed that American knitters are very interested in buying Magic Mohair yarn and learning about the project and the Tajik spinners. To promote the unique yarn, the project needs to focus on advertising and create a multi-media information package (video, photographs, information brochures) about the Tajik spinners, Angora goats and the process of making Magic Mohair yarn.

The yarn sample sale also illuminated the challenge of marketing handspun yarns from variable fleeces. Although handspun yarns are more highly valued by knitters than machine spun yarns, marketing such yarns presents a challenge because of their diversity. Magic Mohair yarns differ based on the spinner's technique and the character of the fleece from which it was spun. The difference in spinning techniques cannot be avoided and individual spinners will have to market their yarn under their names. This will increase the attractiveness of the yarn for the knitters. In order to increase the uniformity of fiber used for spinning, the project plans to create a carding and cleaning center where quality kid fleeces coming from individual farms will undergo standard preparation procedure and will be mixed and carded together to produce uniform batches of fiber. This semi-processed mohair will then be distributed or sold to spinners.

Tajik mohair yarn samples in a yarn store in Madison, Wisconsin, February 2009.

Adding Value to Yarn by Knitting Samples of Luxury Clothing.

In the spring of 2009 the project team began working on the production of samples of knitted clothing such as luxury shawls and sweaters from the Magic Mohair yarn that could be used to solicit orders from American and European stores. The project has set up four knitting groups up to date. This will add further value to mohair and create jobs and income for women knitters. The knitters are receiving advice in terms of design and color from the collaborating scientist and, indirectly, from US knitters and designers.

Knitter in Gulshan village making a scarf from Tajik mohair, May 2009.

Developing Export Products from Quality Adult Mohair: Carpets and Blankets.

The project team is also working to increase the demand for quality adult mohair by developing new products such as hand-knotted carpets and woven blankets. The researchers produced two small, vertical carpet looms based on models obtained through the internet and two groups of women experienced in carpet-making made two samples of small carpets from mohair fleeces of different natural colors in May 2009. The experiment was successful and the samples received very high marks from all Tajiks and Americans. In addition to carpets, which are made from coarser adult mohair, the project plans to build wooden looms for weaving luxury blankets and throws from finer, kemp-free adult mohair.

First sample of mohair carpet made in the Taboshar village, May 2009.

Distributing Information to Angora Goat Producers, Spinners and Knitters.

The project team developed new methods of distributing information to stakeholders. It started using the weekly mohair market as a forum to discuss the project activities with farmers, spinners and knitters. The team published a brochure/manual for spinners, farmers and knitters that describes the project activities and explains how they can participate in the project. The manual provides instructions and guidelines for spinners and knitters about the production of fine, kemp-free mohair, yarns and knitted clothing and explains to farmers how to participate in activities related to Angora goat production. The booklet was translated from English into Russian, Uzbek and Tajik. It is being distributed at the weekly mohair and yarn market in Khodzhand and during meetings and training sessions with farmers, spinners and knitters. All participants have shown a great interest in such information and began to distribute the manual in their settlements and villages to family members, friends and neighbors. In this way, the information about the project can spread quickly within the region. The project team has published the first two drafts of the booklet in the spring of 2009.

Farhod Kosimov distributing information to farmers and spinners, May 2009.

Increase in the Incomes of Angora Goat Farmers and Women Processors.

The production of handspun mohair yarn for export will provide very good earning opportunities for women spinners and knitters and also for Angora goat farmers.

By switching to high-priced yarns, women spinners will be able to earn approximately $240 per month as opposed to $24 per month which they currently earn by producing yarn for Russia. This estimate has been based on the following calculations: an average spinner can produce around 1kg of yarn per week or 4 kg of yarn per month while performing her regular household chores. Working for the Russian market, the spinner buys cheap raw mohair for about $16 to make 4 kg of yarn and sells the yarn for $40 ($10 per kg), earning around $24 per month from spinning. The prices shift dramatically once the spinner starts producing Magic Mohair yarn for the US market: if the spinner buys 1 kg of quality kid mohair for $9 she will spend $40 on raw material (it takes around 1.1 kg of kid mohair to

produce 1kg of yarn). She will be able to sell the yarn for $280 ($70 per kg) and will earn $240 from spinning. An experienced spinner who uses a spinning wheel as opposed to the traditional spindle will be able to increase her productivity at the minimum by 1/2, and earn $360 per month. Such income will considerably improve the livelihood of the woman and her family.

The new export market will also benefit farmers who produce quality fiber by increasing the price of undervalued kid and super kid mohair. The project estimates that the strong demand for fine kid mohair will increase the price of fine, kemp-free kid fiber from the current $3-4 per kg to $9 per kg within a single season. This will make the price of fine, kemp-free mohair equal to the price of the best adult mohair intended for the Russian cottage industry – such mohair sells for $8-10/kg. The project expects that the price of fine, quality fleeces will continue to increase further as farmers realize the value of those fleeces to spinners. Eventually, a high market price for kemp-free, quality mohair will be established region-wide. The decrease in fiber diameter and kemp will also improve the quality of adult mohair fleeces that are sold to Russia. Angora goat kids with fine, long, kemp-free, lustrous fiber will produce quality fleeces that will be in demand on the Russian market as their fiber gets coarser during their adult years. Moreover, quality, kemp-free adult mohair can also be used to make woven blankets and hand-knotted carpets for the US and European market. And finally, quality Tajik mohair that is not processed domestically can be marketed to new international buyers. The project plans to help advertise Tajik mohair to international buyers and processors and facilitate their access to markets.

Women with samples of mohair yarn, Asht village, May 2009.

3.3.4 Improving Gissar sheep management in the communities, the aspects of feeding, lamb breeding, maintaining and sheep reproduction in Central Tajikistan

3.3.4.1 Background

Gissar sheep are known for the production of high quality meat and fat and the market demand for the breed is high. Thus, households are very interested to keep and breed them. However, often the private farms and households do not possess appropriate skills and knowledge for feeding and reproduction of sheep. They often keep low quality or even nonproductive rams, in surplus numbers in the flock, as well as low productive and nonproductive ewes not paying attention to the additional costs of feeding these animals, in particular the resulting overgrazing of pasture. Farmers often keep a mix of Karakul and Gissar sheep, although Gissar sheep shows the best productivity when purebred. In order to raise farmers' income from their flocks more effective management strategies were tested to improve reproductive performance of ewes, lamb survival and growth. Households and small farms in Buzbit,

Karsang and Nematobod village in the Jamoat Dusti, Vahdat district, participated in the surveys and on-farm experiments. The studies were conducted to meet two main objectives:

- To compare flock productivity of the three main sheep grazing systems practiced by households and farmers in the communities;
- To assess the effects of low cost interventions such as strategic feeding and improved management practices.

3.3.4.2 Activity 1. Comparative study of the main grazing management systems

Currently three general grazing management systems are found in the villages:
System I: Year-round grazing of sheep: in winter and spring (December to April) sheep are grazed on winter rangelands (restricted access for some farmers), and in summer (June to September) on high mountain rangelands. For summer grazing the farmers form flocks of sheep of 500-600 heads and arrange grazing with a shepherd.
System II: Summer mountain grazing and winter stall-fed system. Small farmers organize a flock of sheep that are taken in summer to the high mountain range, and during winter the sheep are kept at home using rangelands around village.
System III: Village grazing system: the farmers do not take their sheep to remote rangelands but keep them near their home and graze them all year on rangelands around the village.
System I is considered as the preferred and most productive system. However, access to winter rangelands is limited so that this option is not open for all farmers.
The project encouraged farmers to form joint flocks and send their sheep to summer grazing. Improved management interventions are mainly directed at systems I and II because system III is not seen as a sustainable way to manage sheep. In the beginning of 2007, three groups of households and farmers, with approximately the same total flock size were formed to compare animal performance (Table 100). In the first system 127, in the second 108 and in the third 111 heads of animals were observed, including 103, 83 and 76 head of ewes in each group, respectively. In addition, the feeding rations in winter of the three systems were examined in detail and compared with the animals requirements (Annextables 13-15).

Table 100. Farmers and households that participated in the study by grazing system

System	Farmer's name	Total no of sheep	Including	
			sires	ewes
I	Mahmadsharif Niyozov	59	5	51
	Majit Makhmudov	38	4	30
	Ashur Bobokhonov	30	3	22
	Total	**127**	**12**	**103**
II	Kutbiddin Nematov	14	1	11
	Tojiddin Nematov	17	2	12
	Muzaffar Nurov	16	2	12
	Saidvali Gafurov	18	1	14
	Gurez Davlatov	19	2	15
	Nabi Karaev	24	2	19
	Total	**108**	**10**	**83**
III	Rajab Niyozov	15	1	10
	Talbak Yorov	12	2	8
	Davlatsho Khakimov	9	1	7
	Umar Usmonov	7	-	5
	Abduvohid Abdulkholikov	7	-	6
	Sharof Buriev	19	3	12
	Mahmadyusuf Kholov	14	2	8
	Ermat Alimatov	16	2	11
	Sulaymon Talbakov	12	1	9
	Total	**111**	**12**	**76**
	Grand total	**346**	**34**	**262**

The study showed that the ewes of the first and second group exceeded the ewes in the third group in reproductive performance, liveweight gains and vitality (Table 101). Ewes of the first group performed slightly better than the ewes of the second group but the difference was smaller than the differences of system I and II with the third group.

Table 101. Ewe performance by grazing system in May 2007

Flock performance	System I	System II	System III
Number of ewes	103	83	76
Lambed, heads/ %	102 / 99%	80 / 97%	73 / 96 %
Lambs born, heads / %	104 / 101%	80 /97%	65 / 85%
Lamb survived, heads/ %	102 / 98.0%	78 / 97.5 %	61/93.8%
Live weight of ewes, kg:			
in March	51.6	48.3	45.9
in June	58.8	54.3	51.2
in August	68.5	64.7	53.5
Survival of ewes, %	100	97.6	95.0

Lambs born from ewes that were grazed all year round (system I) were heavier at birth and gained more weight that the lambs in system II and III (Table 102). The higher lamb growth rate in system I – 306 g daily weight gain compared to 274 g and 236 g in system II and III – was related to higher milk production of the ewes in this system.

Table 102. Liveweight gain of lambs and ewes' milk production

Lamb performance	System I	System II	System III
Live weight of lambs, kg			
At lambing	4.70	4.32	3.99
At 20 day age, kg	10.80	9.80	8.70
Absolute weight gain, kg	6.10	5.48	4.71
Average daily weight gain, g	306	274	236
Daily milk production of ewes, kg	1.525	1.325	1.125

A cost-benefit analysis for 100 ewes showed that system I generated US$ 2725 net benefits compared to US$ 2,027 from system II and US$ 1,149 from the third system III (Table 103). The difference was mainly due to higher benefits from sales of lambs.

Conclusion:

As expected animal performance and economic return was clearly superior when animals were grazed all year round on good quality pastures (system I). Also system II generated considerably higher net benefits than system III. As not all farmers have access to good winter pastures, system II can be recommended to these farmers.

Table 103. Economic evaluation of three sheep grazing systems (per 100 head of sheep)

Benefits and costs	System I		System II		System III	
	TJ Somoni	US $	TJ Somoni	US $	TJ Somoni	US $
Sales of sires and male lambs (alive)	11,900	2680.2	7,500	1689.2	4,700	1058.6
Sales of ewes	2,300	518.0	1,900	427.9	1,000	225.2
Sales of female lambs	500	112.6	200	45.1	-	-
Sales of wool	-	-	-	-	-	-
Sales and consumption of mutton and fat	6,300	1418.9	5,800	1306.3	4,600	1036.0
Total benefits	**21,000**	**4729.7**	**15,400**	**3468.5**	**10,300**	**2319.8**
Forage	2,000	450.5	2,400	540.5	2,500	563.0
Maintaining and renting pastures	2,800	630.6	1,200	270.4	500	112.6
Veterinary service	1,500	337.8	1,200	270.4	700	157.7
Shearing	500	112.6	300	67.5	200	45.0
Costs associated with animal sales	400	90.1	300	67.5	400	90.1
Fuel, transportation and other costs	1,700	382.9	1,000	225.2	700	157.7
Total costs	**8,900**	**2004.5**	**6,400**	**1441.5**	**5,000**	**1126.1**
Net benefits	**12,100**	**2725.2**	**9,000**	**2027.0**	**5,300**	**1193.7**

3.3.4.3 Improved feeding and management strategies that can be easily adopted by farms and households.

The above study of medium and small-scale farms showed that in many cases the reproductive potential of ewes and the growth potential of lambs are not fully exploited. Fertility of females in most cases is only 50-60%. One of the reasons is that a high proportion of ewes do not have access to good pastures in the breeding season but instead are kept on pastures of low productivity around the villages. In addition, many ewes during late gestation are kept on winter pastures with insufficient supplementation. To overcome these constraints, two studies were carried out to test the effects of supplemental feeding on ewes' reproductive performance and lambs' growth rates. Furthermore early weaning and subsequent lamb fattening was tested with the objective of allowing a quicker recovery of the ewes. Early weaning would also allow milking of ewes, which is still practiced in some mountainous regions of Tajikistan, mainly on the summer highland pastures. Households process milk of ewes and goat to various products butter, local cheese (iran, katyk), dried katyk (kurut) and store them for winter. These products are considered as valuable source of high-protein animal products, and the households also generate some income from surplus sales. Although at present the sheep and goats in the foothill and lowland areas, are used only for meat production, we conducted a small pilot experiment to assess the potential for sheep milk production and processing.

Subactivity 1: Additional feeding of Gissar ewes during mating under household conditions in 2007

In September during the preparation for mating two groups of Gissar ewes were formed with 30 heads each. Both groups of ewes grazed natural pastures at the boundary of Sultonobod, at a distance of 7-10 km from the village. The improved group of ewes was kept by farmer A. Bobishoev (Karsang village) and received concentrates of 0.3 kg per day (chopped barley and corn) for 30 days. The control group kept by farmer M. Niezov in Nematobod did not receive any supplements. Both flocks were vaccinated against sheep smallpox and were treated against helminths. The liveweight of the ewes receiving concentrates increased by 3.7 kg (daily weight gain of 123 g), while the control ewes lost 3 kg (Table 104). One ewe in the improved group and two ewes in the control group died.

Table 104. Liveweight and survival of ewes in the experimental and the control group

Criteria	Experimental group	Control group
Liveweight of ewes at the start of the experiment (kg)	58.6 ± 0.782	59.3 ± 0.569
Liveweight of ewes after 20 days (kg)	61.4 ± 0.546	58.6 ± 0.443
Liveweight of ewes at the end of experiment (kg)	62.3 ± 0.387	56.4 ± 0.412
Survival of ewes (heads / %)	29 / 96.7	28 / 93.4

Natural mating was used with two rams plus one reserve ram for each group. The improved condition of the ewes led to earlier mating and to a higher conception rate at first service (Table 105). However, also all ewes in the control group had been mated at the end of October.

Table 105. Reproduction parameters observed in the experimental and the control group

Reproductive parameters	Experimental group	Control group
Number of ewes showing oestrus during the first decade of October (heads / %)	19 / 63.3	4 / 13.4
Number of ewes showing oestrus during the second decade of October (heads / %)	9 / 30.0	6 / 20.0
Number of ewes showing oestrus during the third decade of October (heads / %)	2 / 6.7	20 / 66.6
Number of ewes repeatedly showing estrus, (heads / %)	5 / 16.7	13 / 43.3

270 kg grains were fed during the experimental period (0.3 kg x 30 ewes x 30 days) at a total cost of 432 TJ Somoni (US $97.3). This generated an average liveweight difference of 5.9 kg between the two groups of ewes (total value of 3186 TJ Somoni or US $724). However, this a theoretical income while the major advantage lies in improved conception rates.

Subactivity 2: Additional feeding of ewes during the last month of gestation in 2008 and 2009

Two groups of pregnant ewes were formed in February 2008 from the flocks of three farms that graze their sheep on winter pastures (at the boundary of Kyzyl-Aryktov). The basic diet of all ewes consisted of 0.8-1.0 kg motley hay and 0.6 kg of wheat straw per day. The ewes of the experimental group (farmer A. Bobokhonov) were supplemented with 0.3 kg of concentrates during the last 30 days of gestation. The concentrates consisted of a mixture of crushed barley, cottonseed cake and the premix "Rovimix" (Annextable 16) as a source of vitamins, minerals and trace minerals (750 mg per ewe). Thirty ewes kept by the farmers Todzhidin Nematov and Kutbiddin Nematov served as control and did not receive any supplements. Both groups of ewes were vaccinated against smallpox and F&MD and trenched against internal parasites according to the recommended animal health calendar for the region (Annextable 17).

The additional feeding of the experimental ewes with concentrates and the vitamin/mineral mix increased their liveweights and prolificacy (Table 106). The ewes in the experimental group were by 2.9 kg (5.4%) heavier before lambing and by 3.6 kg (7.1%) after lambing than the ewes in the control group. In the experimental group 27 live lambs were obtained from 30 ewes and in the control group only 15 lambs. Lambs were slightly heavier at birth (by 0.3 kg) and showed 29% higher liveweight gains than the lambs in the control group during the first 20 days after birth. The latter was clearly related to the higher milk production of the supplemented ewes (1.65 kg daily compared to 1.27 kg in control group).

In February 2009, the same experiment was repeated with 20 ewes in different farms. The experimental group was kept by farmer Gulandom Khafizova and the control ewes by Madjit Makhmudov (13 ewes) and Vali Gafurov (7 ewes). The basic ration of the ewes in both groups included 0.6 kg motley hay, 0.5 kg lucerne hay and 0.5 kg wheat straw. Starting one month before

lambing the experimental group received 0.3 kg barley grain and 750 mg mineral feed premix per ewe and day. As in 2008 the control group did not receive any supplements.
The results obtained on liveweights of ewes and their lambs confirmed the positive effect of additional feeding of ewes during late gestation. After 30 days just before lambing the ewes of the experimental group had gained on average 6.2 kg liveweight and the control only 3.1 kg (Table 106). After lambing the ewes in the experimental group still showed 8.1% (3.9 kg) higher liveweights than the control ewes. All 20 ewes in the experimental group lambed and 19 lambs survived (95%), while in the control group 18 ewes lambed and only 15 lambs (75%) survived; 5 ewes had aborted or their lambs died in the first days after birth. The liveweight of lambs at birth and at 20 days of age in the experimental group exceeded the control lambs by 0.5 kg or 11.6% and 2.7 kg or 32.1%, respectively. The daily milk production of the ewes in the experimental group was 0.55 kg or 53.9% higher in the supplemented ewes.

Table 106. Differences in reproductive performance, liveweights of ewes and lambs and milk production between ewes supplemented during late gestation and the control

Parameters	**2008**		**2009**	
	Exp. group	**Control group**	**Exp. group**	**Control group**
Number of ewes	30	30	20	20
Liveweight of ewes at the start (kg)			51.2 ± 0.43	50.6 ± 1.03
Liveweight of ewes before lambing (kg)	56.4	53.5	57.4 ± 0.74	53.7 ± 0.86
Liveweight of ewes after lambing (kg)	50.8	47.2	52.3 ± 0.68	48.4 ± 0.74
Lambs obtained (heads)	27	15	19	15
Ewes prolificacy (%)	83.6	50.0	95.0	75.0
Liveweight of lambs at birth (kg)	4.7	4.4	4.8 ± 0.11	4.3 ± 0.10
Liveweight of lambs at the age of 20 days (kg	11.3	9.5	11.1 ± 0.12	8.4 ± 0.09
Total liveweight gain of lambs (kg)	6.6	5.1	6.3	4.1
Average daily weight gain (g)	330	255	315	205
Daily milk production (kg)	1.65	1.27	1.57 ± 0.11	1.02 ± 0.08

Subactivity 3: Early weaning of lambs (at 3 months of age) and subsequent fattening performance in 2008

The objective of this study was to fully explore the growth potential of lambs and to let ewes recover earlier from the milking period to reach a better reproductive performance in the subsequent year. In spring 2008 an experimental (M. Mahmudov) and a control (M. Niyozov) group of 10 male lambs each of equal liveweight and age were formed. Ten lambs from the flock of M. Mahmudov were weaned at 3 month age and grazed on highland pastures (3200-3600 m a.s.l) of Rammit ravine at the boundary of Kanask-Barzangy, at a distance of 150-180 km from the district center Vahdat. Lambs of the control group were kept with their mothers until 4.5-5.0 month age on village pastures (Table 107). Thus, it could be shown that lambs weaned at 3 month age grazing good pastures did not lag behind lambs that were weaned at an age of 5 months in growth and development. On the contrary at the age of 5 months early weaned lambs exceeded their contemporaries by 1 kg. The observations comply with the physiological theory that the growth and development of lambs till 2 month age is strongly related to the milk production of their ewes, and thereafter to fodder supply. Furthermore, the separate grazing of ewes and lambs in the early weaning group contributed to a rapid increase of liveweight and condition of ewes and it is assumed that this would lead to improved reproductive performance of ewes.

Table 107. Changes in liveweight of lambs and ewes

Liveweights and daily weight gains	Exp. group	Control group
Liveweight of lambs**:**		
-at lambing (kg)	4.7	4.7
-at 3 month age (kg)/average daily gain (g)	28.3/263	28.0/267
-at 4 month age (kg)/average daily gain (g)	35.1/223	34.6/210
-at 5 month age (kg)/average daily gain (g)	39.7/154	38.7/136
Liveweight of ewes:		
-at lambing(kg)	53.6	54.1
-after 2 months, (kg)	51.1	52.0
-after 3 months(kg)/average daily gain (g)	53.2/70	54.1/67
-after 4 months(kg)/average daily gain (g)	58.6/180	55.6/52
-after 5 months(kg)/average daily gain (g)	64.3/190	58.2/87

As one important characteristic of Gissar sheep is their fattening ability, fattening performance of early and traditionally weaned males was compared. Fattening started on 15 October 2008 and lasted 45 days. The ration was developed on the basis of locally available ingredients (Table 108).

Table 108. Fattening diet for lambs

Diet components	Quantity (kg)	ME (MJ)	Dry matter (kg)	Digestible protein (g)	Ca (g)	P (g)	Caro-tene (g)
Hay from rangelands	1.0	7.00	0.80	40.0	5.6	1.0	13.0
Wheat straw	0.5	2.60	0.42	4.5	0.7	0.4	2.5
Cotton seed cake	0.3	2.90	0.27	95.7	0.8	2.8	0.3
Chopped barley grain	0.2	4.50	0.30	17.0	0.4	0.8	0.1
Total	**2.0**	**17.0**	**1.79**	**157.0**	**7.5**	**5.0**	**15.9**

At the end of the fattening period early weaned males exceeded traditionally weaned group by 1.6 kg total liveweight gain (22.9%); their average daily weight gain was by 35 g higher (Table 109). Feed consumption per 1 kg of liveweight gain was considerably higher in the traditionally weaned lambs.

Table 109. Fattening performance of 10 early and 10 traditionally weaned Gissar rams over 45 days

Parameters	Exp.	Control
Liveweight at the beginning of fattening (kg)	43.1	42.8
Liveweight at the end of fattening (kg)	51.7	49.8
Absolute gain of live weight (kg)	8.6	7.0
Average daily gain (g)	191	156
Required feed energy (MJ) per kg liveweight gain	89.0	109.3

Subactivity 4: Potential for milking ewes and dairy processing.

Potential for milking Gissar ewes and milk processing was tested in a small pilot study with 10 ewes owned by Gulandon Khafizova. In mid May 2009, 2 months after lambing ewes were milked for ten days. The lambs were separated from the ewes during night and ewes were milked by the farmer in the early morning. Average daily milk yield of ewes increased from 276 g at the start of milking to 469 g after 10 days as ewes got used to milking (Annextable 18). Furthermore, the composition of a composite milk sample at the start and the end of the milking period was analyzed at the Dushanbe milk processing plant (Table 110).

Table 110. Milk composition (%) of composite samples from 10 ewes

Date of sampling	Dry matter	Fat	Protein	Lactose	Ash
4 May 2009	18.76	7.25	5.72	4.82	1.01
12 May 2009	17.87	6.70	5.53	4.74	0.97
Average	18.31	6.98	5.63	4.78	0.99

Together with the farmer Gulandon Khafizova sheep milk was processed into jurgot (yogurt), butter, brynza and kurut under households conditions (Table 111). Through daily milking of one ewe for two months about 30 kg of milk in the value of 60 TJ Somoni can be produced. By processing the milk into brynza or yoghurt, the value can be doubled to 120 TJ Somoni, through kurut production the value can be increased to 40 TJ Somoni, while butter production does not add to the value of the milk due to the low conversion rate.

Table 111. Processing of sheep milk under home conditions

Dairy product	Milk conversion rate (l for 1 kg product)	Price of 1 kg	
		TJ Somoni	USD
Brynza	4-5 l	18.0	4.05
Homemade butter	13 l	25.0	5.63
Jurgot (yogurt)	1 l	4.0	0.9
Kurut	6 l	8.0	1.8

Conclusions:

- Supplemental feeding of ewes with concentrates before mating increases conception rates and prevent losses in ewes that are grazed on village pastures throughout the year.
- Feeding of ewes during late gestation leads to increased lamb survival and growth.
- Early weaning of lambs combined with grazing on good quality summer pastures resulted in good weight gains and rapid increases in the liveweights of their ewes. The fattening performance of early weaned lambs, namely growth rate and feed conversion rate, was even better than in the traditionally weaned lambs.
- Early weaning of lambs would also allow milking of ewes which has a good income potential when processed into traditional dairy products.

3.4 Theme 4: Capacity building and Knowledge sharing

Scientific training and exchange of scientific information on regional and international level is limited in central asia, and the relatively few opportunities for training of scientists are often not linked to on-going research such that researchers returning from training are not able to apply their learned experience on the ground. In pakistan a higher number of international projects have been conducted in last decades, therefore the national scientists are more familiar with community based approaches and research for development of small scale farmers. However, in both regions there are very limited opportunities for farmers to get practical training in the use of technologies to improve crop and livestock productivity, in particular in the frame of a participatory research project. Thus, theme 4 aimed at capacity building of scientists and staff through specific theme related regional or country workshops, on the job training during project implementation, knowledge sharing during the national and regional project workshops and through the project website. The farmers at the research sites received training in more formal training sessions and continuously during the implementation of the project activities

3.4.1 Farmers' training in Central Asia

3.4.1.1 Khujand/Tajikistan

Training sessions with farmers were conducted on key topics related to the project activities in Karadzhingil and Uyas village by Dr. M. Kosimov and colleagues. The following formal training sessions were held:

1. "Selection of Mohair goats in farms to improve breeding progress", held on 4 September 2009 and on 12 October 2008 in Karadzhingil with participation of 13 and 12 farmers, respectively.
2. "Classification of Mohair fleeces on the basis of international norms (in particular fiber fineness)", held on 21 April 2007 and on 25 April 2009 in Karadzhingil with participation of 11 and 12 farmers, respectively and on 3 May 2008 in Uyas village with 11 farmers.
3. "The importance of balanced diets for Mohair goats, to improve productivity", held on 13 January 2009 and on 20 June 2009 in Uyas village with 9 farmers and on 21 October 2008 in Karadzhingil with 12 farmers.

In addition a conference and an auction were held

- The Institute organized and held a national scientific-practical conference "Development of Angora goat breeding in Tajikistan" in 2008
- The Institute together with the Agency Support Development Processing (ASDP) organized and held a national "Exhibition – auction" on pedigree Angora goats and Mohair products in 2009.

3.4.1.2 Dushanbe/Tajikistan

For Theme 2 20 farmers from the villages Buzbit, Karsang and Nematabatwere trained on "Rehabilitating the productivity of pastures and hayfields through oversowing and fertilizer application (nitrogen and phosphorus) and appropriate pasture management" and on "cultivation of forage crops on irrigated land in 2007.

For Theme 3 two training workshops were conducted:

- "Feeding, maintaining and increasing the reproductive performance of ewes" on 12 June 2008,
- "Feeding of pregnant ewes, technologies for growing of lambs, milking of ewes and options for sheep milk processing" on 18 May 2009.

In addition to the farmers and households from the communities, representatives of the local authority and interested livestock specialists were invited. Lectures were given by A. Karakulov, F. Ikromov, Kh. Davlatov and A. Madaminov. Best options for improving sheep productivity through breeding, improved nutrition, prevention and treatment of diseases, processing and marketing and improving pasture productivity through better grazing management, e.g. rotational grazing were discussed.

Besides the formal training sessions farmers were regularly visited by the scientists and all problems discussed with representatives of households and farms. During these visits farmers were advised on selection of best males and females in the mating season, preparation of ewes for mating and lambing, feeding of concentrates and mineral additives, rational use of pastures, stocking of fodders for winter and improvements in the quality of fodders.

3.4.1.3 Kazakhstan

Formal trainings for farmers and households in Akdala village were conducted by the South Western Research Institute under the guidance of Dr. A. Ombaev in particular for Theme 3:

1. "Growing of ewes and lambs (feeding and maintenance during early lambing)", held on 16 October 2007 with participation of 9 households.
2. "Technology of early lambing for obtaining targeted profit", held on 21 March 2008, with participation of 7 households.
3. "Joint action of ICARDA and South-Western Livestock Research Institute in integrated and market oriented livestock production in Kazakhstan", held on 14 April 2008 with participation of 8 households and 15 scientists from Russia and Mongolia.
4. "Marketing of karakul and fat-tailed lambs", held on 24 March 2009, with participation of 7 householders.
5. "Dairy and meat processing methods:

- Milk processing into chechil and cheese: 25 households participated
- Milk processing into kurut, stuffed with different dried fruits: 7 households participated
- Milk processing into homemade cheese: 6 households participated
- Milk processing into yogurt. 7 households participated
- Preparation of melted butter, totra and milk kvas
- Preparation of homemade sausage. 8 households participated

3.4.1.4 Kyrgyzstan

In relation to the project activities on sheep milk production with Awassi sheep in of Chu rayon two training courses were held on the farm "Kenesh" by Drs. R.Z. Nurgaziev, A. Ajibekov and colleagues

1. "The importance of sheep milk production for income diversification", held on 13 December 2007 with participation of Nurjan Abdymajitov (owner of Kenesh farm) and six households from Progress village
2. "Demonstration and Evaluation of Productive Qualities of Awassi Sheep", held on 14 June 2008, with participation of Nurjan Abdymajitov, 5 household from Progress village, and 12 households from Akbeket.

In addition the households from Akbeket received training by the staff of the Kyrgyz Research Institute of Veterinary from 2007-2009 on prophylactic measures, diagnoses and treatment of sheep diseases; on feeding during gestation and lactation and hygienic requirements for sheds for adult and young animals. In particular, the community members in Akbeket were trained on:

- De-worming against intestinal strongilatosis;
- Blood sampling of breeding rams for serological testing for brucellosis;
- Treating sheep against mange, preparing premises for keeping animals in barns (mechanical treatment, disinfection);
- Treatment of sheep against clostridiosis according to the guidelines
- Organization of mating of ewes
- Selection of ewes and preparing breeding rams for mating;
- Training animal owners in rational use of village pastures with additional feeding in winter and early spring.

Farmers and households in Chuy and Kemin province were also informed about the role of communities in joint actions for improved sheep farming. Training materials, such as an animal health calendar for the 12 months of the year, were distributed to the farmers and households and the feedback received from the trainees on the materials was very positive.

3.4.2 Farmers' trainings in Pakistan

The objective of farmers' training was to disseminate the best practices in the area of fodder production, conservation, feeding and milk hygiene to enable small farmers in the project villages to improve their incomes e.g. through higher productivity and higher prices. The trainings also proved to be instrumental to get feedback from the community and to resolve their queries and questions.

3.4.2.1 Forage production

Training of participating farmers in fodder crop production and hay making at both project sites were undertaken about one week before the start of each specific activity. The formal training sessions contained lectures by experts followed by discussion (see some selected photos in Annex 4.1). For some sessions experts also distributed leaflets in the local language specifically prepared for the purpose. The attendance of farmers normally ranged from 20 to 35 farmers in each season depending upon their interest in the respective activity. More interest of the farmers was noticed for fodder production. Actually many farmers showed keen interest to produce seeds of improved varieties but this activity could practically be performed only by those farmers with irrigation facilities as forage seed production is only economical if supplemental irrigation can be provided in the drier periods.

3.4.2.2 Livestock feeding and productivity

Formal as well as informal trainings of the farmers on animal nutrition and feeding were conducted. In the formal training basics of animal nutrition; properties of various feed ingredients; feed formulation; basic livestock management techniques, proper hay making procedures; importance of feeding cereal plus legumes mixed hays; etc. were presented and discussed. Farmers were also instructed about the importance of keeping records on feed intake; feed prices; milk production, weight gain; prices of milk and meat; diseases, vaccination, treatment, sale and purchase; calving dates; mating dates, etc. Farmers were also made aware of the nutritional changes in roughages at the various growth stages and importance of feeding at the proper stage.

Three formal and about fifteen informal training courses on livestock feeding and productivity were held in Lodhay. At the irrigated site, two formal and ten informal sessions in each village were conducted. For the formal sessions, the inclusion of neighboring farmers was encouraged while for the informal sessions that were more project specific usually only the participating farmers attend.

3.4.2.3 Value addition

At the rainfed site in about two and half years 38 formal sessions on various activities were carried out in Lodhay village (Annextable 19). In 2007 training focused on raising awareness on hygienic milking. In year 2008 a high number of knowledge exchange meetings with active community members were conducted on various aspects. For example six practical training sessions were organized on use of teat dips / California Mastitis Test (CMT) kit and clean milk production practices. Five sessions were arranged for women on practical aspects of dairy product preparation at household level. The products prepared were plain and flavored yoghurt (mango, strawberry and mixed flavors). The plain yoghurt was converted into fruit yoghurt of banana, strawberry and apple varieties. Many households started relishing higher quality products for the first time. Further to that, two sessions on perception and product evaluation were arranged. In year 2009, the major emphasis was on training of master trainers on all possible aspects of value addition to ensure sustainability. These included practical hands-on training and/or demonstration: dairy product preparation and clean milk production practices. The male village facilitator was trained as master trainer on simplified milk analysis (by applying fat test and lactometer only) to enhance bargaining power of farmers to sell good quality milk at premium price. He was also trained on formulation/preparation of teat dips using locally available cheap ingredients, thereby cutting the cost of these consumables to almost one quarter of the commercial product. In total 33 females and two male farmers were trained on commercial preparation of dairy products; six farmers were trained on how to test the milk quality; 32 farmers were trained in how to use the CMT kit; on teat dipping and on milk hygiene 42 and 38 farmers were trained, respectively. The perceived impact of the training in Lodhay is that the project village dairy herd is healthier and clinically mastitis-free; and the more hygienic milk produced is fetching a premium price compared with neighboring villages. The women and their families are relishing standard quality dairy products with good hygienic standards.

At the **irrigated site** twenty-five women in the village Chak No. 105/SB and twenty-two women in Chak No. 74/SB attended continuously the training courses for dairy processing during February to March and August to September 2008. The courses were given by two female master students from the University in Sarghoda. Thirteen training sessions were organized for the female members of each group in each village. The topics included:

- Clean milking and clean milk processing
- Concept of cleaning and know how about bacteria and fungi and cleaning of pots.
- Clean milk handling
- Value addition/ dairy technology
- Milk chilling
- Flavored milk (chocolate) making
- Condensed milk making
- Cottage cheese making (3 training)
- Whey healthier making
- Peanut butter making
- Yoghurt (2 training)

As a result of the training in Chak No. 105/ SB thirty-four women and in Chak No. 74/ SB thirty-one women started producing dairy products such as plain, flavored and fruit yogurt, flavored milk, peanut butter and white cheese. The training increased the quality and the shelf live of dairy products and added to the diversity of dairy products in the households.

3.4.3 Specific training courses for project collaborators

3.4.3.1 English training for Central Asian scientists to improve the international scientific exchange

A major problem confronted by Central Asian scientists is their difficulty in communicating in English. This basically leads to their exclusion from international scientific exchange. It also severely limits Central Asian scientists in taking advantage of training and funding opportunities. To help overcome this limitation, the programme offered English courses for scientists engaged in the project to strengthening their research capacity of the partner institutes.

In total 15 researchers were trained in English. The English training course for Tajik scientists was conducted in Dushanbe. Eight Tajik participants (4 from Dushanbe and 4 from Khojand) were trained for three months from 1 November 2007 to 1 February 2008 (Table 112).

Table 112. List of participants of the English training courses conducted in Dushanbe and Tashkent

No	Name	Place of work	Position	Date of Birth
Training in Dushanbe				
1	Kasymov Alisher	Khujand Branch of Tajik University of Technology	Student, part time	10/08/86
2	Makhmudov Khasanboy	Khujand Branch of Tajik University of Technology	Student, part time	21/05/86
3	Samatov Jamshid	Khujand Branch of Tajik University of Technology	Scientist	17/08/83
4	Kasymov Makhmoud	Khujand Branch of Tajik University of Technology	Scientist	18/12/81
5	Ulugov Odiljon	Tajik Research Institute of Livestock	Scientist	17/11/82
6	Daminova Karomat	Tajik Research Institute of Livestock	Scientist	12/05/83
7	Madjidov Sherzod	Tajik Research Institute of Livestock	Scientist	12/05/82
8	Soliev Kobiljon	Tajik Research Institute of Livestock	Laboratory Assistant	27/04/84
Tashkent				
1	Roza Shimelkova	South-West Scientific Center for Agriculture	Scientist	23/09/83
2	Abay Sartaev	South-West Scientific Center for Agriculture	Scientist	01/08/75
3	Maryam Kalginbaeva	South-West Scientific Center for Agriculture	Scientist	26/08/77
4	Kubanchbek Abdukerimov	Institute of Livestock, Veterinary, and Rangelands	Livestock specialist	25/03/81
5	Elmira Akmatova	Institute of Livestock, Veterinary, and Rangelands	Livestock specialist	26/03/70
6	Aliman Kachaganova	Institute of Livestock, Veterinary, and Rangelands	Socioeconomist	16/05/88
7	Altynbek Karybekov	Institute of Livestock, Veterinary, and Rangelands	Range specialist	26/11/79

Four Kyrgyz and three Kazakh participants participated in the English training course conducted from 5 January to 5 April 2008 in Tashkent. The candidates were carefully selected by the national coordinators in agreement with our project staff. Important selection criteria were age – young or middle aged scientists – and a relatively high probability that the trainees would continue working in the partner institutes in the future and support them in linking to international organizations and to international publications.

3.4.3.2 Methodology and planning workshops

Scientific training and exchange of scientific information is somewhat limited in Central Asia. Furthermore, the relatively few opportunities for training of scientists are often not linked to on-going research such that researchers returning from training are not able to apply their learned experience on the ground. The programme provided training and scientific exchange via targeted training of the project staff at ICARDA, workshops in the partner countries on selected topics, in particular specific research methodologies in addition to the scientific exchange during annual national and regional workshops. The area that required the largest attention was in socioeconomic research, with focus on modern methodologies to identify production problems with farmer's participation, characterize production systems, assess and study markets and market potentials, and monitor production systems to evaluate impact. Two regional socioeconomic workshops were conducted to train researchers in modern approaches in participatory research and methodologies of surveying, Rapid Participatory Appraisal, and production monitoring.

Regional Workshop on participatory and socioeconomic research methodologies on 27 March 2007 (Theme 1)

The workshop was held at the South Western Research Center (SWRC) in Shymkent, Kazakhstan on 27 March 2007. A total 14 participants attended the workshop, including two participants from Tajikistan, Kyrgyzstan and Kazakhstan. In addition to the participants from the project team three students from the Kazak-Turkish University attended the workshop. No researchers from Pakistan participated because it would have caused severe logistic problems (language, visa, etc.) and the knowledge, skills and expectations of the participants would have differed too much. The workshop was preceded by a field visit to Khojand (Tajikistan Site) and to research sites in Kazakhstan. The recorded observations from the communities visited at the research sites in Kazakhstan and in Tajikistan (Khujand) were later used in the project reports. The Director of the Center and Project National Coordinator for Kazakhstan, Abdurakhman Ombaev, provided the facilities for the workshop.

Nariman Nishanov (PO, socio-economics, Tashkent Office) organized the workshop and supported the NARS during the workshop guided by Dr. Mekhlis Suleimenov, who also participated in the field visits. Denise Mainville from Virginia Tech University participated and provided support in market research. Dr. Liba Brent (sociologist, consultant) also participated in the workshop and highlighted the role of women in Angora fiber processing work and their role in adding value to local products which is important for household income.

The main purpose of the workshop was to help NARS familiarize with the socio-economic research methods that will be used in the market and livelihood analysis, and that will address research questions relevant to the project goal and in line with the plan developed during the inception workshop.

The methodology for market driven research, the value chain concept and livelihood analysis, the role of gender in value-addition activities were presented and thoroughly discussed. The participants were able to internalize these methods and incorporate them into their research plans during group discussions. The teams presented their plans which were then discussed. The workshop helped NARS to sharpen the research focus on the specific problems with high priority for the project theme and goal, and to develop a strategy for qualitative research (as first step) including secondary data and literature review, to describe the household livelihood strategies, and to explain the market value chain. All NARS groups then presented their plans which were discussed. It was decided that the focus would be on:

- Analysis of sheep market (with focus on meat) and rural livelihoods in Kazakhstan (it is important to note that semi-industrial fattening sheep systems like in other parts of the world, for example in Syria, are emerging in Kazakhstan
- Analysis of marketing of sheep (meat and wool) and rural livelihoods depending heavily on sheep production systems in Kyrgyzstan,
- Market analysis of Angora goat systems and the livelihoods of rural communities relying heavily on Angora goat production in Tajikistan,

Guidelines for the analysis of market value chain and rural livelihood using participatory rural appraisal methods were developed and translated into Russian for the teams to apply in their research activities. The workshop then planned data collection during the first project year, including:

- Description of livelihood strategies for households in the target areas
- Detailed description of the market chain in a written and flow chart form
- Enterprise budgets of representative households and production systems, and marketing costs and profit margins.

Regional training on designing and testing survey instruments from 17-23 November 2007 (Theme 1)

A second socioeconomic workshop on methodology for livelihoods and market analysis and assessment of the biophysical technologies was conducted from 26-30 November 2007 in Tashkent under the lead of Aden Aw-Hassan assisted by Nariman Nishanov. The training workshop was divided into two parts: in the first part the methods required for the socioeconomic activities foreseen in 2008 were developed and discussed by the ICARDA principal investigator (PI), the PO Tashkent and the PIs for socioeconomics from the three Central Asian countries and the coordinator for socioeconomic research in Pakistan. In the second part the national coordinators from Kazakhstan and Tajikistan (Dushanbe site) and the PIs for Theme 3 from Central Asia participated.
In Part 1 of the Workshop on Socioeconomic studies, three major outputs were achieved:

- Description of project sites in order to develop an appropriate sampling frame
- Key research questions to be answered by surveys
- Start of developing the questionnaires to address these research questions

For Part 2 of the Workshop on Socioeconomic evaluation of biophysical interventions, research activities from Theme 3 “Livestock productivity” was chosen as example for the workshop. The PIs presented the main interventions in Theme 3 for each country. Then the data requirements were listed and discussed taking the example of one intervention from each country.

Round table planning workshop on Theme 2 “Pasture and Forage Productivity” in Central Asia on 27 May 2007

The workshop took place on 27 May 2007 under the lead of Asamoah Larbi assisted by Aziz Nurbekov with 12 participants, including the project coordinators from ICARDA and Tashkent office, Mr. Nishanov (PO Socioeconomics), the Principal Investigators from all research sites, two additional scientists from Kazakhstan and Kyrgyzstan and a medium scale farmer from Kazakhstan. The objectives of the workshop were to get to know each other, to review progress made so far, planning of year 2, to identify training needs and to agree on reporting.
First the national collaborators made presentations on the progress in Theme 2 on the basis of the quarterly progress report that had been submitted to ICARDA. The number of participating small and larger farmers was discussed and it was emphasized that the main target group are small farmers but that some interventions where larger fields and resources were required would be tested on medium scale farms.
The activities and the related experimental design under Theme 2 were then discussed in detail using examples that were presented by the national principal investigators. It was agreed that Drs. Larbi assisted by Dr. Nurbekov would develop a questionnaire for a systematic survey on fodder crops and feed resources and distribute it to the national principal investigators. It was further agreed that more

emphasis should be given to forage production than in the previous IFAD programme. The two main areas of research would be: (1) Integration of forages into farming/cropping systems (evaluation of varieties and cropping management options) and (2) Improving carrying capacity of degraded rangelands around villages (enriching with forage plants, rotational use of pastures). In addition strategic supplementation of productive animals with the newly available forages and alternative feed resources should tested.
Finally training and the importance of including graduate students into the project was discussed. The research topics of the students should directly relate to the programme's research activities and have high relevance to the candidate's national agricultural research program. The deadlines for preparing the second annual workplans and annual progress reports were agreed.

3.4.3.3 Training of website managers in Central Asia

Each of the collaborating institutes in Kazakhstan, Kyrgyzstan and Tajikistan nominated a website manager as a resource person to actively manage and update the project website independently of Tashkent office. The nominees (see Table 113) were trained by Sherzod Kosimov, the ICARDA's website manager for Tashkent office. The main topics of the training included:

- Working on images with Adobe Photoshop (image brightness, contrast, resize, cut, save as web and etc.).
- Basics of HTML (converting plain text materials to special web-format, converting tables).
- Working with Control Panel (uploading images to server, publishing materials on Livestock web-site).

Table 113. List of participants and training period for training on website management

No	Full name	Period	Country
1	Ms. Kachaganova Aliman	19-20 May 2008	Kyrgyzstan
2	Mrs. Mohinav Abdulloeva	1-3 July 2008	Tajikistan/Dushanbe
3	Mr. Farhod Kosimov	4-6 July 2008	Tajikistan/Khojand
4	Mr. Aidar Kochkarov	22-24 July 2008	Kazakhstan
5	Mrs. Roza Shmelkova	22-24 July 2008	Kazakhstan

3.4.3.4 Training course on Statistical and Economic Methods for Data Analysis in Pakistan

A six day training course on "Statistical and Economic Methods for Data Analysis Using Software (MINITAB and MS Excel)" was organized for scientists from the participating institutes at ICARDA, Country Office in Islamabad. From each institute two scientists were invited including one actively involved in the project activities. The training was comprised of statistical and economic methods for on-farm data analysis. The course contents (Annex 4.2.1) and its conductance were supervised by ICARDA's country representative (also see some photos of the training sessions in Annex 4.2.2).

3.4.4 Training of the project staff from Tashkent office

The Professional Officers (PO) received individual training at ICARDA HQ several times during the project duration. The objective was to expand their expertise and methodological knowledge to allow them to effectively support the implementation of the three research theme for which they were responsible and to pass their knowledge on to the key collaborating scientists in Central Asia involved in the project. The timing and purpose of the staff training are listed in Table 114.

Table 114. Periods and purpose of trainings of Professional Officers from Tashkent at ICARDA HQ

No	Name	Period	Main topic/purpose
1	Nariman Nishanov	7-21 July 2007	Finalizing the drafting of the project outputs, including identifying research gaps, and elaboration of main structure of the project workplan for the year 2007-2008.
2	Nariman Nishanov	1-16 Nov. 2007	Finalizing the socioeconomic research design, preparation of the regional methodology workshop and to conduct a literature search on market studies (presented during the regional workshop in November 2007)
3	Nariman Nishanov	3 April-8 May 2009	Participation in the individual non-degree training course on "Livestock Marketing Research and Methodologies" at ICARDA HQ; and finalization of the second socioeconomic technical report for the Livestock project
4	Nariman Nishanov	5 Oct.-20 Nov. 2009	Finalization of the second socioeconomic technical report and work on publications with Dr. Aden Aw-Hassan
5	Habibulo Hamdamov	12-26 Jan. 2008	Meeting with Dr. Luis Iñiguez, one of the PIs for Theme 3 to discuss the activities listed in the workplan; to study the new methods and literature; and to prepare a plan for data collection. Training on milk processing and animal nutrition
6	Habibulo Hamdamov	March-June 2008	Individual English training (20 hours)
7	Aziz Nurbekov	12-26 Jan. 2008	Finalize the design of the range and forage productivity research, study statistical analysis with GenStat and to review literature on forage and range productivity.
8	Aziz Nurbekov	19-27 July 2008	Discuss the progress in range and forage productivity research, to discuss the feed survey and create data base for feed survey; to get training on statistical analysis with GenStat; and to review literature on forage and range productivity
9	Aziz Nurbekov	26 Oct.-6 Nov. 2008	Start the statistical analysis with GenStat program; participate in ICARDA 1st Science Week; and to review literature on forage and range productivity
10	Aziz Nurbekov	6-21 Nov. 2009	Continue statistical analysis with GenStat program; to review literature on forage and range productivity; and start drafting final report on forage and range productivity

3.4.5 Postgraduate training

3.4.5.1 Central Asia

In many Central Asian agricultural institutes there is a lack of young researchers. The program encouraged the national coordinators and scientists to involve post-graduate students from their own institutes or local universities through using project activities as field research for dissertations. The first students started their theses research in 2007; up to July 2010 four out of ten Master and PhD students had finished their research (Table 115).[3] Most of the remaining students are expected to finish end of 2010. There were, however, three Kyrgyz and Tajik students in Theme 3 and one Kazakh PhD student in Theme 2 (not listed in the table) that started field research in the project but later abandoned it. After ensuring that the proposed research studies contributed to the planned project activities, the programme supported post-graduate students with a small honorarium and operational support.

[3] In addition to the PhD students listed in the table Nurjan K. Abdumajitov (owner of Kenesh farm in Kyrgyzstan) defended a dissertation on Awassi sheep in 2008; the field work for his thesis had been initiated before the IFAD/ICARDA programme started.

Table 115. List of post-graduate students involved in project activities in Central Asia

No	Name of student	Degree	Institute or university	Official supervisor/ Project supervisor	Title of thesis	Duration of field work
Theme 1						
1	Ms. Alima Aymyrzaeva	Master of Arts Econo-mics	Kazakh-Turkish University, Turkistan town	Dr. Borash Myrzaliev/ Dr. Nurridin. Alibaev	Analysis of households' livelihoods in Southern Kazakhstan	Sept. 2007-July 2009
2	Ms. Khalida Mamanova	Master of Arts Econo-mics	Kazakh-Turkish University, Turkistan town	Dr. Borash Myrzaliev/ Dr. Nurridin. Alibaev	Mutton markets in arid and semi-arid regions of Southern Kazakhstan	Sept. 2007-Dec. 2009
3	Mr. Kobiljon Soliev	MSc	Tajik RI of Livestock, Dushanbe/ Tajik Agrarian University		Sheep production practices in households	2008
4	Mr. Kobiljon Soliev	PhD	Tajik Institute of Agricultural Economics			Jan. 2009-2012 ongoing
Theme 2						
5	Abay Sartaev	Master of Agric. science	South-Western Research Institute of Plant industry and Livestock	Talgat Ibragimov/ Seyfulla Abdiraimov	Increasing forage crops production through planting of maize and alfalfa in South Kazakhstan province	Nov. 2007-Dec. 2009
Theme 3						
6	Rosa Shimelkova	PhD	South-Western Research Institute of Plant industry and Livestock	A. Ombaev	Productive and some biological characteristics of Karakul and fat-tailed lambs with early lambing	Jan. 2009-Dec2009 expected Nov. 2010
7	Ahlima Saniyazova	PhD	South-Western Research Institute of Plant industry and Livestock	A. Ombaev/ Dr. E. Kunanbaeva	Development of the traditional technologies for sheep and cow milk's processing into milk products	Sept.-Dec 2008
8	Katosheva Tulganoy	PhD Phd	Kyrgyz Agrarian University	Razzakov Imatbek	Improvement in the quality indicators of Merino wool	May 2008-Dec. 2009
9	Farkhod Kosimov	PhD	Khujand Branch of Tajik Tajik Research Institute of Livestock	D. Ergashev/ M. Kosimov	Productive and some biological features of colored types of goats"	Jan. 2008-Dec. 2009 expected Dec. 2010
10	Hurshed Davlatov	PhD	Tajik Research Institute of Livestock	Amir B. Karakulov	Comparative study of three Gissar sheep management systems households and small farms	Jan. 2008-Dec. 2009 expected Dec. 2010

3.4.5.2 Pakistan

In Pakistan graduate and post-graduate students from socioeconomics, agronomy and dairy technology were involved in the project activities. Four postgraduate students in socioeconomics finished their theses under the supervision of Dr. Azeem Khan from PARC and Prof. Muhammad Siddique from the University of Faisalabad and five students did their master studies on forage research being supervised by Dr. Ansar from the Arid Agriculture University of Rawalpindi (Table 116). Four of them

completed their degree and among them two have enrolled for higher studies (PhD). The fifth thesis is expected to be completed in September 2010. During the field work the students were supported with a small honorarium and received operational support.

Table 116 . List of post graduate students involved in project activities in Pakistan

No	Name of student	University	Name of supervisor(s)	Title of thesis	Discipline	Duration of field work
1	Khalid Mahmood Layyah PhD	Georg-August-Universität Göttingen	Dr. Muhmmad Azeam Khan; Prof. Folkhard Isermeyer	Analysis of the Development Options to improve the income Situation of Dairying Households in Punjab	Socio-economics	June-Dec. 2006
2	Mehmood Irfan M.Sc (Hons)	Uni. of Agri., Faisalabad	Prof. Muhammad Siddique	Profitability of peri-urban verses rural dairy farming in Punjab, a case study of Sargodha district	Socio-economics	Jan.-June 2008
3	Mehmood Irfan M.Sc (Hons)	Uni. of Agri., Faisalabad	Prof. Muhammad Siddique	Comparative economics of different dairy production systems in Sargodha district of the Punjab	Socio-economics	Jan.-June 2008
5	Muhammad Ahsin Javaid M.Sc (Hons)	Uni. of Agri., Faisalabad	Prof. Muhammad Siddique	Comparative economics of surplus and non surplus producing dairy farmers: a case study of district Sargodha	Socio-economics	Jan.-June 2008
6	Yasir Mehmood M.Sc (Hons)	Univ. Arid Agric.Rawal pindi	Dr. Ansar	Evaluation of Kharif cereal legume mixture for fodder yield and quality under rainfed condition.	Agronomy	July-Dec. 2008
7	Muhammad. Nadeem M.Sc (Hons)	Univ. Arid Agric. Rawalpindi	Dr. Ansar	Evaluation of winter cereal vetch mixtures for fodder yield quality under rainfed conditions.	Agronomy	Oct. 2007-May 2008
8	Adeel Anwar M.Sc (Hons)	Univ. Arid Agric.Rawal pindi	Dr. Ansar	Mixed cropping of non traditional winter legumes and oats for sustainable forage productivity	Agronomy	Oct. 2007-May, 2008
9	Adnan Zahid M.Sc (Hons)	Univ. Arid Agric. Rawalpindi	Dr. Ansar	Effect of cutting and postcutting intervals on hydrogen cyanide content of sorghum forage under rainfed conditions.	Agronomy	July-Dec. 2008
10	Rao Sabbir Sattar M.Sc (Hons)	Univ. Arid Agric.Rawal pindi	Dr. Ansar	Evaluation of different oat-vetch mixture ratios for forage yield and quality under rainfed conditions.	Agronomy	Oct. 208-April 2009 Thesis not yet finished (expected Sept. 2010)

3.4.6 Knowledge sharing

3.4.6.1 Website

A first version of the project webpage was set up in English by Sherzod Kosimov, the web designer in Tashkent office, in second half of 2007. Further improvement of the website was then discussed among the project team in Tashkent and after adjustments the website was translated into Russian. The training of resource persons in the partner institutes in Central Asia was completed in 2008 (see above). However, the training in Pakistan did not take place due to the security situation that had worsened in the second half of 2008 and never improved sufficiently to allow safe trips of Central Asian collaborators to Pakistan. The project webpage (www.icarda.org/cac/livestock.asp) contains a lot of relevant information and was continuously updated during the project duration. However, the interactive spirit using the website as part of a regional and inter-regional information network between the partner institutes could not be achieved which was due to the very limited computing capacity of the partner institutes with exception of the veterinary branch of the Kyrgyz livestock institute.

In addition Liba Brent prepared a special webpage related to value addition (www.adventureyarns.com) where she included information on the women spinners and Mohair products from Khojand.

3.4.6.2 Extension materials produced in Central Asia and Pakistan

A variety of extension material was produced in local languages during the project duration. Below examples are given but the list is not complete.

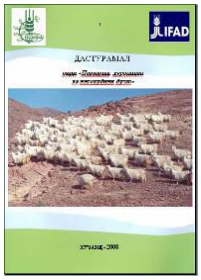
<u>Dushanbe team:</u>

The research team produced a booklet "Recommendations on increasing of ewes' prolificacy and lamb growth at dehkan farms and households" in 2008.

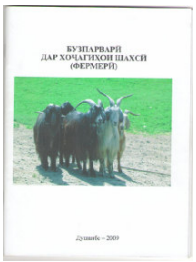
<u>Khujand team:</u>

1. "Handbook for farmers" is a Booklet for record keeping on all issues concerning flock management (*In Tajik and Uzbek)*

2. "Brief Farmer's Handbook" describes the major goat diseases in northern Tajikistan, their prophylaxis and treatment. The book includes a calendar showing the disease prevention measures to be taken in the different seasons of the year. *(In Russian, 19 pages)*



3. "Breeding, feeding and keeping goats" *(In Tajik, 35 pages)*



4. "Goat breeding in private (farmer) households" *(in Tajik, 38 pages)*

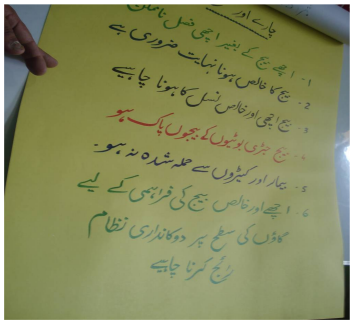
5. "How to breed goats" *(in Russian, in preparation, 27 pages)*

6. "Goat breeding" *(In Tajik, 58 pages)*

7. "Mohair Magic"– Marketing information leaflet. *(In English, Russian, Tajik, Uzbek*)

Pakistan team:

Brochure on "Oat cultivation in pure and in mix stands for fodder production under rainfed conditions" by M. Ansar and A. Hussain. 2008. *(In Urdu)*.



Example of material for capacity building used at the irrigated site.

3.4.6.3 Contributions to journals, conferences, newsletters and news

A number of contributions were published in national and international scientific journals and newsletters. These included:

Journals and National Bulletins:

Ajibekov, A.S. Abdurasulov, A.Kh. Abdumajitov, N. 2007. Effectiveness of managing different genotypes of Awassi sheep in Kyrgyzstan. Bulletin of the Kyrgyz Research Institute of Livestock Farming, Veterinary, and Pastures, No. 1 2007; No 2. 2007).

Ansar, M., Z. I. Ahmed., M. A. Malik., M. Nadeem., A. Majid and B. A. Rischkowsky. 2010. Forage yield and quality potential of winter cereal-vetch mixtures under rainfed conditions. Emirate. J. Food & Agric., 22 (1): 25-36.

Anwar A., M. Ansar., M. Nadeem., G. Ahmad., S. Khan and A. Hussain. 2010. Performance of non-traditional winter legumes with oats for forage yield under rainfed conditions. J. Agri. Res., 48(2):171-179.

Nadeem M., M. Ansar., A. Anwar, A. Hussain and S. Khan. 2010. Performance of winter cereal-legume fodder mixtures and their pure stands at different growth stages under rainfed conditions of Pothowar. J. Agri. Res., 48(2):181-192.

Shah, H., H. Riaz, N.Akmal, M. Sharif and A. Majid. 2010. "Investment Appraisal and Evaluation of Community Based Production of Balance Feed" Pak. J. of Agric. Res., 23:(1-2) (in press).

Davlatov Kh.K., Karakulov A.B., Ikromov F.M., Khamdamov Kh.A. (2009): Gissar sheep productivity in different management systems in modern farming conditions. Reports of Tajik Agricultural Academia of Science, No. 1 (19), 2009. Pp. 34-37.

Ikromov F.M., Davlatov Kh.K., Karakulov A.B., Khamdamov Kh.A. (2009): Influence of additional feeding to reproductive abilities of Gissar sheep at household conditions. Reports of Tajik Agricultural Academia of Science, No. 1 (19), 2009. Pp. 37-40.

Karakulov A.B., Davlatov Kh.K., Ikromov F.M., Khamdamov Kh.A. (2008): Recommendations on increasing of ewes' prolificacy, lamb's growing at dehkan farms and households. Approved by the scientific technical council of the Tajik Livestock Research Institute. Minutes, No. 5, 15 April, 2008. 15 pages.

Kosimov M.A. 2007.Ways of improving the productivity of animals and methods of improving the palatability of roughages (in Tajik). Materials of scientific-practical conference of HFTUT faculty.

Ombaev A.M., Tuekbasov M.K., Kashkarov A., Narbota B.E., Shimelkova R., Khamdamov Kh. 2009. Recommendations on early lambing of Karakul and Fat-tailed ewes for obtaining of targeted

profit, 16 pages. (Approved by the scientific council of the South-Western Research Institute of Plant breeding and Livestock, Minutes No. 5, 3 September 2009.)

Ombaev A.M., Rischkowsky B., Iñiguez L., Khamdamov Kh. 2008. ICARDA in South Kazakhstan. Shymkent, 30 pages.

Ombaev A.M., Kunanbaeva E.M., Narbota B.E., Saniyazova A.J., Khamdamov Kh.A. 2009. Recommendations for increasing livelihoods of communities on the basis of improving means for milk processing (cow and sheep) and production of sausages, 26 pages. (Approved by the Scientific Council of the South-Western Research Institute of Livestock and Plant Breeding, Minutes, No.5, 3 September 2009).

Newsletters and newspaper:

Brent, L. 2009. Women produce mohair yarn and enhance their rights in Tajikistan. IFAD Electronic Newsletter, Making a Difference in Asia and the Pacific, Issue 25 – Rights, March-April 2009

Kosimov M.A., Kosimov F.F. 2008. About the need to create a new breed of Angora goats. In "Rizkofarin" newspaper, No. 1 (2), 6 February 2008).

Kosimov M.A. 2009. Angora goats: tackling unemployment. In "Varorud" newspaper, No. 40 (2), 14 October 2009.

Nurbekov, A., Nishanov, N. Hamdamov, H. 2008. Better animal production through improved management. CAC (Central Asia and the Caucasus) News, 35, January-March 2008, 10-12.

Nishanov, N., Aw-Hassan, A. 2010. Middlemen in the Central Asian livestock markets: do they help or hinder? IFAD Electronic Newsletter, Making a Difference in Asia and the Pacific (in press).

TANs:

Brent, L. 2009. Women add value to Angora goat fiber in Tajikistan - developing local processing, quality and marketing. IFAD Technical Advisory Note (TAN), December 2009.

Conferences:

Rischkowsky, B. 2008. ICARDA's livestock research in Central Asia. International Conference "Agricultural Research Competence for Central Asia and the Caucasus – 10 years of CAC Program 1998-2008, 16 September 2008, Tashkent, Uzbekistan.

Ombaev, A., Nishanov, N. 2009. Livestock farming: linking farmers to markets. 12th Meeting of the Steering Committee of the CGIAR Program for Central Asia and the Caucasus, 12-14 September, 2009, Tbilisi, Georgia.

Radio, TV and exhibitions:

In Kyrgyzstan Professor A.S. Ajibekov organized a number of programs on national radio in 2008 and 2009 in order to promote the findings of the project on Awassi sheep.

Professor A.S. Ajibekov also demonstrated the best Awassi crossbred animals at the animal breeding exhibition of the 4th Republican Caucus of Livestock Farmers on 2-3 July, 2009, in Suusamyr spring, which was visited by H.E. Mr. K.S Bakiev, the President of Kyrgyzstan.

In Northern Tajikistan the most important results from the project were also covered in interviews (3 times) to international Central Asian TV "K +" and republican and regional TVs (3 times), radio (2 times) and newspapers (2 times).

3.4.6.4 National and regional workshops

Inception workshops in 2006

A two day inception workshop for Central Asia in September 2006 in Tashkent involved 19 participants, including ICARDA's Principal Investigators and the Programme Director of MP4, NARS from Kazakhstan, Kyrgyzstan, and Tajikistan, an NGO representative from Tajikistan, and faculty members of Kazakh, Kyrgyz, and US universities. The partner countries had been visited beforehand to encourage and assist with the preparation of workplans. Participants from Kazakhstan, Kyrgyzstan,

and Tajikistan gave presentations of draft country workplans. The workplans for each country were then discussed and modified with the help of ICARDA scientists to ensure activities were addressing the highest priority issues and were manageable and affordable according to the time frame and budget. Refined workplans were presented and discussed so all partners were aware of what was proposed across the region. A draft budget prepared by Dr Iñiguez was discussed and agreed to by all countries.
The Inception Workshop for Pakistan was held on 22 and 23 September 2006 in Islamabad involving 20 scientists from NARS, ICARDA's staff staff, namely Dr. Abdul Majid, country coordinator, Dr. Asamaoah Larbi, Senior Foarge Scientist and Dr. Azeem Khan (Socioeconomist in Pakistan). The workshop explained the implementation strategies and developed workplans for each research sites. Management issues were discussed, and training needs identified.

National annual planning meetings in 2007 and 2008
Prior to the regional workshop national planning meetings were held in each country in August 2007 and October 2008 with participation of all scientists from different insitutes, often district or national government officials, farmers from the project villages, ICARDA's project manager and for the workshops in the Central Asian countries the three POs from Tashkent office. The project teams from both sites in Tajikistan either met in Dushanbe or in Khujand. In these meetings project progress and preliminary findings were presented and the national workplans and budgets for the next project year were developped and discussed.

Khujand
To disseminate the successful results of introduction conferences, seminars and exhibition-auction were organized. These events brought together farmers, leading scientists, local and foreign mass media, representatives of various NGOs. In the second half close of the project cooperation with ASDP (Agency Support Development Processing) and Mercy Corps was initiated in Asht.
1. The branch of the Institute organized and held the Republican scientific-practical conference "Development of hair goat breeding in Tajikistan" (see electronic version of protocol - booklet), 2008
2. The branch of the Institute together with ASDP organized and held the Republican "Exhibition – auction" on pedigree goats of Angora type and products of their processing (see electronic version of protocol - booklet), 2009

Regional workshops in 2007 and 2008 (followed by project steering committee meetings)
The regional programme workshops brought together scientists from Central Asia and Pakistan for the first time. The first Regional Workshop took place on 12 September 2007 at lake Issyk Kul in Kyrgyzstan with a prior field day on 11 September in Akbeket village. The second Regional Workshop was conducted on 25 November 2008, including two field days, the first on 24 November in Khujand and the second on 26 November in Dusti community/Dushanbe site.The first and second regional workshop were attended by 23 and 28 participants, respectively. The participants included the national focal points and national project coordinators from the participating countries, principal scientists from Pakistan, Kazakhstan, Tajikistan, and Kyrgyzstan, the grant manager from IFAD, the project coordinator from ICARDA HQ, ICARDA scientists, the POs from Tashkent office, and in 2007 the Assistant Director General-International Cooperation, Dr. Brent from the University of Wisconsin and Dr. Yusupov, a guest speaker from Uzbekistan. The scientists from the partner institutes in Central Asia and Pakistan presented preliminary results on socioeconomics, forage and range production, on livestock productivity and on value addition.

Final project workshop in 2009
A final project workshop summarizing the most important project achievements was held on 10-11 December 2009 in Tashkent. In addition to the national project coordinators, the workshop provided the opportunity for all participating national scientists to present their research results and technology developments in the form of scientific presentations (Agenda in Annex 4.3). Prior to the workshop all scientists were encouraged to submit abstracts from which the best were selected by the POs and the project coordinator, and the authors invited accordingly. Four to five page extended summaries of the

best presentations are being currently prepared to be included in the proceedings of the workshop that are expected to be published at the end of 2010.

Annual national planning workshop in October 2008 in Shymkent, Kazakhstan

Project team at the final regional workshop in December 2009 in Tashkent

Field day in Khujand/Tajikistan during the regional workshop in November 2009

Field day with male farmer group in Sarghoda/Pakistan in July 2007

4 Assessment of Impact and of Impact Attribution

4.1 Central Asia

In Central Asia no impact assessment at community level was conducted. As most project interventions were tested with a relatively small number of farmers it could not be expected that measurable changes would occur at the community level at the end of the project. Instead for each intervention (with a few exceptions) a cost benefit analysis was carried out and the feasibility of adoption was evaluated. The findings are reported with the technical results in section 3 of this report. A more general assessment on the potential impact is provided in the lessons learnt.

4.2 Pakistan

4.2.1 Impact assessment

In Pakistan a baseline study was conducted in 2007 and repeated in 2009. The study included participating farmers and as a control non-participating farmers in the project villages and farmers

from neighboring villages. At the rainfed site the project village Lodhay and the neighboring control village Nata Mora were included in the survey. At the irrigated site, farmers in the two project villages (Chak No. 74/SB and 105/SB) and in two control villages (Chak No. 72/SB and 100/SB at Sargodha) were interviewed.

As higher quality seeds of both rabi and kharif fodders were provided to participating farmers at the **rainfed site,** which enabled them to get higher fodder yield specially during the rabi season, a potential impact could have been a change in the fodder area per animal unit. However, no clear trend in the changes of fodder areas per animal unit between 2007 and 2009 were observed for participating, non-participating and control farmers.
With regard to concentrate use the project intervention led to a clear change in the types of concentrate used: in 2009 participating farmers used vanda along with the oil seed cake, while in 2007 they were using oil seed cake and choker mix as main concentrate feed. However, overall a decrease of the quantity of concentrate used was observed in the participating farms which is indicative of the drought conditions during the last years at the rainfed site. The drought resulted in low crop productivity and affected the purchasing power of the farmers.
Milk yields of high and average yielding cattle and buffaloes increased in the participating households and decreased in the non-participating households in the target village, but as the milk yields in most cases also increased in the control households in the neighboring village it is not clear if the increase can be attributed to the project.
The comparison of the percentage of farmers being able to sell surplus milk at the start and at the end of the project was also inconclusive; it increased for the participating farmers and the control group in the neighboring village and decreased for non-participating farmers in the research village. In fact, the expected trend (without project interventions) was a decrease due to the drought conditions in 2009.
A clear impact of the project was apparent in the net benefits generated per lactating cow and buffalo. There was a consistent considerably higher increase in net benefits in the participating households comparing 2007 and 2009 than in the non-participating and control households with the exception of the net benefits generated from average yielding cows of the control farmers which increased from 2007 to 2009 while it decreased for participating and non-participating farmers in the target village; however the decrease in net benefits was much higher for the non-participating farmers in the same village.

At the **irrigated site** the yield difference between improved and local varieties in case of sorghum, millet, oat and berseem was significant; the improved varieties could also be harvested over a longer period (higher number of green fodder days) and thus helped to shorten the lean period.

Improved Sorghum variety at the irrigated site in Sargoda

With regard to the fodder area per animal unit a small decrease in the rabi fodder area per animal unit and no change in the kharif fodder area were observed for the participating farmers but there was no clear difference in the changes between participating, non-participating and control farmers.
A clear change in the use of concentrates by project participating farmers for all dairy animals was observed. The use of oil seed cake for high yielding buffaloes increased as well as the use of both oil seed cake and vanda for high yielding cows. In the opinion of the participating and fellow farmers, the balanced feed introduced in the project significantly improved milk yield, body condition of the animals and the quantity of cash income through the sale of additional milk. Farmers reported an increase in daily milk yield of 0.5 to 2 liters through the use of balanced feed. The positive impact of the project intervention on milk yields was confirmed by the impact survey when comparing participating and control farmers although the average difference between participating and control farmers was smaller in the survey than in the experiments. However, there was little or no difference between participating and non-participating farmers in the same village.
The project had a considerable positive impact on the net income of the participating farmers as an increase in their average net income was observed both in case of high yielding and average yielding cows. The same was true for high and average yielding buffaloes.

4.2.2 Evaluation of project interventions by farmers

In addition to the formal impact assessment the socioeconomic team prepared a standard questionnaire to capture the farmers' perception on the interventions.
At the **rainfed site** farmers affirmed sorghum and guar as best kharif fodders and oat and vetch as best rabi fodders. They further declared that use of guar and sorghum in kharif season resulted in savings of straw, and that guar feeding resulted in saving of concentrates like oil, molasses, fennel etc. The oat-vetch combination was liked by the farmers as green fodder due to its high palatability, which was also the case for maize-guar mix as green fodder in kharif. Farmers viewed oat plus vetch hay making very positively and the majority of them stated that they will adopt it and continue on their own. They showed some concern about high labor requirement for hay making. However, contradictory to the positive evaluation of hay making, a decrease in number of hay making farmers was observed in 2009 compared to 2008. It is believed that this should be attributed due to very low rainfall in that year. The farmers embraced the importance of clean milk production and teat sprays and dips to prevent mastitis in dairy animals as it resulted in better bargaining power with middlemen that were prepared to pay higher prices for the higher quality milk. The women and their husbands reported that yogurt made at their home was now well textured, tastier and had longer shelf life. Some of them reported that they were able to sell some peanut and almond mixed yogurt to schools. A good indicator of the perceived positive impact of the project is the fact that the number of farmers participating in the project increased from 24 at the start of the project to 53 at the end.

At the **irrigated site** improved varieties of four fodder crops were introduced. Given the higher yields and better palatability observed by the farmers expressed their high interest to adopt these varieties. The main problem highlighted by the farmers was that seed of millet and sorghum could not be produced due to bird attack and late maturity. Berseem and oat mixture was considered as the best fodder for rabi at irrigated site. Oat was considered the best option for making hay that could be used in lean periods of May-June after the harvest of wheat. According to farmers it was much better than wheat straw with regard to the nutritive value almost equal to the green fodder. Although most of the farmers were interested and appreciated this activity they said that they would not be able to make hay due to their small land holdings and small areas allocated to fodder crops that provide little surplus fodder to be conserved, therefore hay making would be mainly feasible for larger farms.

The farmers' evaluation clearly showed that at **both sites** the project created awareness in the farming community of the benefits from using better fodder varieties. The farmers were also fully aware of all relevant details with regard to improved agronomic practices although they did not know the names of the improved varieties. Furthermore, the farmers acknowledged the usefulness of keeping records for comparing the yields of different fodder crops or the performance of their animals.

5 Project Costs and Financing

The annual budget plan the annual funds were split into seven parts, six country/site budgets for each site in the four countries foreseen for national activities conducted by the collaborating institutions and a regional budget for across site activities such as workshops and regional training. The regional budget was also used to employ staff for regional coordination in Tashkent, cover costs for graduate students and consultants and for buying one vehicle for each region to guarantee efficient transport. Budget codes were assigned to each country and the regional budget. The new countries "Tajikistan and Pakistan" with two reseach sites received a higher share of the budget than Kazakhstan and Kyrgyzstan. For each country the funds were divided according to the activities planned under each of the three research themes.
In Central Asia, Tashkent office was responsible for the administration of funds. In South Asia the project funds were disbursed through ICARDA's Pakistan office.
Audited financial reports were submitted by ICARDA HQ to IFAD for each project year (2006, 2007, 2008 and 2009).

6 Assessment of Grant Management and Partners' Performance

6.1 Monitoring and evaluation

Strategic decisions for project implementation were taken by the Programme Steering Committee (PSC) that was held once a year in one of the participating countries. The PSC included the national focal points (country representatives) from each country, the four national coordinators plus the site coordinator, the project coordinator and three principal investigators from ICARDA, a representative from the funding agency; ICARDA's Country representative from Pakistan and the regional coordinator from Central Asia. In the annual Project Steering Committee Meetings (PSCM) the progress in the implementation of the annual work plans and budget utilization were reviewed. The PSC also amended and approved the future annual work plans and budgets developed during annual national project coordination meetings. The annual plan of work and budget was then completed and revised in line with the discussions of the PSC and then approved by IFAD. Minutes of the PSCM were prepared in English and Russian and shared with all participants and finally approved in the subsequent meeting. A regional workshop and a field day were conducted prior to the PSCM to provide the base for the evaluation of project progress and to discuss scientific findings across research sites.

In each country one day-annual planning meetings were conducted prior to the PSCM. The meetings allowed the multi-disciplinary national project teams to discuss their progress and findings in more detail and to prepare annual workplan and budgets jointly with ICARDA's project manager and the professional officers in Central Asia and with ICARDA's country coordinator in Pakistan. In many national meetings community members participated.

Each national disciplinary team prepared annual progress reports that were compiled by the respective national coordinators and submitted to Tashkent office and to the Country coordinator in Pakistan. The (translated) country reports were then revised by ICARDA's principal scientists and the project coordinator and submitted to IFAD. Financial reports were submitted quarterly in the first year, then this was extended to three times a year to reduce administrative costs while still allowing close monitoring. Furthermore additional technical reports presenting scientific results were prepared by the socioeconomic team, on value addition in Northern Tajikistan by Liba Brent and on the organization and progress in the breeding programs by Joaquin Mueller.
In Central Asia the three Professional Officers for socioeconomics, forages and livestock production based at Tashkent office supported the national teams in project implementation and monitored progress and data collection in the field and linked the national scientists with ICARDA's scientists. The project coordinator visited Central Asia and Pakistan twice or three times per year to oversee the overall project progress and guide the implementation of Theme 3 and 4. In Pakistan monthly project

team meetings were organized by ICARDA's country manager to discuss the progress and difficulties encountered, to exchange results, and to jointly plan the activities in the communities.
As nearly all activities were implemented on farms with the exceptions of a few on-station trials for testing new forage species or varieties, the researchers were continuously interacting with the farmers and therefore received direct feed back on the proposed technical solutions.

With regard to partners performance there is still a huge gap in the capacity of the Central Asian partner institutes to efficiently implement international projects. Proficiency in English is the exception, complete lack of knowledge in English the rule for all senior scientists. This makes it impossible to use readily available scientific material for exchanging knowledge and for training. Instead all material to be used in the project has to be translated into Russian at huge costs (monetary and time) and no direct interaction between Central Asian and international scientists was possible with the exception of Liba Brent who is fluent in Russian. The language barrier also maens that the senior scientists are not up to speed with modern data analysis or the international style of scientific reporting. The strategy that the project followed to overcome this problem was involvement and intensive training of young researchers; however the number of young scientists in the institutes is rather was limited – e.g. there was none interested in forage research – as due to the rather low salaries starting a career in Agriculture is not very attractive.

In Pakistan the researchers are very familiar with international projects and literature and most are fluent in English. Many of the collaborators had been involved in the implementation of the IFAD funded Barani Village Development Project and thus were familiar with community based approaches and brought their experience to our project. Thus, difficulties related to project implementation in Pakistan were more related to administrative and bureaucratic hurdles. The scientists from the National Agricultural Research Center (NARC) – our main collaborators at the rainfed site – needed a permission to participate in the project, which was not easy to obtain as the project was at first not recognized as a research project. Another problem in Pakistan concerned involving scientists from universities in the project activities where additional expertise to the NARC was required. A large range of research and development projects compete for the available expertise and scientists are used to receive relatively large honorariums for their participation which our project could not match. So we had to search for scientists who were willing to accept relatively little compensation for their time, which led to some "turn-over" in the scientists and took time. Fortunately ICARDA's country coordinator has an excellent network and was able to solve these problems and to find very dedicated scientists.

6.2 IFAD supervision mission

When the programme reached mid-term, the Asia and the Pacific Division asked the Senior Technical Advisor on Livestock and Farming Systems (Antonio Rota) in IFAD Technical Advisory Division to undertake a technical review/supervision of the above mentioned grant. The supervision mission was undertaken from 13 to 28 April, 2008 to Kyrgyzstan, Uzbekistan, Tajikistan and Pakistan for a total of 8 days to assess the progress and results of the programme to date, and provide recommendations for future activities. A wrap-up meeting was held on 27 April 2008 in Islamabad. Ms. Carla De Gregorio, IFAD Grant Coordinator for the Asia Division, joined the reviewer in Pakistan for the field visit and the wrap-up meeting. The recommendations (see IFAD Grant 816 Supervision report by Dr Antonio Rota for further information) were used to amend the planned project activities in 2008/2009.

7 Innovation, Replication and Up-scaling

7.1 Representativeness of target sites and farmers

7.1.1 Central Asia

The target villages in Central Asia were selected with a view of being representative for the target region but also considering practical aspects such as distance to the location of institutes and prior relations with the communities. The latter helped the scientists to attract the interest of the farmers and gain their trust to initiate project implementation. It is not easy to convince household farmers to participate in surveys or experiments as they are afraid of taxes and are averse of any governmental influence.

The research activities on livelihood and marketing strategies under Theme 1 were directed at households in all countries. The on-farm experiments in Kyrgyzstan and Kazakhstan were first started on larger farms which was corrected in the second project year by including household farms. In Tajikistan, the project started from the very beginning with a focus on households and small farms for all themes. Nevertheless, it is clear that the farmers and households interested in testing forage, range and livestock management interventions usually represent a relatively resource richer group. The poorest farmers are often neither willing nor able to test new livestock management strategies or cropping practices because of the risks involved in allocating their scarce resources.

7.1.2 Pakistan

The selection of the project villages was based on data collected through rapid rural appraisals. The approach taken for selection of the villages differed between the rainfed and the irrigated site. In the rainfed area, where the BDVP had been conducted and the National Rural Support Programme (NRSP) is very active, the Assistant Director of the BVDP and Professionals of NRSP were consulted for the selection of tarhet villages. They proposed four villages considering the objectives of the project. The main criteria for finally selecting one target village among the four proposed villages were: concentration of small and large livestock; fodder production; availability of farmland and farmers' intentions and interest in the proposed project activities.

In the irrigated area in Sarghoda district thirty-five villages were visited, out of which two villages were selected based on the following criteria: small landholdings and small herd size; dairy and meat production; presence of large and small ruminants; low income of the farmers; farmers' willingness to adopt technologies in crop-livestock systems; willingness of women to participate in the project and access to markets. For both sites village profiles and basic information on marketing were collected during the selection process.

The project interventions in Pakistan involved the village communities as a whole. At the rainfed site a well organized and interested farmer group already existed while at the irrigated site male and female groups were formed for the purpose of the project implementation. Not all interventions were suitable for all farmers: for example the integration of forage production into cropping systems requires sufficient land resources and in some cases access to supplemental irrigation. But even if poorer households could not directly adopt certain practices because of the required land, capital resources or other inputs required, spillover effects from the resource richer to the resource poorer households were expected and observed. For example the increased forage production in the villages also benefited the landless farmers as they could purchase forages directly in their village and did not need to buy from more distant markets.

7.2 Replication and up-scaling

7.2.1 Central Asia

In Central Asia with the exception of the socioeconomic surveys the project dealt with a relatively small number of households and farmers. To replicate and up-scale the results in the same region the findings from the livelihood analysis on access to resources will allow future development projects to

estimate the proportion of households that could possibly adopt a certain technology. This information together with the findings from the cost-benefit analyses for the tested interventions can be used to conduct ex-ante impact assessments for technical interventions. To replicate and up-scale the results in different locations the resource situation at potential target sites and of target farmers need to be carefully evaluated and compared to the requirements for adopting a certain intervention.

Three models of community based livestock improvement have been developed that in our view can be transferred to other locations:

- Development of a Mohair value chain in Northern Tajikistan that combined an improvement package for production (supplementation, health care and a breeding program), intensive training to improve the processing skills of women groups and building market channels. This model is now being tested for other fiber value chains in the new IFAD Grant 1107.
- Enhancing sheep productivity in Central Tajikistan through facilitating mobility between summer and winter pastures clearly proving the benefits from grazing on remote summer pastures to farmers combined with strategic supplementation, an improved health program and linking the community with Gissar sheep breeder to provide access to better Gissar rams. IFAD is currently investigating if this 'model' should be included in an investment project in Tajikistan.
- Organizing household farms in a farmer group for sharing improved rams and starting their own selection program and adopting improved management strategies in Kyrgyzstan.

7.2.2 Pakistan

In both research sites the project addressed the communities as a whole. Interventions were discussed in group meetings and interested farmers then opted for testing the proposed interventions on their fields or with their buffalos and cattle. Neighbouring farmers agreed to act as control. For some interventions it was difficult to find control farmers as all farmers were interested in becoming experimental farmers. The training on improved processing at household scale targeted the women groups in the villages and all women were invited to participate. In the two villages at the irrigated site the buffalo bulls purchased by the project served a large number of buffalo cows in the village. Thus, overall a relatively large number of households were involved in the different activities at both sites. Nevertheless, towards the end of the project it would have been desirable to demonstrate the benefits from improved oat, berseem, sorghum, maize, and millet production, hay making and using balanced feed at an even larger scale. This would have created larger spill-over effects of the tested interventions and would have made it easier to measure the direct and indirect impact of the project at community level.
The project team strongly believes that the forage improvement packages developed by the project for rainfed and irrigated conditions should be outscaled at a regional level. ICARDA's country coordinator tried to attract national funds for upscaling the interventions but has not yet been successful.

8 Sustainability

8.1 Central Asia

The focus of the activities in Central Asia was on testing best-bet practices and interventions with households and farms rather than on developing full intervention packages to be adopted by organized group of farmers.
The project findings indicate a number of technically and economically interesting practices that should now be taken up by more specialized development oriented projects at a larger scale. In Kyrgyzstan and Tajikistan this will require external investments supported by NGOs as the countries lack the organizational infrastructure in the public and private sector.

Even though the NARS scientists are enthusiastic about continuing the work with the communities, they will most certainly lack the operational funds for conducting reliable on-farm research. Thus, the sustainability of the community oriented activities combining training on improved husbandry and establishing a breeding program is questionable as intensive technical support for the breeding component would be needed for a number of years. Progressively responsibilities have to be conveyed to farmers and for this to happen continuous training of farmers is needed. Moreover, a fully functional breeding program will always require some scientific support e.g. for the recording system, estimating breeding values and control of breeding progress. For the Akbeket breeding program in Kyrgyzstan the Veterinary Institute confirmed that they will continue after the end of the project.
In the case of Khujand the response to the new market opportunities on the part of the spinners and farmers has been considerable. Most spinners who learn about the project want to learn how to produce fine yarn for the American market and begin searching for fine, kemp-free fleeces on the local mohair market and on the farms. As more spinners are being trained in evaluating fleeces for kemp and fineness, the demand for this type of mohair has increased dramatically, especially during the 2009 season. Similarly, farmers who learn about the project are beginning to understand the importance of applying new quality standards to goats and fiber and are showing a keen interest in collaborating with the project on breeding for finer fiber and against kemp. As these changes in the utility and pricing of fine mohair become widespread, they present a solid platform for the breeding program. The breeding program is being continued with the most interested breeders at the old project sites but the focus in the IFAD grant 1107 has shifted to the new project site also changing the approach from establishing an individual nucleus in each farm to a nucleus shared by a number of farmers.

In summary, this project cannot claim that the tested interventions in Central Asia will be sustainable in the real sense of the term. Nevertheless it is expected that the households and farms that were directly involved will continue the practices that proved technically and economically beneficial. Furthermore, a considerable number of extension brochures were developed that can be used for farmer trainings even outside the project target sites and build a good basis for the institutes for their future work. However, without additional investments the project findings will largely remain 'on the shelf'.
Thanks to the continued support of IFAD the follow-up Grant 1107 on developing fiber value chains allows the continuation of the promising model of combining breeding, value addition and marketing in Northern Tajikistan in order to create a sustainable value chain. Furthermore, an IFAD investment project planned in Central Tajikistan will work on improved rangeland management (reestablishing mobility through collective action) and on improved husbandry and marketing of Gissar sheep. Probably the longest lasting effect of the project will be the capacity building and knowledge exchange and change in attitude in the NARS that this project has achieved.

8.2 Pakistan

The starting conditions for the project in Pakistan were different from Central Asia. The project built on the experience of the Barani Village Development Project (BVDP) in north-west Punjab Province, for which ICARDA implemented the applied research component that used a community based participatory approach. As ICARDA's country coordinator and a number of the scientists of National Agricultural Research System had been involved in BVDP, the Integrated Feed and Livestock project provided a chance for them to directly build on this experience. This included the awareness of the importance of making technologies sustainable and of ensuring efficient ways for knowledge exchange between all stakeholders – between farmers and scientists, between scientists, between farmers, and between the project and governmental institutions.

At the rainfed site the project created awareness in the farming community on the importance of improved fodder varieties and good agronomic practices, of protein contents in different feeds, of clean milk production for a better bargaining power with middlemen and teat sprays and dips to prevent mastitis in dairy animals. This was clearly shown in the socioeconomic evaluation. In general the farming community at the rainfed site was very pleased with the project activities; demonstrated by the fact that the number of participating farmers increased from 24 at the start of the project to 53 at

the end. Farmers also expressed their determination to continue preparing sorghum and guar hay for winter use and maize-guar mix as green fodder in kharif season. To ensure the continuity and sustainability of dissemination of improved fodder crops/varieties in the area, the establishment of village based seed production is crucial. In the project area fodder seed production has not yet been developed as an enterprise. With the technical support of the project two champion farmers started to multiply seeds of improved varieties of oat and maize which was shown to be economically viable. A number of farmers expressed their intention to produce seeds of improved oats, maize, guar and sorghum varieties. This component will require longer-term training and strong efforts in building the market channels for the seed producers. The fodder research institute understood that they have to put more efforts into establishing the linkages with farmers to ensure that the remarkable advances made in the institute reach the producers. To ensure the availability of improved fodder seeds a short term solution is to further strengthening the link of the farming communities with fodder seed producing institutions. In this regard contacts with private seed companies and the Punjab Seed Corporation were established to improve fodder seed supply.
The original idea to establish a small dairy plant at the rainfed site was abandoned as it would not have been competitive given the high investment costs and the high price for raw milk paid by the middlemen. Thus, value addition then focused on improving the quality of raw milk and dairy processing for home consumption through training of the female members of the participating households to prepare higher quality milk products. The women observed and reported the advantages of the improved household dairy processing methods and were able to adopt these practices. There is no obstacle for them to continue applying these practices for home consumption. Of course how closely the women will follow the instructions in the future will vary considerably and therefore a varying degree of success should be expected over time. Hygienic milking, teat dipping for mastitis prevention along with targeted testing for mastitis as introduced by the project can be perceived a sustainable intervention because it is very cheap and easy to practice, the farmers and the chair of the farmer association were intensively trained and most important the improved milk quality was appreciated by the middlemen through paying a higher price.

At the irrigated site the prospects that the farmers would continue to use the introduced fodder varieties of both summer (sorghum and millet) and winter fodders (oat, berseem) look promising as the interest of directly involved and neighboring farmers was very high and their evaluation of these interventions was positive.
Hay making was considered as very useful by the farmers to overcome the two lean periods after the summer and winter fodder period. With the increasing trend in the importance of livestock production and the related demand for feed hay making is required to improve livestock productivity. However there is a need to demonstrate these interventions at larger areas for further proving their benefits and help to shift the farmers from subsistence to commercial more market oriented livestock farming.
The community organizations developed under the project were active throughout the project duration and the members participated in different interventions tested at their farms. The farmers also started to produce their own seed from improved varieties. Seed production, procurement and distribution through the community organizations can support rapid adoption of promising fodder crops to overcome fodder shortage in the area. The farmers in the two villages have the advantage that they are located relatively near to the Fodder Research Institute and could easily procure new varieties directly. However, this linkage and the supply of new crops or fodder seeds from other areas should be facilitated by development agencies (Extension, NGOs) in the future.

Supplying the farmers at the irrigated site with improved seeds from the Fodder Research Insitute in Sarghoda (October 2006)

At both project sites the feeding experiments with balanced feed showed significantly improved milk yield, body condition of the animals and generated cash income through the sale of additional milk. The experimental results were strongly confirmed by the observations of the participating and neighboring farmers who rated this intervention very highly. To ensure the sustainability of the use of balanced feed two feed mills were installed, one at the rainfed site and one in one village at the irrigated site on a shared cost basis between the project and the entrepreneurs. In the beginning there were some problems with operating the machine. As feed production and marketing was a secondary source of income for the selected entrepreneurs, they also lacked entrepreneur skill. However due to the constant follow up and demonstration through feed experiments both the interest of the entrepreneurs developed along with the demand that had been generated among the community. Therefore the sale of the balanced feed increased from 1.5 tonnes per month from January 2009 to 4.18 tonnes per month at irrigated site and to 17.76 tonnes at the rainfed site in October 2009. The entrepreneur at the rainfed site started marketing outside the village and was also supplying the feed stores in the nearby town market, while the entrepreneur at the irrigated site was selling only at the production point only. The locally produced balanced feed was found cost effective along with better animal productivity over the conventionally used cotton seed cakes. The balanced feed was sold at a competitive price with other available feed rations in the market. For the farmers there was also saving in terms of time (1-2 hours per visit) and transportation cost (Rs.10-15 per bag) if farmers had to purchase from market. These results and the economic analysis (see details in the report on achievements in Pakistan under Theme 1) showed that there is a high probability that the feed mills will be sustainable and show scalability option for the entrepreneurs. Nevertheless, the feed mill entrepreneurs will still need continuous technical backup regarding ration formulation as the price of the ingredients change over time and they have to adjust the mixtures. Also an independent quality control is required to sustain the confidence of the farmers.

Overall, as a result of the interventions, **productivity, knowledge, sustainability, efficiency and marketing ability** was improved. The scientists – biophysical scientists and socioeconomists – felt that the majority of the feed-livestock interventions have a high potential for becoming sustainable and strongly recommend their further support and up-scaling in a follow-up development project.

9 Conclusions and Lessons Learnt

9.1 Lessons learned from Central Asia

9.1.1 General lessons learned

Applying community based approaches require specific skills and experience. For the Central Asian NARS this is still a novel approach. The earlier IFAD funded livestock project was implemented in a period when the transition from large collaborative farms had not been fully completed and many activities were implemented on collective farms that were either in the process of being privatized or dissolved. Thus, in line with their project experience in the previous project the researchers in Kazakhstan and Kyrgyzstan started the project activities on medium-scale private farms and had to be convinced to shift their emphasis to household farms during the first year. Contrarily, the researchers in Tajikistan that had not been involved in the first project started immediately working with households according to the focus of the new project. However, during the duration of the project all research teams fully embraced the focus on household farms and they developed the required skills and experience. Not only the researchers were interacting closely with the households but also the medium-scale farmers in Kyrgyzstan and Kazakhstan took an active interest and were supporting the activities on the household farms. Trainings and meetings were always conducted jointly often using the facilities of the farmers for demonstrations. Thus addressing both types of livestock owners proved to be beneficial.

Forage research is a neglected field in our partner livestock research institutes, traditionally the focus of these institutes has been on breeding, veterinary and rangeland research. Thus, the national project teams were short of specialized forage scientists. In this regard ICARDA has to change its approach in concentrating on the classical NARs and has to open up much more to include universities and other research institutes. The project actually managed to include universities to cover the socioeconomic research as there was no expertise in the main partner institutes but the forage research was undertaken by the rangeland scientists.

9.1.2 Lessons learnt by Themes[4]

9.1.2.1 Theme 1: Socioeconomics

The socioeconomic and market research clearly revealed the high importance of strengthening the skills of households in all aspects of small ruminant management and marketing and the potential advantages of collective actions.

Analysis of livelihoods and access to resources:

- The weakly developed forage and feed base (especially in winter period) is a major problem for all livestock producers. The forage deficit is a consequence of decreased forage cropland area, cessation of subsidies and shift from forage crops to commercially more profitable cereals in irrigated arable land areas.
- The household farms practice an extensive small scale production mainly to satisfy the needs of family members.
- Many households and small farms keep livestock as a form of savings to ensure their welfare rather than as an income generating asset.
- In Tajikistan the remaining big farms (different types of state, cooperatives, and big DFFs) and collective farms do not play a significant role for increasing livestock production. Households are the major producers and suppliers of meat, milk, eggs, and honey to Tajikistan markets;
- The household farms have only limited access to croplands and to remote seasonal rangelands, especially summer rangelands in mountainous area.
- Existing constraints (including complicated access to forage/feed, rangelands, and veterinary services; underdeveloped rural infrastructure, bad access to water, etc.) prevent a more intensive

[4] Conclusions for specific activities are presented in the respective sections on achievements in chapter 4.

and efficient livestock production, create conflicts between different farmer groups (e.g. farms and households), and exacerbate degradation of pasture areas around the villages.
- Mainly women and children are involved in keeping and feeding of animals in household and small farms.
- In sheep the highest share of income in households is generated from selling of live animals, little income is generated from selling other products like wool; only a very small percentage of produced products are processed at household level (in Central Tajikistan about 3%).
- The level of farmers' and households' knowledge on livestock production and in particular feeding and breeding practices as well as rangeland management need urgent improvement;

Market analysis

Sheep markets in Kazakhstan, Kyrgyzstan and Central Tajikistan

- In all countries a high number of animals are sold at the farm gate to middlemen without prior fattening. Fattening operations are mainly undertaken by specialized fatteners.
- In most livestock markets a number of different agents are active including producers, middlemen, fattener, wholesale buyers, butchers, exporters and consumers creating different market channels.
- Livestock markets are mainly located around cities, in the district centers, and in big villages. They operate separately from the food markets.
- There was a general lack of information and analytical data on sheep markets and market prices therefore the project collected price data from the different markets to analyze market integration. This analysis of market integration has not been completed.
- In Kazakhstan the low density of sheep markets and low frequency of market days negatively affect producers' income as this increases the dependence of the producers on middlemen.
- The value added share of producers in the retail price was estimated at 52% in Kazakhstan and in Kyrgyzstan at 58% which indicates a scope for increasing producers' shares through organized collective marketing.

Role of middlemen

- Middlemen have developed a very good livestock procurement system from households at their farm gates and thus link livestock producers in remote areas having a few animals for sale to the livestock markets.
- By selling fattened animals in the periods of a weak supply in the livestock markets traders ensure more stable prices and prevent supply shocks in livestock markets.
- There was no indication for a high market concentration by few traders; the market is rather open for many traders which means that prices are competitive.
- The livestock producer survey realved that middlemen also act as a source of price information for smallholders. At the same time some of the livestock producers consider these traders as agents causing problems for their free market access mainly attributed to the control of prices at livestock markets, creation of deficit in space where farmers can hold their livestock while waiting for sales at market outlets, and low procurement farm gate prices offered to households.

Specificities of the Mohair market in Northern Tajikistan

- The mohair market in Soghd province is unstable and depends heavily on the wholesale customers from Russia, and it is difficult to predict the expected number of foreign buyers. For households with a small number of goats it is difficult to access markets in Russia directly due to the high marketing costs involved.
- Mohair producers with a subsistence income level who cannot wait for more favorable prices as they need the cash for daily expenses. As a result, middlemen with more financial resources and storage facilities benefit from low mohair purchasing prices in the spring season and high selling prices in fall.
- Mohair producers in most cases do not sort the fleeces by quality or other criteria. Such value addition activities as sorting, packaging, and washing of mohair are mainly undertaken by wholesale procurers who are interested in selling big volumes of mohair to customers at markets located in Soghd province or to CIS countries.

- Mohair prices depend on the season, distance between the local markets and central markets and marketing costs.
- Lack of information, shortage of financial resources, and inability to efficiently market mohair put the small producers at a disadvantage and lowers their net income.

9.1.2.2 Theme 2: Forage and raneland research

Forage research

- As irrigated cropland is limited, forage competes with wheat production, introducing summer crops after the winter wheat harvest is seen as the most promising option to increase forage supply on irrigated land. Early maturing mung bean as a food feed crop and pearl millet as green forage were tested as summer crops and showed good results. However, more detailed studies of the nutritional value and other factors likely to influence farmers' choices and preferences are required.
- More research and demonstrations to identify and outscale best agronomic practices with regard to seed rate, planting date, fertilizer type and rate, for well established fodder crops are required to optimize productivity. The findings for maize and alfalfa presented in the report reveal the potential of achieving considerable increases in yields and benefits through simple interventions. This is also evident in the higher yields obtained by farmers compared to households that are related to more optimal use of inputs.
- Optimal agronomic practices are very important for making forage cultivation profitable which has become more challenging due to the recent increases in fuel and fertilizer prices in particular in Kazakhstan. Furthermore, the prices on the forage market vary considerably between years leading to a high variation in the net benefits that can be achieved.

Rangeland research

- A full evaluation of the tested **rangeland rehabilitation** methods was seriously affected by the extreme winter 2007/2008 and the following dry spring and summer, where all measures failed. Under the favorable rainfall conditions in spring 2009 reestablishing indigenous rangeland species in degraded rangelands by oversowing in combination with resting/controlled grazing showed good results. However, a much longer observation period with controlled grazing conditions is required to evaluate the treatments tested.
- Improved **rangeland management** strategies need to integrate the local communities in the decision-making and have to be built on collective actions as the lack of financial resources and social and cultural habits do not permit fencing to control access. Collective actions are also required to facilitate access of the small households flocks to remote summer pastures to restablish flock mobility and decrease pressure on village rangelands.
- The profitability of the interventions tested in Central Tajikistan and Kyrgyzstan to improve hayfield productivity, namely fertilization and oversowing with sainfoin, depended greatly on the rainfall conditions: in dry years like 2008 little difference was recorded between experimental and control fields while in good rainfall years like in 2009 the biomass production could be improved considerably. Thus, moderate input rates should be recommended that achieve nearly the same increase in net benefits in good years as higher input levels but present a reduced risk of financial losses when being ineffective in dry years.
- Biophysical features such as aspect should be considered when selecting sites for rangeland improvement.

9.1.2.3 Theme 3: Livestock productivity

Improved husbandry practices:

- The results from testing early lambing in two seasons in Kazakhstan under different resource situations revealed its advantages and disadvantages: in normal years it can be an interesting strategy to obtain cash income in a critical time of the year and/or for spreading the sales of lambs over two periods. It however requires good management practices and lambing facilities and should not be recommended to resource-poor households.

- Early weaning tested over two seasons in Kazakhstan is technically feasible but does not provide obvious economic benefits as long as it is not linked to an intensive fattening program or to milking of the ewes. The latter was successfully tested and can provide additional benefits but is labour intensive and there is no established market for sheep milk.
- An expected advantage from both practices is higher ewe fertility because early lambing leads to a better feeding situation of the ewes after weaning (weight recovery in late spring and early summer on good pastures) and because early weaning results in a prolonged recovery period for the ewes. However this effect could not be measured in the experimental design.
- Husbandry practices to improve flock productivity were similar in the research sites and included preventive health program, optimizing flock structures by culling unproductive ewes and castrates, better hygiene and strategic supplementation. Options for supplementation were rather limited because of the scarcity in winter feeds.
- Originally it was planned to distinguish effects of improved husbandry and breeding programmes on flock productivity in Akbeket village/Kyrgyzstan and in Khujand/Northern Tajikistan – however during the practical implementation of the activities with the households it became apparent that this was not feasible as the same households were involved in both interventions. Thus, the observed improvements are resulting from a mix of better genetic material, improved selection strategies and husbandry practices.

Breeding programs

- Even with the short implementation period of the breeding program in Akbeket the outcome and the response of farmers can be regarded as positive: the farmers worked well together as a group in sharing rams, organizing mating and keeping birth and liveweight records according to the plan. The first offspring showed higher weight gains after weaning and achieved good market prices. At the end of the project more farmers were interested in introducing Aikol rams.
- In Khujand the breeding program was not implemented as a typical community based program. The farmers applied the agreed selection strategies within their flocks but had no interest in sharing or exchanging bucks or does or joint performance testing. However, a good understanding of common selection traits was achieved over the project duration and record keeping was established. The inclusion of fiber fineness into the breeding objectives was agreed and its importance for the market value of the fiber recognized. The latter was clearly an outcome of creating a demand for fine fiber by the women processors in the neighborhood.
- The project proved that Awassi crossbred sheep can be reared successfully in the Tokmok highlands in Kyrgyzstan without reduction in meat production. Sheep milk production and processing is technically feasible. However, to become a viable production option for the farmers in the region a clear business model would be required. In this regard the difficulties of starting a sheep dairy business were underestimated by the Kyrgyz scientists as there is no tradition of sheep growers to milk their sheep and of consumers to buy sheep dairy products.
- The sustainability of breeding programs is questionable as intense technical support would be needed for a number of years from the NARS scientists but the institutes often lack operational funds to continue intensive field work.

Value adding activities

- In Southwest Kazakhstan a wide range of high-value milk products such as brynza, chechil, yoghurt, kurut, kvass, etc are produced mainly from cow‘s milk. The project trained households in milk processing from cow and sheep milk. Also an improved practice for preparing homemade sausage was introduced that ensured better quality and shelf life. The cost-benefit analysis showed that all processing activities (except butter) generated net benefits and thus can provide a good income opportunity.
- The production of handspun mohair yarn for export in Khujand/Tajikistan can provide very good earning opportunities for women spinners and knitters. By switching to high-priced yarns, women spinners will be able to earn approximately $240 per month as opposed to $24 per month which they currently earn by producing yarn for Russia.
- The yarn export market will also benefit Angora goat farmers by increasing the price of undervalued kid and super kid mohair. It is expected that the strong demand for fine kid mohair will increase the price of fine, kemp-free kid fiber from the current $3-4 per kg to $9 per kg and

continue to increase further as farmers realize the value of those fleeces to spinners. Moreover, quality, kemp-free adult mohair can also be used to make woven blankets and hand-knotted carpets for the US and European market. Eventually, a high market price for kemp-free, quality mohair will be established region-wide.

9.2 Lessons learned from Pakistan

9.2.1 General lessons learned

This project provided a platform for mutually beneficial interaction between farmers and scientists and for multi-disciplinary research. The involved stakeholders with different professional backgrounds followed a common overall goal and worked together on one research platform rather than working in separation. Some of the team members were involved in the introduction of high yielding quality seed of improved fodder / varieties, some were involved in improved agronomic practices, some members covered soil properties aspects, others covered nutritional characteristics of feed and still others covered the value additions aspects.

Through the project scientists got the chance to work with small livestock farmers and directly observe the economic viability of the technologies/interventions that they recommended and tested to improve feed resources and livestock productivity. The scientists learnt that the selection of the proper farmer to work with is very important as with non cooperative farmers efforts and resources were wasted without being able to collect any reliable data. In any case close supervision of input related interventions was found to be essential for getting reliable results. However, the scientists also learnt how to cooperate/interact with less interested farmers. By experimenting on small livestock farms the project team experienced their specific problems and limitations and had to overcome them through finding practical solutions together with farmers and fellow scientists in the field. Scientists learnt understand the farmers' perception and how to convince farmers of the importance of collection of reliable data and keeping their own records on activities related to fodder production and livestock productivity.

The appointment of appropriate site facilitators in remote and rural areas was essential for timely recording of data and ensuring adequate communication regarding interventions, meetings and other issues. Without this support, achieving the goals of this project would have been impossible.

9.2.1.1 Multidisciplinary Approach

- Multi-disciplinary and multi-institutional approach proved very successful in providing a platform for useful and complimentary interactions for farmers, students and scientists.
- Involving multi-country scientists and holding of annual meetings in different countries provided a very good chance of learning from each other professionally as well as cultural aspects.
- The change of the responsible scientists in the socio economic group and even of the project coordinator caused some setback in the continuity of the activities but was however, managed by the timely intervention of the ICARDA's country manager.

9.2.1.2 Working with communities and participatory approach

- The major benefit of working with the community is that scientists get real and timely feedback/perceptions of the farmers about the tested interventions and can readily modify the research methodology or may start some relevant on-station research to find answers to the farmers emerging questions.
- It became clear that farmers are only interested in technologies which result in quick and large differences in the production of crops or animals. Efforts to convince them that a slower but steady increase can be equally beneficial or even more beneficial on the long run, were only partially successful. Consistent efforts were made with practical demonstrations to change the mindset of the farmer in this respect.
- Farmers easily cooperate with scientists when they see some financial benefits. However, providing direct financial benefits e.g. in the form of supplements must stay within close limits.

Providing everything for free is not a good strategy, it is preferable if farmer share a part of the costs. Nevertheless, some form of incentives must be also offered to control farmers to obtain reliable data from them.

- The participatory nature of the project provided opportunity to the scientists to deeply understand the problems and preferences of the farmers and to organize the interventions accordingly.
- Participation of students in various studies proved to be a win-win situation for all stakeholders.

9.2.1.3 Working with ICARDA[5]

- The work of the scientists was facilitated through the efficient and well organized administrative and financial procedures of ICARDA and in particular through the reliable transport to the field provided by ICARDA, which resulted in good achievements with minimum resources and time.
- The regular monthly progress meetings were instrumental to keep all stakeholders on track.
- ICARDA provided an opportunity for on job training of professionals involved in the project.
- ICARDA gathered all stakeholders at one research platform.
- The scientists got the chance to learn and exchange the knowledge with their international counterpart scientists and apply new ideas directly with the end user.
- ICARDA provided incentives for the scientists in form of monetary benefits and capacity building which resulted in good and dedicated work and attitude of the scientists.

9.2.2 Lessons learned by themes

9.2.2.1 Theme 1: Socioeconomics

- The baseline survey helped in the proper selection of interventions to be tested / demonstrated.
- Socio-economic studies gave an insight to the economic viability of various interventions.
- Interim socio-economic studies also guided the scientists to modify their interventions.
- The assessment of adoption process of technologies provides valuable information to the researchers, extensionists and policy makers to identify reasons of slow adoption and diffusion resulting to low productivity

9.2.2.2 Theme 2: Forage production

- For irrigated areas oats and berseem proved to be the best combination for winter fodder while for the rainfed areas the oats and vetch combination was more successful.
- For the summer season mixed cultivation of maize, millet, sorghum with guar at the rainfed site and with cowpea at the irrigated site achieved provided good fodder yields and good quality.
- Production of cereal and legume hay proved very successful and popular with the farmers, especially for milking buffaloes and cows, when compared with wheat straw, the roughage traditionally used in the lean period.
- Conserving fodder not only provides the opportunity to feed the animals during the lean period but also to harvest fodder at the optimal nutritional stage although farmers were not always able to cut the crops at the proper stage for making hay because of socio-economic problems which then resulted in lower quality hay.
- As the farmers appreciated the use of improved varieties in terms of quantity, quality, market value and improved livestock productivity, seed production for fodder crops at farmer's fields proved to be a viable enterprise while ensuring availability of seed of improved varieties to the local community.
- Seed production for summer fodder crops at the irrigated site was problematic due to bird attacks and late maturity.

[5] This section was written by the Pakistani team and only edited by the project manager.

- Where irrigation is available green fodder production from multiple planting of maize proved the best option followed by multicut sorghum-sudan grass hybrid during the dry season.
- Selling of green fodder to the town market provides a good income opportunity but labour and transportation costs limit the small land holders to fetch the higher prices on the main market therefore they prefer to sell to neighboring farmers.

9.2.2.3 Theme 3: Livestock Productivity

- Using improved fodders (hay of cereal and legumes) and concentrates (using various industrial by-products) proved to be economically beneficial for dairy animals but not for intensive fattening.
- The installation of small scale feed mills proved to be a very successful intervention in the rural communities improving the access of small farmers to concentrates with regard to saving time and money (no or little transport charges and comparatively cheaper than on the market), confidence in the ingredients used and having the possibility to get concentrates on loan to be paid back at the time of crop harvest.
- However, the feed entrepreneurs were facing price competition from large players in the market and the recommended rations have to be continuously adjusted as the prices of the available feed ingredients change overtime.
- Provision of livestock scales (for the experiments) also improved marketing of livestock as well as control of feeds, fodders and agricultural inputs.
- Introduction of teat cups and CMT has proved useful and acceptable to the farmers.
- Hygienic milk production and improved processing methods were welcomed by the women groups, in particular introducing improved dairy products at village level was adopted for home consumption and raised the quality standards and shelf life.
- The new quality dairy products could not be marketed due to the required of governmental registration and taxation which is not easily affordable for small farmers. However, products such as flavored yogurt, flavored milk, (peanut butter at rainfed site) and whey healthier were adopted at household level by the community and the skills of the local women were enhanced. At the rainfed site there was also little economic incentive for commercial dairy processing as the price of the raw milk was quite high and showed an increasing trend, here the increased quality was of interest to the middlemen who honored this with a higher price.
- Experimental design: splitting herds into two – control and experimental group was less successful than in Central Asia as some farmers then used the feeds designated for experimental group for both groups so that no differences between groups could be recorded. Thus, it is recommended to establish experimental and control groups for feeding trials on separate farms. Because of the small herd size and high diversity of the animals it was difficult to find a sufficient number of animals in the same production stage, age and sex, and kept under comparable management for setting up the experiments.

9.3 Lessons learnt in capacity building

- The opportunities provided by the project for knowledge exchange proved useful for the capacity building of farmers, students and participating scientists.
- Training farmers in various aspects of their farming systems increased their knowledge and their confidence in the scientists' ability of understanding their conditions.
- Extension material was produced directly linked to the project based supported the t to farmers
- Working on-farm and in close interaction with the farmers allowed the scientists to continuously adjust the proposed practices to the farmers' reality and to evaluate technical and socioeconomic performance under realistic conditions.
- Informing and discussing with farmers about marketing options for fodders, seeds and livestock products helped farmers and scientists to fully evaluate socioeconomic benefits from best practices.

- Involving students and using project activities for thesis research supported reliable data collection and analysis and exposed the Central Asian and Pakistani students to an international scientific environment. It also helped to convince the involved academic institutions, e.g. NARC in Pakistan that the project was not a development project.
- Training of the scientists in statistical and economic analysis of the data was found to be beneficial in terms of improved knowledge and analytical ability.
- The extension material produced by the project teams was considered as useful by the framers as it was directly linked to the project interventions and the interaction with the farmers during the field work and training sessions.

10 Major Lessons for IFAD

Multi-country inter-regional programmes: The idea to combine Central Asian countries and Pakistan in one program originated from IFAD's Asia and the Pacific Division. Unfortunately the anticipated across region learning and knowledge exchange was limited because the scientists could not talk to each other without an interpreter and by the fact that the security situation did not allow visits of Central Asian scientists to Pakistan. The Pakistani scientists highly appreciated the opportunity to learn more about Central Asian agriculture and culture. However, the Central Asian scientists would have probably scientifically benefited more from visiting Pakistan than the Pakistani from their visits to Central Asia. In Pakistan they would have been exposed to research on forage production and community based approaches in action.
As the economic and political situation and the climate in Pakistan and Central Asia are different, most technical solutions are not readily applicable in the other environment and even less so lessons learnt related to marketing and institutional support.

Multi-disciplinary approach: All partners and governmental officials that got acquainted with the project highly appreciated the multi-disciplinary and integrated nature of the project. This was indeed a novum in Central Asia especially the inclusion of livelihood analysis and market research. And also in Pakistan this was the first integrated feed-livestock project including socio-economic aspects. Ideally this approach should lead to the development of innovation packages for communities. In our project this was best accomplished in Pakistan where the project focused on a specific topic, namely filling feed gaps through forage production and utilization of these forages for dairy and meat production. In Central Asia the topics were more diverse and the activities within the three themes at the project sites were not as well integrated as in Pakistan. This was due to the fact that each national team in Central Asia developed its own research agenda and thus there were a number of different topics of similar importance so that there was no clear focus of the project.

Efficiency in implementation and coordination: This grant was overloaded with a diverse set of multi-disciplinary activities to be implemented at six research sites in four countries in two regions. This caused high transaction costs for monitoring and coordination at the expense of operational costs available for each site. It also limited in-depth analysis and full integration of activities and findings. ICARDA's in-kind contribution with regard to staff time, in particular for project coordination, was huge. Implementing this type of project with a budget of 1.2 Million USD and a part-time project coordinator as in-kind contribution is not advisable.

Project duration and timing: Developing sustainable community based livestock interventions with a timeline of three years is unrealistic. Furthermore, starting such a project in summer means that there is a high risk to miss the first mating and winter cropping season unless the research teams had already well established contacts with farmers in the selected research sites. It is often not feasible to convince farmers within two to three months to change their mating or cropping systems, etc.
The relatively short duration of grants is even worse when it comes to implementing breeding programs – in our case after three and a half years a good understanding between ICARDA's and the national scientists and the sheep/goat owners had been established and first improvements can be seen. Thus, it is very fortunate that at least in Northern Tajikistan the breeding program can be continued in

the new grant program. Livestock projects should ideally be planned with a longer-term horizon; best would be a two phased approach: a testing phase on smaller scale for four years – starting in spring in locations with seasonal mating in autumn to provide enough time to plan interventions in the flocks – and a consolidation/upscaling phase of at least another three years connected to an investment project.

Project goals and related expectations: It is very important to ensure that the implementing institution and IFAD have enough time to discuss the goals and objectives of grants to understand the expectations of the two institutions with regard to the deliverables of the grants beyond merely agreeing on the text in the project proposal. In this context it should be more clearly distinguished between grants 1) that are adapting and outscaling technologies that were proven under similar farming conditions, and 2) those where a set of new technologies is being tested or proven technologies are being adjusted to specific conditions. In the first case more and resource-poorer farmers can be included into the activities and a wider impact can be expected, while in the second case a more scientific setup is required which will limit the number and type of farmers.

Linkages with investment projects: IFAD's expectation that it is the responsibility of each grant project to closely work with the investment projects in the respective country can often not be met; grant projects with their limited resources that already have to link multi-counrtry teams do not have the resources – time and funds – that would be required to link with investment projects that are often implemented at different sites with a diverse portfolio of activities. Furthermore there is often relatively little interest of the local executors of investment projects in the work of grant projects. There is clearly a need for an agreed strategy of how these links can be really achieved and under which conditions they are useful. There are two ways to guarantee realistic linkages: 1) the grant is planned as part of an investment project to adapt technologies to specific field conditions; 2) the grant is considered as a pilot project in the countries where IFAD sees a potential for investment project that should develop intervention packages that will then be followed up with an investment project immediately after the grant phases out or even over-lapping. Our project could be seen to fall under this category as some components may provide the base for investment projects in Tajikistan; the work with Gissar sheep may be followed up by a sheep and rangeland improvement project.

Capacity building: Improving scientific and technical competence of partner scientists and technicians in research methodology, data analysis, and reporting through working in multi-disciplinary teams, training and workshops enhances research efficiency in the future. It enables the partner institutes to continue this line of research after the grant phases out and to become partners for other organizations. Thus, a major output of this grant is capacity building of NARS scientists. Although this is difficult to measure or prove, ICARDA considers this output of very high value.

11 Annex 1: Description of Project sites

11.1 Kazakhstan

11.1.1 Geographical information

There are three project villages in Kazakhstan. Akdala village is located in the Arys district, in South Kazakhstan province (Annexfigure 1), at 90 km from the City of Shymkent (42^{0}27′59.60″ N and 68^{0}54′10.60″ E). Dermene village is located in 40 km from Arys district, in 115 km from the Shymkent (42^{0}31′24.05″ N and 68^{0}47′19.46″ E). Akbulak village is located in South Kazakhstan province, 30 km from Shymkent (42^{0}23′16.90″ N and 68^{0}47′19.46″ E).

Annexfigure 1. The four project sites (main villages) in Kazakhstan, Kyrgyzstan and Tajikistan in Central Asia

11.1.2 Livestock sector status

As of 1 June 2009, compared to the same date in 2008, in the entire republic in all farm types the number of cattle has increased by 211.4 thousand or by 2.9% and formed 7,421 thousands; that of sheep and goats – respectively by 844.3 thousand or by 3.9% and 22,708.3 thousand; horses – by 90.4 thousand or by 5.8% and 1,645.1 thousand; camels – by 8.3 thousand or by 5.2% and 167.9 thousand; poultry – by 1,978.4 thousand or by 6.4% and 32,779.9 thousand, the number of pigs has decreased by 23 thousand or by 1.2% and formed 1,922.5 thousand. As of 1 June 2009 the flock of cattle owned by households accounted for 83% of the total, while 17% are kept by the agricultural enterprises; in case of sheep – 66.4% and 33.6%, correspondingly; goats – 83% and 17%; pigs – 82.9 and 17.1%; poultry – 51.8 and 48.2%. Per capita consumption of meat and meat products in Kazakhstan in 1990 formed 73 kg, and in 2008 - 49.2 kg, while the rational norm is equal to 54.7 kg. Per capita milk and dairy products' production in 2008 reached 207.8 kg (norm is 76.5 kg), that of potato – 45.5 kg (norm 86 kg), vegetable and gourds -73 kg (norm 100 kg), vegetable oil -11.2 kg (norm 69.7 kg), bread – 122.5 kg (norm 56.8). Analysis of the above mentioned data shows the low level of staple food consumption by the population, and this gives an incentive for increased livestock and crop production.

According to the data of the statistics department of Kazakhstan, as of 1 July 2009 the flock of sheep in the republic formed 22,076 thousand, including 4,406 thousand in South Kazakhstan.

11.1.3 Brief description of farming systems

Traditionally, agriculture in south Kazakhstan is dominated by mid-size and small farms. Agricultural production is based on irrigated farming. Most of the farm land is privatized comprising mostly agricultural enterprises/individual farms, some agricultural co-operatives, joint-stock companies, limited partnerships and few state-owned enterprises. Akdala village occupies 133,760 ha of land, including 90,800 ha dedicated to agriculture. Rangelands cover most of the area (76,800 ha) and a small portion is dedicated to hayfields (3,000 ha) and cultivated forages (3,000 ha), while crops occupy 8,000 ha. The total area of the Dermene village is 115,000 ha including 85.0 thousand of agricultural lands (irrigated land – 2,000 ha, rainfed land – 10,000 ha, orchards – 143 ha, area under cotton – 400 ha, area under cereals – 317 ha, area under forage crops – 255 ha, rangelands – 40.4 thousand ha including winter ranges – 3,900 ha and summer ranges – 6,500 hectare). Akbulak village has 40,000 ha of rainfed lands, 3,000 ha of irrigated land, and rangeland is 50,000 ha. Water is pumped from wells and partially obtained from the Arys and Syrdarya rivers except Akbulak village where water supplied by springs near by the village all around the year. Project site's rangeland is typical semi-desert steppe. Ephemers are the major components of the grass cover including desert sedge, bulbous bluegrass (Poa bulbosa), and others that are a good forage in both fresh and dry forms throughout a year, especially well consumed by sheep. Grass cover remains green for not more than 50-60 days. The dominating crops include wormwood (Artemisia) – a shrub consumed by sheep throughout a year except hot summer period, and (Alhagi camelorum) camel's-thorn.

11.1.4 Soil characterization

In the areas of major importance for livestock, located in the north in the hunger steppe zone on sirozem soil, range productivity is under high risk due to climate conditions (temperature and precipitation). The soils are serozem, gray-brown, brown desert, takyr-like, and in the irrigated area - meadow-marshy, mostly saline with salt amount of 33 to 325 t/ha in 2 m layer and humus content of 0.5 to 2.5% in the cultivated layer. Over the past 12 years, more than 50% of fields in the whole Arys district have been ranked as low to very low in P_2O_5. Almost all the areas of the project pilot site are located in desert hunger zones. This is why the soil fertility is very low.

11.1.5 Climatic conditions

The climate is continental, with hot temperatures and low air humidity in summer time and cold and quiet unstable winter with low snow fall. Average frost-free period lasts for about 225 days. Average daily temperature is 16.9^0C. A long term annual precipitation level is around 350 mm. However, rainfall varies strongly over the year. Precipitation starts to fall at the end of September and early October. The highest precipitation falls in winter and spring seasons (78%) followed by autumn (18%) and summer (4%). Low precipitation level permits only irrigated crop production.

11.1.6 Constraints

Most of livestock is owned by household farms coexisting with small- and medium-size farmers. Households however, as it happens in the rest of the country, have s small number of animals and are poor. Seasonal ranges are overgrazed and require management. Main production constraint for all farmers is winter feeding; in addition a severe constraint for households is the lack of access to remote rangelands which leads to degradation of nearby village ranges. Enhanced production of fodder is needed to cover the feed gaps particularly during winter feeding. An enhanced feed base could provide scope for an organized community-based marketing of livestock products.

The markets of the region offer important opportunities for lamb and mutton meat and milk products, however households do not have the means and technologies to access these opportunities and benefit

from the relatively high prices. As the market of the wool is depressed there is a need for diversification of production.

11.2 Kyrgyzstan

11.2.1 Geographical information

Akbeket settlement is located in the Kemin district (5 km, far from the district center) in Chuy province (Annexfigure 1), at 95 km from capital city of Bishkek ($42^0 80' 77.60''$N and $75^0 62' 58.60''$ E). The Progress settlement is located in 15 km from Tokmok town, in 79 km from the Bishkek ($42^0 41' 41.41''$N and $75^0 25' 15.45''$). The Aq-Zhol (former Komsomolsky) village is located in Sokolokskiy district, Chuy province, 15 km from Bishkek capital city of the Republic of Kyrgyzstan ($42^0 58' 33.08''$ N and $74^0 29' 11.03''$ E).

11.2.2 Livestock sector status

Until recently fine-fleeced sheep-tending was a leading sector of livestock farming in Kyrgyzstan. But in recent years of reforms in the agricultural sector of Kyrgyzstan, fine-fleeced sheep-breeding declined, which led to the reduction of the herd. Currently the population of fine-fleeced sheep decreased by three quarters compared to 1990. The low prices for fine wool, lack of marketing, poor infrastructure of local markets have been hindering the development of fine-fleeced sheep-breeding in the country.

As a result of economic reforms in the rural areas, composition of rural producers has radically changed in Kyrgyzstan. Currently the main producers of livestock products are household farms, which account for 53.6% of deadweight meat, 55% of raw milk, 49.4% of eggs, and 48.7% of wool.

11.2.3 Brief description of farming systems

The total area of the Akbeket village is 26,320 ha including 85.0 thousand of agricultural lands (irrigated land – 3,201 ha, rainfed land – 393 ha, orchards – 11 ha, hayfields 452 ha, rangelands – 22,656 ha). Population of the village is amounted 4,650 people and 1,050 households. The Progress settlement occupies 18,907.0 ha of land, including 4,026 ha arable land (irrigated land is 3,614 ha and rainfed is 412). Natural pasture is 10,855 ha. Main agricultural crops are corn, alfalfa, wheat, barley and some vegetable crops. Major income source of the rural households of these two villages is agricultural production including both crop cultivation and livestock production. Majority of smallholders (85%) are involved in forage crop production. Forage is partly used for feeding of their animals and for selling. Vegetables, fruits, and food crops (wheat and maize) are grown mainly for personal consumption by about 15% of households. The main vegetation component of the winter communal rangeland of the Chuy province, where project villages are located, is mat-grass (*Stipa capillata)*, Wallis fescue/Volga fescue (*Festuca Valesiaca "Glaucantha"*), awnless brome/Hungarian bromegrass (*Bromus inermis Leyss)*, Kyrgyz wormwood (Artemisia), and Kochia (*Kochia prostrate)*, and rhubarb (*Rheum L.*). The Aq-Zhol village has 600 ha of irrigated land, 16 ha backyards. Water is coming from canal "Bolshoy Chuyskiy canal". Main source of water for cattle is canal. The main income of the village population is not agriculture and not cattle. Most of them are working in the city Bishkek and in the Manas airport.

11.2.4 Soil characterization

According to Kyrgyz Research Institute of Soil Science in the experimental site soil types are sierozems and mountain-valley dark-chestnut. Humus content in the upper layer of the sierozem soil is ranged between 0.8-1.4 percent. In the deeper soil the quantity is decreasing and total nitrogen content is amounted 0.2-0.25%. Mountain-valley dark-chestnut soil are occupying in the upper altitude which is more than 1700-2000 m above sea level. Humus content is fluctuated around 4.5-6.5%, total nitrogen 0.2-0.4%, total mobile content of phosphorus is P_2O_5 –0.5-0.23%, K_2O – 2.32-9.0%. There are no salted soils in the project sites.

11.2.5 Climatic conditions

The climate of the Chuy province is continental: cold winters and hot summers with big local deflections depending on the altitude. In summer the average temperature in the project site was ranged from +23.3 to +24.8 degrees C (the highest temperature can be more than +40 degrees C) in 2007 while the highest air temperature was recorded (26.3 ^{0}C) in 2008. In winter there are frosts through the lowlands and highlands. During the winter season the air temperature went down – 10.4 degrees C. According to the data of the Chuy Meteo Station, located in Chuy province, the average long-term precipitation is 496 mm, distributed as 97 mm in fall (September- November), 96 mm in winter (December-February), 213 mm in spring (April-May), and 90 mm in summer (June-August).

11.2.6 Constraints

The constraints in the Kyrgyz sheep production sector are similar to those in Kazakhstan. In Kyrgyzstan an additional problem is the low price and unorganized marketing of Merino wool which used to be a major product. The decreasing importance has led to a decline in the number of Merino sheep and to a deterioration of the wool quality and genetic value of the breeding flocks.

11.3 Tajikistan – Khujand site

11.3.1 Geographical information

The Ismoil community area of the Bobojon Gafurov district of Soghd province is located on the right shore of the Syrdarya river at the foothills of Kuramin ridge and in the Syrdarya arid rangelands. It is located 32 km of the city of Khujand, and has a common border with the Tashkent province of Uzbekistan in the north. The Uyas village is located 29 km from Khujand city ($40^{0}20'54.70''$ N and $69^{0}52'20.95''$ E).

11.3.2 SR sector status

Angora goat breeding is the main activity in foothill areas along with the breeding of Jaidara sheep, Jaidara goats and cattle. Households in Ismoil Jamoat mainly generate their income from crop production, production of small ruminants and cattle. The climate is dry and moderately hot, suitable for Mohair goats. Access to markets is often affected by lack of adequate roads.

According to the official data, currently there are more than 1.4 mln. goats in Tajikistan (www.stat.tj). They include about 500,000 Angora mohair-breed goats and their cross-breds. The research conducted in 2006-2007 shows that the estimated number of mohair goats in Tajikistan is around 300,000. Out of that, approximately 270,000 mohair goats are produced in two pilot regions of the Sogd province. In the Bobojon Gafurov region, there are around 150,000 goats and in the Asht region there are around 120,000 goats. The Matchinsk region has a much smaller number. One goat produces 1.5 kg of mohair a year. The Soghd province is a leader in tending Tajik Angora breed and 87% of goats of this breed are concentrated in two districts (Bobojon Gafurov and Asht) of the country.

11.3.3 Brief description of farming systems

Ismoil community involves 22 villages (kishlaks) and 4,063 households. The population amounts to 21,535 people including 11,091 women. The total area of irrigated land is 5,979 ha while ranges occupy 33,396 ha. The total area of community is 68.6 thousand ha. The region is poorly developed and displays high poverty. The main activity is agriculture involving the interaction of different types of farms: there are 3 production cooperatives, 27 private farms and the already indicated 4,063 households. Farmers also crop wheat and barley for own consumption and to feed their animals. Fodder crops include sorghum, maize and alfalfa. Some households grow for family consumption horticultural crops and fruit trees such as apricot, almond and walnuts. The total area irrigated land of Uyas village is 450 ha while ranges occupy 3,032 including 2582 ha of communal and 450 ha rented. Cotton is a number one crop to be cultivated in the village because for cotton there is state quota to produce it. Other crops are including wheat, barley, fruit trees, grapes, vegetable, sometimes they grow forage crops such as maize, sorghum, alfalfa, and melons, gourds.

11.3.4 Soil characterization

In Northern Tajikistan soils are sierozem, heavy clay loam, with organic matter content of 0.92% and bulk density of 1.37 g/cm^3. Morphological description of soil structure of the investigated project site is ranged from layer to layer. In the upper layer soil color is gray with a brownish tint, light loamy with stones in the form of boulders with a lots of gravel, unstructured with a large number of plant roots and rootstock of the soil there are also some while in the lower layer the soil color is grayish-brown is composed of coarse sand with harassing a small amount of soil and stones of medium size in the form of boulders and gravel. There are some rootlets.

11.3.5 Climatic conditions

The climate is dry and moderately hot. Winter temperatures in the plains could be as low as -3 to -5^{0}C. Snow cover is usually 3-7 cm. Sharp frosts are observed once in 3-5 years when night temperatures fall down to -25^{0}C. In these occasions the snow cover could be 20-30 cm. The long term average annual precipitation is 152 mm. The frost-free period covers some 185 days. Sum of the temperatures >+10C° reaches 4000 C. Total annual amount of sunny days is about 270 days.

11.3.6 Constraints

- The old farming system collapsed but a new system has not yet been fully developed: With the collapse of the Soviet Union the collective the former collective farms (kolkhozes and sovkhozes) were dismantled in Tajikistan. The new private farms are basically household farms.
- Goat owners face difficulties in mohair-oriented Angora goat farming: In Northern Tajikistan Tajik mohair goats are traditionally kept basically on marginal pastures with a relatively scarce fodder base. The new producers of mohair goats in the private sector have limited skills in animal husbandry and have little access to technologies to improve the offtake from their flocks. Highly productive animals do not get adequate attention. Sometimes livestock farmers continue to maintain low-quality and non-productive females with clear implications on expenses for feeding and over-grazing of pastures.
- Farmers lack access to improved animals: There is a need for creation of breeding flocks (nucleus) so that the farmers can get access to breeding animals through a decentralized systems of animal breeding.
- Existing mohair standard does not meet modern technological requirements of world market: It is known that at the international market there is much higher demand for fine fiber than for coarse mohair. And the price for fine fiber is usually 3-5 times higher than for coarser fiber. In the Tajik market, it is the opposite – the price for the coarse Angora mohair is higher than for the fine mohair. Thus, the existing standard of Angora mohair does not match with the requirements of the international market in a number of important criteria.
- Engaging women in adding value to mohair: There is a need to include women in the production process and use and further develop their local knowledge in the production and processing of products. Prices at international markets for white and naturally coloured mohair are promising, thereby offering an opportunity to increase households income and provide employment opportunities for rural women.
- Access to pastures and legal status of ownership of pastures.

11.4 Tajikistan – Dushanbe site

11.4.1 Geographical information

The Dusti community situated 30 km South-East of Dushanbe in Central Tajikistan and is used by livestock from many villages in that Central part of Tajikistan. GPS coordinates of the project villages are as follows: Buzbit 38^{0}30′26.55″ N and 69^{0}00′23.97″ E and elevation is 858 m; Nematabad 38^{0}30′03.41″ N and 68^{0}59′28.38″ E and elevation is 847 m; Karsang 38^{0}29′29.25″ N and 68^{0}59′13.16″ E and elevation is 849 m. Relief of this area is a floodplain terrace.

11.4.2 Livestock sector status

Agriculture contributes significantly to national economic development, allowing reducing poverty and achieving food security. More than 51% of the working population are involved in agriculture and the contribution to the GDP is 23-25%. Livestock production includes cattle, sheep and goat breeding, horse breeding, poultry farming and bee keeping. According to statistics at the beginning of 2009 in Tajikistan the number of cattle was 1,797.5 thousand heads, including 932 thousand of cows; there were 2,893 thousand of sheep and 1,260 thousand goats, 76.6 thousand horses heads, and 3,674.5 thousand poultry. More than 80.0% of sheep and goats, and 70.0% of cattle are concentrated in the private sector. Production of livestock products in the republic in 2008 was as follows: 129.7 thousand tonnes of meat, 600.0 thousand tonnes of milk, 5.2 thousand tonnes wool, 27.2 million eggs, and 2.1 thousand tonnes honey. Prices of major products are shown in Annextable 1.

Annextable 1. Market prices of main animal products (2009)

Name of products	Price, somoni	Price in USD
Milk, 1 kg	2.0	0.45
Meat,1 kg	18.0	4.05
Eggs,10 pcs.	7.0	1.58
Wool,1 kg	0.8	0.18
Raw skins (1 pc): cattle	25.0	5.63
sheep and goat	5.0	1.13

11.4.3 Brief description farming systems

The total area of the Buzbit village is 2,253 ha including 2,130 of agricultural lands (irrigated land – 180 ha, rainfed land – 15 ha, hayfield – 23 ha, rented rangelands – 1,800 ha and communal rangeland is 50 ha) and waste lands – 123 ha. Nematabat village occupies 1,430 ha of land, including 1,396 ha dedicated to agriculture (Rented rangelands cover most of the area (1,200 ha) while communal pasture near by the settlement is only 80 ha and there is no hayfield; Irrigated land is 50 hectare and the rest land is waste land and amounted to 34 ha. Karsang village has less land compared to other two villages mentioned above. The village area is 1,322 ha including 123 ha irrigated land, rainfed land – 19 ha , hayfield 9 hectare total communal rangeland is 80 hectare and rented rangeland or winter rangeland – 1,000 ha. Major forage crops cultivated by households of the three villages include cereals mainly wheat, leguminous plants, alfalfa for green forage and hay, maize for silage and green forage, and straw for forage. Livestock production is mainly stall-fed all around the year.

11.4.4 Soil characterization

Central Tajikistan's soil is moderately eroded dark sierozems, middle loam (topsoil) and heavy loam (lower layers). Organic matter, content of carbonate and pH ranged from 2.8 to 0.3%, 14.5 to 10.5%, and 7.5 to 8.7 respectively at the 0-5 and 80-100 cm deep profile. Soil - brown carbonate, heavy, large-dusty, medium-and heavily eroded. The humus content in the horizon 0 - 15 and 15 - 31 cm is 3.05 and 1.80 % and total nitrogen is 0.18 and 0.12%. Phosphorus in the upper layer of the soil is 0.15 – 0.12 %, but mobile forms of phosphorus are only 8,5 - -5,5 mg / kg of soil. The dark sierozems soils are basically used for irrigation, while brown soils for dry land farming.

11.4.5 Climatic conditions

The climate of Central Tajikistan is classified as continental with hot summers and cold winters. The climate in the projects site has a low humidity with hot summer and mild winter.The average summer temperatures is 30ºC often surpass 45°C; the average winter temperature in January is about +1.9°C, with absolute minimum as low as -30°C. Tajikistan experienced the worst winter in 44 years in 2008. Night temperatures ranged from -15°C to -25°C for extended periods in January and sometimes in February. The winter in 2007 and 2009 were as usual comparing to long term average temperatures. The winter of 2009 was favorable to the plant growth and development and warmer than usual and almost without snow while in 2008 were recorded heavy snowfalls especially in mountain areas.

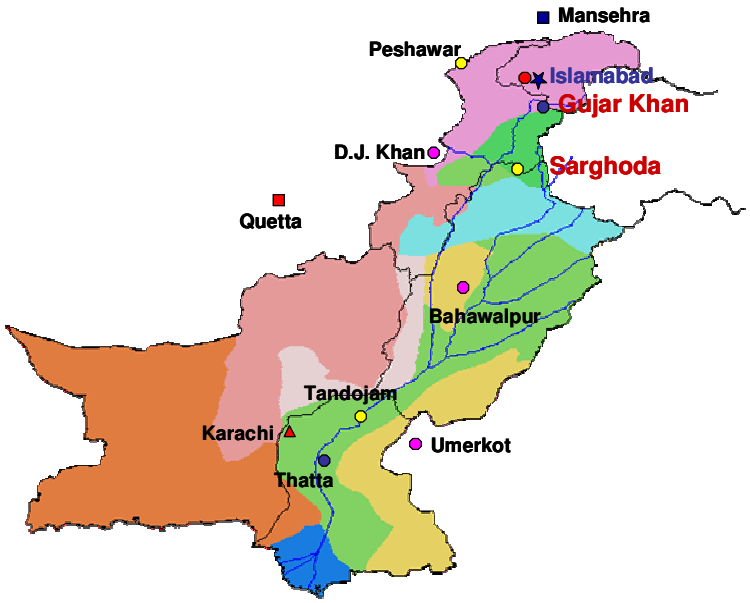
11.4.6 Constraints

About 90% of the sheep meat production is concentrated in private farms and households. There are a number of problems contributing to low livestock productivity and low income:

- Lack of resources and capital as well as limited knowledge of advanced management practices: Private owners, new farmers and households often do not have the relevant knowledge of technology for husabndry, feeding reproduction and breeding of sheep.
- Low breeding value of animals: Households often keep low productive females, as well as low-grade sires. They do not take into account the expenses for feeding and keeping surlus animals. Some household flocks consist of fat-tailed, Karakul and fine-wool sheep and uncontrolled mating leads to low quality crossbred animals not corresponding to market opportunities.
- Degradation and deterioration of village pasture due to overgrazing: The vegetation disappears (only 100-150 kg ha^{-1} of dry edible biomass) and soil erosion is increasing. Even the pasture areas for grazing sheep and goats of the private sector is also inadequate.
- Low productivity and fertility of females because of inadequate feeding during mating and late gestation.
- Lack of animal health control and disease prevention: Methods for anthelminthic and insecticidal treatments are missing and vaccination is not conducted regularly but in response to disease outbreaks; for example brucellosis is wide-spread in Tajikistan and the prevalence of brucellosis is the highest in Central Asia.
- Lack of organized product marketing and markeit infrastructures: Market channels for sheep pelts and wool have nearly disappeared.
- Lack of knowledge on technologies for product processing: Households do not apply further processing of sheep and goats products (processing of fiber, leather, raw milk, etc.).

11.5 Pakistan

The project activities were implemented with communities at two pilot sites representative of the rainfed (Barani) and irrigated small-scale fodder/crop-livestock farming systems in Pakistan. The rainfed site was located in Gujar Khan Tehsil of district Rawalpindi and the irrigated site in Sargodha district, both in the Punjab province of Pakistan (Annexfigure 2). Gujar Khan and Sargodha are in a distance of about 100 and 200 km, respectively to Islamabad, and are accessible by road during all year. Annual rainfall in Gujar Khan ranges between 400-600 mm. Sargodha has a similar range of annual rainfall, but access to canal and tube well irrigation. Four distinct seasons are recognized: A cold winter from December to February; a spring season from March to May; a hot summer from May to August (hot rainy season); and autumn beginning from late September until frost at the onset of winter.



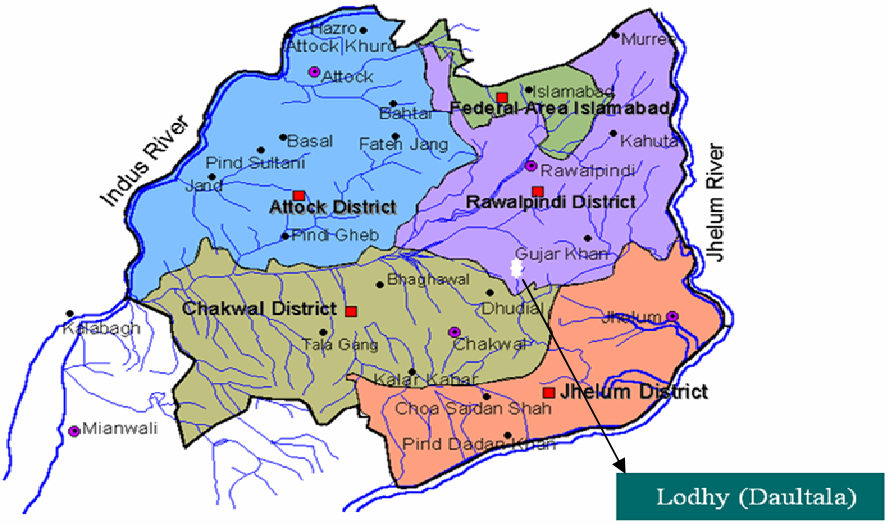
Annexfigure 2. The two project sites Gujar Khan and Sarghoda in Punjab Province

Small-scale crop-livestock farming systems predominate at both project sites. About 90-95% of farmers in the target communities own livestock. Livestock rearing provides opportunities for improved human nutrition, cash income, asset building, and employment, raw materials for agro-based industries and manure for soil fertility improvement. Cattle and buffalos are fed farm produced fodder crops and crop residues. Sheep and goats depend almost entirely on grazing degraded rangelands. In winter, all animals are fed indoors on mostly low-quality crop residues and/or conserved fodder supplemented with farm-grown or purchased concentrates. May-June and December-January are the critical periods when feed deficits are high, particularly in the rainfed areas. Productivity of the rural livestock industry is low partly due to poor feeding management, inadequate housing, animal diseases, poor market access, and lack of policy support.

Fodder production is an important part of the cropping systems. Major constraint for improving fodder production in the area is poor linkages between farmers and researcher/scientists, low access to seed improved fodder crops/ varieties. Poor adoption of agronomic packages, lack of quality seed, poor soil fertility, low integration of fodder legumes into the cropping systems to increase fodder availability and improve soil fertility are among the major constraints of fodder production. The following are the salient problems associated with fodder production.

- Low priority given to fodder crops compared to staple food (wheat) and commercial crops (groundnut)
- Low yield potential and low nutritional quality of local fodder varieties
- Lack of dual purpose composite varieties which can be used both fodder and seed production
- Lack of tolerance to biotic and abiotic stresses
- Lack of knowledge for seed production from fodder crops and of a viable seed production system for fodder crops
- Low rate of adoption of approved varieties and production technology due to prevailing risk of drought and non availability of moisture
- Lack of introduction of nontraditional forage crops (Vetch, Rice bean, elephant grass, low sugar and quick growing sugarcane)
- Standardization of livestock feeding for achieving maximum output of milk and meat
- Lack of “farmer proven” fodder conservation technologies to overcome the problem of fodder scarcity during lean period and to conserve the fodder during excess period such as August/September and March/April.

The rainfed site – the village Lodhay (or Lodhy) – is located in Daultala union council of Tehsil Gujar Khan, District Rawalpindi (Annexfigure 3). Rawalpindi geographicallybelongs to Pothowar Plateau whch is formed by four rainfed districts, namely Rawalpindi. Jhelum, Attock and Chakwal. Pothowar Plateau is lying at a height of 360 to 570 meters, east of the Indus and west of the Jhelum River.



Annexfigure 3. Location of the Lodhy Village (Pothwar Plateau), Tehsil Gujar Khan, District Rawalpindi (rainfed site)

In summer, the mean daily temperature is 38°C. In winter, the mean daily temperature range is 3-6°C. It is an undulating and degraded area (see photo), consisting mainly of sandstone and covered by varying thickness of loess deposit, which erodes easily. Erosion as well as water stress are the main natural problems being confronted by the agriculture of this area. Gully erosion is very prominent in the area. The average farm size per household is about 5.6 ha of which about 3 ha are arable. About 67% of the total arable land per household is devoted to food crop production, 23% to fodder crops, and 10% to cash crops. Nearly 20-30% of the arable land is left fallow each year. The primary crops are wheat, corn, sorghum, millet, *Brassica*, mungbean, mashbean, guar and groundnut. Planting of wheat after wheat or maize/sorghum after wheat is common and results in reduced grain yield. The high cost of green forage, wheat straw and concentrates is an important constraint affecting dairy production. The situation worsens in May-June and December-January when the prices of forage and feed increase and the livestock depends on wheat straw, dry maize, sorghum and millet stalks. There is a market for selling green forages to middlemen that sell them to urban dairies.

Undulating and degraded farmland in Lodhay village – rainfed site

The water supply for the irrigated site in Sarghoda is from the Punjab rivers and controlled by some large dams, notably the Tarbela on the Indus and the Mangla on the Jhelum. There is a network of linked canals that distribute the water to the communities. Some farmers have their own tube-wells to supplement crop requirements. Commercial forage production in the irrigated areas has become an important and profitable business and surplus green forage is transported to forage-deficient big cities such as Rawalpindi-Islamabad, Mirpur, and sometimes to Lahore. The soils in Sargodha area vary from clay loam to silty loam having salt belts in certain ranges. At the irrigated site, two villages (Chak No. 74/SB and 105/SB) were selected for project interventions.

Meeting with the male farmer group at the irrigated site in July 2007

12 Annex 2: Additional tables for Theme 2

Annextable 2. Names of survey villages by country and number of households interviewed

Country	Name of village	Total no of households	No of households interviewed	Survey conducted
Kazakhstan	Akbulak	80	27	10.07-05.08
	Ak-dala*	462	28	10.07-05.08
	Dermene	150	19	10.07-05.08
	Sub total	692	74	
Kyrgyzstan	Akbeket*	1050	27	11.07-04.08
	Ak-Zhol	460	22	11.07-04.08
	Progress*	402	26	11.07-04.08
	Sub total	1912	75	
Central Tajikistan	Buzbit	252	25	04-06.08
	Nematabat*	67	23	04-06.08
	Karsang	170	27	04-05.08
	Sub total	489	75	
Northern Tajikistan	Kipchoq	74	30	12.07-05.08
	Michurin	150	30	12.07-06.08
	Uyas (incl. Takli)	724	30	12.07-06.08
	Sub total	948	90	
Grand total		3169	314	

*Villages where field activities in theme 2 and 3 were carried out.

Annextable 3. Land use in the selected villages across countries: irrigated, rainfed and pasture land (ha)

Village	Interviewed households									Total	Official statistics of the selected villages						Grand total
	Irrigated			Rainfed			Pasture				Irriga-ted	Rainfed	Hay-fields	Communal		Waste lands	
	private	rent	Sub total	private	rent	Sub total	private	rent	Sub total					Commu-nal	rent		
Kazakhstan																	
Akbulak	69.5	94.0	163.5	823	122	945	0	0	0	1,109	2,900	22,000		11,000	0	2,300	39,309
Ak-dala	378.9	232.0	610.9	0	0	0	0	1,160	1,160	1,771	10,389	12,000	3,000	75,640	0	30,960	133,760
Dermene	118.7	80.8	199.5	157	0	157	430	0	430	786.5	5210	1,345		35,980	0	17,890	61,212
Kyrgyzstan																	
Akbeket	108.5	44.1	152.6	0	0	0	45*	0	45	197.6	420	0	40	2,200	0	1,223	4,036
Ak-Zhol	59.4	79.8	139.2	0	0	0	52*	0	52	191.2	4568	0	230	0	0	189	5,126
Progress	90.4	70.5	160.9	0	0	0	16*	105.5	121.5	282.4	2,300	2,500	348	4,356	0	1,100	10,854
Central Tajikistan																	
Buzbit	3.2	11.4	14.5	0	24	24	10*	13	23	61.5	180	15	23	50	1,800	123	2,253
Nematabat	3.1	21.9	25	3.5	17	20.5	13*	7.5	20	66	50	0	0	80	1,200	34	1,430
Karsang	3	21.0	24	1	27	28	10*	17	27	79	123	19	9	80	1,000	12	1,322
Northern Tajikistan																	
Qipchoq	32.5	13.7	46.2	1	0	1	1	0	1	48.2	230	0	0	1,000	0	0	1,278
Michurin	6.6	0	6.6	0	0	0	0	0	0	6.6	190	0	0	0	0	45	242
Uyas	31.2	3.6	34.8	0	0	0	0	0	0	34.8	450	0	0	2,582	450	211	3,728

* including hayfields

Annextable 4. Dry matter forage yields of Alfalfa as influenced by different ammophous application rates and farms in Central Tajikistan

Farms	Treatments	Dry forage yield, t/ha			Farms	Treatments	Dry forage yield, t/ha		
		2008	2009	Mean			2008	2009	Mean
F1	AC	4.0	3.7	3.9	F4	AC	4.5	4.1	4.3
	A40	6.1	4.8	5.4		A40	5.2	4.8	5.0
	A60	6.7	4.5	5.6		A60	5.2	4.6	4.9
	A80	4.5	4.5	4.5		A80	4.3	4.3	4.3
F2	AC	6.7	4.4	5.5	F5	AC	2.8	4.2	3.5
	A40	7.7	4.9	6.3		A40	3.9	4.2	4.1
	A60	7.6	4.4	6.0		A60	3.7	4.8	4.2
	A80	4.1	4.1	4.1		A80	4.7	4.7	4.7
F3	AC	4.3	3.7	4.0	F6	AC	4.1	4.6	4.3
	A40	4.7	4.5	4.6		A40	3.7	4.8	4.2
	A60	5.0	4.3	4.6		A60	3.8	4.6	4.2
	A80	4.2	4.2	4.2		A80	4.3	4.3	4.3
T	<.001				T	<.001			
T.F	<.001				T.F	<.001			
T.F.Y	<.001				T.F.Y	<.001			

13 Annex 3: Additional tables for Theme 3

Annex 3.1. Draft standard for Mohair classification in Northern Tajikistan

The proposed draft of new standard for Tajik mohair "Unwashed classed Angora goat hair" includes the following sections by which Mohair will be classified:

1. Thinness
2. Length
3. General appearance
4. Color

1. Thinness

1.1. Super fine (Young stock of 6 months and 1 year old) (Super Fine Kid & Kid lines) are in the range of up to 24 microns

Super fine hair is obtained when shearing selected young animals of 6 months and 1 year old having most fine fleece (or parts of fleece).

1.2. Fine (Young stock of 1 year old) (Kid lines) – from 24 to 27 microns

Fine hair is obtained mainly from 1 year old young animals and selected 2 year old female goats having more fine hair.

1.3. Semi-fine (Second-year stock) (Strong Kid lines) – from 27.1 to 31 microns

Semi-fine. Normally this group includes mohair obtained from 2 year old young animals, as well as coarsened mohair from 1 year old young animals and fine mohair from 3 year old or older goats.

1.4. Semi-coarse (full aged goats) (Young Goat Types). Ranges from 31.1 to 37 microns.

Semi-coarse. Most of full aged goats when shearing give the mohair of such character.

1.5. Coarse (Adults, old goats) (Adult lines) 37.1 microns and more

Coarse. Mainly this group mohair is received from adult male-goats breeders, goats-castrates and older females.

2. Length

When processing the hair, the uniformity of length is as important as the uniformity of fineness. The more uniform the staple length within a fleece is, the better this indicator. Since goats are sheared once a year in Tajikistan, the hair length meets the industry requirements. However, the introduction of a twofold shearing within a certain contingent of the herd is promising.

The length requirements are divided into 3 groups: A – long, B – medium and C – short.

Fully aged and old goats (adults)

A – length from 17 cm and more
B – length from 12 cm to 17 cm
C – length up to 12 cm

Young stock (kids)

A – length from 15 cm or more
B – length from 10 cm to 15 cm
C – length from 6 cm to 10 cm

For assessing the staple length, representative staples from different topographical areas of the fleece should be examined.

3. General appearance

3.1. General appearance of the hair is characterized by luster intensity, crimp of locks and kemp,

grease. Depending on these indicators the general appearance of the hair is classified into uniform and not uniform types:

3.1.1. Uniform.
Hair with luster, with high waviness, of lock structure, consisting mainly of uniform fibers. Kemp is not present or small number of dry and dead fibers is allowed in locks up to 5% of the total mass of hair. Grease content is optimal – 4-7%.

3.1.2. Not uniform.
Hair with insignificant sheen (semi-luster), with low waviness, of lock structure. Locks consist of long down, transitional fibers and guard hair. The percentage of dead fibers, guard hair, kemp in the total mass of hair is indicated.
This hair is obtained from low-class, semi-coarse downy goats and their crosses with Angora goats.

3.2. Fault negatively affects the quantity and quality of goat hair:

3.2.1. Normal
Hair which permits vegetable (hay, straw, all kinds of thistle, etc.) and mineral (dust, dirt) impurities not exceeding 3% of the mass of dirty (unwashed) hair.

3.2.2. Faulty
Hair which permits vegetable and mineral impurities exceeding 3% of the mass of dirty (unwashed) hair with an indication of the content of impurities. Stain of lock staples is allowed.

4. Color
4.1. White.
Hair of Tajik breed Angora goats is mostly of white color.
Depending on the color of grease and mineral impurities, the unwashed hair may have different shades.

4.2. Colored.
However, unlike other breeds of this type, its structure contains quite a lot colored fibers.

4.2.1. Light gray
White with sprouted colored fibers.

4.2.2. Black
Black natural color, light fibers occur in a small quantity.

4.2.3. Combination of colored fibers
Naturally colored hair: gray, dark gray, tan and all shades of brown.

The work results predetermine the assessment of quality of raw goat hair prior their shearing depending on their sex and age. This in turn enables a person – a non-specialist – to determine what quality a sheared fleece belongs to.
Through introduction of a new standard the improvement of Mohair quality will be achieved, the selection traits based on economic value will be identified, more rational and more targeted use of raw material by farmers will be ensured. This is supposed to create a more favorable business climate for the production of high quality Mohair and facilitate entry to foreign markets.
The practical significance of the study is that the research results contribute to division of raw materials to more uniform ones in the qualitative aspect immediately after shearing of goats. It meets the requirements for classification of mohair in the global market. It also brings attention of farmers (producers of mohair) to selection of goats with desired raw material.

Annextable 5 (Kazakhstan). Winter feeding of ewes in Kasymbay's farm for early and traditional lambing in the season 2007-2008

Fodder	**Period of feeding**	**Daily ration, kg**	**Number of days**	**Costs of fodder, tenge**	**Costs for 1 animal, tenge**
Early lambing					
Hay	December-February	1.5	90	8	1080
Concentrates	December -January	0.3	60	24	432
Concentrates	February-March	0.5	60	24	720
Total					**2232**
Traditional lambing					
Hay	December-March	1.5	120	8	1440
Concentrates	December -January	0.3	60	24	432
Concentrates	February-April	0.5	90	24	1080
Total					**2952**

Annextable 6 (Kazakhstan). Winter feeding of ewes in the household Abdukarim for early and traditional lambing in the season 2007-2008

Fodder	**Period of feeding**	**Daily ration, kg**	**Number of days**	**Costs of fodder, tenge**	**Costs for 1 animal, tenge**
Early lambing					
Hay	December-February	2,0	90	8	1440
Concentrates	December -January	0,5	60	24	720
Concentrates	February-March	0,7	60	24	1008
Total					**3168**
Traditional lambing					
Hay	December-March	2,0	120	8	1920
Concentrates	December -January	0,5	60	24	720
Concentrates	February-April	0,7	90	24	1512
Total					**4152**

Annextable 7 (Kazakhstan). Winter feeding of ewes in the households Ergesh and Andas for early and traditional lambing in the season 2007-2008

Fodder	**Period of feeding**	**Daily ration, kg**	**Number of days**	**Costs of fodder, tenge**	**Costs for 1 animal, tenge**
Early lambing					
Hay	December-February	2.0	90	8	1440
Concentrates	January- February	0.4	60	24	576
Total					**1656**
Traditional lambing					
Hay	December-March	2.0	120	8	1920
Concentrates	December-February	0.4	90	24	864
Total					**2784**

Annextable 8 (Kazakhstan). Winter feeding of ewes in the households Kasymbay, Abdukarim and Abish for early and traditional lambing in the season 2008-2009

Fodder	**Period of feeding**	**Daily ration, kg**	**Number of days**	**Costs of fodder, tenge**	**Costs for 1 animal, tenge**
Early lambing					
Hay	December-February	2.0	90	7	1260
Concentrates	December-February	0.5	90	22	990
Total					**2250**
Traditional lambing					
Hay	December-March	2.0	120	7	1680
Concentrates	December-March	0.5	120	22	1320
Total					**3000**

Annextable 9 (Kazakhstan). Winter feeding of ewes in the household Bahytjan for early and traditional lambing in the season 2008-2009

Fodder	**Period of feeding**	**Daily ration, kg**	**Number of days**	**Costs of fodder, tenge**	**Costs for 1 animal, tenge**
Early lambing					
Hay	December-February	1.5	90	7	945
Concentrates	December-February	0.3	90	22	594
Total					**1539**
Traditional lambing					
Hay	December-March	2.0	120	7	1680
Concentrates	December-March	0.5	120	22	1320
Total					**3000**

Annextable 10 (Kazakhstan). Changes in liveweights (kg) of Karakul and fat-tailed **ewes** for early and traditional weaning in 2008

Time	Farm/households					
	Kasymbay				Abdukarim	
	Karakul		Fat-tailed		Fat-tailed	
	early	traditional	early	traditional	early	traditional
At lambing	35.67	35.59	41.61	40.65	43.78	43.30
15 day	35.53	35.93	42.04	42.28	46.86	46.80
30 day	40.06	40.46	44.24	44.28	49.95	49.81
45 day	42.17	42.25	46.33	46.47	51.52	51.68
60 day	45.42	44.68	49.36	47.22	52.31	51.97
75 day	50.06	47.06	52.04	49.76	55.80	53.66
90 day	52.67	50.09	53.37	51.07	58.25	55.25
105 day	52.76	50.42	55.21	52.65	60.12	56.76
120 day	54.31	51.03	56.23	54.09	64.48	58.68
135 day	55.14	52.94	58.32	56.24	65.73	59.13
150 day	57.56	53.40	59.54	57.34	67.44	60.64
165 day	58.08	54.18	61.43	60.17	68.06	62.46
180 day	58.54	57.74	63.62	61.46	68.34	64.48
195 day	59.86	59.46	63.98	62.57	68.78	65.98
210 day	59.96	59.47	63.79	62.48	67.81	66.21

Annextable 11 (Kazakhstan). Changes in liveweights (kg) of Karakul and fat-tailed ewes for early and traditional weaning in 2009

Time	Farm/households s									
	Kasymbay				Abdukarim		Bahytjan		Abish	
	Karakul		Fat-tailed		Fat-tailed		Fat-tailed		Fat-tailed	
	early	trad.	early	trad.	early	trad.	early	trad.	early	trad.
At lam-bing	36.98	36.95	41.79	41.80	44.23	44.53	42.74	43.16	43.58	43.58
15 day	36.38	36.27	41.57	41.67	45.08	45.18	43.58	43.90	43.71	43.60
30 day	38.54	38.69	43.88	43.94	47.28	47.36	45.74	45.03	45.66	45.77
45 day	42.78	42.87	45.54	45.46	50.90	51.31	47.24	47.54	47.87	47.26
60 day	45.94	46.16	48.74	48.58	51.76	52.54	49.56	49.88	49.94	49.58
75 day	48.72	49.58	51.58	51.64	53.56	53.97	51.13	51.34	51.24	51.93
90 day	50.44	51.28	53.94	53.28	55.87	56.46	53.44	53.96	53.08	54.26
105 day	50.81	51.66	56.10	54.61	58.16	57.74	55.93	55.30	55.49	55.66
120 day	52.46	52.40	57.29	57.08	61.68	59.83	58.56	57.46	58.17	57.93
135 day	53.58	54.18	59.46	59.04	63.54	61.29	61.03	58.89	60.83	59.54
150 day	56.10	54.83	60.67	60.21	66.14	62.87	63.46	61.44	62.78	61.84
165 day	58.84	56.28	62.38	62.29	67.74	64.21	65.34	62.90	64.80	63.29
180 day	59.26	58.29	64.44	62.96	69.47	65.67	67.16	64.04	66.74	64.96

Annextable 12 (Kazakhstan). Milk production of Karakul and fat-tailed ewes after early and traditional weaning of lambs in the farm Kasymbay in 2009

Date	Karakul		Fat-tailed	
	traditional	early	traditional	early
15/05/2009	-	534	-	556
22/05/2009	-	525	-	525
29/05/2009	-	510	-	510
03/06/2009	-	490	-	495
08/06/2009	-	476	-	482
13/06/2009	-	422	-	465
18/06/2009	-	405	-	410
23/06/2009	-	396	-	424
28/06/2009	-	362	-	403
03/07/2009	146	321	164	357
08/07/2009	132	245	155	288
13/07/2009	120	185	143	213
18/07/2009	110	142	137	176
23/07/2009	101	107	120	142
28/07/2009	95	97	105	112

Annextable 13 (Dushanbe). Rations of ewes during the winter feeding period in the first system

Name of fodder	Amount, kg	Feed (starch) unit	Exchange energy, Mj (megajoule)	Dry matter, kg	Digestible protein, g	Calcium, g	Phosphorus, g	NaCl, g	Sulfur, g	Iron, mg	Copper, mg	Carotene, mg
Pasture forage	3.0	0.64	8.76	1.06	84.0	3.30	2.10	-	1.8	42	3.6	90.0
Barley grain	0.3	0.34	3.36	0.25	25.5	0.60	1.17	-	0.4	15.0	1.3	0.2
Cotton cake	0.2	0.22	1.90	0.18	67.0	0.55	1.85	-	0.8	45.6	2.85	0.2
NaCl	0.011	-	-	-	-	-	-	11.0				
Total	3.5	1.20	14.02	1.49	176.5	4.45	5.12	11.0	3.0	102.6	7.75	90.4
Require according to standards		1.20	13.5	1.90	100.0	6.40	3.70	11.0	3.0	62.0	14.0	13.0

Annextable 14 (Dushanbe). Rations of ewes during the winter feeding period in the second system

Name of fodder	Amount, kg	Feed (starch) unit	Exchange energy, Mj (megajoule)	Dry matter, kg	Digestible protein, g	Calcium, g	Phosphorus, g	NaCl, g	Sulfur, g	Iron, mg	Copper, mg	Carotene, mg
Wheat straw	1.0	0.22	5.2	0.8	9.0	3.3	0.9		1.0	80.0	1.1	5.0
Motley hay	1.0	0.48	7.0	0.8	40.0	5.6	1.0		1.4	170.0	2.4	13.0
Wheat bran	0.4	0.30	3.7	0.3	38.8	0.8	3.8		0.7	68.0	4.5	1.0
Barley grain	0.2	0.23	4.5	0.3	17.0	0.4	0.8		0.3	10.0	0.8	0.1
Na Cl	0.011	-	-	-	-	-	-	11.0				
Total	2.6	1.23	20.4	2.2	104.8	10.1	6.5	11.0	3.4	328.0	8.8	19.1
Require according to standards		1.20	13.5	1.9	100.0	6.4	3.7	11.0	3.0	62.0	14.0	13.0

Annextable 15 (Dushanbe). Rations of ewes during the winter feeding period in the third system

Name of fodder	Amount, kg	Feed (starch) unit	Exchange energy, Mj (megajoule)	Dry matter, kg	Digestible protein, g	Calcium, g	Phosphorus, g	NaCl, g	Sulfur, g	Iron, mg	Copper, mg	Carotene, mg
Wheat straw	0.5	0.11	2.6	0.42	4.5	0.7	0.4		0.5	204	0.55	2.5
Motley hay	1.0	0.48	7.0	0.80	40.0	5.6	1.0		1.4	170.0	2.4	13.0
Cotton cake	0.4	0.44	3.8	0.36	134.0	1.1	3.7		1.6	91.2	5.7	0.4
Barley grain	0.2	0.23	4.5	0.30	17.0	0.4	0.8		0.3	10.0	0.8	0.1
Na Cl	0.011	-	-	-	-	-	-	11.0				
Total	2.1	1.26	17.9	1.88	195.5	7.8	5.9		3.8	475.2	9.45	16.0
Require according to standards		1.20	13.5	1.90	100.0	6.4	3.7	11.0	3.0	62.0	14.0	13.0

Annextable 17 (Dushanbe). Health calendar for sheep flocks using grazing and grazing/stall-feeding systems

Name of activity	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Dehelminthization			20								10	
Anthrax vaccination			17									
F&M disease vaccination			30					15				
Smallpox vaccination				1					1			
Shearing				15				15				
Bathing				25				20				

Notes:
1. Vaccine against anthrax by 0.5 ml subcutaneously;
2. Vaccine against F&MD by 1.0 ml subcutaneously;
3. Vaccine against smallpox by 1.0 ml subcutaneously;
4.Ivermectinum against mange and nemathodosis – 1 ml for 50 kg of live weight;
5.Bathing – 10 ml of neocidolum to 10 l of water;
By necessity farmers use also following vaccines:-against bradzod, emphysematous carbuncle, -leptospirosis

Annextable 16 (Dushanbe). Composition of 1 kg of premix "Rovimiks" (made in Poland $9.4/kg)

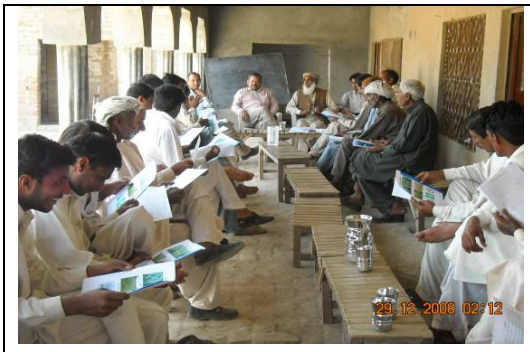
Vitamine A	IU	4000000.00
Vitamine D_3	mg	12000000.00
Vitamine E	mg	6000.00
Vitamine K	mg	1200.00
Vitamine B_1	mg	400.00
Vitamine B_2	mg	1600.00
Vitamine B_6	mg	1200.00
Vitamine B_{12}	mg	6.00
nicotinic acid	mg	1200.00
pantothenic acid	mg	200.00
folic acid	mg	200.00
biotin	mg	10.00
Holin chloride	IU	160000.00
iron	mg	10000.00
manganese	mg	40000.00
zinc	mg	24000.00
copper	mg	2000.00
iodine	mg	200.00
cobalt	mg	40.00
selenium	mg	80.00
calcium	g	184.10
antioxidant	mg	200.00

Annextable 18 (Dushanbe). Milk yields of selected Gissar ewes from 3-12 May 2009

ID of	Date of milking and milk yield, kg										Total,
ewe	03/05	04/05	05/05	06/05	07/05	08/05	09/05	10/05	11/05	12/05	kg
3978	0.22	0.28	0.32	0.30	0.33	0.35	0.35	0.33	0.35	0.43	3.26
3929	0.30	0.35	0.40	0.38	0.34	0.40	0.42	0.45	0.42	0.45	3.91
2962	0.25	0.32	0.28	0.32	0.36	0.40	0.30	0.39	0.48	0.58	3.68
2950	0.28	0.32	0.35	0.33	0.34	0.40	0.35	0.35	0.45	0.48	3.65
5088	0.35	0.38	0.40	0.38	0.38	0.33	0.36	0.35	0.38	0.43	3.74
2708	0.32	0.34	0.40	0.42	0.44	0.38	0.42	0.45	0.40	0.45	4.02
2454	0.28	0.32	0.35	0.34	0.38	0.42	0.35	0.45	0.45	0.46	3.80
2134	0.20	0.28	0.31	0.36	0.40	0.38	0.36	0.42	0.40	0.43	3.54
3918	0.25	0.25	0.27	0.32	0.34	0.38	0.38	0.42	0.48	0.51	3.60
2357	0.31	0.43	0.35	0.37	0.38	0.42	0.37	0.42	0.48	0.47	4.00
Total	2.76	3.27	3.43	3.52	3.69	3.86	3.66	4.03	4.29	4.69	37.20

14 Annex 4: Capacity building and knowledge exchange

Annex 4.1: Selected photos from farmers' trainings in Pakistan



02.12.2009

FIELD DAY TRAINING PROGRAMME ON SUMMER
FODDERS TO ENHANCE THE MILK AND MEAT PRODUCTION
NARC UNIVERSITY ICARDA

29.12.2008 03:00

Annextable 19. Brief of significant traing sessions held with the community members of village, Lodhay, Pkistan (2007-09).

S #	Dates	Session Title	Nature of Session	Place of & Participants*
2007				
1	28-07-07	Appraisal & creation of value addition interest group	Mobilization / Knowledge Exchange	Lodhay, 20 M
2	25-08-07	Appraisal and creation of clean milk interest group	Mobilization / Knowledge Exchange	Lodhay, 10 M
3	29-11-07	Adoption of clean milk production practices	Awareness/ Knowledge Exchange	Lodhay, 6 M
2008				
4	25-01-08	Use of CMT kit	Practical Training	Lodhay, 1 M
5	31-01-08	Use of teat dips	Practical Training	Lodhay, 4 M
6	14-02-08	Use of CMT kit and teat dips	Practical Training	Lodhay, 4 M
7	28-02-08	Milk hygiene/clean milk harvesting methodology	Practical Training	Lodhay, 4 M
8	16-04-08	Milk hygiene/clean milk harvest/ use of teat dips	Practical Training	Lodhay, 7 M
9	18-04-08	Use of CMT kit/clean milk harvest/use of teat dips	Practical Training	Lodhay, 7 M
10	21-04-08	Dairy product preparation / Discussion on 'Manual'	Training & Knowledge Exchange	Lodhay, 3 F
11	03-05-08	Dairy product preparation at household level	Practical Training & Knowledge Exchange	Lodhay, 2 F; 1 M
12	04-05-08	Dairy product preparation and its evaluation	Practical Training & Knowledge Exchange	Lodhay, 3F; 1 M
13	18-06-08	Market visit / survey for business entry	Knowledge Exchange / Awareness	Lodhay, 2 M

14	29-06-08	Market linkage activity by introducing product samples	Knowledge Exchange / Awareness	Lodhay, 2 M
15	18-07-08	Dairy product preparation at household level	Practical Training	Lodhay, 14 F
16	19-07-08	Dairy product evaluation by sensorial means	Knowledge Exchange	Lodhay, 1 M
17	23-07-08	Commercial preparation of dairy products	Practical Training / Knowledge Exchange	NARC, 1 M
18	24-07-08	Commercial preparation of dairy products	Practical Training / Knowledge Exchange	NARC, 1 M
19	25-07-08	Commercial production of dairy products	Practical Training / Knowledge Exchange	NARC, 1 M
20	21-08-08	Awareness/perception/future vision on project activities	Knowledge Exchange	Lodhay, 10 M
21	24-08-08	Dairy product preparation at household level	Practical Training / Knowledge Exchange	Lodhay, 5 F
22	27-09-08	Product perception, its evaluation and woman enterprise etc.	Knowledge Exchange / Awareness	Lodhay, 7 F
23	30-11-08	Milk hygiene/clean milk harvest/ use of dips	Refresher on the milk hygiene	Lodhay, 4 M
24	30-12-08	Use of CMT kit and teat dips / milk sampling	Dip preparation / dispensing	Lodhay, 7 M
2009				
25	06-01-09	Cheap substitute of teat dips/milk sampling/ Ann work plan	Knowledge Exchange / Awareness	Lodhay, 4 M
26	18-01-09	Milk hygiene/clean milk harvest/ use of teat dips / CMT	Practical Training to small farers	Lodhay, 6 M
27	08-03-09	Dairy product preparation (cheese, whey-drinks, peanut butter)	Practical Training & Knowledge Exchange	Lodhay, 15 F
28	09-03-09	Product evaluation / clean milk harvest, use of teat dips, CMT	Knowledge Exchange / Demonstration	Lodhay, 4 M
29	28-03-09	Milk testing for fat and total solids to enhance bargain power	Demonstration / training of master trainer	Lodhay, 4 M
30	09-04-09	Milk hygiene / clean milk harvest / dips & mastitis / CMT Kit	Demonstration /training of master trainer	Lodhay, 4 F
31	16-05-09	Milk testing simplification by Gerber / ready reckoner	Demonstration & awareness to seller group	Lodhay, 4 M
32	30-06-09	Formulation of teat antiseptic and introduction of spray bottles	Demonstration / training of master trainer	Lodhay, 1 M
33	18-08-09	Cheese preparation and packing at household level	Demonstration / training on white cheese	Lodhay, 4 F
34	19-08-09	Dairy product preparation / efficient use of household gadgets	Focus on training of women master trainer	Lodhay, 4 F
35	20-08-09	Milk hygiene / mastitis / clean milk harvest / use of teat dips	Training to selected farmer as master trainer	Lodhay, 6 M
36	22-11-09	Formulation of CMT kit reagent	Demonstration / training to master trainer	Lodhay, 1 M
37	11-12-09	Use of CMT kit paddle as strip cup	Demonstration and practical training	Lodhay, 6 M
38	23-12-09	Field day wrap up meeting	Review/perception /evaluation of the project	Lodhay, 28 M

*M, male and F, female

Annex 4.2. Training course on Statistical and Economic Methods for Data Analysis Using Software in Islamabad/Pakistan

Annex 4.2.1. Schedule of the training course on Statistical and Economic Methods for Data Analysis Using Software (MINITAB and MS Excel)

Date	Time	Topics	Resource Persons
		Part 1. Economic Analysis	
1	08:30—10:30	Introduction to the training course on economic analysis of on-farm experimental data. Purpose of Economic Analysis of experimental data Data Requirements for Economic Analysis	Dr. M. Sharif
	10:30—11:00	Tea Break	
	11:00—13:00	Basic Concepts and calculation of Costs that vary, Opportunity cost, Field Price of output, Field cost, Identifying Variable Inputs, Total costs that vary	Hassnain Shah
	13:00—14:00	Lunch Break/Prayer	
	14:00—16:30	Practical Session {on Data of the individual scientist/discipline}	Hassnain Shah
2	08:30—10:30	Calculation of Gross field benefits, net benefits and partial budget with different example {Crop input *fertilizer, seed etc, livestock experiments {feed}	Dr. M. Sharif
	10:30—11:00	Tea Break	
	11:00—13:00	Practical session {on Data of the individual scientist/discipline}	Dr. M. Sharif/ Hassnain Shah
	13:00—14:00	Lunch Break/Prayer	
	14:00—16:30	Dominance Analysis, Net Benefit Curve Marginal Analysis,	Hassnain Shah
		Marginal Rate of Return Making Rrecommendations using Marginal Analysis Analysis Using Residuals and Interpretation of results	Dr. M. Sharif/ Hassnain Shah
		Tea Break	
		Variability and Risk (Variability in Yields Minimum Returns Analysis, Dealing with Risk in On-Farm Research, Variability in prices and Sensitivity Analysis Reporting results of economic analysis	Dr. M. Sharif
		Lunch Break/Prayer	
		Practical session	Hassnain Shah
		Part 2. Economic Analysis Section	
4	08:30—10:30	Introduction to the course and basic concepts Introduction to MINITAB -15 Software	M. Asif Masood
	10:30—11:00	Tea Break	
	11:00—13:00	Practical session on arranging data from different experiments on MINITAB for Analysis	M. Asif Masood
	13:00—14:00	Lunch Break/Prayer	
	14:00—16:30	Hands on Practice on Descriptive Statistics and Exploratory data analysis {EDA} using MINITAB by individual scientists on their respective experimental data	M. Asif Masood
5	08:30—10:30	Independent and Paired T-Test using MINITAB Practice on field data example of each individual scientists	M. Asif Masood
	10:30—11:00	Tea Break	
	11:00—13:00	Regression Analysis using MINITAB	M. Asif Masood
	13:00—14:00	Lunch Break/Prayer	

	14:00—16:30	Running Simple Linear regression and Multiple Regression on individual data from different disciplines	M. Asif Masood
6	08:30—10:30	Lay out and design of experiments	M. Asif Masood
	10:30—11:00	Tea Break	
	11:00—13:00	ANOVA of different experimental designs using MINITAB-Practical Session	M. Asif Masood
	13:00—14:00	Lunch Break/Prayer	
	14:00—16:30	Interpretation and reporting results	M. Asif Masood

Annex 4.2.2. Selected photos from the training course on Statistical and Economic Methods for Data Analysis Using Software (MINITAB and MS Excel)

Dr M. Sharif, Director, SSI, NARC answering questions from the participants.

One of the lectures of the training course

Participants with Dr A. Majid, ICARDA Country Representative of Pakistan

Discussion after the training lecture

Annex 4.3. Agenda of the Final Regional Workshop in Tashkent, 10-11 December 2009

First day, 10 December

Welcome and opening remarks

Chairperson: Dr. Zakir Khalikulov, Acting Regional Coordinator ICARDA-CAC

09:00-09:10 Welcome by ICARDA
Dr. Zakir Khalikulov, Acting Regional Coordinator ICARDA-CAC

09:10-09:20 Opening statement
Ms. Laura Puletti, IFAD

09:20-09:30 Objectives of the Workshop
Dr. Barbara Rischkowsky

Guest presentation from Uzbekistan

Chairperson: Dr. Mounir Louhaichi, ICARDA

09:30-10:00 The new desert pastures management system and its use in Uzbekistan
Dr. S. Yusupov, Research Institute of Karakul Sheep Breeding and Ecology of Deserts, Samarkand

Pakistan

Chairperson: Dr. Aden Aw-Hassan, ICARDA

10:00-10:30 Baseline and impact assessment studies at the rainfed and irrigated project sites
Abid Hussain, Pakistan Agricultural Research Council

10:30-11:00 Coffee break and group photo

Pakistan (cont.)

Chairperson: Dr. Barbara Rischkowsky, ICARDA

11:00-11:30 Fodder yield and quality of summer cereal-legume and winter cereal-vetch mixtures under rainfed conditions
Dr. Muhammad Ansar, PMAS-Arid Agriculture University Rawalpindi

11:30-12:00 Effect of feeding improved roughages and concentrates on milk and meat production in cattle and buffalos
Dr. Imdad Mirza, National Agricultural Research Centre

12:00-12:30 Enhancing land productivity with cereal legume mixes of improved fodder crop varieties under irrigation
Dr. Ghulam Mahyuddin, Fodder Research Institute

12:30-13:30 Lunch

Pakistan (cont.)

Chairperson: Ms. Laura Puletti, IFAD

13:30-14:00 Economics of small scale production of balanced feed: the case of an community action project in Pakistan
Dr. Imdad Mirza, National Agricultural Research Centre

14:00-14:30 General discussion on lessons learnt from the project with a brief introduction by Dr. Muhammad Ansar, National Project Coordinator

Kyrgyzstan

Chairperson: Prof. Khudaybergen Abikerimov, Deputy National Coordinator, Kazakhstan

14:30-15:00 Sheep milk and dairy products market survey
Dr. Jayik Isakov, Kyrgyz Agrarian University

15:00-15:30 Effect of different seeding rate of sainfoin and nitrogen fertilization on productivity of degraded rangelands in Kyrgyzstan
Dr. Kenesh Joldoshev, Kyrgyz Research Institute of Livestock and Pasture

15:30-16:00 Coffee break

16:00-16:30 Results of introduction of improved husbandry practices to the sheep farm
Dr. Khudaybergen Abykerimov, Kyrgyz Institute of Veterinary

16:30-17:00 General discussion on lessons learnt from the project introduced by Dr. Khudaybergen Abikerimov, Deputy Project Coordinator

19:30 Workshop Diner

Second day, 11 December 2009

Kazakhstan
Chairperson: Dr. Abdirakhman Ombaev, National Coordinator, Kazakhstan

08:30-09:00 Improving corn cultivation in south Kazakhstan
Acad. Seyfoulla Abdraimov and Abay Sartaev, SWC

09:00-09:30 Improving body weight of Karakul lambs with early lambing
Dr. Marat Tuekbasev, SWC

09:30-10:00 General discussion on lessons learnt from the project introduced by Dr. Abdurakhman Ombaev, National Project Coordinator

Northern Tajikistan
Chairperson: Ms. Laura Puletti, IFAD

10:00-10:30 Analysis of local mohair markets and traders
Mr. Shamsiddin Makhmudov, NGO Agrotechnology

10:30-11:00 Coffee break

Northern Tajikistan (cont.)
Chairperson: Ms. Laura Puletti, IFAD

11:00-11:30 Introducing none traditional forage crops (pearl millet and sorghum) into the crop rotation system
Dr. Abdumutalib Jamoliddinov, Khojand Branch Tajik University of Technology

11:30:12:00 Comparative characteristic fiber productivity and quality of angora goats with different fiber colors
Mr. Farkhod Kasymov, Tajik Research Institute of Livestock

12:00-12:30 General Discussion on lessons learnt from the project introduced by Dr. Ma'tazim Kasymov, Project Site Coordinator Khodjand

12:30-13:30 Lunch

Central Tajikistan (cont)

Chairperson: Dr. Davlatjon Komilzoda, Vice President Tajik Agricultural Academy

13:30-14:00 Access to natural resources by smallholders undertaking lamb production
Dr. Gulomqodir Safaraliev, Tajik Research Institute of Livestock

14:00-14.30 Effect of ammophous fertilizer on alfalfa (Medicago sativa) productivity
Dr. Abdulla Madaminov Tajik Research Institute of Livestock

14:30-15:00 Influence of geo-morphological landscape patterns on vegetation characteristics in Central Asia
Dr. Mounir Louhaichi, ICARDA

Central Tajikistan (cont)

Chairperson: Dr. Aden Aw-Hassan

15:00-15:30 Gissar sheep productivity in different management systems and improving reproductive performance of ewes
Khurshed Davlatov and Fazliddin Ikromov, Tajik Research Institute of Livestock

15:30-16:00 Coffee break

16:00-16:30 General discussion on lessons learnt from the project introduced by Fazliddin Ikramov, Director of Tajik Research Institute of Livestock

Closing Session

Chairperson: Dr. Zakir Khalikulov, Acting Regional Coordinator CAC, ICARDA 16:30-17:00

16:30-16:45 Concluding remarks

Dr. Barbara Rischkowsky, ICARDA Project Coordinator

16:45-17:00 Closing remarks
Ms. Laura Puletti, IFAD