Trends in Livestock Population and Composition through Derived Productivity in Kyrgyzstan: A Case Study in Ala-Buka district

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Abstract

Population of all major species of livestock has been constantly increasing over the years with decline in productivity at national and district levels. This study tries to analyse the major constraints affecting livestock population and composition and its derived productivity at household level. In this study 240 households selected randomly from two Village Governments of Ala-Buka district, representing entire two types of agro-pastoral systems, were surveyed by using semi-structured questionnaire. The results showed livestock population increase in both Village Governments in general, with predominance of different livestock species and by physiological state. Income from livestock was main trend in increasing livestock population and changing herd composition, whereas seasonality in forage supply and its shortage were basic trend in decreasing livestock numbers by species and declining productivity of livestock. Forage scarcity was main factor for regulating of herd size and time shortage for hay making and accumulating other forage, was main problem in less forage storage. Forage availability and shortage affect milk yield and lactation curve. The lactation curves were very sensitive in winter and autumn calving in 1-May Village Government and in winter and summer calving in Baltagulov Village Government by natural breeding. It suggests that households in both Village Governments are suffering more from 'low productivity' due to higher number of cows calved in winter. Thus, affect total milk yield in the district and national level as cattle are becoming less productive thereby decline in productivity. These problems need to be addressed to involve artificial insemination practices and trainings for improving winter forage quality and support in forage trading at local and national levels.

1. Introduction

Kyrgyzstan is a mountainous country with livelihood condition of its population determined by climate, landscape, soil, water resources, biodiversity, as well as social and economic conditions. Most of its population derive a substantial proportion of its income from livestock and farming. Moreover mountainous pastures, which consists 86% of total agricultural land favour livestock in Kyrgyzstan.

Livestock production is practiced in different forms; on one hand commercially intensive livestock production associated with food chains that support the global food supply system. Such system provides jobs and income to producers and others involved in the processing, distribution, and marketing chains in associated support services. On the other hand, livestock kept in traditional production systems support livelihoods, household food security and serve as insurance assets for selling at the time of urgent need (Steinfeld et al, 2010). The agro-pastoral system includes subsistence farming of main food crop and an

increasing extent, cash crop farming and the practice of transhumance[1]. Access to common properties, pasture all year round for grazing and supplementary feed from cropping increased livestock population in general in the country. In other words, an increased demand for livestock and livestock products has resulted in increased number of livestock by species and also by changing its composition. Increased demand for meat and milk production has forced to increase number of animals without considering forage availability and pastures productivity, especially in the case of cattle. This is the main factor in decreasing productivity of livestock species that can lead to other constraints of livestock sector.

The aim of this study is to analyse main trends in livestock population and composition, and analyse the factors affecting livestock productivity at household level. In the second section constraints to livestock production systems are discussed. This section discusses reasons of increasing livestock population and changing composition, and sustainable management of pastures in Kyrgyzstan. Third session describes study area, and methodology for data collection and analysis. Trends in livestock population, changes in livestock composition at national, district and household levels are studied in the fourth section. This section includes information on income sources and major problems of keeping livestock. Forage shortage affecting livestock productivity and seasonal lactation curves was also analysed. Conclusion and recommendations are given in the fifth session.

2. Constraints to Livestock Production Systems

Raw economic figures do not capture the full significance of livestock production to economies and livelihoods around the world. One important consideration in this respect is the prevalence of livestock holding among the world's poor. It is estimated that about 70% of the world's 1.1 billion rural poor people, who live on less than US$1 per day, are dependent on livestock for their livelihoods, at least to some extent. Livestock provide draught power for more than 320 million ha of farmland−one-quarter of the earth's total area under crop production. In total, it is estimated that the livestock sector employs 1.3 billion people and creates livelihoods for one billion of the world's poor (World Bank, 2007).

Livestock diversity depends on the condition of the area; climate, landscape and forage species. The number of specialized meat breed of cattle in Kyrgyzstan is significantly less. Thus, beef industry is based on calves produced by dairy cows. But in Kyrgyzstan, there are 4.435 million ha summer pastures possible to breed beef cattle. Study on crossbreeding of local Ala-Too breed with Aberdeen-Angus confirmed this hypothesis; abilities and genetic potential of cross-bred to perform well in Chuy region (Nogoev, 2008).

One of the characteristics of the mountain region is its richness in biodiversity but it also impedes the transfer of technology from one region to another. Other constraints include lack of methodologies for integrating research results into technological alternatives, inappropriate incorporation of socio-economic aspects into the technology development and transfer process, and irrelevance of technological innovations to farmers (Leon Velarde, 1999). Shortage of animal feed and the low adoption of technologies to improve feed production are some of the key constraints in the livestock sector. Tree fodder is an integral part of feed in many highland mountain areas. However, the tannins present in many trees have negative influence on protein digestion (Djikman, 1999). The low returns that farmers receive from investments on livestock or another hinders the development of livestock production. The low price for milk has been seen as a disincentive for smallholder dairy farmers in the mountain areas (Tulachan, 2000). Inadequate veterinary services and health care are general and serious problems for the development of the livestock sector. In the highlands, the withdrawal of subsidised extension and veterinary services has affected not only animal health but also the adoption of technologies (Staal &Jabbar, 1999)

Beauvais (2005) focused on defining practical and economically viable ways of increasing productivity of Kyrgyz sheep and cattle herds, focusing on animal husbandry. From seven case studies in Karakol in Yssyk-kol region, are associated with loss of productivity. Poor control of nutrition, lack of breeding strategy, poor treatment of disease, poor hygiene and transportation methods are major problems that resulted in loss of productivity.

Kyrgyz Pastoralism is much more than simply a mode of livestock production; it is also a consumption system that supports Kyrgyz population, a natural resource management system, poverty reduction, development livestock contribution, decreasing external-internal migration and also support of the pastoral livelihood systems. Esengulova (2007) pointed out, that in Kyrgyzstan where all pastures belong to state. There is a weak land legislation, absence of maps of pastures which show boundaries, status of land, lack of knowledge on sustainable practices among land users, inequitable access to resources and unregistered rights, maximization of pasture use is in place. There is over exploitation of pasture. The same study emphasized development of local community association for management of high altitude pastures in Kyrgyzstan; based on comparison of pasture condition in pre-soviet, soviet, post-soviet and present period.

There are few studies about livestock production systems in the South-Western Kyrgyzstan. Further research is required to

find out if the problems are common to small holders across the region and in the other regions of Kyrgyzstan. Certain areas of animal husbandry on small holdings could be further improved through more in depth research which would be crucial in finding out the feasibility of certain education and co-operative programs for the contribution of livestock to rural livelihoods.

3. Study area and Data collection

Ala-Buka district was selected for the study, which is located in the south-west of Zhalal-Abad region, Kyrgyzstan. Within the area of 3 thousand km^2, the district is bounded by Chatkal and Aksy districts of Zhalal-Abad region in East, West and North and Namangan region of Uzbekistan in south part (Figure 1).

There are eight local administrations (Village Government, VG) in Ala-Buka district. Altitude of the district ranges 1,000-3,900 m above sea level. Ala-Buka village, that is the centre of district, is located 250 km far from Zhalal-Abad region centre, 700 km far from capital city-Bishkek, and 55 km far from Namangan city, Uzbekistan. Namangan city (Uzbekistan) is the nearest market on which most households' economy strongly depends. About 87% (a total 87,722 people, DADD, 2010) of population live in rural area; in the north part livestock is main source of livelihood, while in the south part it is replaced by farming-cash crop. Amount of agricultural land area are shown in the Table 1.

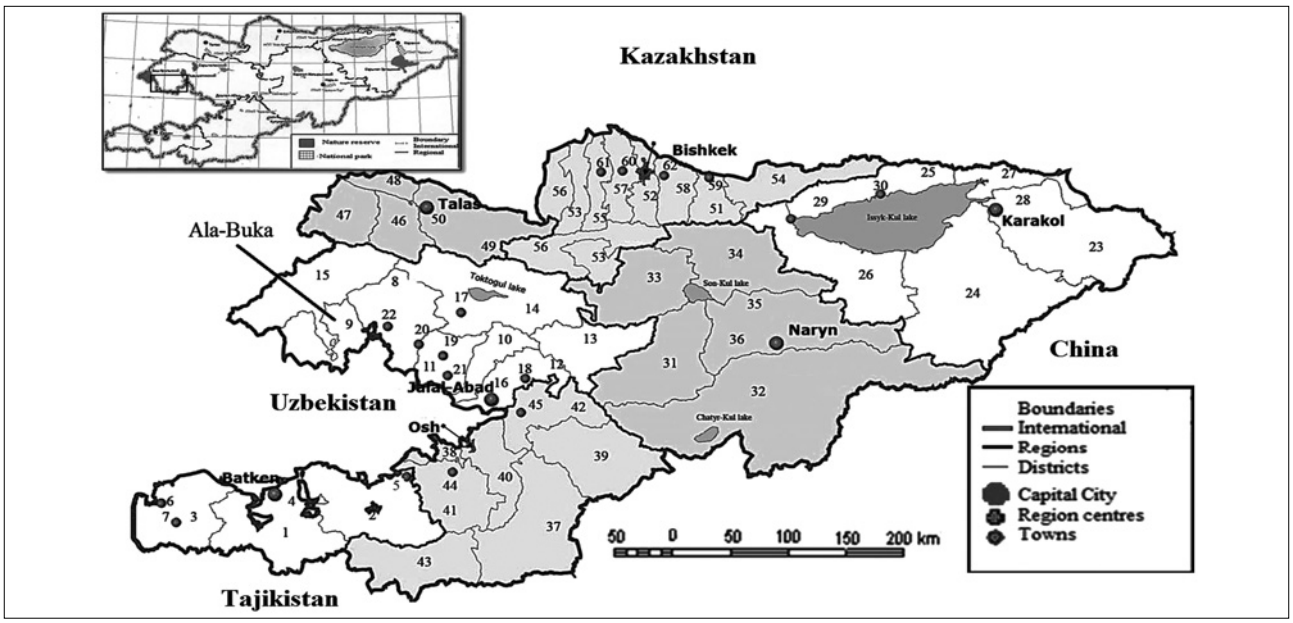


Figure 1. Map of Kyrgyzstan showing Ala-Buka district

Table 1. Agricultural land in Ala-Buka district.

Land Type	Area (ha)	%
Pastures, total	129,429	72.8
Remote (summer) pastures	72,075	56.2
Intensive (spring/autumn) pastures	47,616	36.3
Near-village (winter) pastures	9,738	7.5
Arable land, total	21,134	11.8
Irrigated land	16,718	9.4
Dry land	5,416	2.4
Hay land	400	0.2
Orchard	1,517	0.8
Forest	25,375	14.4
Total agricultural land	177,845	100.0

Source: Gosregistr, 2010

The research was conducted in two VGs: 1-May Village Government (MVG) and T. Baltagulov Village Government (BVG) respectively (Figure 2.). A household survey was conducted both in MVG and BVG to gather basic information on livestock holdings, livestock compositions, income sources, and forage availability, consumption and storage. Total of 240 households, 120 households from each VG were selected for detailed study on the basis of the household survey, using stratified, random sampling procedure to ensure that the full range of household sizes was covered. Household survey was conducted with semi-structured questionnaire. Questionnaire consisted of three main parts: the first is livestock and land holding with socio-economic issues, second part is about feeds, feeding methods and output from livestock and third part content is about access to pastures, pasture management, and pasture conditions. A total of 80 pastoralists, 40 from each VG were selected and interviewed in order to gain additional information, including information on pastures and grazing management of chosen Village Governments that are strongly related with them. Information also collected through interviews with farmers, key informants' interviews, discussions with agricultural specialists and government officers of local administration and district. To analyse the quantity and quality of livestock and land holding, sampled household were stratified in four groups: No livestock-G1, 1-20 livestock-G2, 20-60 livestock-G3 and more than 60 livestock-G4; for land holding: no land, 0-1ha, 1-5ha and more than 5 ha respectively.

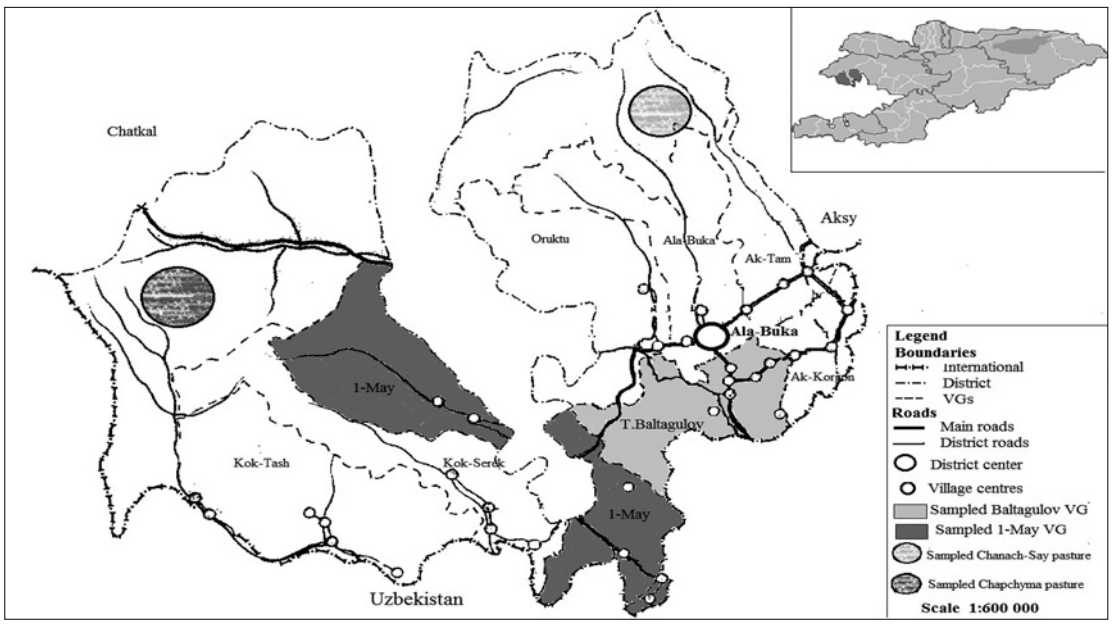


Figure 2. Map of Ala-Buka district showing 1-May and T. Baltagulov Village Governments

This research is basically quantitative study with simple calculations by using basic statistical tools. Data entry and analysis was done by using Excel. Quantification livestock species number and lactation curves for cattle were done by using Excel for which cows were divided according to calving season, lactation period, parity and length.

4. Trends in livestock population

4.1 National Level

After the independence from the Soviet Union in 1991, the number of livestock rapidly declined till 2001, and slowly but significantly increased thereafter (Figure 3). Intensive, industrialized livestock production systems were replaced by grazing and mixed–crop livestock or agro-pastoral systems. In 1988, towards the end of the Soviet era, just 500 agricultural enterprises (collective and state farms) controlled 98% of the arable land. The quasi-private sector consisting of hundreds of thousands of small household plots controlled the remaining 2% of the arable land. Land reform distributed land to roughly 1.2 million farmers: about 900,000 household plots and 300,000 peasant farms.

Twenty years later, in 2008, the share of agricultural enterprises (about 1,200 privatized collective and state farms) in arable land had gone down to 25%, while the share of the individual sector (the traditional household plots and some 300,000 peasant farms that have emerged since 1992) had increased to 75% (Lerman et al., 2009). The last decade has seen considerable changes taking place in livestock population, composition, and management systems in Kyrgyzstan, with different

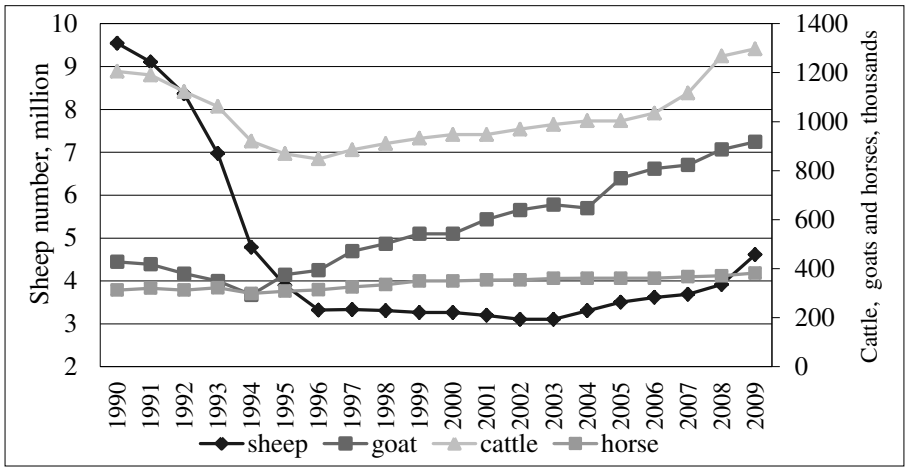


Figure 3. Changes in total livestock number (thousand head) in Kyrgyzstan
Source: MAWRPI, 2010

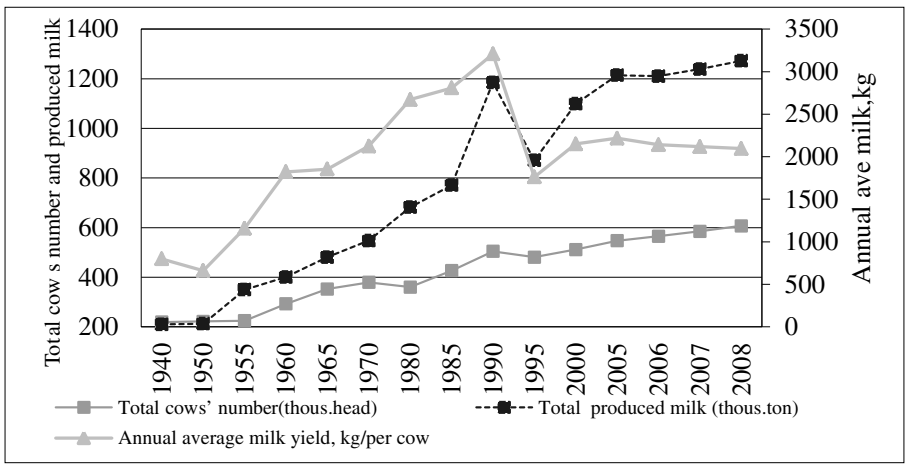


Figure 4. Total cows number and its productivity during 1940-2008 in Kyrgyzstan
Source: Nogoev, 2008

predominance of livestock species. In 1990, the country had about 10 million sheep and goats, 1.2 million cattle, including 75 thousand yaks, 313 thousand horses. At the beginning of 2009 in the republic there were 1.178 million heads of cattle, 4.5 million heads of sheep and goats, 355 thousand horses (Nazarkulov, 2009). Cattle remained main livestock specie in household level. From 1940 to 2009 total cattle number rose from 555 thousand to 1,168 thousand. In 1990, the percentage of purebred[2] was 85 % of total cattle number. Introduction of crossbreeding for improved milk-production resulted in increased interest in cattle-raising in the 1980's and 90s; milk yield of cows reached to 3208 kg per cow in 1990 (the highest average milk yield). Cows are mainly raised in state−owned farms, while households had 1-2 cows in general among all rural families regardless of ethnic background. Thus, the total number of cattle has remained stable since independence (Figure 4). From 1990, there is sharp decline in number of cattle from 1,219 thousand to 920 thousand heads of cattle and also milk yield decreased from 3208 kg to 1761 kg till 1995. However, the population of cattle, as well as milk yield, increased till 2005 (2218 kg) and again there was a decline in milk yield. The milk yield of cows decreased from 3208 kg to 2069 kg per head between 1990 and 2009 and increases in livestock production come from increases in low productive animal numbers. There are also other factors responsible for the decline in the yield such as decreasing number of purebred animals, due to lack of control in animal breeding and animal health which affect livestock productivity at regional and national levels (MAWRPI, 2009). At national level, it was considered that the current levels of animal productivity in terms of milk and wool are low−due to poor nutrition, the high incidence of diseases, and poor farm management. Lack of good-quality fodder to sustain animals through the long and harsh winter is a critical issue. Many animals lose half of their body weight during winter, and mortality among young animals is very high. This poor nutritional status is closely linked to the problem of animal diseases. After a long winter with poor nutrition, often having lambed or calved, animals are highly susceptible to infections (World Bank, 2005). Therefore,

increase in livestock production is realized by increase in numbers of animals.

4.2 District level

The similar changes to population of livestock in their total yield of milk production were observed at district level as well (Figure 5 and 6). Numbers of goats and sheep have increased significantly while cattle are almost stable in number. Horse number has changed drastically: it dropped sharply between 2004 and 2006 and increased again. One of the reasons for change in number can be development of other sectors of economy or changes in infrastructure. Another main stimulus for the change is agricultural policies, services and institutional and community-based rural development. Unsatisfied working of above mentioned stimulus, such as inappropriate policy mechanisms, lack of services in terms of agro-veterinary services, bad conditions of pasture-village link roads and lack of institutional development activities in district level have led to decline in both crop-livestock and pasture productivity. Another consequence of this recent change has been employment patterns; migration became an important livelihood strategy to diversify the sources of income. It was observed that livestock and cropping is increasingly financed through remittance which leads to increase in population of livestock. Availability of resources in terms of forage is also important for stable herd size.

Mixed farming systems are conducted on a small scale by households and combine various sources of feed: natural pastures, hays from hay lands (meadows), crops residues, forage crops, and rare bought feed at markets. These systems became more sustainable and dominated in rural areas. There are many benefits from integrating crop and livestock production; livestock are sources of draught power, fertilizer, and insurance asset. On the other hand, non-product purpose of livestock continue to give more pressure to pastures; most areas of land are used for cash crop leading to decrease in forage cropland

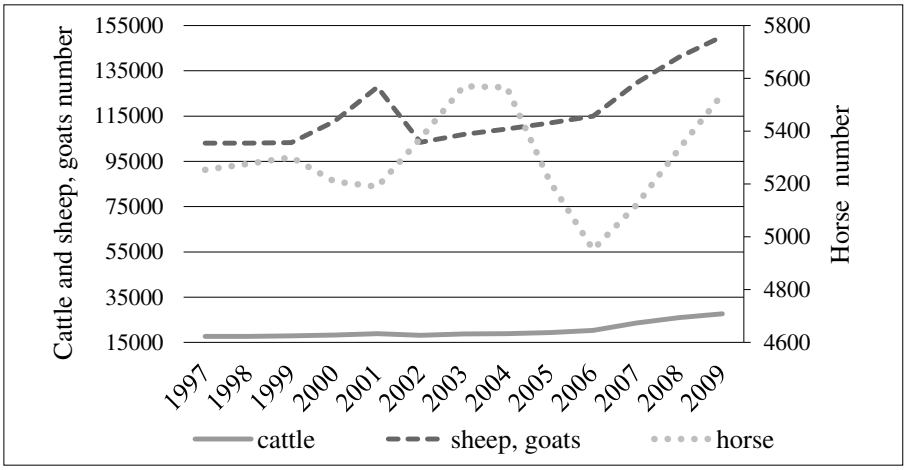


Figure 5. Total livestock number by species in Ala-Buka district in 1997-2009
Source: DADD, 2010

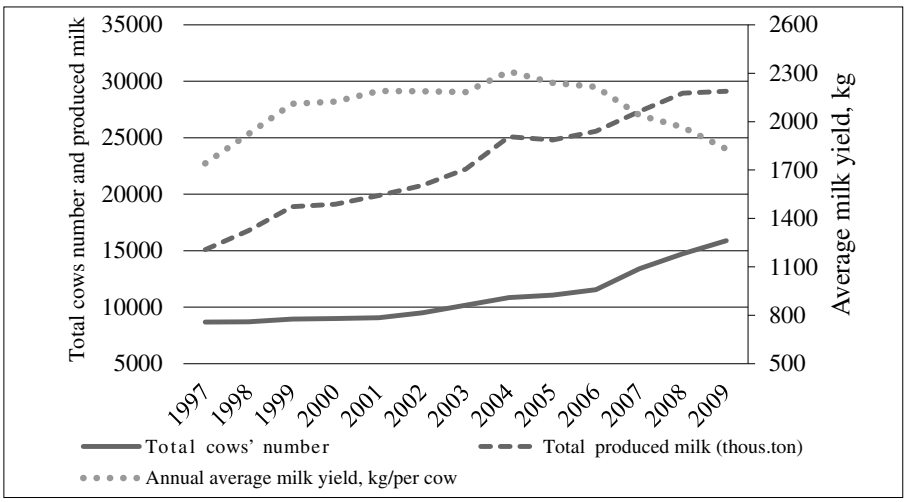


Figure 6. Changes in cows' number, average milk yield and total milk production in Ala-Buka district in 1997-2009
Source: DADD, 2010

areas. These points necessitated to examine the share of crop and livestock in household level and among peasant farms, since total livestock population in district level is increasing with declining productivity.

4.3 Household level

There was unclear impression, what is the condition at household level; livestock number by all species is increasing or decreasing since in national and district levels livestock population increase. For this purpose, the households' own perceptions of changes in their herd sizes during 2005-2010 years were studied in both the VGs, which shows a great variation (Table 2). The result shows that in general, total livestock population is increased for 65% BVG and 63% households (HHs) in BVG and MVG, respectively. However there was observed decrease in number by some species.

Table 2. Households' perception in herd-size change during 2005-2010.

Change in LS numbers	In general		By species							
			Cattle		Sheep		Goats		Horses	
	BVG	MVG	BVG	MVG	BVG	MVG	BVG	MVG	BVG	MVG
Less	7	14	32	17	9	27	47	3	5	11
Same	24	16	52	25	36	22	9	18	39	28
More	65	63	14	48	55	49	34	62	7	35
No definite answer	4	7	5	10	5	2	10	17	49	26

Source: Field survey, 2010

Majority (62%) of the sampled HHs in MVG perceived that there is increase in goat numbers. Similarly, 48% of sampled HHs experienced increase in cattle in MVG. Whereas, in BVG, 55% of sampled HHs experienced increase in sheep keeping. It indicates change in importance of livestock species in HH economy overtime, which is discussed in detail in the next section of this paper. The most noticeable change is the decrease in cattle and goats' numbers which is 32% and 47 % of HHs' herds in BVG, respectively. Sheep number decreased to 27 % in HHs' herd in MVG. In BVG the majority of households perceived no changes in cattle and horse numbers. During five years, it has remained at the same level of 52 % and 39 % of HHs, respectively. However, the numbers have increased to 48 % and 35 % of HHs in MVG.

Majority of households keep livestock in both the VGs; 80 HHs from a total of 120 HHs in BVG and 92 HHs in MVG, respectively. Livestock holding by different species and physiological state (age, sex and lactation stage of cows) is given in Table 3 and 4. The number of animals has altered the relationship of livestock to the overall production systems and to the natural resource management.

In addition, changes in the natural resources themselves have also had an impact on livestock management practice. Each variation has an importance in household livelihood, the differences between age and sex groups explain the importance of livestock on their livelihood based on market demand and products consumption. As shown in Table 3 and 4, herd composition of the households indicates that there were more female animals than male. For all livestock species, average livestock number per HH is higher in MVG. The higher numbers of female cattle reflect the major reason for keeping cattle, which is milk production for self-consumption, selling in the market and using dung as winter fuel. In case of other species, they have more female animals in order to increase herd size and to sell live animals to augment household income. Male animals are mainly

Table 3. Livestock holding: total cattle number by physiological state

VGs	Physiological state	Male		Female			Total
		Bulls	Calves	Calves	Heifers	Cows	
BVG	Total number	38	50	46	33	104	265
	Average number per HH, n=80[1]	0.4	0.6	0.5	0.4	1.3	3.3
	Range	1.6	0.9	0.8	1.4	1.8	3.8
MVG	Total number	102	109	74	75	178	537
	Average number per HH, n=92	1.1	1.2	0.8	0.8	1.9	5.8
	Range	2.4	2.1	1.4	1.4	2.3	5.8

Note: [1] - These 80HHs in BVG and 92 HHs in MVG are with different species in their herd.

Table 4. Livestock holding, total sheep, goats and horse number by physiological state

			Total	Male	Female	Castrated	Age[1] 1	2	3	4<
Sheep	BVG	Total number	1095	227	804	50	328	241	249	264
		%	100	21.4	74.4	4.5	30.9	22	22.7	24.4
		Ave number per HH, *n*=58	18.8	3.9	13.8	0.8	5.6	4.1	4.3	4.5
		Range	18.8	4.6	14.3	7.1	8.2	7.7	8	11
	MVG	Total number	3559	671	2476	412	1118	646	960	833
		%	100	18.8	69.7	11.5	31.6	18.1	26.9	23.4
		Ave number per HH, *n*=68	52.3	9.8	36.4	6	16.4	9.5	14.1	12.2
		Range	52.3	11.1	39.3	14.4	21	14	20	21
Goats	BVG	Total number	217	29	183	5	44	36	123	14
		%	100	13.3	84.4	2.3	20.2	16.5	56.9	6.4
		Ave number per HH, *n*=28	10.8	1	6.5	0.1	1.5	1.2	4.3	0.5
		Range	10.8	2	9.6	4.2	3.3	3.6	12	4.6
	MVG	Total number	2082	511	1373	309	624	444	748	256
		%	100	24.7	60.5	14.8	29.9	21.3	35.9	12.2
		Ave number per HH, *n*=73	28.5	7	18.8	4.2	8.5	6	10.2	3.5
		Range	28.5	9.1	19.3	8.1	12.4	8.8	14.1	7
Horses	BVG	Total number	27	12	15	–	7	3	10	7
		%	100	44.4	55.6	–	25.9	11.1	37.1	25.9
		Ave number per HH, *n*=12	2.2	1	1.2	–	0.5	0.2	0.8	0.5
		Range	2.2	1.2	3	–	1.5	3.3	1	1.4
	MVG	Total number	128	60	68	–	29	17	45	37
		%	100	46.8	53.2	–	22.6	13.2	35.3	28.9
		Ave number per HH, *n*=30	3	2	2.2	–	0.9	0.5	1.5	1.2
		Range	3	2	3.4	–	2	1.7	2	2.7

Source: Field survey, 2010
Age[1]- the age group of livestock species 1–0-1 year old, 2–1-2 years old, 3–2-3 years old, 4–more than 3 years old

kept for selling live animals in local market, whereas male horses are kept for draught power and transporting and later, after fattening, are sold in market to purchase the other one. Only few HHs keep breeding bulls. Castrated animals are kept for fattening; selling in the market and slaughtering for winter food storage (traditional method of controlling herd size through food security). All households can't afford meat as a regular component to their diet, because household welfare and income levels are different. It is mostly consumed during cold season; in autumn and winter.

4.4 Income sources at household level

Livestock have remained an essential component of farming systems, where crop production is not feasible. Thus, there exist different types of livestock production systems with dominating livestock (in MVG) or dominating crop productions (in BVG). The percentage of households with different herd size categories with mixed livestock species is given in Figure 7 by stratifying households in four groups. Around 33% of HHs in BVG falls in G1 category, where the HHs do not have any livestock, whereas the figure is only 23% in MVG. These HHs' main income sources are farming, wage and off-farm employment. This is one of the reasons of change in livestock numbers, livestock holding increase with decrease in cash crop and vice versa. In BVG, a significantly higher proportion (38.3%) of HHs falling under G2 category hold 1-20 mixed livestock numbers compared to MVG with only 5.8%. Usually, HHs in this group keep a 5-10 sheep or goats or 1-2 cattle, or one horse. Majority of animals are kept under stall-feeding during morning and evening providing crop residue and weeds from cropland or HH plot, whereas during day time, they are grazed in near-village pasture. HHs under this category keep livestock mostly for self-consumption of livestock products. Significantly lower proportion of HH (19.1%) in BVG falls under G3 category in contrast to 42.6% in MVG. The HHs in G3 category hold 20-60 livestock. In case of MVG, main livestock species in their herd

are goats and sheep. High altitude, more pastureland, less cropland and harsh climate are important reasons of farmers' preference for sheep and goats in MVG. MVG also has significantly higher proportion (28.3%) of HHs under G4 category, which has more than 60 livestock species, compared to BVG where only 9.3% of HH falls under G4 category.

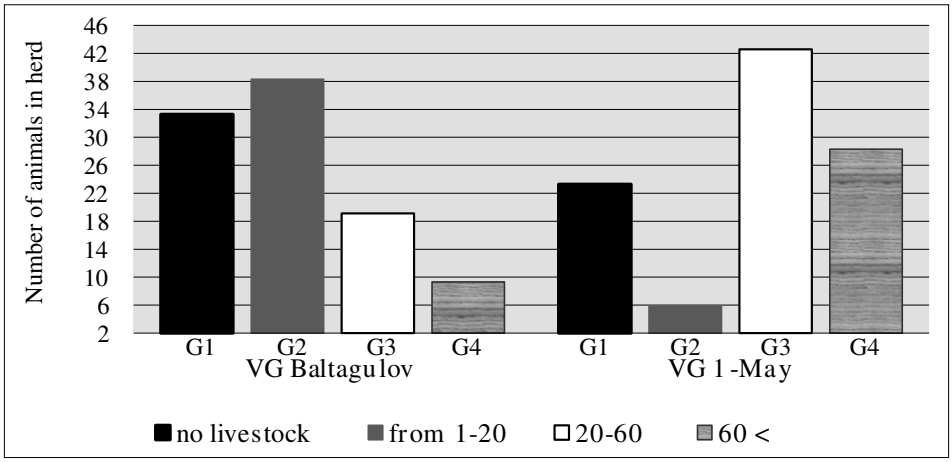


Figure 7. Percentage of households in different herd size categories with mixed species
Source: Field survey, 2010

For HH under G4 category, the main income is from livestock and its derived products. Households under this category can't get enough cash crop from their own land due to lack of water during growing season and bad physic-chemical properties of soil (stony and saline), which force HHs to increase in livestock numbers to meet livelihood needs. Thus, increase or decrease is closely interconnected with land size and soil quality. Income from cash crop and farming can affect income from livestock (Figure 8). Majority (52.5%) of HHs have 0-1 ha of land in MVG, compared to 29.1% in BVG. In contrast, majority (54.1%) of HHs in BVG holds 1-5 ha of land, whereas in MVG only 25.8% of HHs hold 1-5 ha of land. Around 6 % of HHs in BVG own and rent more than 5 ha of land, whereas, in MVG only one HH has such amount of land.

The share of income from different income sources by income groups show the importance of the livestock sector for different income groups (Figure 8). Farming and cash crops together constitute the largest share of income among the households falling under G1 category in both the VGs; BVG (41%) and MVG (40%). Potato and sun flower are the most important cash crops grown in the study area. HHs under G1 category do not have any income from livestock.

This is one of the reasons of change in livestock numbers, livestock holding increase with decrease in cash crop and vice

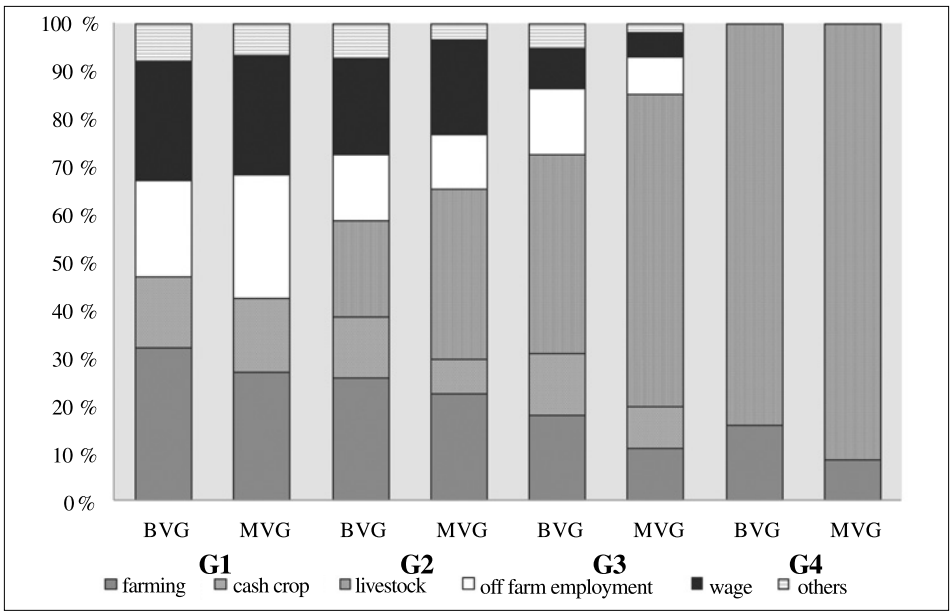


Figure 8. The share of income by different sources
Source: Field survey, 2010

versa. Other important sources of income for this group are wage labouring followed by off-farm employment and others. Other sources of income include hay, forage crop (lucerne), wheat straw and maize stover trading, selling honey, non-wood forest products, such as fruits and medicinal plants. For all income groups, maize and wheat are the most important crops cultivated under farming. Both of these crops are multipurpose crops used for human consumption (grain) as well as livestock consumption (crop residue and grain as basic and supplementary feed). For HHs falling under G2 group, farming (farming and cash crop) is still an important source of the income contributing 44% of the total income in BVG. However, for household in MVG, livestock constitute the highest share (41%), followed by crop and cash crop farming.

Share of income from livestock increased for HHs in G3 to G4 categories. It is 84% in the case of HHs under G4 category in MVG. Throughout, the income shares from livestock in G2, G3 and G4 are higher in MVG, reflecting relatively higher importance of livestock in MVG. In both the villages, livestock products are mainly raw milk of cattle and horse and traditionally processed dairy products. Livestock can be sold all year around, but the main sale takes place in August-October, when livestocks return from pastures (cash income). Such cash income is mainly used for the preparation of wheat sowing in autumn as well as growing season in spring. In addition, the cash income is crucial for payment to technical services, purchasing fuel and fertilisers. Another major sale of livestock takes place between February and March, when forage shortage occurs. This takes place as means for subsistence survival. Thus, farmers are forced to sell bulk of their livestock at lower price. This increases the poverty. However, at the same time, it also gives new opportunity for "new business", businessmen who send those animals to summer pastures and sell those livestock again in autumn at higher price. This causes temporary increase in livestock holding among the buyers.

4.5 Livestock Composition

Livestock composition with average number of species in households' herd of both VGs is shown in the Table 5. Compare to other species in the herd, the number of sheep is significantly high (18.8 per HH in BVG and 52.3 per HH in MVG) in both VGs' households. High number of animals is an additional income source that can help to perform other socio-cultural functions, as well as nomadic people's most of cultural activities and ceremonies related with livestock. However, traditional and modern private livestock management strategies had been developed to regulate herd size, according to the available forage supplies. The sale of animals in autumn, after returning back from summer pastures when animals are in good condition with grazing–based fattened or slaughtering at the beginning of winter followed by the traditional meat storage for long, cold winter are the examples.

Table 5. Characteristics of survey households by livestock holding

Species	Average number of livestock per HH	
	BVG	MVG
Cattle	1.8	2.3
Sheep	18.8	52.3
Goats	10.8	28.5
Horses	2.2	3
Donkey	0.7	1

Source: Field survey, 2010

Quantity of slaughtering animals depends on size of household and their economic condition. In some cases, slaughtered bull or horse is shared among relatives or neighbours.

During the second decade of independence, in connection with transition to a market economy, the pedigree structure of sheep has changed. Thus, in 1990, the share of fine wool production was 87%, semi-fine wool production was 7%, semi-coarse wool production was 3%, and coarse wool fat-tailed production was 3% of the total sheep wool. In 2003, the share was 31.3% (fine wool), 6.2% (semi-fine wool), 0.6% (semi-course wool), and 61.9% (course wool). The increase of fat-tailed meat sheep has a niche value in the domestic mutton market (Ajibekov, 2005). Exotic breeds of sheep like Edilbaev and Gissar fat-tail are becoming more popular among the farmers. Even in remote areas, farmers prefer to raise these breeds. One of the raised Gissar breed in BVG is shown in Figure 9.

Gissar breed adapts to mountain conditions well. Lambing usually takes place in a year giving total of 2-3 lamb birth, which in case of earlier breed was 1-2 lamb. Thus, a wide adoption of this breed is one of the reasons for the faster increase in livestock numbers and also higher profit from selling live animals.

Figure 9. Gissar breed ram and lambs in BVG.
Source: Field survey, 2010

Historically, goat breeding has been a traditional sector of the animal husbandry in the country (Alymeev et al. n.d.). Large areas of semi-arid and steppe type of remote natural pastures also promoted goat breeding during the Soviet time, especially in Batken and Zhalal-Abad provinces for producing wool and down. In MVG, Angora, Cashmere and local breeds are common, while in BVG, milking goats and hybrid Saanen (Zaanen) breed are becoming popular (DADD, 2010). During the interviews, most households from MVG informed that goats' number is increasing in their herd. Less cropland area and easy access to common property pastures, well-adapted to harsh climate conditions and natural resource based fattened feeding systems make the goats more preferable. Goats are easy to feed, thus require less labour and forage. In addition, they give two kids in a year. Goats served as an asset can be easily sold in the market at the time of urgent household needs, fertilisers, fuel and veterinary treatments.

A goat promotion project organised in Ala-Buka district by district and local administration and two breeding farms initiative in 2001-2005, called "An Iron Goat", helped to increase the number of goats in the study area. Under "An Iron Goat" program 2-3 goats are provided to poor households in VGs through local administrations. After a year, when those goats give birth, kids become their own, goats should be given to other families identified as poor by the program. Less feed requirement and relatively easy rearing practice make goat keeping well accepted by poorer HHs. In addition, a higher demand for goat milk makes goat popular among the poors. However, there is a growing concern that whether increasing numbers of goats is an indication of increasing rural poverty. Thus, there is future uncertainty that cattle will be replaced by goats in rural areas.

Majority of HHs retain their cattle in near-village pastures all year around, which leads to overgrazing near-village pastures. Households increase cattle numbers in their herd in order to increase additional cash income through increased production. Ability and probability of market participation by farmers will be reduced significantly when the small quantities of milk from local cows are too small in order to save time and labour necessary to reach market. HH sells dairy products to intermediary women buyers of dairy products who significantly increased in BVG because of low price of dairy products in the market. The price paid is almost equal to transportation cost. Besides, it also requires extra labour for handling and is time consuming. Intermediaries buy dairy products from farmers owning 1-2 cows in lower price than market as they have small quantities of milk (daily 5-6 litres milk, excluding self-consumption). In case of MVG, livestock holders and livestock producers are generally scattered in remote rural areas and summer pastures that are often characterised by inadequate access to roads and transportation facilities. They increased cattle number due to transhumance movement to summer pastures where the dairy products can be increased with sufficient grazing. Households prefer bulky sell of dairy products without intermediaries. Households will accumulate products during summer and sell in late autumn or winter, when the demand for dairy products is high and consequently the high price.

Almost all the HHs have at least one donkey in both the VGs, while horse is owned by few households only. Horse is kept by well-off households. Since it requires more forage and extra care, it cannot be affordable to all the households. Horse and donkey provide draft power, which is important in farming activities. The attributes of draft animals are subsidiary for agricultural machines; ploughing and mulching the land, transporting the physical products, income-employment gain (services to other farmers) and socio-cultural (nomadic culture, having a horse) and ecological services. Besides, abandoned or lack of roads for trucks in remote pastures enhanced use of donkeys and horses as main transport during transhumance movement.

4.6 Major Problems of Keeping Livestock

In agro-pastoral systems, social, economic, and environmental constraints cannot be solved in isolation. Just providing some projects or policy intervention to one factor cannot give successful results. They are interdependent and related to each

other. Ignorance of one of them causes another problem. Stability or accessibility of one factor creates opportunities for the development of the other. Degradation or negative changes related to a certain factor may cause vulnerability of the other factor. There are priorities and gaps in increase in livestock population and change in composition of herds at household level. The major problems of keeping livestock from own experiences of households are given in Figure 10.

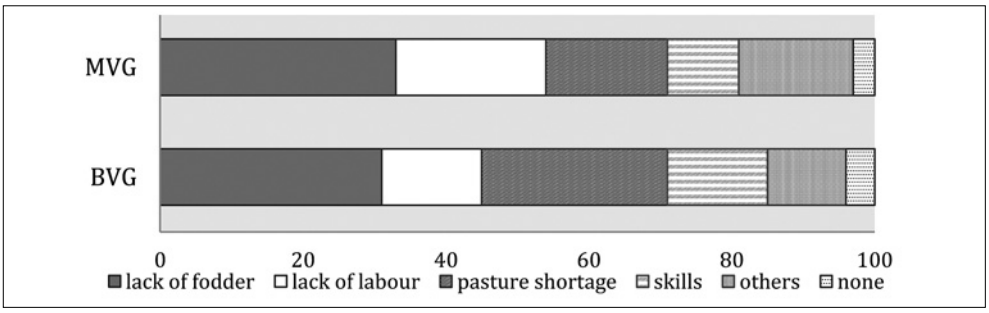


Figure 10. HHs' identification of major problems of keeping animals from their own experiences
Source: Field survey, 2010

Lack of fodder from the end of winter to mid spring and pasture shortage are perceived as the major problems by almost 50% of the HHs in both the VGs.

Lack of labour is another important problem faced by 21% of HHs in MVG and 14%, in BVG. There is lack of labour especially during the time for herding animals as part of transhumance movement. This problem is coped by reducing the herd size and also by keeping more animals permanently in near village pastures. Lack of skill is another important problem faced by herders. For instance, lack of information in interconnection between producer–consumer chains has caused the problem of selecting the species having higher demand thereby leading to inappropriate composition of animals in the herd. Other reported problems include unfavourable weather, such as sudden snow during spring and summer, heavy rain after shearing of animals and diseases. These problems are of minor but more relevant during grazing time in summer pastures.

As a result, animals suffered from feed scarcity problem (Figure 11). Very serious scarcity occurs from March to April in MVG, which in case of BVG, it extended till May, but with less intensity of the problem compared to MVG. Lower score in BVG is related to pasture shortage in early spring, which is mainly due to the early movement to pastures when grasses do not grow well. In the case of MVG, however feed scarcity is related to less crop land areas per household; bad condition of drainage systems or lack of water during growing season adversely affects productivity of forage crops and cereals.

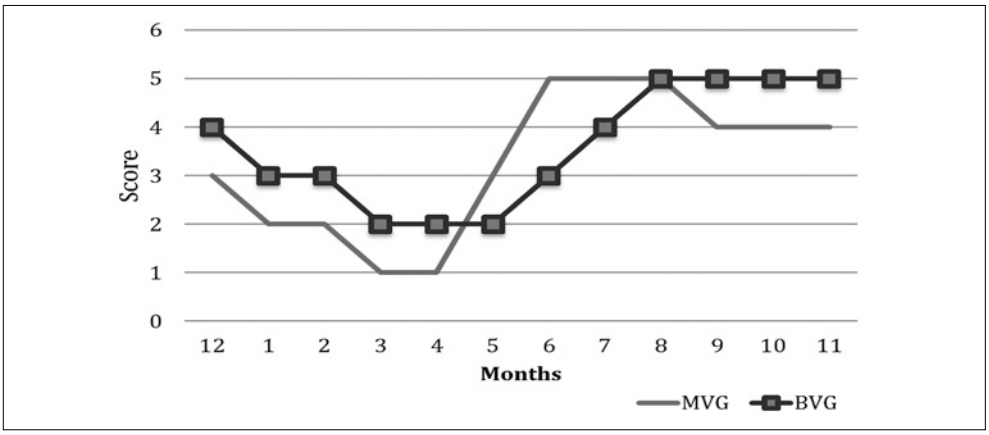
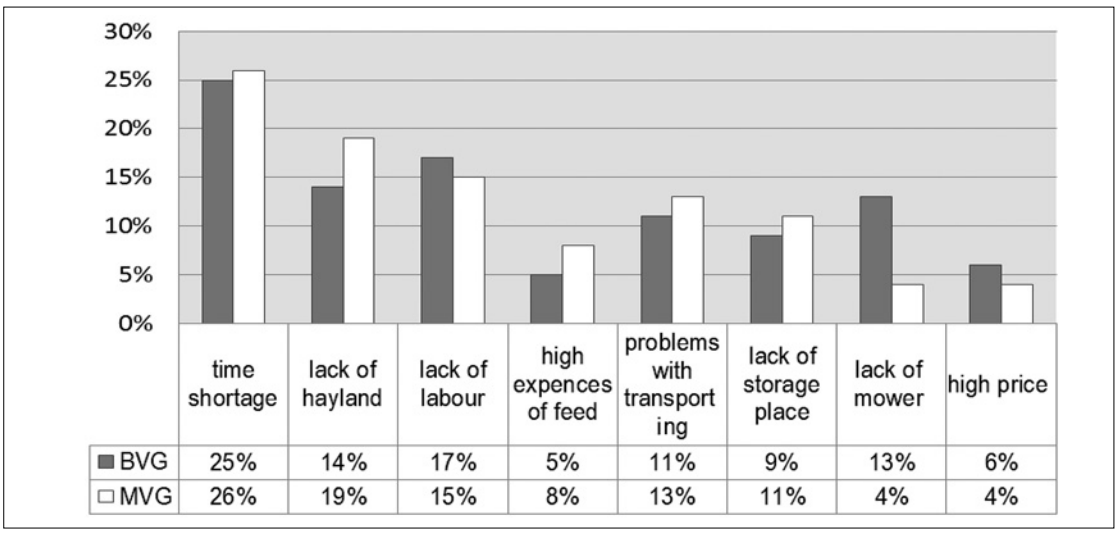


Figure 11. Annual feed scarcity problem by month
Source: Field survey, 2010
Note: *- feed scarcity ranks from 5 "no problem" to 1 "serious feed scarcity"

Forage scarcity increase livestock mortality. During winter, animal loss liveweight and in early spring, they are weak and less resistant to cold weather and diseases and poisoning from plants. Poisonous grass species cause high mortality in April (mostly in MVG) and in May in BVG, when hungry animals are allowed to access in pastures dominated by such poisonous grass species[3]. In recent years, sheep mortality rose after shearing in May and early June, due to heavy rain and occurrence of even snow in intensive pastures.

There are different reasons of forage scarcity; lack of land for forage crop growing, or growing only cash crop, which do

not have forage residue (such as potato and sunflower) or lack of finance for purchasing it from the market in winter, when the price reaches the higher levels. Hay land is important forage source in both the VGs. In remote areas, households store only hay for winter feeding which will be fed when heavy snow occurs. Other times they will be grazed in near-village pastures or even in intensive pastures. Time shortage for hay making and storing is the main problem that leads to forage shortage in both the VGs (Figure 12). A quarter of HHs in both the VGs found time shortage for hay making (including mowing, drying, transporting and storing) as the main problem. It is understandable, that lack of labour has affected time shortage for storing forage. However, during interviews with farmers and agricultural specialists it was found that climate change impacts on forage storage. Early maturing of hays, forage grasses and forage crops such as Lucerne are caused by rising temperature. Farmers told that mowing would be starting 15-20 days earlier than before; grasses are also flowering earlier. In addition, the weather is becoming hotter and dryer. As a result, grasses are maturing so quickly that it reduces nutritive value of forage. Seven-ten years ago farmers had enough time for mowing[4]; collecting and transporting of hay back home, and the quality of the grass was also valuable. Sudden heavy rains occur during collection and transportation of hay.



	time shortage	lack of hayland	lack of labour	high expences of feed	problems with transporting	lack of storage place	lack of mower	high price
BVG	25%	14%	17%	5%	11%	9%	13%	6%
MVG	26%	19%	15%	8%	13%	11%	4%	4%

Figure 12. Main problems related to forage storage
Source: Field survey, 2010

Besides, density and quantity of forage species are also decreasing; as the height of forage species is also reducing. Poisonous and low nutritive value plant species are dominating. Such kinds of changes are happening in pasture land also. Most of the studies showed that, declining pasture productivity is the result of overgrazing and lack of grazing management (Balyan, 1978; Fitzherbert, 2005; Esengulova, 2007). However, pasture degradation was observed even in not stocked intensive and remote pastures in the study area. Hotter (rising temperature) and dryer summer (decreasing precipitation amount) affect alpine and subalpine pasture species. There was observed unbalance of pasture composition, by increase in non-edible, poisonous and noxious plant species. Forage species are thus suffering from triple risks; overstocking, dominating non-edible plants and climate change.

4.7 Forage Shortage Impact on Productivity of Livestock in Terms of Milk Production

Majority of the HHs keep local breed Ala-Too meat-dairy direct cattle. Selling fresh milk and dairy products by farmers started after independence mainly as additional income source of households. Since most of the lactated cows are grazed in near-village pastures, they are bred naturally. Farmers do not care about the quality of bulls in grazing herd. Even it is high quality bulls; they will be over used in large size herds. There is no artificial insemination service in the study area. These issues can be one of the reasons of decreasing milk productivity in the district. Milk productivity was analysed in 98 cows from BVG; 178 cows from MVG's households. They were classified according to lactation length, parity, and calving season as shown in Table 6, 7, and 8. Lactation length varied from 186-365 days with different parity and breed.

Usually local breed have short lactation period (10.1% in MVG, 6.1 % in BVG) with less amount (3-5 litres per day) and high fat content milk. This breed has small body shape and body condition is good fitted for mountain climate. Main percentages of lactation length are from 279-305 days in both the VGs. In MVG 13 cows or 7.3% have 365 days of lactation lengths, which can milk all year round from current calving to the next one.

Table 6. Variation in lactation length of cows' number

VGs	Total cows' number	Lactation days						
		186	227	248	279	305	330	365
MVG	178	18 (10.1)	24 (13.4)	28 (15.7)	32 (17.9)	49 (27.8)	14 (7.8)	13 (7.3)
BVG	98	6 (6.1)	11 (11.2)	28 (28.6)	27 (27.6)	23 (23.4)	3 (3.1)	–
Total	276	24 (8.7)	35 (12.6)	56 (20.2)	59 (21.4)	72 (26.3)	17 (6.1)	13 (4.7)

Source: Field survey, 2010
Note: Figures in the parenthesis indicate percentage

Table 7. Variation in parity of cows' number

VGs	Total cows' number	Parity						
		1st	2nd	3rd	4th	5th	6th	7th
MVG	178	33 (18.5)	29 (16.2)	56 (31.7)	31 (17.4)	13 (7.3)	11 (6.1)	5 (2.8)
BVG	98	25 (25.7)	17 (17.3)	22 (22.4)	16 (16.3)	6 (6.1)	11 (11.2)	1 (1)
Total	276	58 (21)	46 (16.6)	78 (28.6)	47 (17)	19 (6.8)	22 (7.9)	6 (2.1)

Source: Field survey, 2010
Note: Figures in the parenthesis indicate percentage

BVG has significantly higher proportion of cattle with lactation length of 248 and 279 days, whereas MVG has significantly higher proportion of cows with lactation length of 305 days. The highest number of cows belong to 3rd parity (33 or 18.5%) in MVG, whereas in BVG it is 1st parity (25 or 25.7%). Milk yield depends on parity as well, which suggests higher milk yield is in MVG (Table 8)

Table 8. Variation in milk yield by parity

Parity	Average milk yield, kg		Min milk yield, kg		Max milk yield, kg	
	BVG	MVG	BVG	MVG	BVG	MVG
1st	1107	1290	500	680	1810	1830
2nd	1402	1643	540	750	2000	2606
3rd	1255	1396	530	710	2640	2940
4th	1751	2069	1210	960	2650	2911
5th	1205	1955	784	1410	1470	2660
6th	1614	1658	730	685	2760	2650

Source: Field survey, 2010

The minimum milk yield was at 1st stage in both the VGs; (500kg and 680 kg in BVG and MVG, respectively). The maximum milk yield was indicated in 4th stage in BVG (2650 kg) and 3rd stage in MVG (2940 kg). The mean milk yield for all cows was 1358.65 kg and the standard deviation is 522kg, which is lower compared to national level (2069 kg) and district level (1903 kg). The amount of milk yield depends on breed quality, parity and calving season and also forage availability.

Table 9. Variation in number of cows by calving season

VGs	Total cows' number	Calving season			
		spring	summer	autumn	winter
MVG	178	80 (49.7)	23 (12.9)	31 (17.5)	34 (19.7)
BVG	98	26 (26.7)	3 (3.1)	8 (8.1)	55 (62.1)
Total	276	106 (44.3)	26 (9.4)	39 (14.1)	89 (32.2)

Source: Field survey, 2010
Note: Figures in the parenthesis indicate percentage

Milk yield by calving season is affected by feed sufficiency in winter and summer (Figure 13). Milk production and reproductive performance are the most important factors determining profitability of cows reproductive inefficiency and lack of artificial insemination are second to low milk production as the leading cause of culling in cows. Number of cows in spring calving season is significantly high in MVG, while in BVG number of cows in winter calving season is significantly high. This

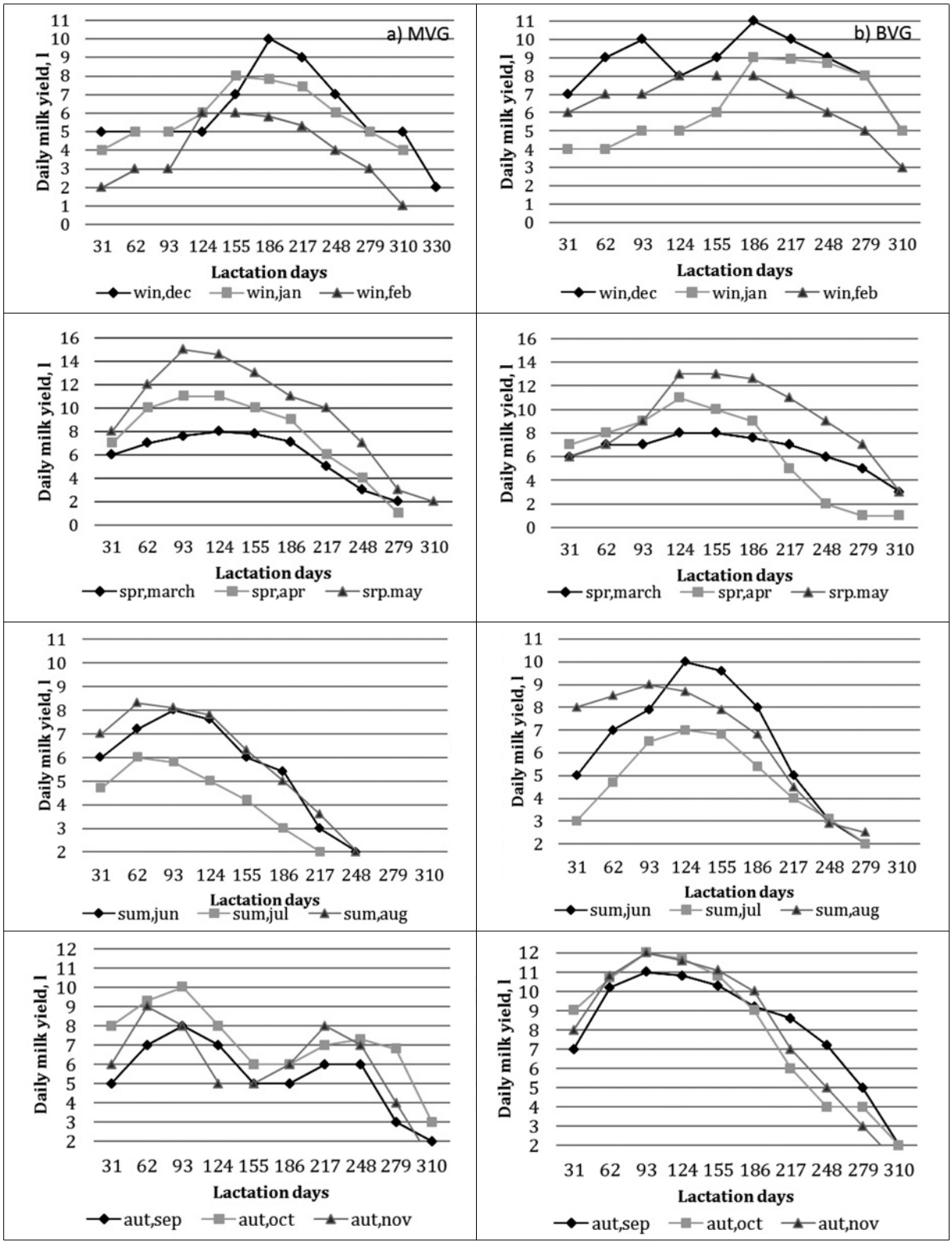


Figure 13. Forage shortage affect seasonal lactation curves
Source: Field survey, 2010

was because of natural mating i.e. when cows gain enough live weight, they will have good body condition score. For example, if the calf is born in April, mating takes place in August when enough grass is available. Despite this, farmers usually keep two cows with different calving season in order to supply fresh milk and dairy products all year around. Therefore, household could select cows for winter and summer or spring and autumn calving seasons. Number of cows in summer and autumn calving is lower in both the VGs, even though they have significant positive changes in lactation curves. The lactation curves are very sensitive in winter and autumn calving in MVG, while it is noticeable in winter and summer parity in BVG. Higher decrease in milk yield can be observed in these seasons. It can be concluded that cows in BVG are suffering from 'low productive' as higher proportion of cows are having winter calving, while similar issues can be observed in MVG with dominating spring and autumn calving. Thus, calving season affects total milk yield in this district and national level as all cows become low productive and decline in productivity during such seasons.

5. Conclusion and Recommendations

The households' own perceptions of changes in their herd sizes showed that total livestock population was increasing in both the VGs' HH. By species, cattle and goats number in MVG and sheep number in BVG have increased. Considerable decline in cattle and goats number in BVG and sheep number in MVG were also observed. Herd composition of the households indicated that there were more female animals than the male, which leads to increase in herd size and to sell more live animals to augment household income.

Main reason of changes in herd composition was market demand for live animals and livestock products. Horse and donkey numbers increased due to inefficient agricultural machines and necessity of draft power, transportation, income-employment gain, socio-cultural and ecological services.

Main trends of changes in livestock population reflected the importance of income from livestock. Less cash cropland area and easy access to common property pastures and natural resource based fattening feeding systems lead to increase in animal numbers. Consequently, most households suffered from forage shortage problem during winter and early spring, when animals are fed under stall feeding. It gives more degrading pressure on near-village pastures. Declining pasture productivity was observed even in not stocked intensive and remote pastures of the study area.

Forage availability and scarcity affect milk yield and lactation curves by calving season. The lactation curves are very sensitive in winter and autumn calving in MVG, while it is noticeable in winter and summer calving in BVG. Higher decrease in milk yield is observed in these seasons, affecting the total milk production in district and national level. It was concluded that cows in BVG has lesser milk yield, with 'low productive' statement, by dominating cows number in winter calving while similar issues holds true in MVG due to higher incidence of spring and autumn calving. These problems need to be addressed to involve artificial insemination practices, trainings for improving winter forage quality and support in forage trading at local and national level in order to increase milk yield efficiently.

Endnotes:

[1] Transhumance -seasonal movements of herders with livestock between village and pastures; a settled period is winter, when animals graze in near-village croplands and feed with supplementary feed in the sheds (Late November–mid April). Spring migration starts to the spring pasture above the village (Mid April - May). Migration to the summer pasture is during June and August. (In 1-May VG till the 1st snowfall or September). Returning back to autumn pasture is until mid-October and rapid migrate back to village and winter pastures.

[2] The Ala-Too breed of cattle of meat-and-dairy direct has been developed in 1950. It is improved crossbred of local cattle with Swiss brown and Jersey blood and it make up about 85% of the total cattle number. Oluya-Ata breed which make up about 10% of the cattle in the republic are black and white graded up from Friesian / Holstein imports (Nogoev, 2008; Fitzherbert, 2005)

[3] Poisonous grasses cannot be easily observed, when that species grow with other species. In some cases, poisoning can be observed when the thirsty livestock drink water immediately after eating suspected poisonous plants in near-village semi-arid pastures of BVG. During spring, very cloudy weather favours the build-up of nitrates in plants, which cause nitrate-nitrite plant poisoning. Nitrate–NO_3 and nitrite- NO_2. Factors which cause nitrate nitrite poisoning, accumulate in the plant include drought, cloudy or cold weather, herbicide application–especially phenoxy, herbicides such as 2, 4-D and wilting. Nitrates have a direct caustic effect on the lining of the gut if consumed in large quantities. Signs of poisoning include diarrhoea, salivation and abdominal pain. Nitrites are much more toxic. Sheep are more efficient at converting nitrite to ammonia, so this may be the reason why they are less susceptible to nitrite poisoning than cattle. In 1996, high mortality of animals was observed in Chapchyma pastures in MVG, when continuous rainfall occurred for about 41 days.

[4] During Soviet time hay mowing was done by agricultural machines, which in Kyrgyzstan was well-developed. However at household level, mowing was done manually and it increased after independence.

References

Abdurasulov, Y. (2009). *Condition of Agrarian Sector of Kyrgyzstan*. Bishkek: AKIpress.

Ajibekov, A. (2005). Animal Husbandry in Kyrgyzstan. *Strategies for Development and Food Security in Mountainous Areas of Central Asia* (p. Paper 5.). Dushanbe: GTZ.

Alymeev, A. Abdurasulov, A.H. Nogoev,A.I. Toygonbaev,S. Catkankulov,E. Jeenbekova,B.(n.d.). *Charachteristics of Southern Kyrgyzstan's goat breeds and types*. Bishkek. http://arch.kyrlibnet.kg/uploads/36

Aydaraliev, A. (2001). *Mountains of Kyrgyzstan*. Bishkek.

Balyan, G. (1978). *Forage Plants of Kyrgyz Republic: its cultivation in acclimatized deserts, semideserts and steppes*. Frunze: Kyrgyzstan.

Blummel, M., Wright, I.A. and Hegde,N.G. (2010). Climate Change Impact on Livestock Production and Adaptation Strategies: A Global Scenario. *Lead Paper, ISDA, India*, 136-147.

CACILM. (2005). *National Framework Program, Kyrgyz Republic*. http://www.adb.org/Projects/CACILM/milestones.asp

Cees da Haan, P. G. (2010). Structural Change in the Livestock Sector. In H. M. Steinfel, *Livestock in a Changing Landscape Volume 1* (pp. 35-51). Washington /Covelo/London: Island Press.

Chilonda, P. A. (2006). *Indicators to monitor trends in livestock production at national, regional and international levels.* Rome: FAO, Animal Production and Health Division, Livestock Research for Rural Development 18(8) .

NSC, (2004). *Kyrgyzstan in Figures*. Bishkek: National Statistic Committee of Kyrgyzstan.

DADD, (2009). *The Passport of Ala-Buka District*. Ala-Buka: Ala-Buka District State Adiministration.

DAR. (2010). *The passport of Ala-Buka District*. Ala-Buka: District Administration of Ala-Buka.

Dijkman, J. (2000). Researchand Development Challenges in Livestock Production Systems: A Report of the E-Conference. In P. M. Tulachan, *Contribution of Livestock to Mountain Livelihoods* (pp. 109-123). Kathmandu: ICIMOD.

Djikman, J. (1999). *Livestock Production in Areas of High Pressure Crop-Livestock Farming Systems in the East African Highlands*. Kathmandu: ICIMOD

Esengulova, J. A. (2007). *Community Management of High -Alpine Grasslands in the Kyrgyz Republic: Social, Economic and Ecological Implications*. Bishkek: Public Fund 'Ak Terek'.

Farrington, J. (2005). De-development in Eastern Kyrgyzstan and Persistence of Semi-nomadic Livestock Herding. *Nomadic Peoples*, 9 (1-2): 171-197.

Fitzherbert, A. (2005). *Country Pasture/Forage Resource Profiles. Kyrgyzstan. Grassland and Pasture Crops*. Bishkek: FAO.

GEF/UNDP. (2008). *Demonstrating Sustainable Mountain Pasture Management in the Susamyr Valley, Kyrgyzstan*. http://www.undp.kg/en/resources/project-database/archive-projects

Goat Handbook, G. F. W. Haenlein; R. Caccese; U. Delaware, Newark. (1992). *Goat Handbook*. USA: Agricultural Research Service, USDA.

IFAD. (1999). *Integrated Feed and Livestock Production in the Steppes of Central Asia*. Rome: IFAD, Livestock and Rangeland Related Technical Assistance Grant.

IFAD. (2004). *Livestock Services and the Poor a Global Initiative Collecting, Coordinating and Sharing Experiences*. IFAD. DANIDA, The World Bank. 152 p. www.ifad.org/lrkm/book/english.pdf

Ionov, P. (2004). *Vulnerability and Adaptation of Plant Species and Communities to Climate Change*. Bishkek: UDK528:581.524:577.41.

IPCC. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability; Summary for Policy Makers*. http://www.ipcc.eg/SPM13apr07.pdf.

Kaufmann, R. and Mohamed A.M.S. (2000). Animal Agriculture and Watershed Management: Reconciling Public and Private Good. In *Contributioon of Livestock to Mountain Livelihoods, Chapter 15* (pp. 203-221). Kathmandu: ICIMOD.

Kerven, C. (2005). *Cashemere Marketing: A new Income Source for Central Asian Livestock Farmers*.

Kerven, C., Alimaev, I., Behnke, R., Davidson, G., Franchois, L., Malmakov, N., Smailov, A. Temirbekov, S. and Wright, I. (2004). Retraction and Expansion of Flock Mobility in Central Asia: Costs and Consequences. *African Journal of Range and Forage Science*, 21(3): 91-102.

Leon-Velarde and Quiroz, P. Z. (2000). Sustainability Concerns of Livestock-Based Livelihoods in the Andes. In *Contribution of Livestock to Mountain Livelihoods* (pp. 183-201). Kathmandu: ICIMOD.

Lerman, Z. (2009). *Agrarian Reforms in Kyrgyzstan Achievments and the Unfinished Agenda*. FAO, Regional Office for Europe and Central Asia Policy Studies on Rural Transition No.2009-1.

Lushihin, M. (1959). *The Kyrgyz Fine-fleece Wool Sheep*. Frunze: Kyrgyz State Printing.

Miller. B.(2001). *Empowering Women to Achieve Food Security Rights to Livestock* 2020 FOCUS No. 6. Washington, DC: International Food Policy Research Institute.

Nazarkulov, A.N. Mukashev, Z.M. and Nurdinov M.S. (2003). *The Aikol meat-greasy pedigree group*. Bishkek: KNII Animal Huzbandry, Veterinary and Pastures, UDK 636.082.11 No.25-2003.

Nazarkulov, K. (2009). *Animal Husbandry in Kyrgyzstan. Condition, Problems and Ways of Improvement*. Bishkek: MAWRPI, Bishkek www.agroprod.kg.

Nogoev, A. (2008). *Selectional-technological Methods of Increasing Beef Production in Kyrgyzstan*. Bishkek: Kyrgyzstan.

Sere & Steinfeld N.S. (1996). *World Livestock Production System: Current status, issues and trends*. Rome: FAO Animal Production and Health Paper 127.

Shukurov, E. (2004). Ecologcal Value of the Kyrgyzstan's Forests and the State Support for Their Preservation. *Regional Forest Congress*. Bishkek.

Sileshi, Z. & Tegegne, A. (2000). Challenges and Opportunities for Livestock Development in the highlands of Ethiopia. In P. M. Tulachan, *Contribution of Livestock to Mountain Livelihoods* (pp. 95-102). Kathmandu: ICIMOD.

Singh, V. (1999). *Draught Animal Power in Mountain Highland Agriculture: Issues and Options*. India: GB Pant University of Agriculture and Technology.

Staal S.J. & Jabbar M. A. (2000). Markets and Livestock in the Coming Decades: Implications for Smallholder Highland Producers. In *Contribution of Livestock to mountain Livelihoods Chapter 4*. (pp. 57-71). Kathmandu: ICIMOD.

Steinfeld, H. S. (2010). *Livestock in a Changing Landscape*. Washington: Islandpress.

Tashi, N.& Partap, T. (2000). Livestock Based Livelihoods in Tibet, China, and Sustainability Concerns. In P. M. Tulachan, *Contribution of Livestock to Mountain Livelihoods: Research and Development Issues* (pp. 171-183). Kathmandu: ICIMOD.

The Great Soviet Encyclopaedia. (1929-1990). Moscow.

Tulachan, P. (1998). *Gender Differences in Livestock Production Management in Chitwan District of Nepal*. Kathmandu: ICIMOD.

Tulachan, P. (2000). Livestock Production and Management Strategies in the Mixed Farming Areas of the Hindu Kush-Himalayas, Asia. In P. M. Tulachan, *Contribution of Livestock to Mountain Livelihoods: Research and Development Issues* (pp. 123-135). Kathmandu: ICIMOD.

van Veen, T. (1995). *The Kyrgyz Sheep Herders at a Crossroads*. Pastoral Development Network,Series 38.

Wendy, B. (2005). *Kyrgyz Herds:A Report to Investigate Ways to Improve Productivity*.

Wright, I. & Duncan, A. (2005) Livestock, Fodder, Pastures and People: An Integrated Study in the Northern Areas of Pakistan. Kathmandu: ICIMOD.

Wood, P. (1967). Algebraic Model of the Lactation Curve in Cattle. *Nature, London*, 216:164-165.

Wood, P. (1969). Factors Affecting the Shape of the Lactation Curve in Cattle. *AnimalProduction*, 11: 307-316.

World Bank. (2005). *Kyrgyz Republic Livestock Sector Review: Embracing the New Challenges*. World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/KYRGYZEXTN

Zapata, A. (1997). *Systems of Milk Production in the Andean Regions: A Paradigm Shift and New Considerations*. Colombia: Fundation CIPAV.

Zarate, A. (2000). Livestock Biodiversity in Mountains/Highlands - Opportunities and Threats. In *Contribution of Livestock to Mountain Livelihoods, Chapter 5* (pp. 71-83). Kathmandu: ICIMOD.

Zhang, Y., Kurokawa, Y., Motobayashi,T., Kamada,T., and Itabashi, H. (2008). Rumen Fermentation, Blood Metabolism and Milk Production by Dairy Cows Fed Rice Whole Crop Silage. *The Japanese Journal of Animal Hygiene*, 34: 51-59.