Michael Succow Stiftung
zum Schutz der Natur

Ecosystem-based Adaptation in Central Asia

Vulnerability of High Mountain Ecosystems to Climate Change in Kyrgyzstan's Naryn region

– Ecological, Social and Economic Aspects –

Greifswald, December 2015

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the Parliament of the Federal Republic of Germany

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Ecosystem-based Adaptation in Central Asia

Vulnerability of High Mountain Ecosystems to Climate Change in Kyrgyzstan's Naryn region

– Ecological, Social and Economic Aspects –

Based on the report by

Dr. Anne Zemmrich

to the Michael Succow Foundation

Michael Succow Foundation for the Protection of Nature
Ellernholzstraße 1/3, 17487 Greifswald, Germany
Tel.: +49 (0)3834 - 83542-18
Fax: +49 (0)3834 - 83542-22

E-mail: jonathan.etzold@succow-stiftung.de
www.succow-stiftung.de

Cover picture: Landscape south of the villages Bash-Kaiyndy & Bolshevik in Kyrgyzstan

Content

List of Figures

List of Tables

1. Glossary and abbreviations of terms and transcription used in the text

1.1 Glossary & abbreviations

Aiyl Okmotu – [aiyl - Dorf, okmotu - administration] is a village council elected by village residents.

Aryk – irrigation channel. Within the project region these channels carry water from mountain creeks to the hay field area and are E –W oriented as connection channels and for irrigation through the hay fields mostly N / NNE – S / SSW oriented.

Dshailoo – Pasture ground distant from the village residence that is grazed in summer and requires a separate living accommodation, commonly a yurt. Village residents of the project region use remote and close summer dshailoos.

DWA – **D**rinking **W**ater **A**ssociation of Aiyl Okmotu that is responsible for availability and conservation of and access to drinking water.

Ks - Kyrgyz som is the Kyrgyz currency; 1 € was equivalent to 72 Kyrgyz soms in August 2015.

Leskhoz [les - forest, khozyaystvo – economy] Forest manager. Forest land is common property of and managed by the village. The forest manager is employed by the Aiyl Okmotu.

Oblast – Upper administration unit in Kyrgyzstan. In an international comparison it corresponds to a province, in Germany it ranges between a federal state and a county.

Rayon – Lower administration unit in Kyrgyzstan below the oblast. In an international comparison it corresponds to a district, in Germany to a county.

Vulnerability - The degree to which a livelihood system is susceptible to, or unable to cope with adverse effects of climate change including climate variability and weather extremes.

WUA – **W**ater **U**se **A**ssociation of Aiyl Okmotu is responsible for irrigation water.

Yurt – Living tent of Kyrgyz people made of sheep felt that is fixed on a woody grid wall. It is used as living accommodation at the summer dshailoo.

[Square brackets] indicate comments of the author.

1.2 Transcription

Transcription of Russian, Kyrgyz and Tajik terms follows the Romanization table for Cyrillic letters according to the Encyclopaedia Brittanica (1997). The special Kyrgyz characters were transcribed as follows Ң/ң with NG/ng, Ө/ө with Jo/jo and Ү/ү with Y/y.

2. Introduction and scope of the report

Expected effects of climate change in Central Asia will exhibit an increase of the inter- and intra-annual variability of precipitation (Bolch 2007, IPCC 2007, Thomas 2008) and a continued rising glacier retreat with altered drain off regimes (Khromova et al. 2003, Solomina et al. 2004). Still major uncertainties exist about long-term trends in average annual temperature, rainfall amount and climate hazards including their economic and cultural consequences. For the high mountain area of the Kyrgyz Tien Shan a temperature increase of 2.4° C is predicted 2040-2070 by other sources (project background document without source). However, these changes will threaten the food security through water shortage, land abandonment and land degradation that is amplified by population growth in the region. Hence, there is an urgent need to adapt local land use to these changing climate conditions by any assistance including technical, institutional and policy support to strengthen the resilience of affected communities and their environment.

Fig. 1: The position of the project region in Kyrgyzstan (source: https://upload.wikimedia.org/wikipedia/commons/4/40/Kyrgyzstan_1996_CIA_map.jpg).

The present report is part of the project "Ökosystembasierte Anpassung an den Klimawandel in Hochgebirgsregionen Zentralasiens" that aims to identify and establish adaptation measures to climate change in selected exemplary regions of Tajikistan and Kyrgyzstan. The project region in Kyrgyzstan Bash-Kaiyndy is situated in the SSE of the country within the Naryn province and includes the two villages Bash-Kaiyndy in the West and Bolshevik in the East within the At-Bashy river floodplain (Fig. 1). Bash-Kaiyndy is the larger of two villages with approximately 4752 inhabitants divided into 1087 households. The smaller village Bolshevik hosts approximately 1000 inhabitants in 232 households. Both villages are framed by the At-Bashy river in the N and the glaciers of At-Bashy mountain range in the South (Fig. 2). Both villages are situated on a road that connects the villages N and S of the At-Bashy mountain range with the district centre At-Bashy. The road provides access to the remote summer pasture of Ak-Say valley for village residents. The rural population live a kind of subsistence agriculture that is based on the production of livestock and the cultivation of vegetables and fruits. Water for drinking and irrigation comes from the 15-20 km remote glaciers of the At-Bashy mountain range (Tab. 1). Increasing social differences are indicated, so far, by few, very rich and poor households. Social differences range, for example for livestock property, from (absolutely no) less than 100 up to (temporarily) 5000 animals; for house ownership, from two residential houses of large size until sublease life. Life is mainly governed on a village level by the village council Aiyl Okmotu that is elected by the village residents.

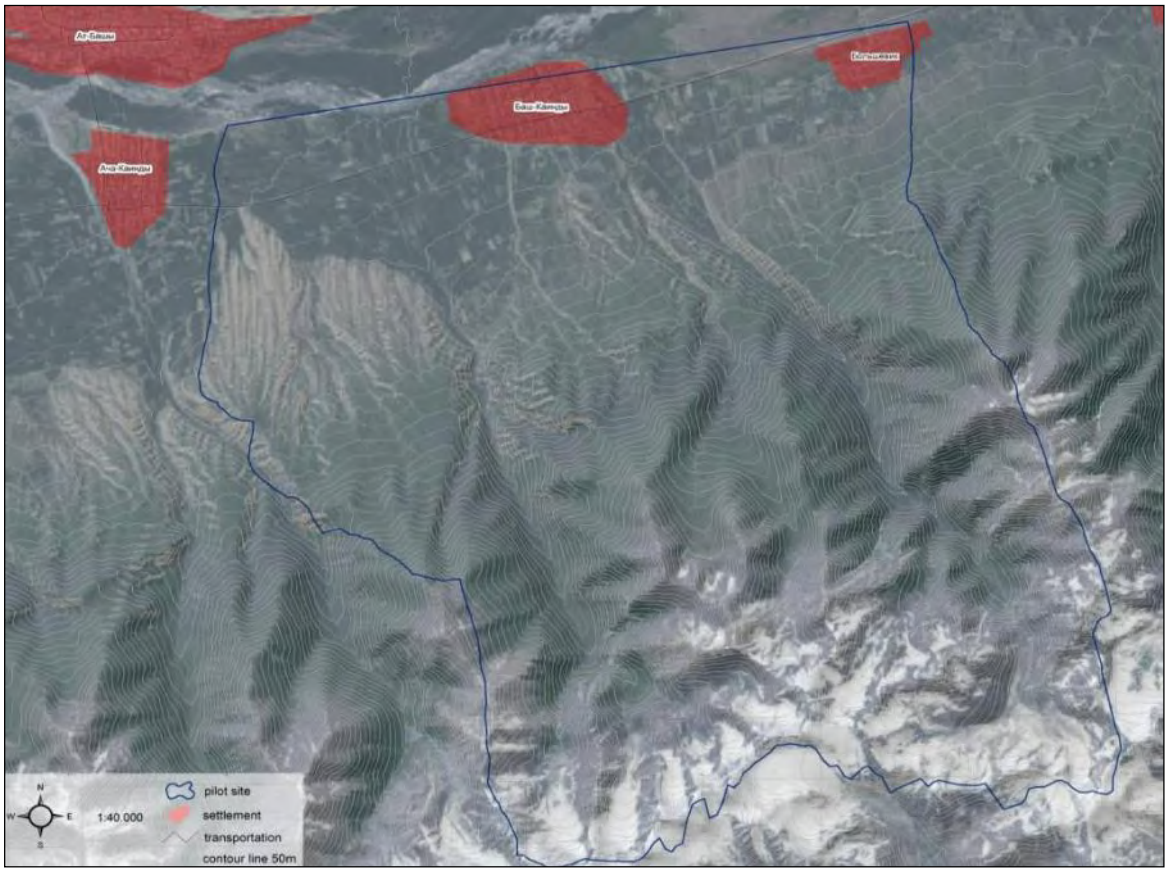


Fig. 2: Satellite image of the project region (source: https://www.google.de/maps/place/Kirgisistan/).

The present report bases on a field survey in the At-Bashy project region between August, 24 and September, 9 in 2015 and will address following issues (original assignments as formulated by the Michael Succow Foundation in German are given in brackets):

Ecosystem goods and services and their spatial and temporal distribution in chapters 4.1 and 4.2 *(Identifikation von Ökosystemgütern und -leistungen einschließlich ihrer saisonalen und räumlichen Dimensionen, die von der lokalen Bevölkerung in den Pilot-Wassereinzugsgebieten genutzt werden.)*,

Availability of ecosystem services & ecosystem health and function in chapter 4.3 *(Analyse und Abschätzung von Ökosystemgesundheit und -funktion in den Pilot-Wassereinzugsgebieten. Identifikation von Veränderungen der Verfügbarkeit von Ökosystemgütern und -leistungen, welche von der lokalen Bevölkerung wahrgenommen werden.)*,

Vulnerability of livelihood in chapter 4.3. and 4.4 *(Nachweis und Analyse der Verbindung zwischen Vulnerabilität der lokalen Bevölkerung, Ökosystemgesundheit und -funktion sowie der Verfügbarkeit von Ökosystemgütern und Ökosystemdienstleistungen.)*,

Discussion of results and methods in chapters 5 and 6 (*Identifikation von rechtlich-institutionellen, administrativen, technischen und informellen Defiziten für eine ökosystembasierte Anpassung, soweit sie auf lokaler Ebene sichtbar werden. Dokumentation zu den Erfahrungen mit der Durchführung der Vulnerabilitätsanalyse und Empfehlungen für die Entwicklung von Guidelines.)*

to conclude with recommendations in chapter 7.

Tab. 1 Basic data of the project region in Kyrgyzstan.

Data	**Project region**
Administrative position	Naryn oblast, At-Bashy rayon
Geographic position	426 km SSE of Bishkek, 6 hour's drive
Settlements	Villages Bash-Kaiyndy & Bolshevik
Altitudinal range	2100 – 4300 m asl from At-Bashy river floodplain to mountain peak
Mean annual rainfall	280 mm in the lowland
Climate	Arid climate in lowland & village

3. Methods

The field work started with a village workshop to introduce the project and project participants Maya Eralieva, Bilimbek and the author and reasons for our current village visit. The workshop aimed to identify key stakeholders and contact partners as well as interests and needs of village residents.

For the identification of natural resources, land use products or ecosystem goods and services including their spatial and temporal distribution following two approaches of knowledge acquisition were used: (I) interviews with village residents (annex 9.5) and (II) field surveys. Field surveys were carried out as direct observations during village walks and field mapping by field protocols (annex 9.6). In interviews with villagers simple terms beyond the project terminology were used to ensure a relaxed conversation atmosphere that contributes to unbiased answers. This terminology uses, for example, nature for ecosystem or form of work for land use. The interviews use standard methods of participatory rural appraisal (Kirsopp-Reed 1994) as indicated in Table 2. During the village workshop, an interactive round of questions, inviting and structured interviews of participants and discussion forums were carried out (Tab. 2, annex 9.1). A participatory resource map drawing with subsequent joint presentation of maps was used for an initial location of ecosystem goods and services during the workshop.

Direct observations through village walks at different daytimes and weekdays identified the daily working routines and gender aspects of labour division.

In a separate discussion forum during the workshop and by interview meetings with key informants, such as the land specialist, the leskhoz, a member of the pasture committee and the court of elders (Tab. 2), changes of ecosystem health and functions were explored.

In field surveys and village walks for observing daily working routines representative ecosystems that mainly provide the livelihood of village residents were identified. In subsequent field mappings ecological data of ecosystem components were recorded by field protocols, photo images and GPS data (annexes 9.6-7).

The link between population vulnerability and ecosystem health was observed, on the regional level, by comparing the natural conditions that provide water access to the two villages and, on the individual level, by informal talks with village residents (chapters 4.3 and 4.4). Consequences of availability of and access to water are discussed in a social perspective (chapters 5. and 7.).

Tab. 2: Overview of contact partners, issues discussed and methods applied.

Information source & meeting date	Issues discussed	Applied method	Data in annex
Village workshop with residents from Bash-Kaiyndy & Bolshevik, 26.8. 2015	Introduction of project & introduction of participants. Nature around villages as source of livelihood, their ecological conditions and responsible village stake-holders were identified.	Village workshop in a simple language (beyond project terminology), structured & inviting interviews of participants, group discussions, participatory resource map drawing, joint presentation & discussion of resource maps	9.1, 9.4
Khaynbek, Leskhoz for riverside forests in Bash-Kaiyndy, 27.8. 2015	Responsibility of different forest types in villages	Open interview	9.5.1
Shanybek T. Kanaliev, Land specialist of Aiyl Okmotu of Bash-Kaiyndy, 27.8. 2015	Land distribution and land lease. Ecological conditions of land in & around villages.	Semi-structured interview, transect walk through hay fields and fallow land	9.5.2
Kubanbek, Leskhoz for spruce forests of Aiyl Okmotu, 28.8. 2015	Management of spruce forest and ecological conditions of forest.	Semi-structured interview & transect walk	9.5.3
Keldibek Zhenaliev, pasture committee of Aiyl Okmotu of Bash-Kaiyndy, 30.8. 2015	Patterns of livestock production & ecological conditions of pastures	Semi-structured interview & participatory visit of pastures including transect walk	9.5.4
Hay field owner S of Bash-Kaiyndy, 31.8. 2015	Ecological conditions of hay fields	Open interview	9.5.5
Baktybek, head of various initiatives from Bolshevik, 02.9. 2015	Water availability & access, school & child care situation and social problems of Bolshevik	Semi-structured interview with observational visit of school & child care	9.5.6
Maametov Toktonaly, court of elders of Bash-Kaiyndy, 2.9. 2015	Personal life as influenced by history, perspective on future, ecosystem health	Interview as key informant on local village history and alteration of / in village over time	9.5.7
Young man, resident of Bash-Kaiyndy, 4.9. 2015	Water availability & access to water, ecological conditions of pastures & hay fields.	Open interview	9.5.8
Old man, resident of Bash-Kaiyndy, 6.9. 2015	Water availability & access to water, social conditions among village residents	Open interview, semi-structured interview	9.5.9

4. Results

4.1 Ecosystem goods and services and their spatial distribution

The perspective of all workshop participants considers water, air and sun as main ecosystem goods which facilitate the harvest of energy, domestic animals, forage, berries etc. (Tab. 3).

Tab. 3 Gifts provided by nature, their utilization and responsible counterparts as identified by the village workshop. [The table is the result of the workshop and uses the terms applied by the villagers.]

Nature's gift	**Nature products used by humans**				**Stakeholders**			
Water	Water for drinking & irrigation		Fish	Hydro-power	DWA, WUA	Private fisher	At-Bashy hydropower station	
Sun	Solar energy & warmth		Energy					
Air	Breathing air							
Land/Soil	Plant nutrients	Vegetation incl. medical herbs & honey	Vegetables: potatoes, wheat. Pastures & forage. Forests: wood/timber.		Land specialist of Aiyl Okmoty	Pasture committee	Beekee-pers	Sawmill-operator
Animals	Cattle, horses, sheep, camels		Wild animals (wolves, bears, eagles, wild sheep)		At-Bashy hunting inspection			

These ecosystem goods can be translated into livestock, forage, fruits and vegetables, timber, firewood, wild berries and wild animals. Major land use types are livestock production and cultivation of fruits and vegetables. Their integration in the on-site environment including the spatial distribution and utilization time are given in Figures 3, 9 and in Tables 4, 5.

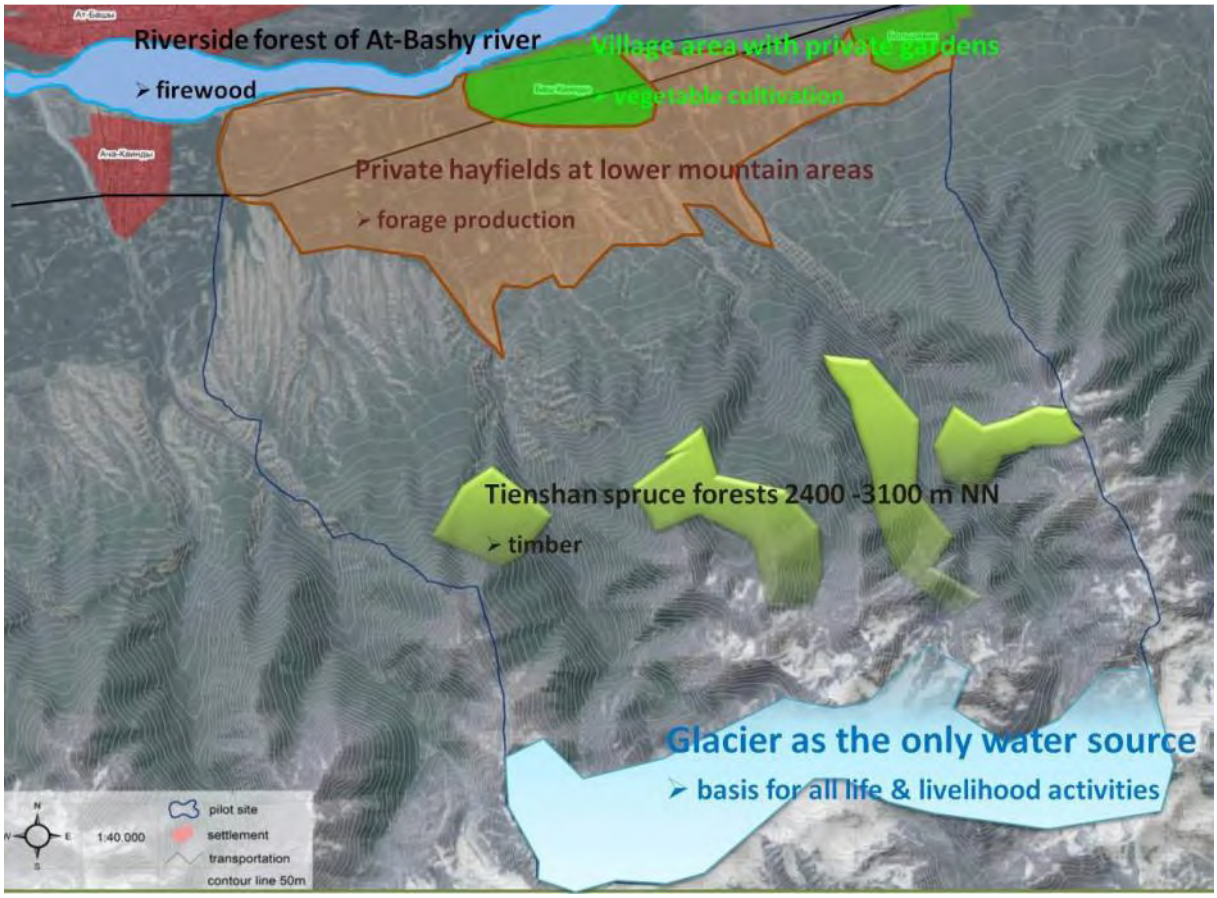


Fig. 3 Integration of types of land use and their products in the ecosystems of the project region.

Tab. 4 Ecosystems of the project region and their ecosystem goods as identified by field work.

Ecosystem	Natural vegetation	Spatial distribution	Area in km² & %	Ecosystem good	Time of usage
River floodplain	Wetlands & riverside forest	N of villages between 2050 – 2100m asl	1.2 km², 0.6 %	Firewood, seabuckthorn berries (*Hippophaë rhamnoides)*	Fall to spring, early fall
Village area	Wetlands mainly replaced by gardens & irrigated meadows	1st fluvial terrace, Bash-Kaiyndy at 2150m asl, Bolshevik at 2200m asl	4.5 km², 2,3 %	Vegetables: potatoes, tomatoes, onion, spicy herbs; fruits: apples, raspberries, black & red currants	Plantation in spring, harvest/collec-ting in fall
Foothill	Semi-desert, dry steppe	S of villages between 2050 – 2350m asl (2100 – 2700m loess soil hill with semi-desert in W part of project region)	52.4 km², 26.6 %	Irrigated fields of forage crops (90 %) & vege-tables (10 %), spring pasture in W part → livestock	Plantation in spring, harvest in fall
Piedmont	Dry steppe and meadow steppe	S of villages between 2250 – 2500m asl	22.2 km², 11.3 %	Spring & fall pasture → livestock	Spring & fall, chapter 4.2
Montane forest belt	Spruce forest & shrub meadow steppe	S of villages between 2600 – 3100m asl	29.7 km², 15.1 %	Timber, summer pasture → livestock, berries: *Ribes spec.*	Summer, see chapter 4.2
Alpine belt	Meadow steppe	S of villages above 3100 – 3600 m asl	34.9 km², 17.7 %	Pasture → livestock, very limited area	Summer, see chapter 4.2
Glacier belt with bedrock	None	S of villages above 3700m asl	50.8 km², 25.8 %	Water	All year long

Tab. 5 Types of land use, their products and their spatial distribution as a synthesis of tables 2, 3 and field surveys.

Ecosystem good	Land use	Place of use	Responsible counterpart
Livestock, meat, milk, heating fuel	Livestock production	Remote & close pastures	Pasture committee
Hay & esparcet forage	Forage production	Hay fields around village on private land between 2150 – 2300 m asl S of village	Pasture committee
Vegetables & fruits	Vegetable & fruit cultivation	Private gardens & close to village on private land	Individual village residents, not organized
Timber, fire wood/ seabuckthorn berries	Forestry / private business	Montane spruce forest, river forest/river forest	Separate leskhoz for river & montane spruce forest, private sawmill operator
Water for drinking & irrigation	Household, crop farming (forage, vegetables)	Houses & gardens, hay fields around villages on private land	DWA – drinking water, WUA – irrigation water
Honey	Bee keeping	Hay fields, montane spruce forest	Individual bee keepers (not organized)
Fish (trouts)	Trout breeding	At-Bashy river near village	Two individual fishers
Wild animals	Commercial & individual hunting	Montane spruce forest	Hunting inspection at Naryn oblast level
Wild herbs	Private business	Montane spruce forest	Not identified/ developed (?)
Natural beauty	Tourism as private or village business	Nature around village, waterfall	Not identified/ developed (?)

4.2 Spatial and seasonal patterns of grazing and forage production

55991 hectares of summer pasture are used by the residents of Bash-Kaiyndy and Bolshevik which are situated as close pastures approx. 50-80 km E of the villages and as remote summer pastures at Ak-Say Basin between 100 and 120 km ESE from Bash-Kaiyndy (source: village workshop 8/26 2015). [Close and remote pasture are local terms which are used in the report to support future communication.] The latter pasture is close to the Chinese border. Foreign project members require a permission (propusk) to cross the guarded mountain pass but locals not. For the majority of village population livestock production represents the main basis for livelihood (Tab. 6) and determines the seasonal living and working patterns. It comprises the grazing period outside the villages in summer, haymaking on private land in fall and hay feeding and additional grazing from winter to spring. Spatial and seasonal patterns of livestock production are introduced in detail as follows:

In **Spring** from March to early June livestock feeds mainly dry hay fodder. After snow melting an additional grazing in the wetlands around the villages, in the dry steppe belt or in hay field areas of foothills S of villages (insofar as hay remains are available from fall) is increasingly possible with each day. During spring these fields are accessible to each village resident independent of land ownership or tenancy. Due to the nutritional conditions spring is the most critical time of the year for livestock which are affected by the availability of forage and workforce for cattle drive within families.

In **Summer** after opening of the mountain pass in June a part of the family migrates with the majority of livestock to the close summer pasture between 2000-3000 m asl or to the remote summer pastures in the Ak-Say Basin above 3000 m asl. Grazing at these summer pastures facilitates animal fattening. Single suckler cows stay in the village to provide remaining family members with milk. The area of the remote summer dshailoo at Ak-Say Basin is accessible for all residents of the Nayryn oblast. Unfortunately, there is no information on grazing intensity, water availability and ecological conditions there.

Fall starts with return of selected family members, mostly men, for haymaking at the end of August. The remaining part of families follows between the end of September and the beginning of October. In fall land ownership and tenancy are in force and each family harvests on its own field ground. After haymaking forage fields are freely accessible to each village resident and provide forage after mid-September.

In **Winter**, as long as foothills are covered by snow, usually between the end of November until early March, livestock is fed by dry fodder consisting of hay, esparcet and fodder cereals. Only horses and goats may paw free remaining herbs when depth of snow is limited.

Haymaking and probably all types of work outside the house area (livestock grazing, transportations etc.) are the work of men while all types of work in and around the residential house including cooking, kitchen work and the production of vegetables and milking are women's work. Cattle drive to and from pastures around the village in the morning and evening is children's work in warmer seasons and men's work in winter.

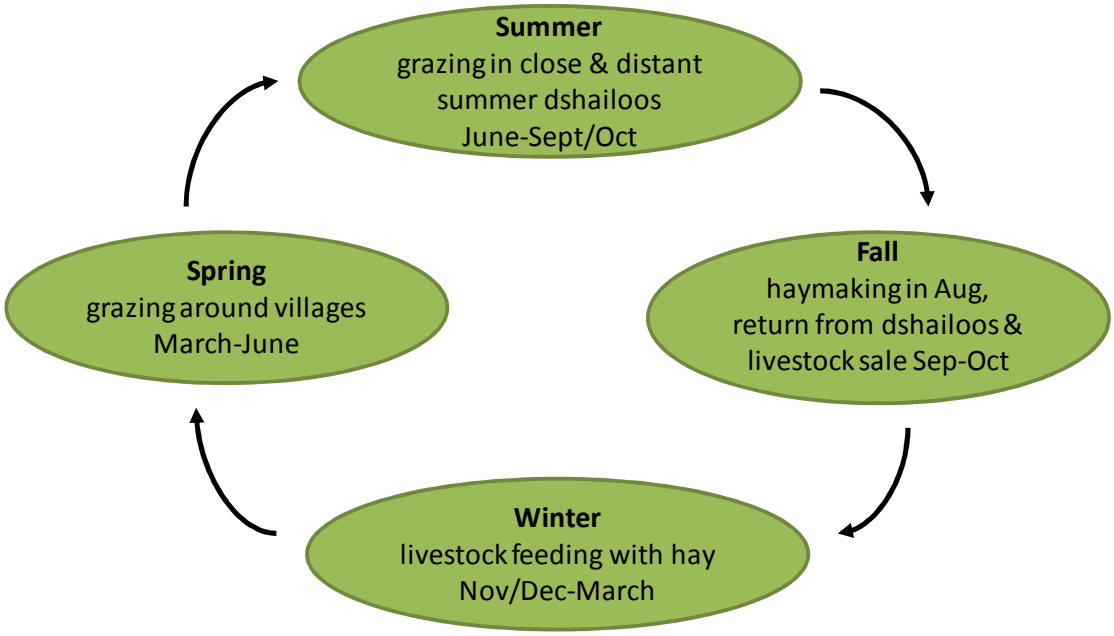


Fig. 4 Locations and times of livestock grazing and fodder provision which determine seasonal life cycle of village residents.

4.3 Vulnerability of livelihood

To assess the vulnerability of villagers the availability of ecosystem goods and services and their contribution of agricultural and natural products to livelihood is comparatively ranked (Tab. 6). Low ordinal ranking value indicates a low contribution and high value a high contribution to livelihood. The ordinal ranking value for the respective product suggests a higher or lower contribution to livelihood in comparisons with other products only. Values ranges from I to IV. This evaluation reflects the village

level, i.e., it is estimated in the perspective of the majority of village residents. The trout breeding, for example, is lowly valued, because it provides the basic livelihood but for two families only. On the level of individual village residents it would have been valued highly. The individual level of this assessment, i.e., the particular importance of selected land use types for certain families is not part of this report and must be considered separately for individual cases elsewhere.

Table 5 reveals water, livestock and forage production as the most important land use products that enable life in the villages and around. Livestock conveys the direct access to cash income for the majority of village residents but rests upon on the availability of water and forage fields. Livestock and forage production are connected by the seasonality of the vegetation cover and associated farming patterns as characterized in chapter 4.2. Production of vegetables happens in private gardens around residential houses which are irrigated from the same source that serve for drinking water namely small water bodies or channels passing through the villages mainly in South-North direction.

Fig. 5 Fuel is often provided by cattle dung.

Tab. 6 Ranking the contribution of agricultural & natural products (ecosystem goods) to livelihood in a village perspective. Italic and underlined terms contribute to the ranking.

Ecosystem Good	**Relevance**	**Ranking value**	**Contribution to livelihood**
Water	*Basis* for life & all livelihood activities	IV	**highest**
Livestock	*Cash* income, *basic* food, (main?) source of heating fuel	III	**highest**
Summer pasture & hay forage	Summer & winter *basis* for livestock	III	**highest as prerequisite for livestock**
Vegetables & fruits	*Basic* food, *additional* income	II	high
Timber	House construction *1x in lifetime*, with loam from a loam pit SSW of Bash-Kaiyndy	I	low
Fire wood	Often *substituted* by cattle dung, Fig. 5	I	low
Fish: trouts	Principal income for *two* families	I	low
Honey, berries	*Additional* income	I	low
Wild animals	Role of hunting is not identified but supposed to be of minor role	?	low
Wild herbs	Not yet developed	-	none
Natural beauty for tourists	Not yet developed	-	none

Livestock is the main source of cash income. Livestock production requires a sufficient size of forage fields that has to cover the feeding needs of animals in winter. Forage production then again requires water for irrigation. The area of forage fields is finite but can be increased or decreased for individual families by buying and selling and depends on the social conditions of households. Social conditions differ within the villages and range, for example for livestock property, from (absolutely no) less than 100 up to (temporarily) 5000 animals and these differences are increasing (chapter 2). To raise cash income, villagers

must increase their livestock number that requires additional areas of forage field and more water. Water is a fixed amount that already does not cover all needs neither in Bash-Kaiyndy nor in Bolshevik (chapter 4.4). The individual need of an increased amount of water than currently is available reduces water availability for each individual village inhabitant. Consequently, livestock number, forage field size and water availability link the ***climate vulnerability with a social vulnerability***!

4.4 Availability of ecosystem services and ecosystem health and function

4.4.1 Availability of ecosystem goods

The comparison of water access reveals obvious differences among Bash-Kaiyndy and Bolshevik for the following reasons: The highly rugged land surface S of the village improves water inflow to Bash-Kaiyndy and through its hay field areas resulting in four perennial water streams. In contrast, Southern land surface above Bolshevik is more evenly increasing and forage fields are fed by two perennial water streams only which must be shared with the neighbouring villages Bash-Kaiyndy and Birinchi May (Fig. 6).

Informal talks with village residence confirm the better availability of water and depending agricultural products in Bash-Kaiyndy: ***Drinking water and water for vegetable cultivation is provided***. Irrigation water for the hay fields does not cover all needs. The author met one family [there are probably more] which had to move their home resident from the hay field area down to the village because of missing paid work. Each year, additional winter fodder is bought for approx. 4 Mill. Ks in Bash-Kaiyndy (annex 9.5.2 and 9.5.5 interview protocols with Shanybek and hay field owner).

In contrast, villagers of Bolshevik complained ***the shortage of all types of water including drinking water***. The reconstruction of the Eastern of the two major channels by villagers was just in progress in the time of the interview (Fig. 6; see annex 9.5.6 interview protocol with Baktybek). According to statements of locals and own observations, the irrigated field area is limited and significantly smaller than the area in Bash-Kaiyndy (Fig. 3). The disadvantaged access to water was repeatedly expressed by inhabitants of Bolshevik.

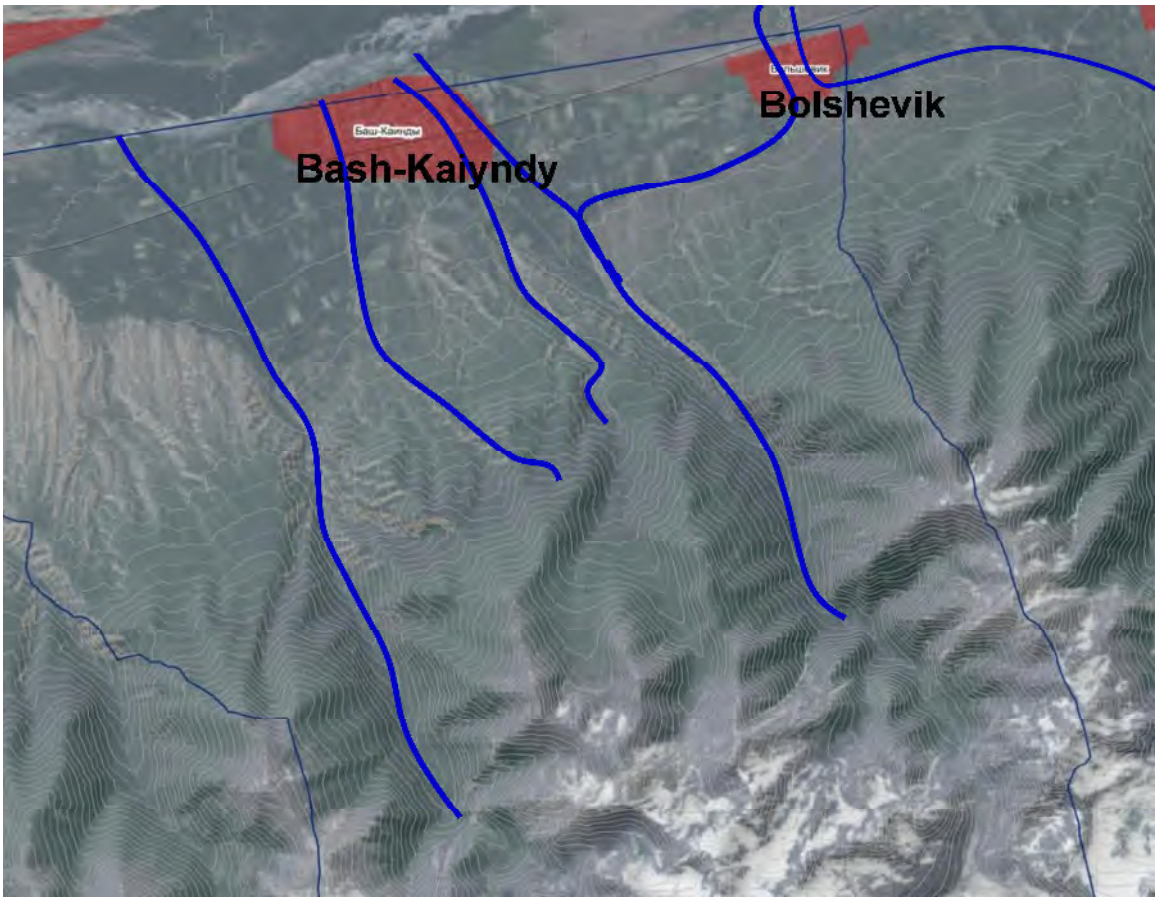


Fig. 6 Water supply by perennial mountain rivers for the project villages. The thin line in dark blue colour marks the E and W border of the project region. Note the land surface provides Bash-Kaiyndy with three independent tributaries while Bolshevik shares two tributaries with neighbouring villages in the E and in the W. (Source: https://www.google.de/maps/place/Kirgisistan/, modified.)

Climate change and its effects on the availability of ecosystem services used by the local population as perceived by participants of the village workshop comprise direct effects, such as:

a an increasing frequency of drought events,

b the reduction of annual snow cover from 1-2 m to 30-50 cm including the complete lack of snow cover in 2010,

c the disappearance of the glacier that in earlier times covered the mountain pass

and

d an increasing shortage of water,

e dried-out springs,

f the wetlands close to villages turned into dryland and wild frogs living in it disappeared,

g the occurrence of new species, such as a coyote [local term; unclear which species is meant because this and no familiar species is distributed in the region], a snake and black poisonous spider,

h the decrease of tab water pressure,

i the decline of forage yield from 40-50 to 15-20 centner per ha and

j the fire that destroyed 2 1/2 ha of cultivated land last year.

However, contrasting assessments were also expressed outside "official meetings" during informal talks and estimate as follow:

A there is enough water but …,

B water is not at places where needed,

C see the running water [due to missing maintenance] and the dry irrigation channels,

D necessary maintenance of irrigation channels is missing.

Latter both statements can be confirmed by own observations of water carrying channels and dry channels (Fig. 7, 9) and a broken well with running water but outside the irrigation fields N below of the project villages (Fig. 8).

Fig. 7 Water dam facility NE of Bash-Kaiyndy N of the hay fields at the position lat: 41.163749, long: 75.926079 (Source: own image P1010524.jpg from 09/04/2015).

Fig. 8 Broken well N of road between Bash-Kaiyndy and Bolshevik close to the area of irrigated fields (Source: own image P1010370.jpg from 09/01/2015).

4.4.2 Ecosystem health and function

Present text considers ecosystem functions as the biological, geochemical and physical processes which take place within an ecosystem and respond to all natural impacts including human activity. As long as these processes provide viable populations of native species, their diversity and natural variability, the ecosystem is considered to be in good or healthy conditions.

The prescribed sampling method and the limited field work for 3 weeks may not cover a complete assessment of ecological conditions as discussed in chapter 6. However, the sustainable land use, i.e., the limited impact on an ecosystem by low use intensity, in all types of ecosystems allows the summary statement that main ecosystems within the project region are in good ecological conditions (see Tab. 7). This statement cannot be extended to the remote summer dshailoo of Ak-Say. This area is accessible to all inhabitants of the Naryn oblast and is more intensively used by people per area unit compared with the area of the project villages. Details about the ecological conditions of ecosystems of the project region are found in Table 7.

Tab. 7 Ecological conditions of ecosystems of the project regions according to field sampling (see annex 9.6) and own observations. The ecosystem column corresponds with map of Fig. 12.

Ecosystem	Current vegetation	Number of corresponding sampling plots	Ecosystem health & function according to field data	Ecosystem health & function according to observation
River floodplain	Wetlands & riverside forest	None	Not mapped due to small % area.	Cannot be assessed precisely. No overuse due to inaccessibility. Soil loss at river slopes and slopes of inflowing mountain streams due to natural erosion of loess soil
Village area	Irrigated gardens.	None	Not mapped because private house area.	Vegetable and fruit cultivation supported by irrigation, the use of dung only to fertilize und light harvest technique.
Foothill	Forage fields & semi-desert	Semi-desert: 27, 27.1&.2, 31, 31.1 irrigated fields: 61, 64-65, 67-68, 68.1, 69-71	Good. Neither degradation nor erosion marks visible in the fields. Grazing tracks in selected areas of semi-desert > 10 years old without erosion or grazing indicators.	Manual harvest or by light technique, dung as fertilizer and the low grazing intensity outside the vegetation period provide good conditions of this ecosystem.

Ecosystem	**Current vegetation**	**Number of corresponding sampling plots**	**Ecosystem health & function according to field data**	**Ecosystem health & function according to observation**
Piedmont	Dry steppe and meadow steppe	46, 46.1&2, 47, 47.1&2, 53-54, 56	Good, neither degradation nor erosion marks visible in the fields.	These areas appear to be not used during the vegetation period due to their upper position above hayfields and the relief intensity (see Fig. 13)
Montane forest belt	Spruce forest & shrub meadow steppe	12-14, 16, 84	Good, good rejuvenation of spruce. No soil erosion, blowdown or insect calamities.	Good conditions reflect the statement of the leskhoz that each harvested spruce is being replaced (annex 9.5)
Alpine belt	Meadow steppe	16 marking end the forest belt	Not mapped because not accessible by project car.	Good conditions (Visual impression of the single place visited is limited for a general assessment.)
Glacier belt with bedrock	None	None		

5. Discussion of results

The conclusive evaluation of these partially contrasting observations would require long-term climate data and the socio-economy including insights into their changes over time that are beyond this report. Own investigations about ecosystem health were prescribed to certain sampling protocols (annex 6.6) which allow an assessment of current in-situ status only as discussed in chapter 6.

Some of the observations expressed by village residents may originate from elsewhere because both villages, Bash-Kaiyndy and Bolshevik, have no pipe system for tap-water (h). Additionally, a missing stable snow cover for the lower mountain belt of the Naryn area (b) is quoted by the National Atlas of Kyrgyz Republic (ANKR 1987).

However, repeatedly observed dry irrigation channels and remnants of a once extensive irrigation system (Fig. 10) confirm a better water supply in the past (d, e).

Fig. 9 Empty channel below and N of plot 47 near that is currently unconnected to the irrigation net; see figure 11 (Source: own image P1010307.jpg from 08/31/2015).

However, to which extent these observations are consequences of a climate change-driven water scarcity or the liquidation of state kolkhozes and the former cooperative management of the irrigation have to be addressed by social-economic investigations and analyses of long-term climate data if available.

Own field observations and informal talks with village residents allow the following but preliminary statement: A widely ramified system of channels irrigated forage fields in the past during the Soviet era. The dominating soil texture in the project region is loess soil, an aeolian deposit (of the quaternary glaciation) that is easily eroded by wind and runoff water (see images P1010265-266.jpg in annex 9.7). The time of highest rainfall coincides with the peak of snow melt and cause, additionally, erosive streamflow in June. Hence, the loess-type of irrigation channels requires labour-intensive maintenance each year. The cooperative labour organization including the sharing use of technique disappeared with the liquidation of kolkhoz structures and was replaced by the individual organization of labour on a family basis; circumstances which were complained by many village residents in informal interviews.

Otherwise, some of the dry channels are consciously excluded from the irrigation net (see Fig. 11) as observed during field work.

Moreover,

- the unequal access to water among Bash-Kaiyndy and Bolshevik (chapter 4.4),
- the impression that the reconstruction of one of the two main channels in Bolshevik is a volunteer / private initiative of villagers (annex 9.7.6),
- the consciously exclusion of selected irrigation channels from the irrigation net (see Fig. 11) as a kind of irrigation regulation,
- the differing answers of village residents about reasons for water scarcity and
- the unequal social conditions within villages and the role of water for cash-income of individual families (chapters 2 and 4.3)

suggest access to water and forage fields and their irrigation affect cash-income and associated social disparities. They might be mechanisms through which climate change-driven resource limitations link climate vulnerability with a social vulnerability. Hence, the organization and management of natural resources in the project villages should be the focus of a socio-economic analysis based on recommendations given in chapter 7.

Fig. 10 Remnants of a previously extensive irrigation net N of irrigation fields close to At-Bashy river (Source: own image P1010615.jpg from 09/06/2015).

Fig. 11 Regulation of the irrigation net? Consciously disconnected irrigation channel S of Bash-Kaiyndy near plot 47 in the middle of picture (Source: own image P1010306.jpg from 09/31/2015).

6. Discussion of methods

6.1 Ecosystem health and function & availability in ecosystem services

The identification of availability changes of ecosystem services and the assessment of ecosystem health and function in the project region were prescribed to EbA datasheet-field protocols (Field protocols DataInput_EbA 2015.xls). This type of field protocols has limits for the analysis of effects of the changing climate on ecosystem health and function for following reasons (annex 9.6 Field protocols DataInput_EbA Zemmrich 2015.xls).

A) No information on the reference condition for soil and vegetation (refers to natural conditions) were provided. They cannot be identified during 3 week field work even by expert knowledge.

B) The field protocols originate from the bioindication approach of the Greifswald School of landscape ecology (Succow & Joosten 2001) which considers vegetation as an integrative response of ecologically effective site conditions (Ellenberg 1956, 1958). Primary aim of this approach is the quantification of in-situ vegetation-soil relationships based on a high resolution sampling of abiotic factors and vascular plant species along ecological gradients. Among abiotic factors those are identified that drive changes in species composition including their value ranges that contribute to the occurrence of certain assemblages of vascular plant species. As a result, these species assemblages can be used to indicate ecologically relevant abiotic, mostly soil properties, but in-situ only. This approach was developed for landscape planning of former GDR in the 80ies to reduce costs of time consuming soil analyses.

The assessment of ecological changes would require vegetation and soil data for reference plots from previous time. Within a spatial set of those reference plots the bioindication approach sensu Succow & Joosten (2001) would support high-resolution analyses of ecological effects of climate changes in a scientific perspective that might be far beyond the project targets. Necessary data are accessible from the nineties from various areas in Kyrgyzstan but outside the current project region (Kungey & Terskey Alatoo in the Issyk-Kul Basin, Kochkor Region, Song Kjöl Plateau & Ak-Shirak Massif of Central Tien Shan; see references in Gottschling 2003).

C) Major changes in climate conditions increasing the vulnerability of the local population are perceived in the limited availability of water for irrigation purposes. Primary water source in the project region are the glaciers approx. 10-15 km S of the villages Bash-Kaiyndy and Bolshevik. Their water runs off from the glacier source through mountain streams and breaks up into a widely ramified network of irrigation channels above the agricultural land area S of the villages. Effects of water decrease can thus primarily be detected by the spatial analysis of watered field areas. Hence, it is suggested to map the plugged effective irrigation network in contrast to un-plugged dry channels. Additional interviews with the administrative

authority for irrigation (WUA-Water Use Association, Tab 3) on regulation principles of irrigation and end-consumption will reveal current water requirement and coverage.

D) In Kyrgyz transhumant pastoralism seasonal migration is limited to summer pastures only and during the rest of the year livestock grazes in lower altitudes and the lowland around the villages. In winter livestock is mainly fed by hay fodder. Hence, these areas with natural vegetation serve as fall or spring pastures. Changes in quality and quantity of forage from these pasture grounds were not mentioned by the villagers.

6.2 Analysis of livelihood vulnerability

Climate change is primarily perceived as the scarcity of water by the local population. The role of livestock production as main cash income, involved water and hay field requirements for forage growth and social disparities within the villages transform climate vulnerability into a socially driven vulnerability of livelihood. Hence, it is assumed that an unequal access to water in response to natural conditions will increase the social vulnerability of livelihood among the two project villages. Hence, an ecosystem based adaptation strategy has to address a socially compensating access to the limiting resource on the village level and individual level of village residents. The comprehensive understanding of the management of all limiting resources (only water so far identified) including the access to and the allocation among village residents should be addressed by future analyses of livelihood vulnerability.

6.3 Ecosystem-based Adaptation approach (EbA)

EbA is defined as the use of biodiversity and ecosystem services in a sustainable manner that does not decrease life quality of future generations as adaptation to the adverse effects of climate change on local spatial scales (SCBD 2009; for more details see http://www.naturalresources-centralasia.org/assets/files/EbA_Conference/Shaun%20Martin EN.pdf).

Land use as practised in the project villages (Fig. 12) may be considered as a daily praxis of EbA because production of livestock, fruits & vegetables, timber, trout and honey is based on natural resources such as productivity and species diversity of hay fields and alpine vegetation, water from glaciers and trees from spruce and riparian forests (see Tab. 4. & 5, chapter 4.2). It facilitates the food self-sufficiency of village residents outside competitive markets; circumstances which contribute to sustainable procedures without mass production, fertilizer, antibiotics or further chemicals. The amount of harvested hay, timber, trouts and wild berries does not reduce their regrowth and indications of degradation were not observed (own observations; see annexes 9.5 interviews protocols with village residents and 9.6 field protocols).

The arising question, what should be implemented as EbA has to include the radius of operations which differ among genders, families and social groups and additionally, has to focus on the social vulnerability of livelihood. Recommendations for the further identification of EbA measures are given in chapter 7.

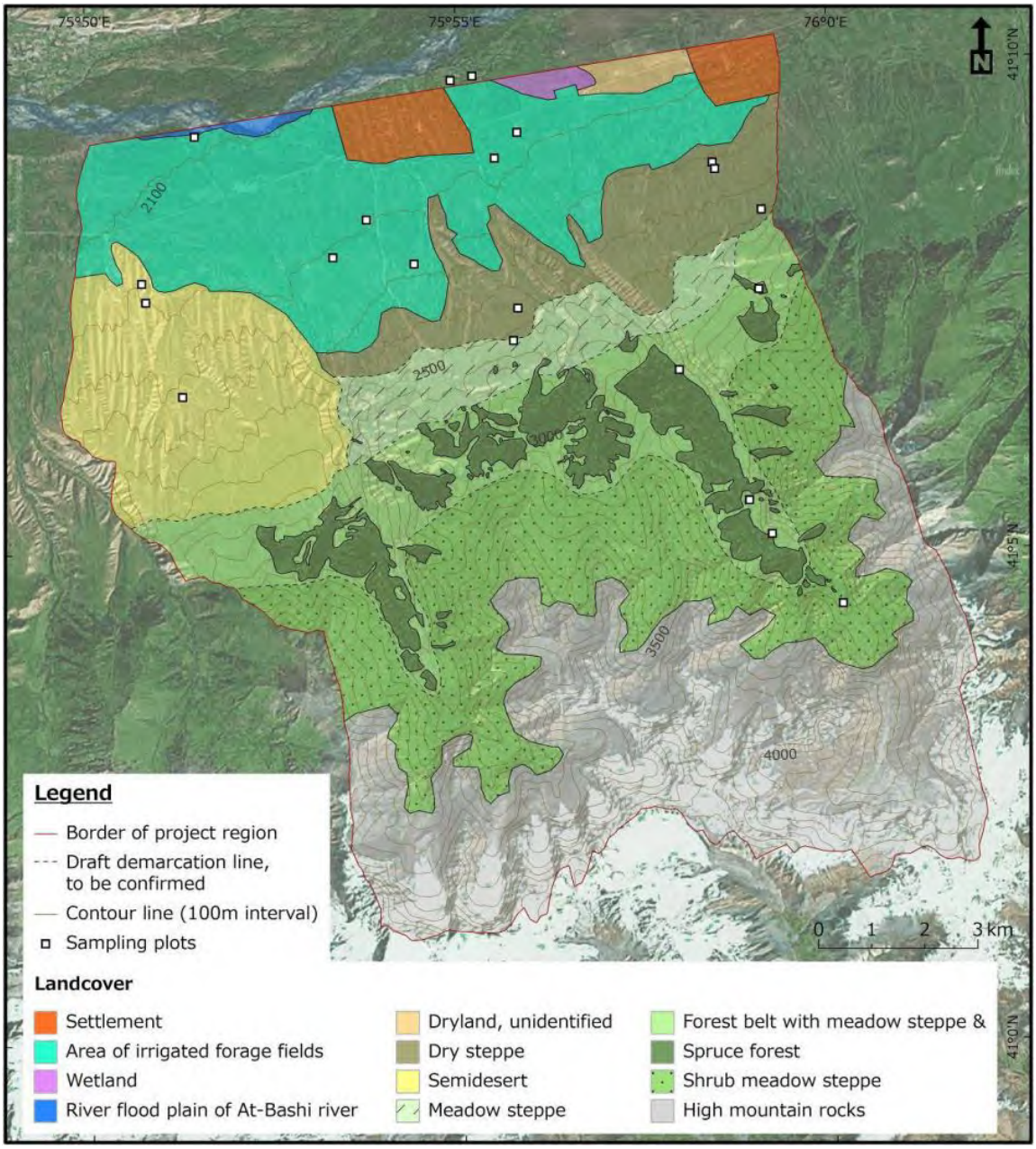


Fig. 12 Environment of the project region with distribution of ecosystems, land use and their relation to altitude. (The map is provided as file in the annex folder '9.9_Ecology GIS Zemmrich EbA 2015').

7. Recommendations

(1) The **extension of the project region** to the close and remote summer pastures and to the At-Bashi river valley comprising fuel sources is suggested to cover the complete life circle of the local population. These areas host (key?) resources for life and livestock (Tab. 6). Understanding the entire role of these areas for livelihood and the ecological conditions of vegetation, water supply, growth and regrowth of trees and shrubs including their alteration in a changing climate will disclose potential EbA measures. The ecological assessment of regional summer pastures should include the study on pasture degradation carried out by the Aga Khan Foundation (further information can be obtained from Maya Erelieva/GIZ).

(2) The **socio-economic evaluation** of all key resource areas and their relative contribution to livelihood is suggested to complement introduced findings. This analysis should aim to:

- identify still missing key resources for livelihood and distinguish the most limiting resources.
- The clarification to which extent the availability of the key resources water and vegetation changed due to climate change and/or kolkhoz liquidation (see chapter 5) will reveal potential EbA measures. The revival of the cooperative maintenance of the irrigation net may improve the efficiency of irrigation and thus enhance the relative water availability. Satellite images covering a long period (LANDSAT since the 1970s) as secondary data are advised to distinguish the reduction of melting water from missing maintenance and involved the deterioration of irrigation.

The analysis should address the organization and management of limiting resources including access to them for village residents. The currently proven limiting resource is water; further supposed are areas of forage field and summer pasture. Socially dependent perspectives of resource limits must be a special focus of this analysis to identify and social dependencies (see chapter 4.3 & 5.). This has to be also considered by the methods to obtain information. Further issues which should be clarified by the socio-economic analysis in detail are:

- regulation of access rights to key resource area,
- ecological conditions of close and remote summer pastures which are not included in this report because they are currently outside the project region,
- gender and social aspects of the use of key resource areas,

- reveal backgrounds for the "degraded" areas [outside the project region] which were presented to the author (e.g., GPS 8 & 9 of annex 9.8, see annex 9.5.2 interview with the land specialist) and identify reasons of deterioration [the area is excluded from the irrigation net due to a broken well; hence the term does not imply an ecological assessment],

- effects of kolkhoz liquidation on availability and use of water for irrigation (consider the many ruined buildings from the Soviet past within forage field area, e.g., GPS 30, 31 of annex 9.8).

For this study it is recommended to meet interview partners with engineering knowledge about the irrigation system in the past including Soviet times (irrigation engineer).

High forage residues were repeatedly observed (Fig. 13) during this study. An examination on their specific purposes (as additional winter fodder, for fertilization, or simply loss due to obsolete technique) will clarify the potential need for effective harvest technique (robust, adapted to ground surface, deep cutting, economic operation and maintenance by consumption of simple petrol available in the region, simple repair instead of sophisticated electronic machine).

Approaches for the processing and the marketing of primary products are recommended over the long term to reduce the number of people which depend on livestock production but use local primary products.

(3) Village residents operate within a web of relations formed by social, economic and administrative responsibilities which form a family, business and hierarchical network. This network governs the radius of operation that varies among villagers. Major project challenge will be the development of EbA measures in the perspective of village residents that includes their needs and responsibilities which distinguish among families and individuals over time. For a long-term project success the role of village residents should shift from hosts of the project to their constitutive key players. Basic prerequisite is a **permanent project presence** in a village that the project may become a part of the overall village network and transform from the key initiator to a supportive guest. Furthermore, the permanent project presence indicates a true connectivity of project participants with village inhabitants and thus, facilitates to validate insights of the socio economic study by complementary or alternative information. Like an old-established inhabitant during an interview said *"... to understand the water issue in the village you must experience the life of the village not only along a year but for many years. Then you may establish measures that affect the village."*

(4) The changing climate within global change points to a future which will be completely different from anything that humans knew before (Chakrabarty 2009). The adaptation to this unknown future is a part of the project challenge and, to be successfully, must happen in an alternative

thinking, what is still unknown to us. As descendants of the Western culture we may learn this thinking from indigenous cultures which survived millennia without degrading their environment; or to quote Albert Einstein "*Problems can never be solved with the same way of thinking in which they were created.*" To learn from traditional indigenous thinking, for me, personally, means to appreciate the interconnectedness of all forms of being (Lutz 2016). In an agreement with Western logic, this approach will put mitigation of climate change first.

Fig. 13 High forage residues of harvested hay field S of At-Bashy river, 29.08. 2015.

8. References

Akademi Nauk Kirgizkoy Respubliki (ANKR) 1987. Atlas Kirgizkoy Sovetskoy Sotsialisticheskoy Respubliki. Tom pervyy. GUGK Moskva.

Bolch, T. 2007. Climate change and glacier retreat in northern Tien Shan (Kazakhstan/Kyrgyzstan) using remote sensing data. Global and Planetary Change 56: 1-12.

Chakrabarty, D. 2009. The climate of history: Four theses. Critical Inquiry 35: 197-222.

Ellenberg, H. 1956. Aufgaben und Methoden der Vegetationskunde. Einführung in die Phytologie Bd. IV, 1.Tl. Verlag Eugen Ulmer, Stuttgart.

Ellenberg, H. 1958. Über die Beziehungen zwischen Pflanzengesellschaften, Standort, Bodenprofil und Bodentyp. Angewandte Pflanzensoziologie 15: 14-18.

Encyclopaedia Brittanica 1997. The new Encyclopaedia Brittanica, vol. 22, Chicago.

Gottschling, H. 2003. Die Naturräume des Biosphärenreservates Issyk-Kul in Kirgisistan. Eine landschaftsökologische Studie in Transekten. PhD thesis at the University of Greifswald.

Intergovernmental Panel on Climate Change (IPCC) 2007. Climate change 2007: The physical science basis. Summary for policymakers. Cambridge University Press, New York (www.ipcc.ch/ipccreports/ar4-wg1.htm).

Khromova, T.E., Dyurgerov, M., Barry, R.G. 2003. Late-twentieth century changes in glacier extent in the Ak-Shirak range, Central Asia determined from historical data and ASTER imagery. Geophysical Research Letters 30: 1863.

Kirsopp-Reed, K. 1994. A review of PRA methods for livestock research and development. RRA Notes 20: 11-36.

Lutz, H. 2016. 'They talk, we listen!' Indigenous knowledges and Western discourse. Zeitschrift für Kanada-Studien (in prep).

Secretariat of the Convention on Biological Diversity (SCBD) 2009. Convenient solutions to an inconvenient truth: Ecosystem-based approaches to climate change. In: The World Bank, IUCN (eds.), Connecting biodiversity and climate change mitigation and adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal, Technical Series: 41.

Solomina, O.N., Barry, R.G., Bodnya, M. 2004. The retreat of Tien Shan glaciers (Kyrgyzstan) since the Little Ice Age estimated from aerial photographs, lichenometric and historical data. Geografiska Annaler. Series A 86: 205–216.

Succow, M., Joosten, H. 2001. Landschaftsökologische Moorkunde. Schweizerbart, Stuttgart.

Thomas, R. J. 2008. Opportunities to reduce the vulnerability of dryland farmers in Central and West Asia and North Africa to climate change. Agriculture, Ecosystems & Environment 126: 36-45.

9. Annexes

9.1 Concept & schedule of village workshop

to be held on August 26th between 9 AM- 1 PM

draft by Anne Zemmrich

Workshop aims 1. Land use types: what types, how and where they are used?

2. Importance / relevance in the perspective of all residents

3. Geographic position of land use types within project area

4. Ecological health of these land use types with reference to their position (e.g., where are good and bad pastures situated)

5. Identification of representatives for landuse organizations which have best knowledge about them and are ready for joint field trips

6. Preparation of field work schedule (who will when accompany Anne into the field?)

Workshop steps	**CAT colleagues involved**	**Material need**	**length**
1. Informal introduction by coffee & tea offer, set up decoration		poster with nature images, flowers, grasses for decoration	as long as participants arrive
2. Short introduction of Anne	Maya/Bilimbek		5’
3. Anne’s personal introduction (relation to Kyrgyzstan, lessons learned in Kyrgyzstan, reasons for return –> aims)		Anne’s diploma thesis	5’
4. Personal introduction of workshop participants with his/her expectations & wishes	Maya/Bilimbek	Pass round particip. list	?
5. Interactive question round on nature components (landuse types) used by residents, how and where they are used (tap	Maya/Bilimbek	1 Pinboard, 2 flipcharts, pin sticks,	30’

water in village, creek water outside), who is the provider and who are the users		cards of var. formats, pencils in var. colors	
6. Order of landuse types according their importance in the perspective of all residents / key persons	Maya/Bilimbek	1 Pinboard, pin sticks	15'
7. Coffee break			20'
8. Spatial position of landuse types by participatory drawing	Maya/Bilimbek	2 Flipcharts, color pencils	15'
9. Transfer drawn map into GIS map	Maya/Bilimbek	GIS maps A1	10'
10. Rough assessment of ecological health of landuse types for the project area (e.g., where are the good & bad pastures, assessment criteria)	Maya/Bilimbek	GIS maps A1	15'
11. How ecological health changed in last 10 years, which changes are observed, GFZ questions on natural hazards*	Maya/Bilimbek	GIS maps A1	20'
12. Preparing time schedule for the field trips for the following days. Ask residents for contact data/phone.	Maya/Bilimbek	Participation list	?

**** Questions on natural hazards by the colleagues of GFZ***

1) Did you suffer anormal high water in the river (you remember year and time of the year)?

2) Did you suffer or observe a landslide nearby the village? (you remember year and damage) → locate on map?

3) Did you feel stronger earthquakes and you remember when?

4) If yes, were these earthquakes accompanied or directly followed by landslides?

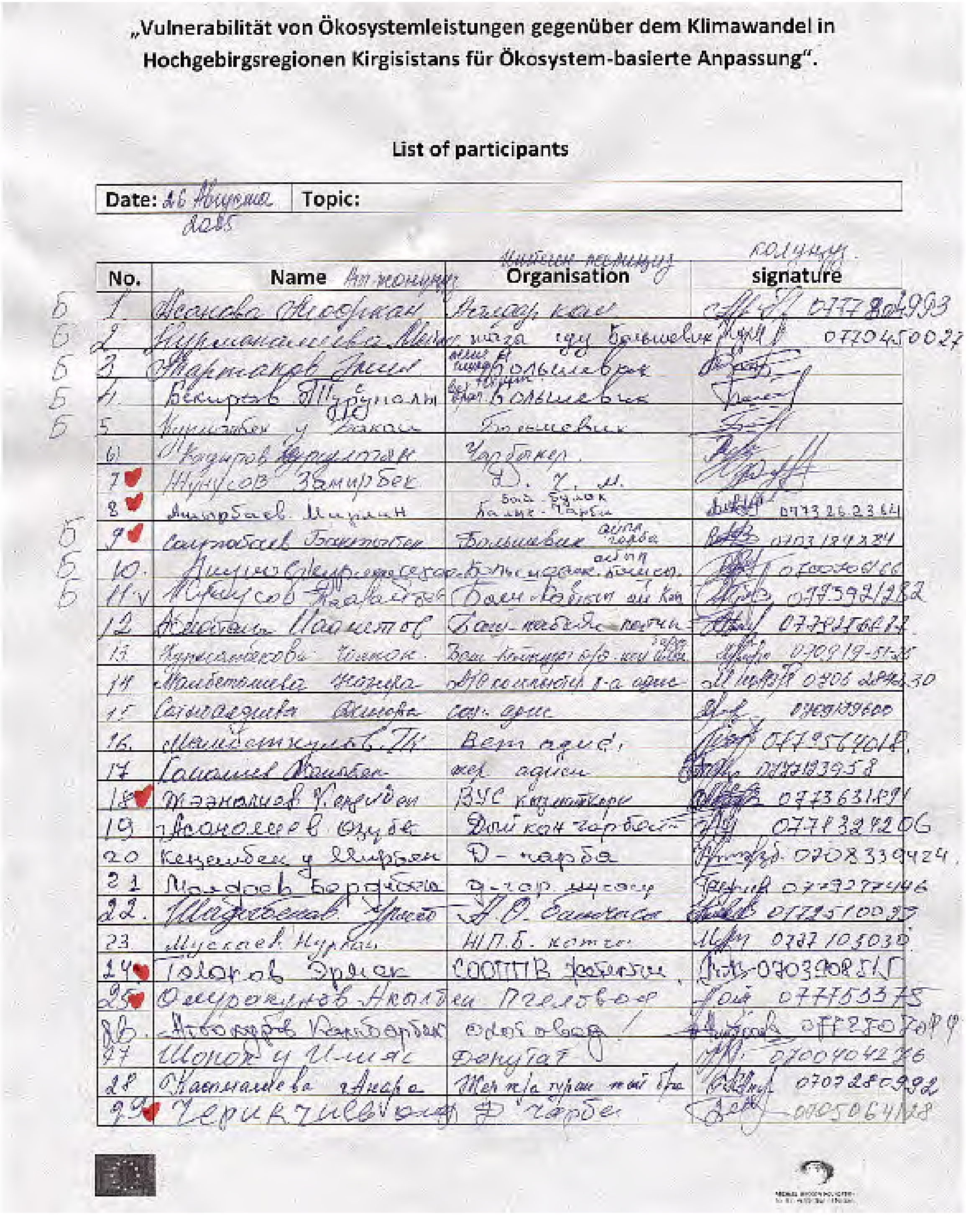
5) Did you ever observe daming of the river due to landslides or mudflows?

6) Did you suffer heavy rainfalls; when, how often, in what time of the year; any landslides, mudflows following the rainfalls?

Also of major importance are questions to the perception of people in the village for climate change and possible relations between natural hazards and climate change.

Is there any knowledge/perception of climate change? Is there any knowledge/perception of the interaction between climate and risk (e.g., landslides, flood, drought)?

9.2 Participant list of village workshop at August 26 2015 in the Aiyl Okmotu building of Bash-Kaiyndy


„Vulnerabilität von Ökosystemleistungen gegenüber dem Klimawandel in Hochgebirgsregionen Kirgisistans für Ökosystem-basierte Anpassung".

List of participants

Date: 26 Августа 2015	Topic:

No.	Name	Organisation	signature
1	[illegible]	[illegible]	0777804993
2	[illegible]	[illegible]	0770450027
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]

No.	Name	Organisation	signature
6	[illegible]	[illegible]	[illegible] 0777 621744

Attached as well as file “9.2_Participant list Village Workshop_EbA Zemmrich 2015.pdf”.

9.3 Resource maps as main result of village workshop

Fig. 14 Village with land use products / ecosystem goods in the perspective of village residents, group 1.

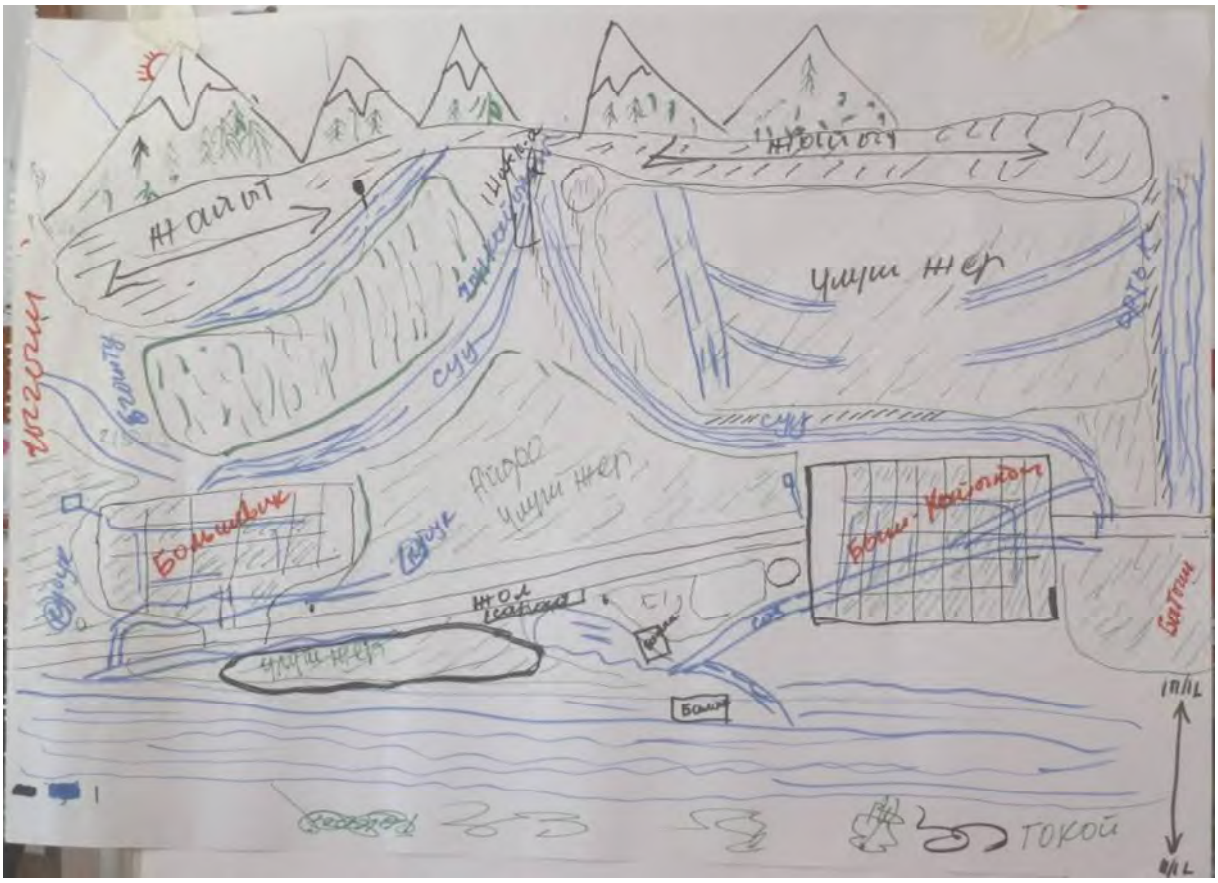


Fig. 15 Village with land use products / ecosystem goods in the perspective of village residents, group 2.

Attached as well as file "9.3_Map village workshop_Group 1.jpg, 9.3_Map village workshop_Group 2.jpg)"

9.4 Overview of information obtained from the workshop with village residents of Bash-Kaiyndy in the Aiyl Okmotu building on August 26.

Expectation & wishes of workshop participants concern:

- Theoretical knowledge on climate change, ecology & nature
- Practical knowledge on improved management of nature's gifts

- Improved environment around the village
- Improved infrastructure in & for the village

Observation of natural hazards & climate change:

Increasing droughts, water shortage,

Fire of last year destroyed 2 1/2 ha of cultivated land

Occurrence of new species (coyote, snake, black poisonous spider)

Disappearance of wild frogs in wetland close to village

Wetland turned into dryland

Glacier pass disappeared

Before 40-50 centner, today 15-20 centner per ha can be harvested

2010 no snow cover at all

Before snow cover between 1-2 m, today not higher than 30-50 cm

Rivers do not reach mouth, irrigation water from montane rivers not hay fields

Springs dried out

Tab water pressure decreases (they do not have tab water)

Good side of climate change

Tomatoes can be cultivated, impossible 10-15 years before

Spiritual values & traditions

Two secret springs S of village (see village map) where locals clean and take care for the spring environment.

At May, 5 each year locals butcher a sacrificial animal to appreciate nature for its services in the last year and to request for successful harvest in current year.

9.5 Protocols of interviews with village residents

9.5.1 Khaynbek, leskhoz of alluvial forests of At-Bashi river floodplain N of Bash Kaiyndy, meeting in his private hay field, 27.8. 2015

We meet him while haymaking with family members and friends. He informs us about the separated forest responsibility between Kubanbek, responsible for spruce forests, and him, responsible for riverside forest. Since we are looking for the leskhoz of spruce forests and because he is busy with haymaking, we ask for the living place of Kubanbek and leave the field.

9.5.2 Shanybek T. Kanaliev, land specialist of Aiyl Okmotu, 27.8. 2015

Responsible for land since privatization in 1995.

Each inhabitant of Bash Kaiyndy including children of villagers born before 1995 received 34-35 sotka (1 sutok=1/3 of ha). Other village could distribute approx. 1 ha per resident due to lower population density.

Bash-Kaiyndy with high population density; in other villages residents received more private land during privatization, land areas does not cover needs of village residents.

His duties comprise responsibility for private land, monitoring the obedience and implementation of *land use regulations of Aiyl Okmotu* including the monitoring of irrigation and water provision of these land areas.

Forage field is one land category that cannot be changed in utilization by owners.

350 ha of state land offered for renting to locals, 167 ha of them is dried and cannot be used.

In Bash-Kaiyndy 2250 ha private land in total. Each year, additional winter forage needs to be bought for approx. 4 Mill. Ks.

His information on land use give hint for a predominant subsistent food production in both villages.

The availability of historical land use maps and historical images he denied.

Occurred degradations

- weed infestation of an annual grass (*Poa cf. tectorum/oxyodon*) due to water shortage at a certain area S of Bolshevik due to water shortage at GPS 9: 10 years ago water reached the village from spring, today it flows only 100 m (my own observation placed the spring into neighboring valley; Kanaliev responded that this area was irrigated by a glacier fed mountain river)

- 167 ha of formerly cultivated land N of Bolshevik is not used due to water shortage at GPS 8 for the last 12 years, dyke establishment is planned with funds of Aga-Khan Foundation
- Sum of degraded areas between Bash-Kaiyndy and Bolshevik is 360 ha with increasing tendency
- Car number increase in the last 20 from 3 to 10 times. *(What is the main wind direction including foehn winds? Where all the dust blows from dry gravel roads within the area?)*
- According to Kanaliev soil S of Bolshevik are more stony and gravelly and faster warms up in summer time. Hence vegetation of forage fields grows faster. According to my own observations: Water access of Bolshevik is limited and less water reaches these fields. Hence, there grows drought adapted vegetation with different species and probably with lower nutritive value.
- GPS 10: SSW of Bash Kaiyndy: favourable forage field just within harvest time, example of hay field in good conditions with sown esparcet, good water supply due to loess soil with high water capacity but vulnerable through streamflow discharge

9.5.3 Kubanbek, Leskhoz of spruce forests of Aiyl Okmotu, 28.8. 2015

Born here, his father worked here for 20 years and he took over his responsibility. There is no illegal only controlled cutting of 30 – 40 trees per year, harvested trees are replaced by planting the same amount as cut trees at lower forest border, tree growth at upper forest border is limited by rocks (own observation), rejuvenation here is limited, he grows seedlings from collected seeds (the only reproduction mode of *Picea schrenkiana*). [Own observation during transect walk: lower forest border artificially enlarged by tree cultivation since for every cut tree a compensation tree must be planted.]

2400 ha forest cover At-Bashy rayon & can be used by all residents of At-Bashy rayon.

Further use of forest: berry collection (black currant, *Ribes nigrum*, seabuckthorn (*Hippophaë rhamnoides*) in creek valley, introduction of other tree species from Issyk Kul region with faster growth.

Felling of single old tree at steep slopes when rejuvenation is possible [along all forest altitudes good rejuvenation of *Picea schrenkiana* was observed].

Observations of ecological changes: no critical changes observed, similar conditions as before accept for drier soils, caused fire in last year. [His comments were confirmed by own observations].

Snow slides occur 1 x in 10 years, small effects of the last year snow slide during forest field trip (single broken trees, 28. August 2015). This year much rainfall, impossible to show drier sites.

9.5.4 Keldibek Zhenaliev, member of pasture committee of Bash-Kaiyndy Aiyl Okmotu, 30.8. 2015

Born in this region and all the time he was working in agriculture, today responsible for military issues at Aiyl Okmotu.

He informed about the author about following issues:

Pass to remote summer dhailoo Ak-Say (approx. 100 km distant to Bash-Kaindu) opens in June and is open for all residents of Nary oblast, probably many people there in summer time.

Locals who do not want/cannot move so far, closer summer pastures are available around 40-50 km E of Bash-Kaiyndy between 2600 m & 2750 m asl. They are cold: Cary-Tal, Bosogo I, Bosogo II.

Livestock number range from less than 100 to (temporarily) 5000 depending on the activity, the relationships and the cleverness the herders possess.

Family stay at summer pasture until end of September/begin of October. What about school attendance? "*The kids have there own school at summer at dshailoo*…", was the answer of his wife, I asked.

9.5.5 Hay field owner S of Bash-Kaiyndy, 31.8. 2015 31.8. 2015

An accidental meeting during field work in hay fields S of Bash-Kaiyndy; talk about the left house nearby which indicate former occupancy and he informs about: up to 3 years ago the family inhabited the house. They moved due to water shortage. "*Water does not fill all aryks anymore. There is nothing to do to live from… Water is available until June only and then it gets dry...*" The water is regulated by closing and opening the outflow gullies to save or leave water for main gullies.

9.5.6 Baktybek, head of various initiatives and respected as informal head of Bolshevik, 02.9. 2015

He confirms the limited water access of village Bolshevik. Above the village mountain is +/- one mountain ridge without deep dissections which are necessary for perennial water. Above Bash-Kaiyndy those fragmentations are established by drainage water from glaciers and mountains and provide the village with more water.

Two irrigation channels, Nayyndy-Choyut from West and Tyjuk bogashgy-Sarl doboy from E, provide the village with water. Their water have to be shared with the neighbouring villages. They must be reconstructed but money is missing.

He was just busy with further village residents to maintain/built the main irrigation channel.

He introduced several village activities:

- Zhamat, a village organization for young men living in socially complicated funded by Netherland. Young men are taught to grow vegetables for own use and sale to learn missing/lost self-responsibility (alcohol heritage left by Russians within competition society).
- School and child care are built by villagers at the base of a hay store shelter. Class rooms carry the name of those people who funded their construction. Child care and school each with own kitchen. Meals of child care have to be partly paid by parents with state support, for pupils state fully provide meals.

The impressive activities are faced with the poor supply of school and child care (poor teaching material of school, e.g., no any computer; the same applies for the child care).

The village guided by Baktybek is very active to get funds for the village: UNDP grant fund for well reconstructions N of the village, Russian fund supports 4 projects of village infrastructure

9.5.7 Maametov Toktonaly, member of the court of elders of Bash-Kaiyndy, 02.9. 2015

He was born and grew up in Bash-Kaiyndy. At the end of World War II he was 7 years old. We start the talk with our memories how this last war influenced our both life. He asked how in Germany the youth today reflects this war.

The main impact of changes in his life was the independency of Kyrgyzstan and the return of Islamic faith.

For the future he wishes that our both people will live in joint exchange and understanding. His information on ecological changes were very limited.

The former relation to nature he expressed in responsibility in term of cleaning of summer pastures and water sources. He miss that in today's time since waste is be find everywhere in nature [due to highly increased occurrence of not compostable waste].

9.5.8 Young men and resident of Bash-Kaiyndy, 04.9. 2015

Accidental meeting during field work at Eastern end of Bash-Kaiyndy. After informing him on reasons for my stay in the village and the work on site he presents following information:

"There is enough water but at wrong places. We need to store the water in a huge water tank above the hay field area. We need to construct a big water tank and we need a better distribution of water."

9.5.9 Old men and resident of Bash-Kaiyndy, 06.9. 2015

Accidental meeting during village walk through NE margin of Bash-Kaiyndy. After introducing myself and the project we start a talk about the technique for hay making he is using, further available technical equipment and its cost, and livestock numbers. He owns approximately 300 stock cattle which are still with his family at Ak-Say dshailoo. Cattle number of single resident may reach between 3000 and 5000 stock. Then we continued the talk on the role of hay for livestock and water need for irrigation. He means that there is much water, sufficient water but… [And then he stopped talking. The time of our meeting was to short for trust building and every following word would have been a judgment...]

9.6 Protocols of field sampling in ecosystem of semidesert & dry steppe, forest and hay field (as files only)

Attached as file '9.6_Field protocols DataInput_EbA Zemmrich 2015.xls'.

9.7 Images of project area (as jpg files only)

Attached in folder '9.7_Images Field Trip EbA Zemmrich Aug-Sept 2015'.

9.8 GPS points and images (as files only)

Attached in folder '9.8_GPX_GPS Points EbA Zemmrich 2015'.

9.9 GIS project of the project region (as folder only)

Attached as folder '9.9_Ecology GIS Zemmrich EbA 2015'.

9.10 Interim Report - EbA Workshop 9.9 2015 (as file only)

Attached as file '9.10_Interim Report_Zemmrich_EbA Seminar 9.9 2015.pdf'.

9.11 Images Soil & Vegetation (as files only)

Attached in folder '9.11_Images Soil & Vegetation'.