REPORT

Proposal No 26199 - Syr Darya

Co-ordination of scientific activities towards elaboration of common strategy for environmental protection and sustainable management in Syr Darya River Basin, in Uzbekistan and Kazakhstan.

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A. The basic information and maps about study sites

A.1. Administrative and territorial division subject of inquiry

Below were described 4 study areas located in the territory of Kazakhstan which were finally selected during the first workshop of the Syr Darya project progress and realization. Each of study area is characterized by different natural conditions and various anthropopressure.

1. The Keles river basin (study site No 2) is located in south-east part of Kazakhstan in Kazygurt and Saryagash regions. The majority of soils of this study area is affected by erosion processes.
2. Kazakhstan's part of Golodnaya Steppe (Study site 6 a) is located south from Chardara Reservoir (middle flow of Syr-Darya river) and cover completely the territory of Mahtaaralsky part of South Kazakhstan region. It is an area of intensive agricultural land use with well developed irrigation system using for cotton growing.
3. Chardarinsky Massif (study site 4) covers the territory north from Chardara reservoir. From the east site this study area is bordered by Saryagash region. Chardarinsky massif is flat and homogenous part of South-Kazakhstan region. This region is characterized by intensive agriculture with cotton and rice as the dominating crops.
4. Shielysky Massif (study site No 5) is a part of Kyzyl-Orda Region located in predelta of Syr-Darya river. This region is completely occupied by the rice production.

Current soil status of Golodnaya Steppe, Chardarinsky and Shielyski territories is characterized by secondary soil salinization and flooding processes due to devastation of collector-drainage systems. Moreover the soil and crops pollution with heavy metals is observed.

The above mentioned study areas are characterized by various density of population, ranging from 136,4 (pers/km^2) in Mahtaarasky region to very low - 1,0 (pers/km^2) in Shielysky region. It should be mentioned that in these regions people work mostly in agriculture (crop production and pasturage) and no big towns (over 50.000) exist. The population density is presented in Table 1.

Table -1 Demography of study areas

Study sites	**Administrative regions**	**Area, 1000 km^2**	**Population, thousand/ man**	**Density of population, man/ km^2**	**Number of towns**		
					< 5 000 inhabitants	**> 5000 inhabitants**	**> 50 000 inhabitants**
Keles and Kurkeles River Basin	Kazygurtsky	4,1	92,2	22,5	62	2	0
	Saryagashsky	7,7	220,9	28,7			
Kazakhstan part of Golodnaya Steppe	Mahtaarasky	1,8	245,6	136,4	36	4	0
Chardarinsky Massif	Chardarinsky	13,0	70,0	5,4	27	1	0
Shielysky massif	Shyelysky	73,9	74,0	1,0	32	1	0
Total		**100,5**	**702,7**	**7,0**	**157**	**8**	**0**

***** *Density of population South-Kazakhstan oblast – 16,9 man/км^2, in Kysyl-Orda oblast – 2,6 man/км^2*

B. Physical-geographical conditions of research objects

B.1. Basin of the river Keles and Kurkeles.

B.1.1. Geographical location.

This basin is a sub-basin of the river Syr Darya and is located in the south-east part of South-Kazakhstan oblast and covers the territory of Kazygurt and Saryagash administrative regions. In the north it borders with Sairam and Tolebi regions, in the east and south-east – with Uzbekistan Republic, in the south across the Chardara reservoir - with Makhtaaral region and in the west – with Chardarinsk and Arys regions. The basin is separated from the basin of the river Ugam by the watershed of the ridge Karzhantau, and from the basin of the river Arys - by the watersheds of the ridges Kazygurt, Beltau and Kauynbaimoldy.

B.1.2. Geomorphology.

The basin is divided into three typical large geomorphologic regions – mountain, piedmont, and lowland. The mountain region covers southern and south-eastern parts of the territory and it is represented by the ridges Karzhantau and Kazygurt. The relief is represented by a dissected denudation- tectonic complex. The ridges are surrounded – partially or completely – by the flat piedmonds. The lowland part is represented by a flat accumulative plain – river plains and river plain benches of river valleys.

B.1.3. Geological structure.

The mountain regions largely consist of Carboniferous and Cretaceous rocks. The piedmont plain consists of Cretaceous and Tertiary rocks. The lowland part is built of the rocks of Quaternary period.

B.1.4. Geographical zonality.

On the territory of the Keles river basin 3 zones, 4 belts and 6 regions of vertical zonality are determined according to the numbering of zones and belts, accepted for the South-Kazakhstan.

3. *Mountain and piedmont zone of dry juniperus light forests, bushes and bush large grass semi savanna* (altitude from 1000-1200 to 2200-2400 m). Mid-annual temperature varies from 6 to 10^0C. The annual amount of precipitation ranges within 600-800 mm. Vegetation cover presents mainly 3 types of phytocoenoses: 1. Dry juniperus light forests with undergrowth, consisting of meadow-steppe grass vegetation. 2. Bush and grass-bush communities with a great amount of meadow-steppe grasses. 3. Bush cereal-large grass semi savanna, consisting of large ephemeroid cereals and bushes.

On this area dominate sandy and loamy soils. They are bedded on compact rocks or broken-stone at a small depth. Ground waters do not influence greatly on the process of soil formation.

4. *Piedmont zone of large cereals semi savanna* (altitude from 600 to 800-1200 m). Mid-annual temperature is 10-12^0C. Mid-annual amount of precipitation ranges from 400 to 600 mm. Natural vegetation is presented by the so-called large cereals semi savanna. *Agropryron repens* dominate together with the other ephemeroids and ephemers. Loess loams, Cretaceous and Tertiary loose sediments serve as soil formation rocks on ouval-rolling surfaces. Alluvial and dellu-

vial-prolluvial two-layer deposits play the role of soil formation rocks at flat sites. Ground waters are located very deeply and do not participate in the process of soil formation.

5. Piedmont zone of low grass semi savanna is a zone bordering with latitudinal desert zone. Two geo-bioclimatic or soil provinces are clearly observed in it: southern – at the piedmont plains of West Tyan-Shan and South Karatau and northern – at the piedmont plains and lowland of North Karatau. The zone with its southern province and two belts covers the territory of the river Keles basin.

5A. *Piedmont belt of ephemeroid low grass semi savanna* (from 300-400 to 500-600 m). Mid-annual temperature is 12-14^{0}C. Mid-annual amount of precipitation differ from 300 to 400 mm. Natural vegetation cover is largely represented by ephemeroids and ephemers. Soil formation rocks are represented mainly by loess loams and Cretaceous and Tertiary rocks. Ground waters are located very deeply and do not influence on the process of soil formation. In the river valleys ground waters are located at the depth 4 – 5 and influence to some extend on the soils, increasing soil humidity and salinization.

5B.*Piedmont belt of ephemeroid-ephemer low grass semi savanna* (from 250 to 300-400 m). It is an alternating belt to a desert zone and the first step to vertical zonality. Mid-annual temperature makes up 12-13^{0}C. Mid-annual amount of precipitation differs from to 200 - 300 mm. Natural vegetation cover is represented mainly by ephemers. Ephemeroids occupy a subordinate pos tion.Medium silt (loess), light loams and loamy sands were found at this territory. Ground waters are located very deeply and do not influence on soil formation. They occur at an average depth (4-6 m) in the river valleys and have a weak chloride-sulphate mineralization.

B.1.5 Soils.

The following soil types were described on the territory of basin.

Mountain brown soils within basin of Keles river are formed under conditions of mid- and low-mountains with shrubs and grass-shrubs cover on northern slopes of hills.
Description of the profile: The depth of humus horizons (A+B)=75 cm, $A_1^д$ – 10 cm (brown-grey, clumpy), AB = 13-18 cm (grey-brown, granular), B_1=21-24 cm (brown, granular), B_2=23-30 cm (light brown, granular), BC=20 cm (yellow-brown, clumpy). Horizon 0-44 cm is rubble. HCl-reaction at 45-52 cm. White yellow spots of carbonates from 95 cm. Total organic C 6-9 %, total N – 0.4-0.5 %, C:N ratio >10, pH - neutral. Fulvic acid dominate over humic acids. Sum of exchangeable cations (25-35 meq per 100 g of soil).

Foothills grey-brown soils. Natural vegetation is presented with coarse-grain grasses with ephemeres and ephemeroides.
Description of the profile: The depth of humus horizons (A + B) 60-95 cm, including A=20-22 cm. The depth is higher in leached soils and lower in carbonate soils. The horizon A is gray or dark grey and has clumpy-granular structure. Horizon B is more brown with granular structure with developed earthworm perforation. Carbonate alluvial horizon is apparent. In leached soils the layer of carbonates is detected in bottom of the profile, whereas usually it is observed in the middle part of the profile and in the carbonate soils close to humus horizon. Total organic C varies from 2 to 3,5%. C/N ratio is between 8-10; Sum of exchangeable cations (15-21 meq per 100 g). Soil pH – alkaline or weakly alkaline. Humic acids dominate in organic matter of leached soils and have similar content in carbonate soils. Texture is closer to heavy clay-loam.
Sierozems in the basin are located in mid and lower part of foothill plains of Karzantau and Kazygurt ridges. Vegetation is short-grass ephemeroides and non-abundant ephemeres.

Description of the profile: Humus horizons A+B=55-65 cm, A=20 cm is grey coloured and characterised by presence of carbonate horizon (Вк) and carbonate-illuvial horizon (Ск). Total organic C – 1-2 %, organic N - 0,09-0,15% with C/N ratio 7,5-10. Fulvic acids dominate in organic matter. The content of carbonates in top horizon is 7-14% and increases with depth. Sum of exchangeable cations (10-14 meq per 100 g). pH – alkaline. Texture is heavy and normal clay-loam.

Meadow Sierosems are located on low terraces of river flow and other lowlands and depressions at the peripheries of foothill plains. These soils are formed under conditions of additional moistening with surface or ground water from 4-6 m depth. Among vegetation, it could be found a meadow species together with species specific for natural zones. Meadow Sierosems are characterised by wider humus horizons (A+B = 65-90 up to 100 cm) with grey or grey-brown colour, flat horizons, absence of carbonates and non-apparent carbonate-alluvial horizons. Total organic C – up to 1.5%, N – 0.07-0.09 % in ploughed horizon, C/N ratio 8-11. High carbonates content in top horizons – 13-16 %. Cation-exchange capacity 12-15 meq per 100 g soil. pH – alkaline. Texture is close to loess heavy clay-loam and light clay-loam.

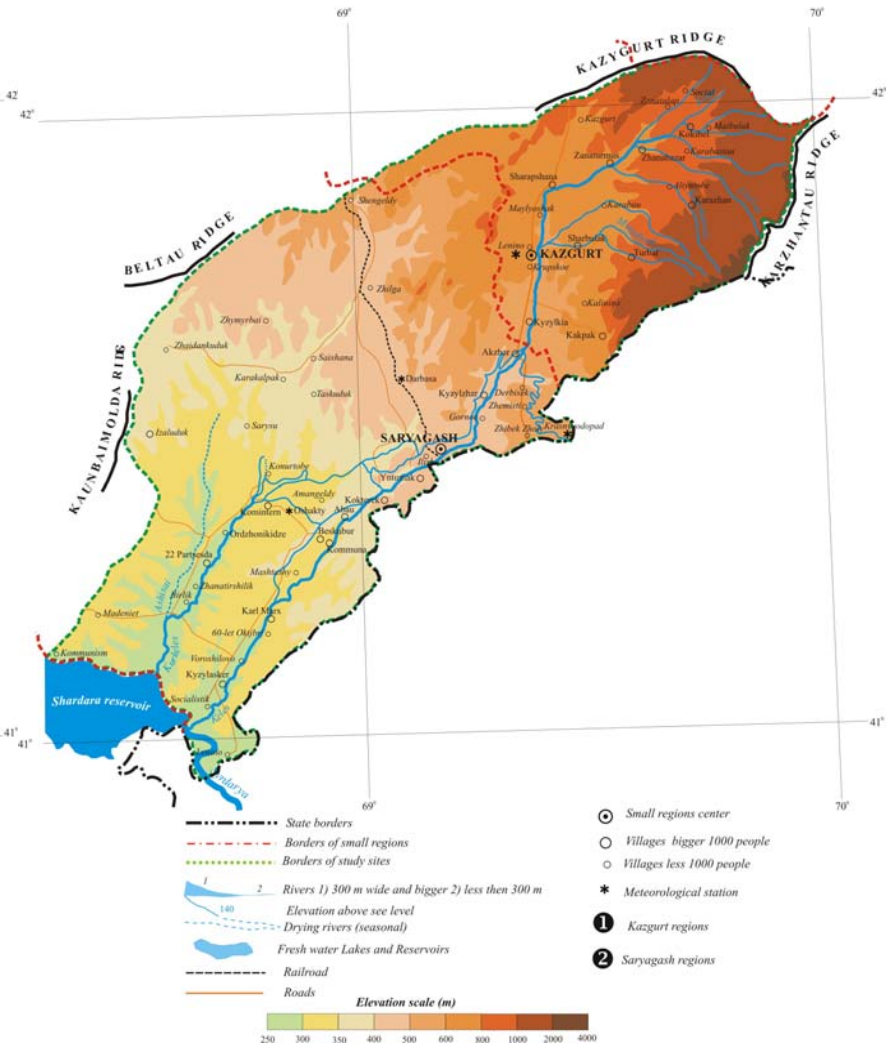
Soils along river flows are formed within modern river terraces under periodical flooding and constant moistening with shallow ground waters. Natural vegetation is characteristic for flooded meadow. We concentrate on alluvial meadow massif in along Syr-Darya river flow.
Description of the profile: horizon A+B is not very deep and grey coloured. Horizons are organized in apparent layers, with presence of ochre and glay spots. Total organic C – 1-2 %, N – 0.05-0.3 %, C/N – 10-12. The content of carbonates is changing with depth depending on original content of carbonates in alluvial horizons. Cation-exchange capacity 7-15 meq per 100 g soil. pH – alkaline. Among anions in saline soils are chlorine and sulphates with domination of sodium salts. Texture is clay-loam.

B.1.6. Natural landscapes.

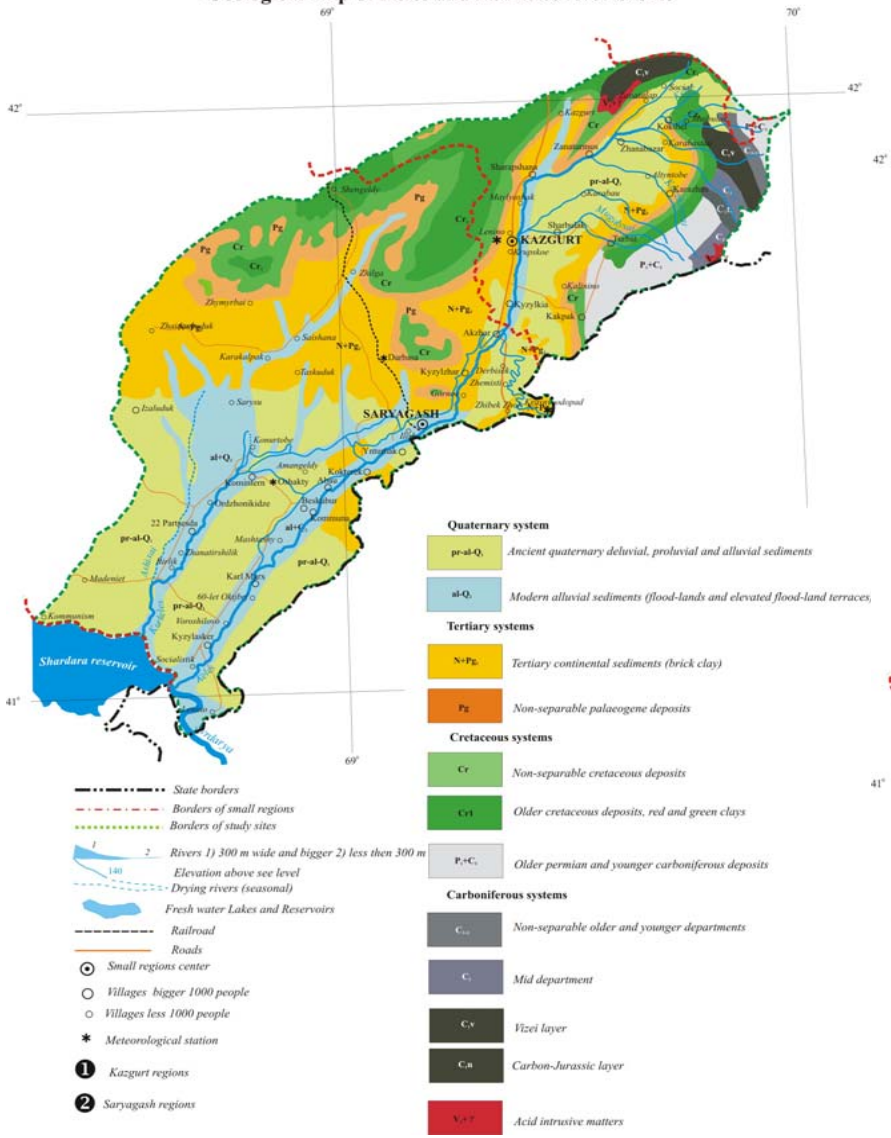
There are three zonal types of landscapes within the river Keles basin: forest, steppe and semi-desert. They all refer to mountain class and low mountain subclass. The major part of the territory is occupied by semi desert type with two types – piedmont, consisting of clays, loams and sands and piedmont alluvial-prolluvial plain, consisting of loams and sands. The steppe type, represented by lowland, also occupies the considerable part of the basin. The forest type occupies an insignificant part of Karzhantau ridge mountain zone.

Administrative map of Keles and Kurkeles river basin

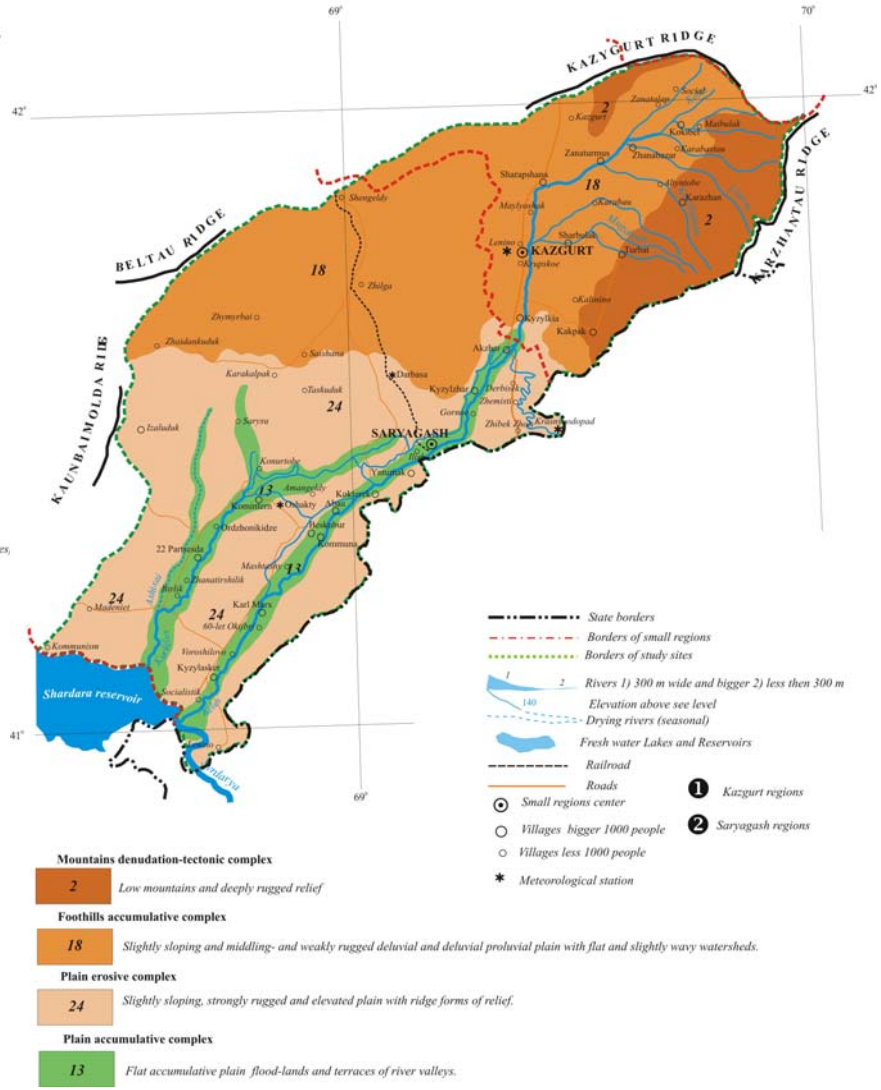
Physical map of Keles and Kurkeles river basin



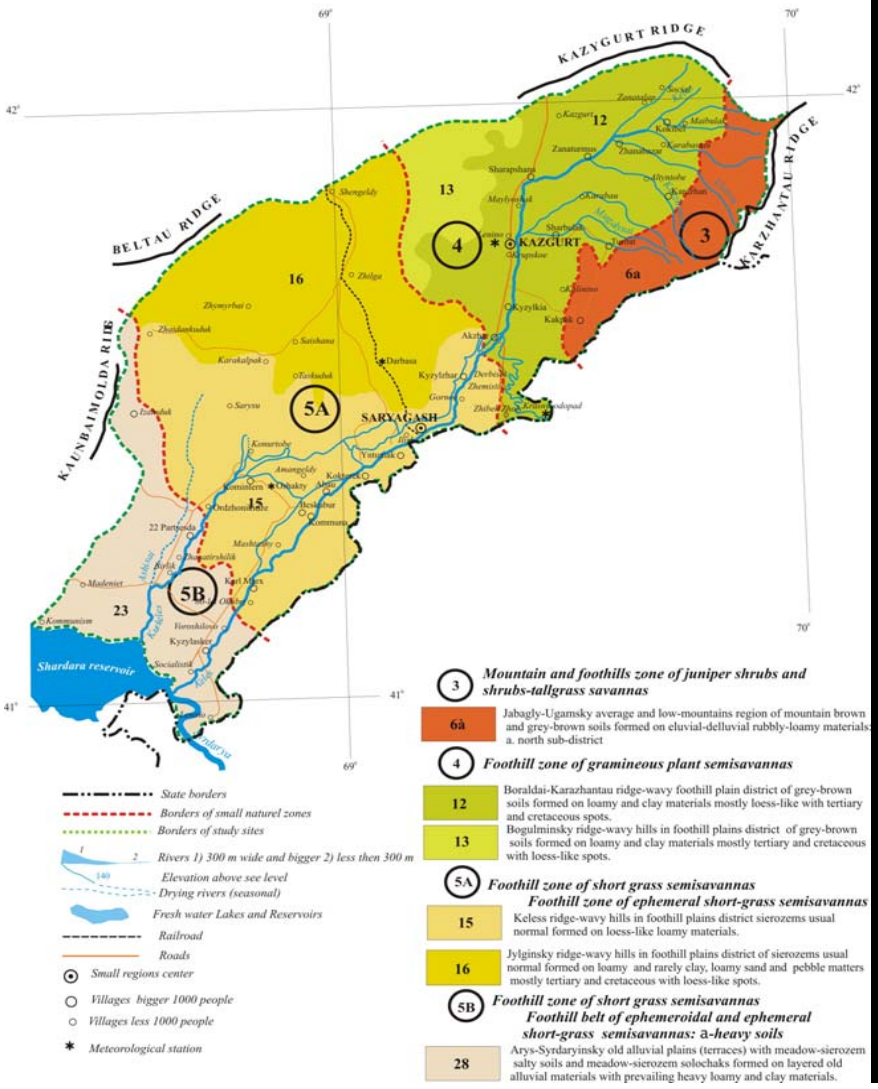
Geological map of Keles and Kurkeles river basins



Geomorphological map Keles and Kurkeles river basins



Natural zones of Keles and Kurkeles river basins



- State borders
- Borders of small naturel zones
- Borders of study sites
- Rivers 1) 300 m wide and bigger 2) less then 300 m
- Elevation above see level
- Drying rivers (seasonal)
- Fresh water Lakes and Reservoirs
- Railroad
- Roads
- Small regions center
- Villages bigger 1000 people
- Villages less 1000 people
- Meteorological station

3 *Mountain and foothills zone of juniper shrubs and shrubs-tallgrass savannas*

6à Jabagly-Ugamsky average and low-mountains region of mountain brown and grey-brown soils formed on eluvial-delluvial rubbly-loamy materials: a. north sub-district

4 *Foothill zone of gramineous plant semisavannas*

12 Boraldai-Karazhantau ridge-wavy foothill plain district of grey-brown soils formed on loamy and clay materials mostly loess-like with tertiary and cretaceous spots.

13 Bogulminsky ridge-wavy hills in foothill plains district of grey-brown soils formed on loamy and clay materials mostly tertiary and cretaceous with loess-like spots.

5A *Foothill zone of short grass semisavannas*
Foothill zone of ephemeral short-grass semisavannas

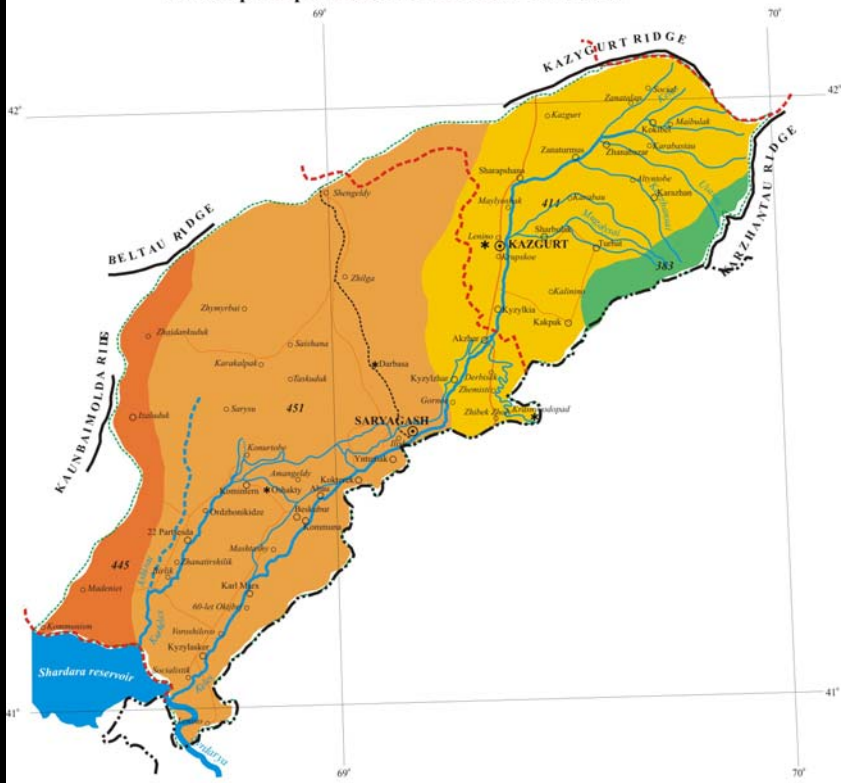
15 Keless ridge-wavy hills in foothill plains district sierozems usual normal formed on loess-like loamy materials.

16 Jylginsky ridge-wavy hills in foothill plains district of sierozems usual normal formed on loamy and rarely clay, loamy sand and pebble matters mostly tertiary and cretaceous with loess-like spots.

5B *Foothill zone of short grass semisavannas*
Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: a-heavy soils

28 Arys-Syrdaryinsky old alluvial plains (terraces) with meadow-sierozem salty soils and meadow-sierozem solochaks formed on layered old alluvial materials with prevailing heavy loamy and clay materials.

Landscape map of Keles and Kurkeles river basins



- State borders
- Borders of small regions
- Borders of study sites
- Railroad
- Roads
- Small regions center
- Villages bigger 1000 people
- Villages less 1000 people
- Meteorological station
- Kazgurt regions
- Saryagash regions

Mountain landscape.
Low-mountains Forest landscape

383 *Hilly ridges composed of limestones, alleviolites, gravelites, sandstones, tuffs with wild apple forests, meadows, meadow-steppes on mountain chernozems, mountain kastanozems.*

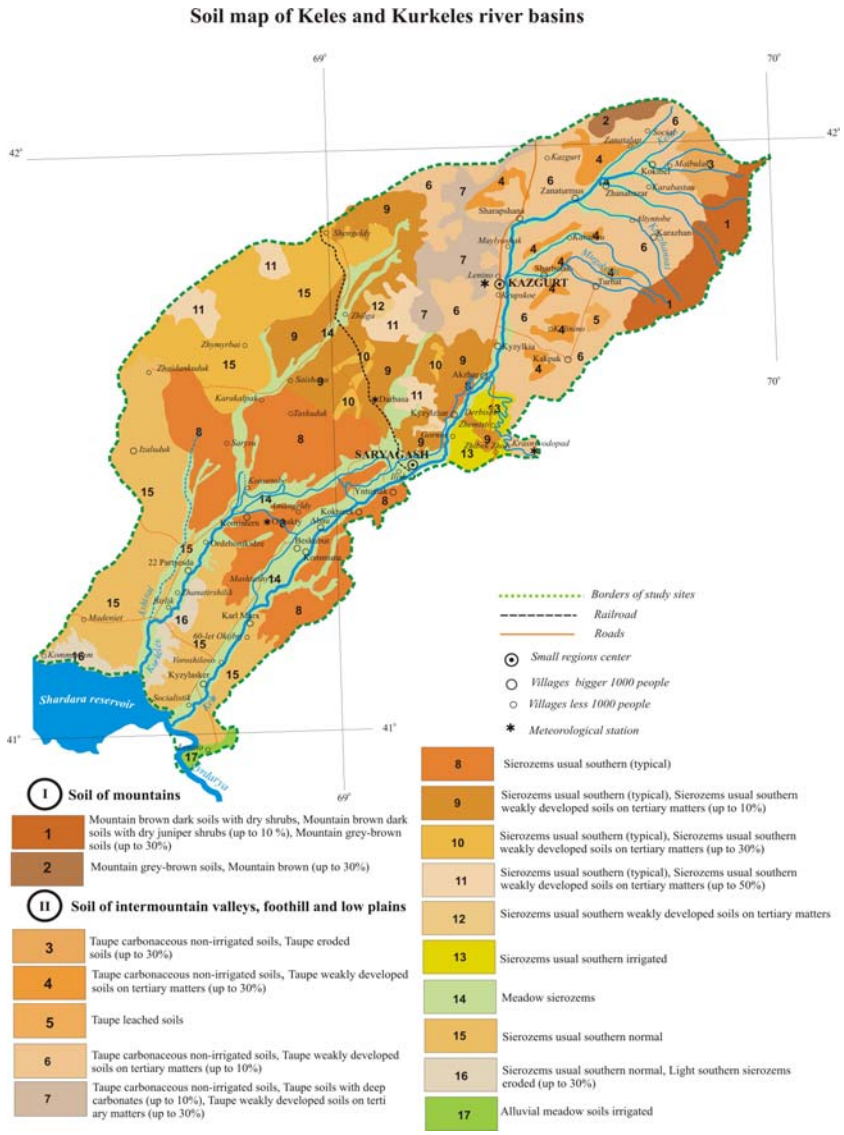
Mountain landscape.
Low-mountains Steppe landscape

414 *Hilly ridges composed of sandstones, sandy tuffs, tuff porthytes with couch-grass and shrubs formed on mountain chernozems.*

Mountain landscape.
Low-mountains Semideserts landscape

451 *Foothills composed of loam, clay and sands with domination of sedge and fowl-grass ephemeral plants on south usual sierozem.*

445 *Foothills alluvial-prolluvial plain consisting of loamy-sand and gravel-shingle materials. Domination of sedge fowl-grass ephemeral plants on south usual sierozem.*



B.2 Shardarinsky massif

B.2.1. Geographical position.

The study area called Shardarinsky massif is located in the middle stream of the river Syr Darya within Shardarinsky administrative region of South-Kazakhstan oblast. It covers the basic agricultural territory of the region (Kyzylkum massif of irrigation) and partially the adjacent massifs of Kyzylkum and Izakuduk. It borders with the Republic Uzbekistan in the south and west, Arys region in the north, Saryagash region in the east.

B.2.2. Geomorphology.

Geomorphologic conditions of the massif are not differentiated. The massif can be divided into two large geomorphologic regions according to its surface structure – piedmont and plain. Gently sloped and flat accumulative forms of relief are typical for the major part of the massif. Erosion forms of relief occur on a small territory of northern-east part of the massif.

B.2.3. Geological structure.

The geological structure of Shardarinsky massif is not complex. The piedmont plain consists of Cretaceous and Tertiary rocks. The rocks of the Tertiary system are represented by not dissected Pallaeogene and Tertiary continental (brick-red suite) deposits. The Cretaceous system is represented by the deposits of bottom geological series: red and green clays, Cretaceous not dissected deposits. The plain part is represented by the rocks of Quaternary system – old Quaternary delluvial, prolluvial and alluvial and young alluvial deposits. Quaternary eolian deposits also occur.

B.2.4. Geographical zonality.

The main part of Shardarinsky massif territory is located within the first step of vertical zonality in the *piedmont belt of ephemeroid-ephemers low grass semi savanna.* This belt was described in detail above in the description of the geographical zones in the Keles river basin. Therefore its description is not given here.
Natural vegetation is represented by forest-meadow, river plain meadow and halophytes primitive plant aggregations. Poorly layered alluvial deposits play the role of soil formation rocks. Ground waters occur at 3-4 m from the surface. They have a weak chloride-sulphate mineralization and cause a slight salinization of surface soil horizons everywhere.

B.2.5. Soils.

Soils were formed according to natural zones with intrazonal factors caused by Syr-Darya river. Sierozems, meadow-sierozems and alluvial meadow soils are similar to those in Keles river basin.

Takyrs are located on old-alluvial north left shore of Syr-Darya river. These soils were formed (degraded) from meadow and meadow-swamp saline soils with high humus content due to desertification. Profile is weakly differentiated. The top 0-5 cm is formed from dense and porous crust. Below is located a dense brown horizon 10-15 cm with located deeper features of relict soils. Total organic C – 0.7-0.8%, N – 0.05-0.06%, C/N – 7-8. Carbonate content at the top is 12%. pH – alkaline. CEC 5-6 meq per 100 g soil. Soil complex is saturated with Ca and partly Mg. Texture at the top is clay-loam and deeper sand-loam. Some features of remaining salinization are also characteristic.

Solonchaks within the massif represent an important type of saline soils. Profile is weakly differentiated however, the top horizons (A+B) 35-50 cm are slightly dark due to humus content. The presence of layered crust at the top, as well as and numerous crystals of salts at 5-15 cm depth are also characteristic. Chlorides and sulphates are the main anions present in this type of soil. Meadow solonchaks have 1-3 and up to 4 % total organic C and 0.07-0.15 up to 0.25 % organic N. C/N ratio is 9-12. Carbonate content varies within the range 6-16 %. CEC 5-13 meq per 100 g soil. Soil complex is saturated with Ca and partly Mg. pH – alkaline. Texture is heavy and normal clay-loam.

Solonetz are located in flat depressions under byurgun and tas-byurgun vegetation. Solonets are covered by a porous crust. Description of the profile: A=6-10 cm with deeper B=20-30 cm up to 40-50 cm horizon which has more heavy mechanical composition. Lighter yellow-brown salt horizon is located deeper. Chlorides and sulphates are the main anions. The deepest horizon is layered and has lower salt content.
The content of total organic C in desert takyr-similar solonets is 0.6-1 % whereas the N content varies in the range 0.04-0.07 % N. C/N ratio is 8-10. The content of fulvic acid

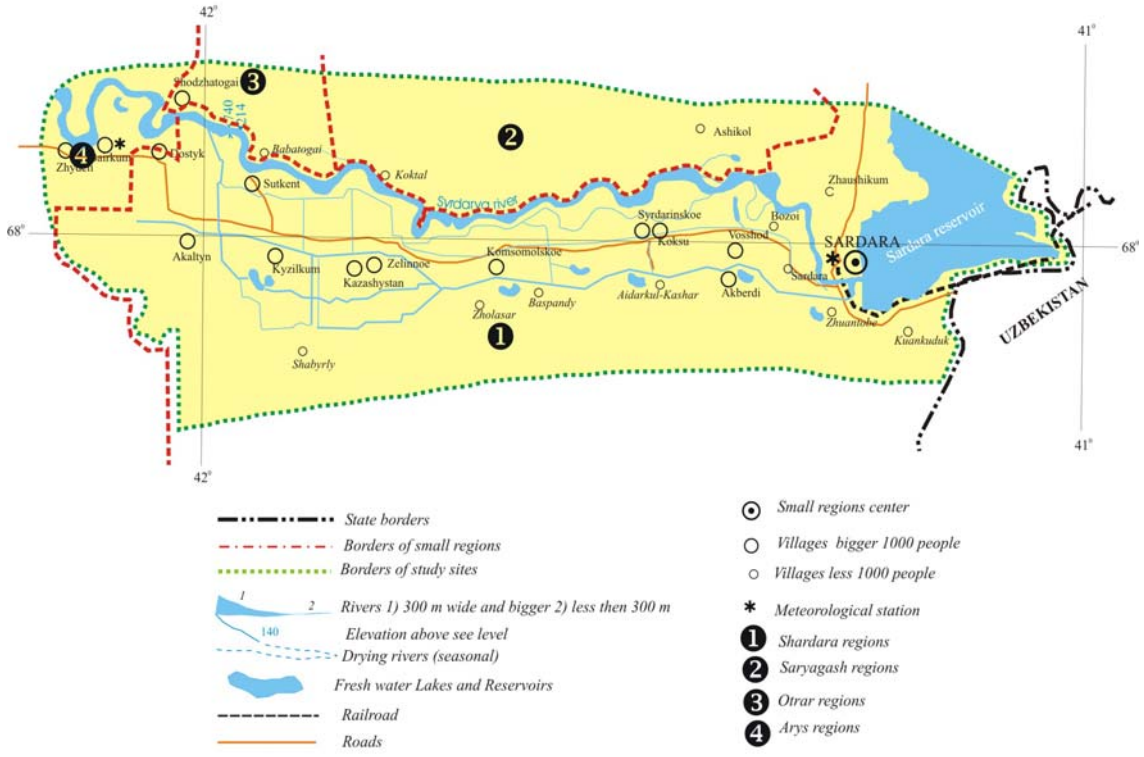
is 4-5 times higher then that of humic acids. Carbonate content 15-16 %. CEC 4-10 meq per 100 g soil. The content of exchangeable Na in top horizons may achieve 5-20 % and increases in salt horizons up to 35-65 %. pH – alkaline, in salt horizons strongly alkaline. Texture is clay-loam.

Sands occupy huge territories and are represented by fixed **sierozems**, weakly fixed and migrating barkhanes, ridge and ridge-hilly sands. Sands in the massif represent a part of Eastern Kyzyl-Kum and island sands Iza-kum located mostly in old-alluvial plains of Syr-Darya river. Vegetation is mostly represented by sagebrush-haloxylon and ephemeral-haloxylon communities with shrubs and ephemeres. Profile is weakly differentiated however, sands with low humus content, sands with initial stages of humus formation, with not visible humus horizon and sands without any features of soil formation and absence of humus horizon can be distinguished. All these types are characterized by the absence of apparent carbonate-illuvial horizon, associated with modern soil formation. Sierozem sands contain total organic C 0.1-0.7 % and total N - 0.005-0.04 % depending on sand content. Carbonate content 6-8 %. CEC less then 2-4 mg eq per 100 g. Calcium prevails in the sum of exchangeable cations of the soil. pH alkaline. According to granulometric composition, sands are small-grained with not significant contribution of fine particles (1-2 % and up to 5-10 %).

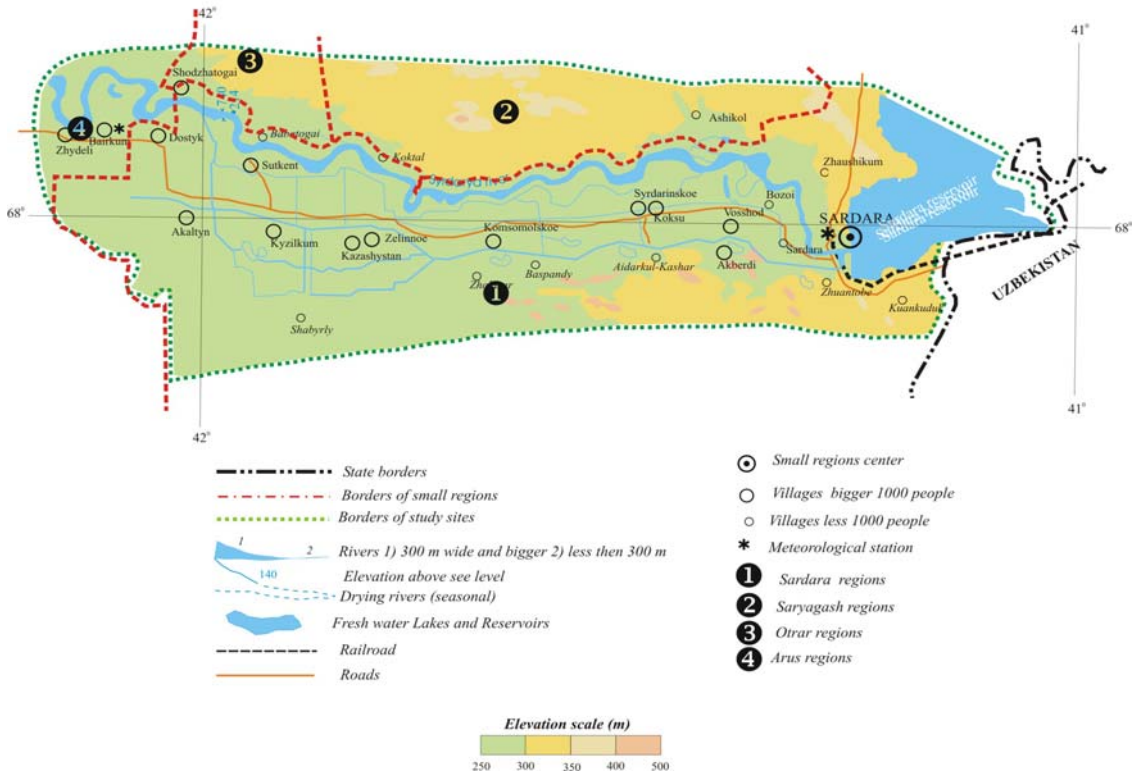
B.2.6. Natural landscapes.

The natural landscapes of Shardarinsky massif are represented by two zonal and one azonal type of landscapes. The semi desert landscape, represented by a piedmont alluvial-prolluvial plain, consisting of loams and loamy sands with ephemeroids vegetation prevails in the upper piedmont part. The semi desert part is completely represented by desert landscapes. On the plains located in depressions xerophytes, halophytes and psammophytes grow. The azonal valley type of landscape, represented by river plain, consisting of loams, sands with tugai is observed at the both banks of the river Syr Darya.

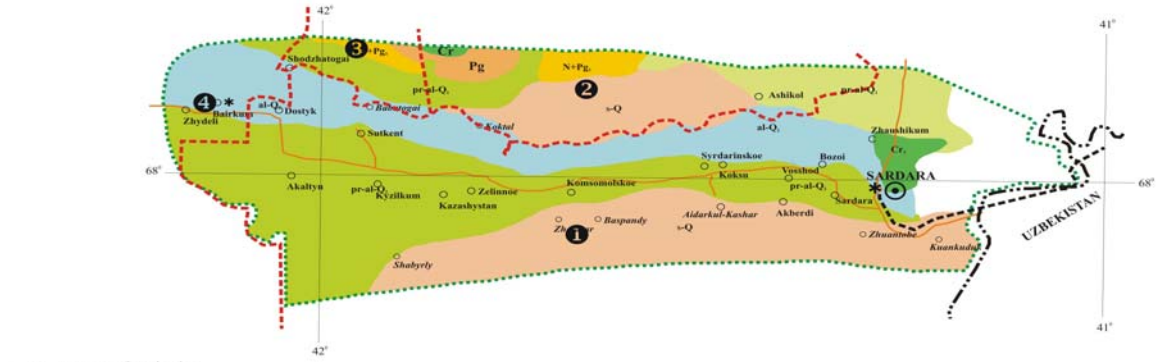
Administrative map of Shardara massiv



Physical map Shardara massiv



Geological map of Shardara massiv



State borders
Borders of small regions
Borders of study sites
Rivers 1) 300 m wide and bigger 2) less then 300 m
Elevation above see level
Drying rivers (seasonal)
Fresh water Lakes and Reservoirs
Railroad
Roads
Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station
1 Kazgurt regions
2 Saryagash regions
3 regions
4 regions

Quaternary system

- pr-al-Q$_{II}$ — Ancient quaternary deluvial, proluvial and alluvial sediments
- pr-al-Q$_{III}$ — Younger delluvial, proluvial and alluvial sediments of elevated terraces of Syr-Darya (3, 4 terraces)
- al-Q$_{IV}$ — Modern alluvial deposits (flood-lands and elevated flood-land terraces)
- v-Q — Aeolian deposits

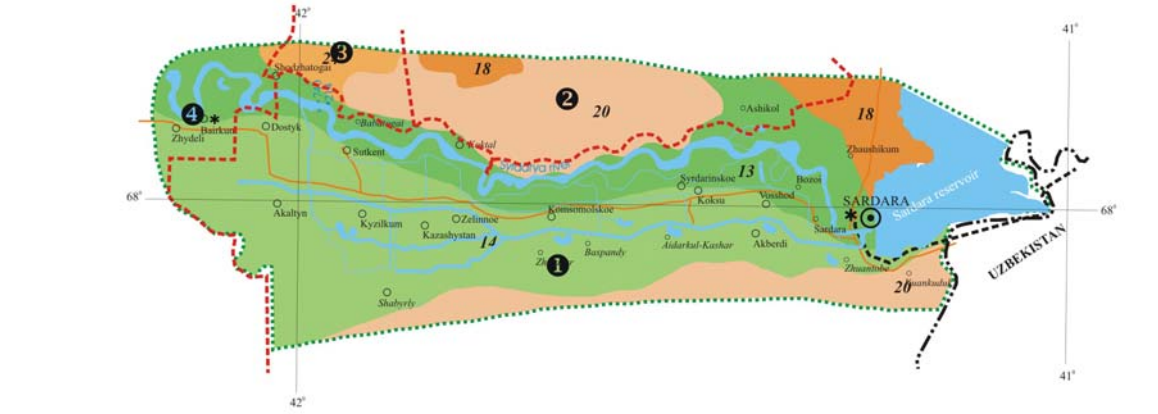
Cretaceous systems

- Cr$_{II}$ — Non-separable cretaceous deposits
- Cr — Older cretaceous deposits, red and green clays

Tertiary systems

- N+Pg$_{I}$ — Tertiary continental sediments (brick clay)
- Pg — Non-separable Palaeogene deposits

Geomorphological map of Shardara massiv



Foothills
Accumulative

18 — Slightly sloping, average and strongly rugged deluvial and deluvial-proluvial plain with flat slightly wavy watersheds.

Plain
Accumulative

13 — Flat accumulative plain flood-lands, terraces of river valleys

14 — Slightly sloping alluvial plain composed of takyrs elevated terraces of river valleys

20 — Plain with ridge and hilly forms of relief

Plain
Erosive

24 — Slightly sloping, strongly rugged elevated plain with hilly forms of relief

State borders
Borders of small regions
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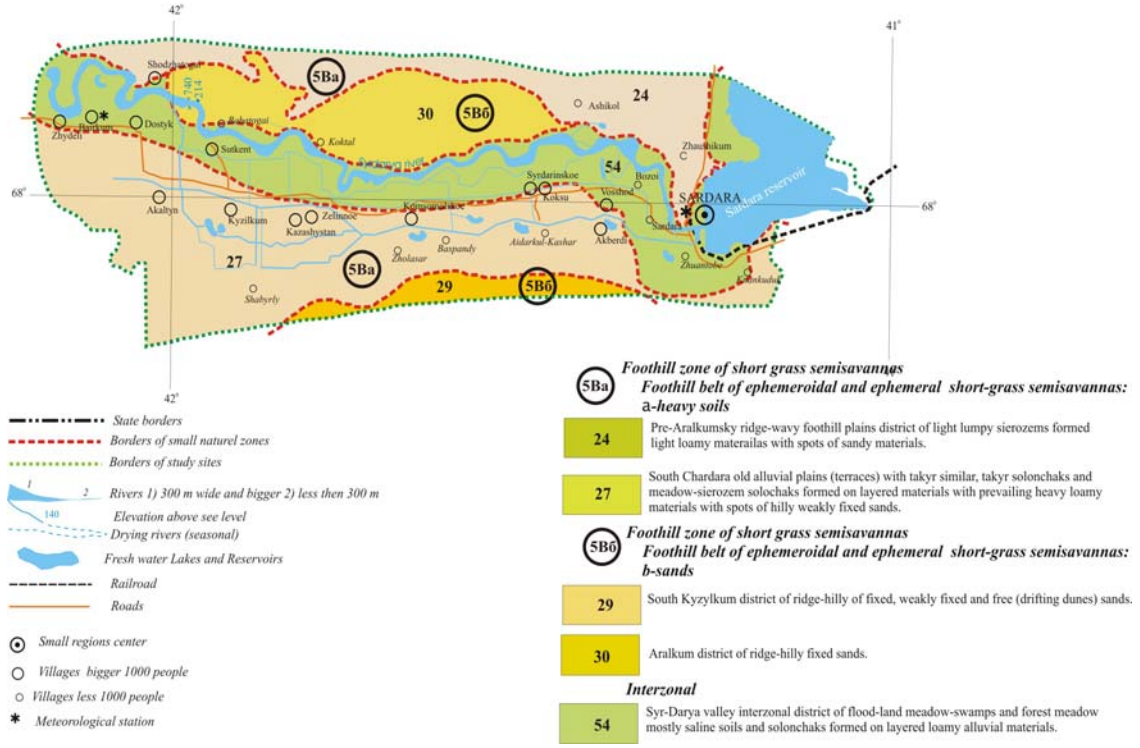
Meteorological station
1 Sardara regions
2 Saryagash regions
3 Otrar regions
4 Arus regions

Natural zones Shardara massif



5Ba ***Foothill zone of short grass semisavannas***
Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: a-heavy soils

- **24** Pre-Aralkumsky ridge-wavy foothill plains district of light lumpy sierozems formed light loamy materailas with spots of sandy materials.
- **27** South Chardara old alluvial plains (terraces) with takyr similar, takyr solonchaks and meadow-sierozem solochaks formed on layered materials with prevailing heavy loamy materials with spots of hilly weakly fixed sands.

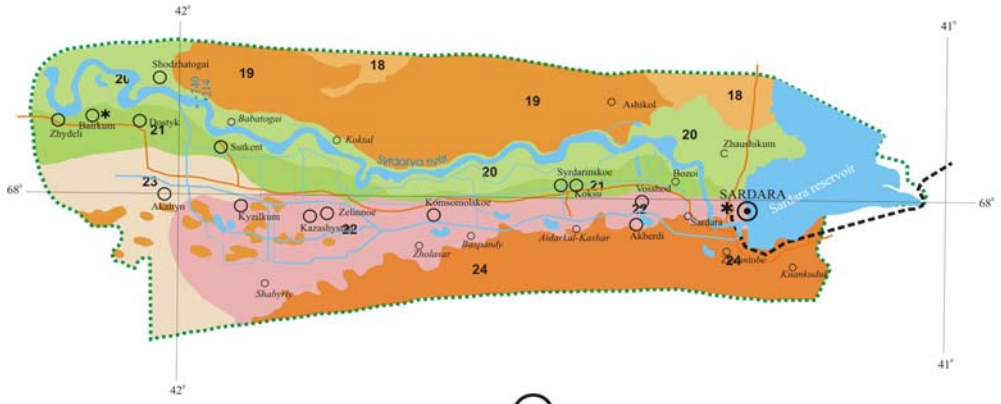
5Bб ***Foothill zone of short grass semisavannas***
Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: b-sands

- **29** South Kyzylkum district of ridge-hilly of fixed, weakly fixed and free (drifting dunes) sands.
- **30** Aralkum district of ridge-hilly fixed sands.

Interzonal

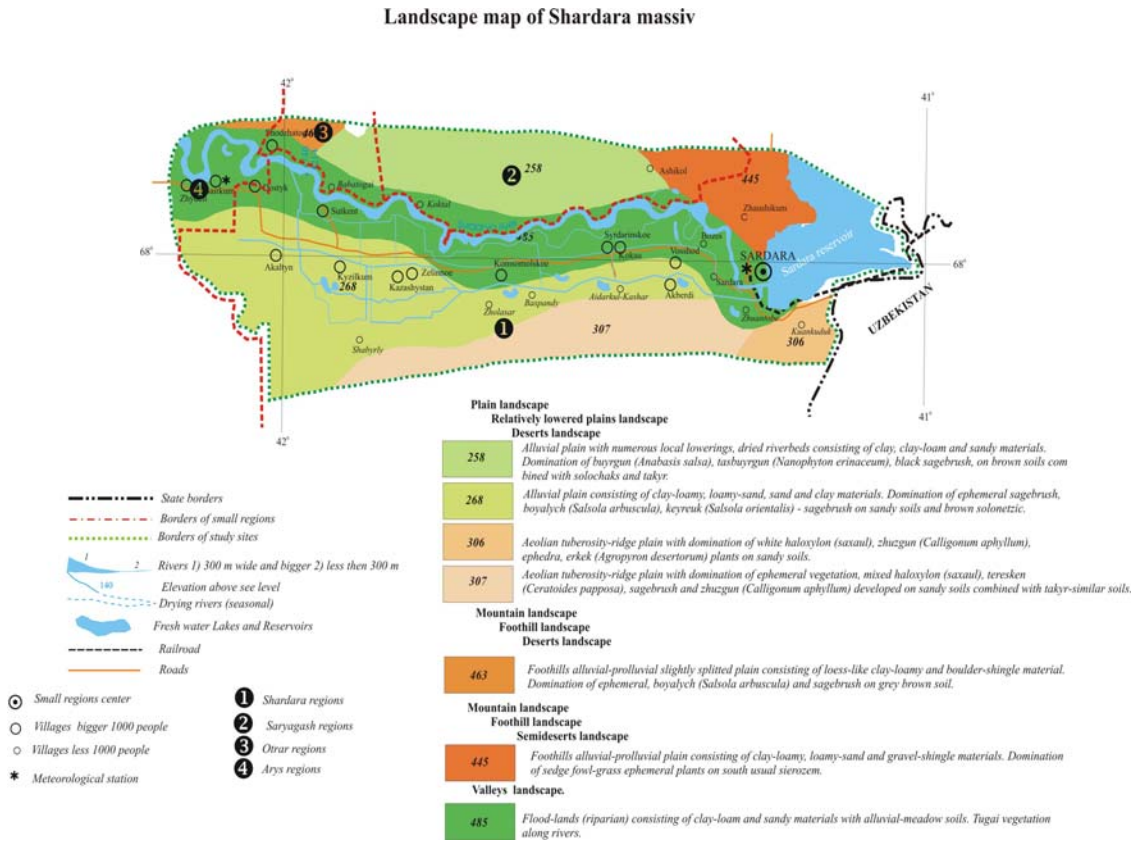
- **54** Syr-Darya valley interzonal district of flood-land meadow-swamps and forest meadow mostly saline soils and solonchaks formed on layered loamy alluvial materials.

Soils map of Shardara massif



2 Soil of intermountain valleys, foothill and low plains

- **18** Sierozems lights southern, Hilly fixed sands (up to 10%)
- **19** Hilly fixed sands
- **20** Alluvial meadow salty soils, Meadow solonchaks (up to 30%)
- **21** Meadow-sierozems similar to solonchaks, Weakly fixed hilly sands (up to 30%)
- **22** Desert solonetz similar to solonchak with crust, Takyr similar soils with processes of salinization (up to 10%), Meadow sierozems soils with processes of salinization (up to 10%)
- **23** Takyr similar soils with processes of salinization, Desert solonetz with crust (up to 30%), Weakly fixed hilly sands (up to 10%)
- **24** Ridge-hilly sands weakly fixed, Fixed ridge-hilly sands (up to 50%), Free sands (up to 30%)



B.3. Kazakh part of Golodnaya steppe

B.3.1. Geographical position.

Golodnaya Steppe massif is located on the left bank of the middle flow Syr Darya river close to Chardara reservoir. It covers the territory of Makhtaaral administrative region of South-Kazakhstan oblast specializing in cotton production.

B.3.2. Geomorphology.

The geomorphologic conditions of Golodnaya Steppe are not differentiated The relief of the whole massif territory is represented by a flat and not dissected accumulative plain of valley bottoms and plain flooded benches of river valleys.

B.3.3 Geological structure.

The geological structure of Golodnaya Steppe is also differentiated. The whole territory is covered by the rocks of Quaternary system – upper quaternary diluvial, proalluvial and alluvial deposits of high benches of the river Syr Darya.

B.3.4. Geographical zonality.

The territory of Golodnaya Steppe is located within the first step of vertical zonality – *piedmont belt of ephemeroid-ephemer low grass semi savanna*. The description of this belt is given in detail in section B.1.4.

B.3.5. Soils.

Soils were formed according to natural zones with azonal factors caused by Syr-Darya river. Sierozems, meadow-sierozems and alluvial meadow soils are similar to those in Keles river basin.

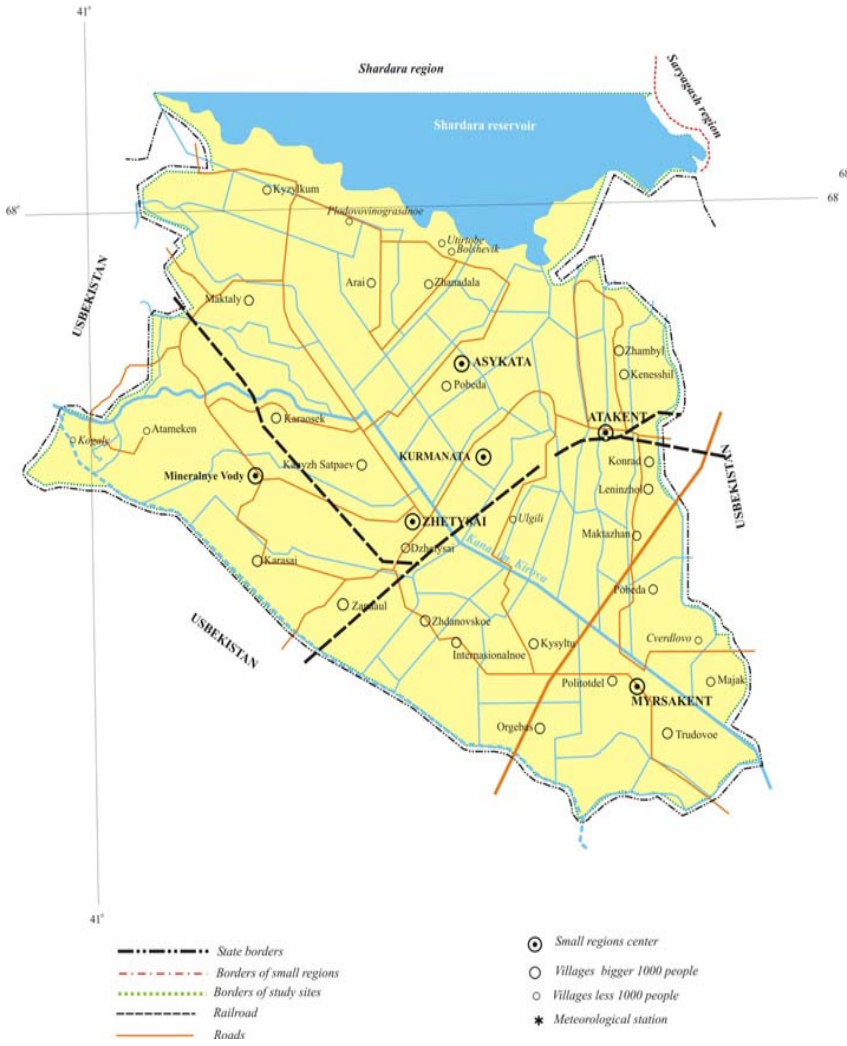
Takyrs are located along south shore of Chardara reservoir. They differ in salinity level from this type of soils in Chardarinsky massif. Salt crystals could be observed through-out the whole soil profile. The highest salinity (up to 2.5-3 %) is detected at 70-100 cm depth with lower salinity in higher and deeper layers. Dominating anion is SO_4^{2-} and cations – Ca^{2+} and Na^{+}. pH is alkaline. Salt horizon is located at depth 20-70 cm, with 18 % of Na in sum of exchangeable cations.

Meadow-bog soils are located in central part of Shardarinsky depression. The level of ground waters is shallow and ground waters are slightly mineralized. Dominating plant species are sedge, rush and reed. In the profile dark clumpy unstructured humus horizon is visible, which is transformed to gley bluish-grey clumpy horizon at 30-50 cm depth. Some crystals of salts could be observed in top horizon. Total organic C – 3-4 %, N – 0.2 %, C:/ ratio >11.The content of carbonates in gley horizon is higher then 30 %. CEC 20 meq per 100 g. In gley horizon 6-7 meq per 100 g. Absorbing complex is saturated with Ca and Mg. pH alkaline. Ions Cl^{-}, SO_4^{2-}, Na^{+}.
Solonchaks in Kazakh part of Golodnaya Steppe are typical and located at the peripher-ies of Sardobinskaya depression. Ground waters are shallow (up to 3 m depth) with high salinity. Vegetation is represented by halophytes. In contrast to meadow solonchaks, profile is not very deep, less differentiated and has lower level of total organic C and higher salts content. The content of salts in top horizon is up to 5-8 % and decrease with depth. Dominating anions are - SO_4^{2-}, Cl^{-}, cations - Mg^{2+}, Ca^{2+}, Na^{+} with prevalence of Mg above Ca. Typical solonchaks has lower total organic C, N and C:N ratio then meadow solonchaks. CEC 6-8 meq per 100 g. Absorbing complex is saturated with Ca and partly Mg. pH alkaline and strongly alkaline. Soil profile is not layered and texture is heavy clay-loam and clay.

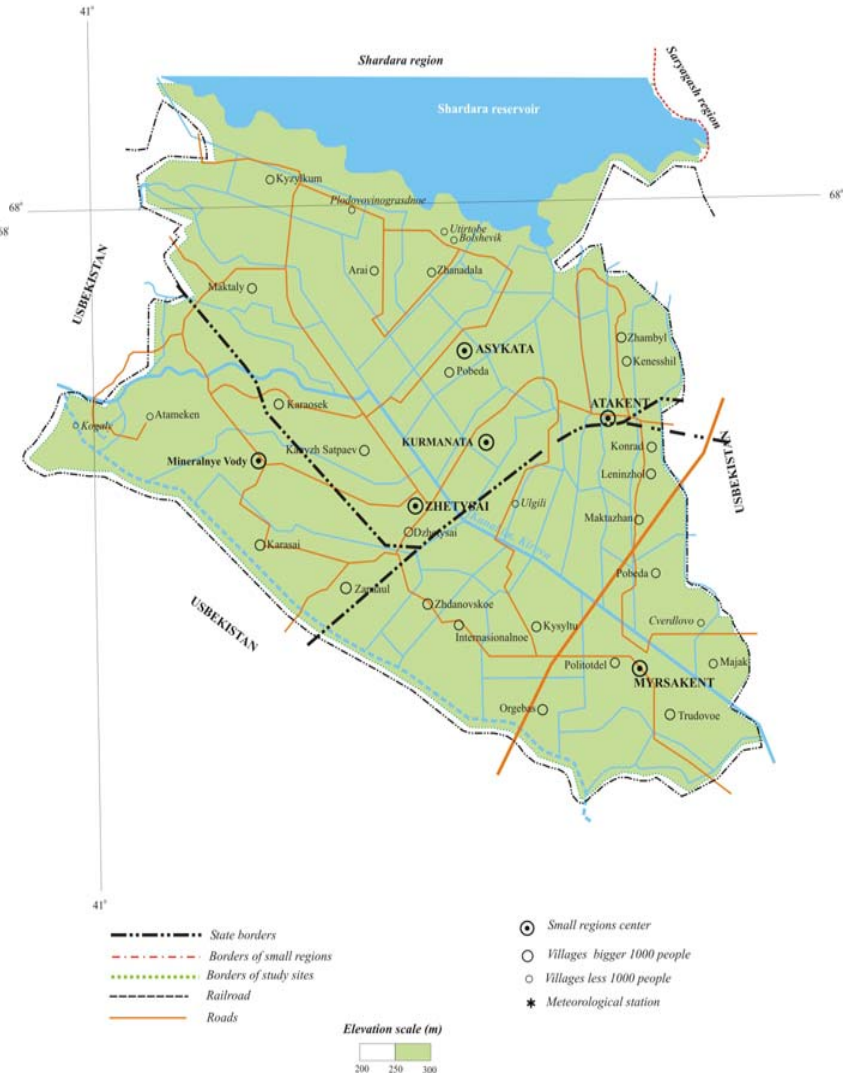
B.3.6. Natural landscapes.

The natural landscapes of Golodnaya Steppe are rather monotonous due to a simple steppe surface structure and monotonous geological, geomorphological and other natural conditions. They are represented by semi desert piedmont plain, consisting of loams with ephemeroid-ephemer veget

Administrative map of Golodnaya step



Physical map Golodnaya step



Geomorpholodical map Golodnaya step

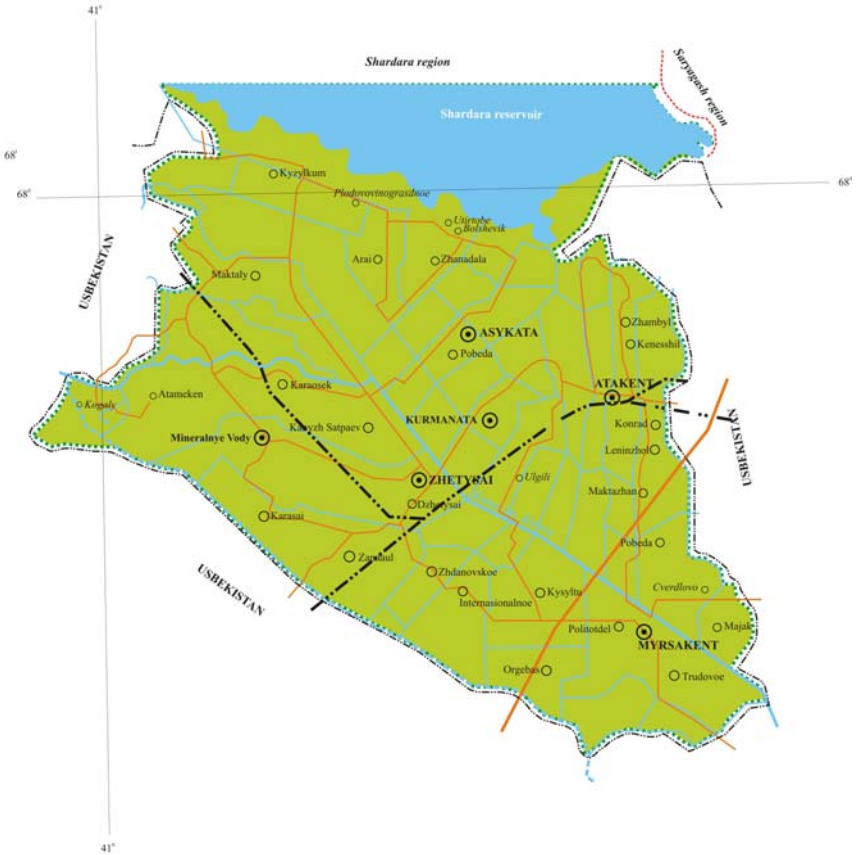
State borders
Borders of small regions
Borders of study sites
Railroad
Roads

Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station

Plain
Accumulative

13 Flat accumulative plain flood-lands, and terraces of river valleys

Geological map Golodnaya step



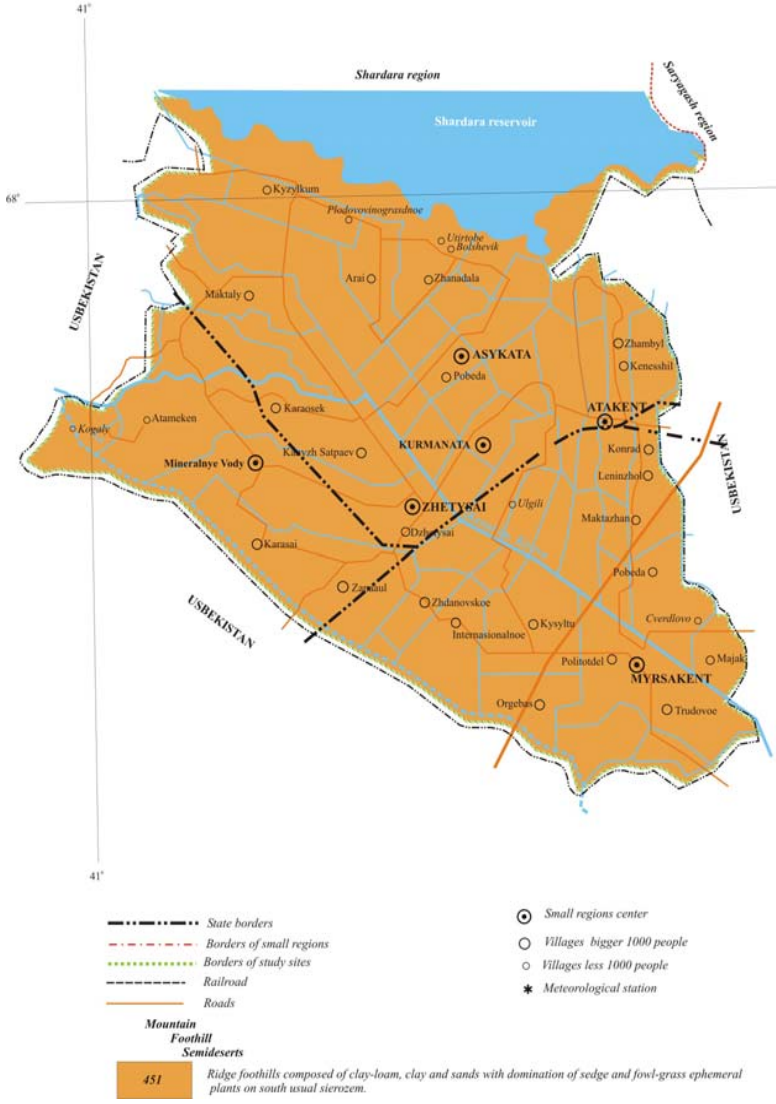
State borders
Borders of small regions
Borders of study sites
Railroad
Roads

Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station

Quaternary system

pr-al-Q, *Younger quaternary deluvial, proluvial and alluvial sediments of elevated terraces of Syr-Darya (3, 4th terraces)*

Landscape map of Golodnaya step



Natural zones of Golodnaya step

B.4. Shieliysky Massif

B.4.1 Geographical position.

This massif is located in the pre-delta part of the Syr Darya basin. It occupies the territory of rice growing massif (the same name), takyr-sandy plain Daryalyk-Takyr, lower flow of the river Sarysu, south-west borders of North Karatau and a part of sandy massif Kyzylkum. It borders Syr Darya region of Kyzyl- orda oblast in the north and west, Republic Uzbekistan – in the south and Zhanakorgan region of Kyzyl -orda oblast and Suzak region of South-Kazakhstan oblast – in the east.

B.4.2. Geomorphology.

The geomorphology of this study area is characterized by different forms of relief. Two typical large geomorphologic regions are met here: mountainous and plain. The mountainous region occupies the eastern and north-eastern parts of the territory and it is represented by the ridge North Karatau. The relief of the ridge is represented by a deeply dissected denudation-tectonic complex. The plain part, within the research territory, is represented by a weakly rolling denudation plain with hillock forms of relief, erosive gently sloping dissected raised plain and flat accumulative plain – river plains and flood-plain benches of river valleys. Erosion-accumulative takyr-like and lake basins are also met here.

B.4.3. Geological structure.

The geological structure of Shieliysky massif is characterized by a complex structure and heterogeneity. The mountainous Karatau part consists of sedimentary rocks, continental deposits of Devonian, Ordovician, Cambrian, Proterozoic systems. The rocks of Tertiary and Cretaceous systems are located on the so- called “Tertiary-Cretaceous plateau”. They are represented by neogenic brown clays and not dissected Cretaceous deposits. The most distributed deposits are: upper- and middle quaternary and current alluvial deposits of the Quaternary system.

B.4.4. Geographical zonality.

The region of the research is located in the desert zone of the vast Turan lowland. The climate is extremely continental: hot dry summer and cold winter with unstable snow cover. The average annual temperature of air is between +7 to +11^{0}C. The massif is very arid; the precipitation ranges from 152 to159 mm/ year. The territory is subdivided into 4 natural zones:

1. *Piedmont and lowland desert zone of Karatau.* The north-west borders of Karatau mountains cover the massif. The low parts of the north piedmont slope with elevation 180-300 m are covered by *Anabasis salsa* vegetation. *Artemisia* and *Anabasis* vegetation is distributed higher and closer to the mountains.
2. *Desert right bank zone covers Sarysu delta solonchakous desert and Daryalyk-Takyr ancient alluvial-plain regions.* The northern desert is almost an ideal plain. The vast takyrs with the spots of takyr-like solonchakous alkaline soils prevail. The ground waters are located at 7-10 m depth. They are saline. The pastures are poor, waterless, autumn-spring; the stock of forages is 0, 8-1 c/ha.
3. *Central agricultural zone.* The region of Shieli oasis with azonal hydromorphic soils and solonchaks. This is region of intensively developed irrigation.
4. *Desert left bank zone.* Kyzylkum region of ridge-hillock fixed, at some places weakly fixed and dune moving sands. The sands have a hillock-ridge relief. The vegetation

cover is represented by *Artemisia terra-albae* Krasch, *calligonum aphyllum, Ammodendron bigolium* Pall. and *Holoxylon persicum*. The soil formation process is weakly pronounced. Profile differentiation into horizons is almost absent.

B.4.5 Soils.

Sierozems are formed mainly on slightly sloping surfaces of foothill plains in Northern Karazhantau with grain-sagebrush vegetation. As soil-forming matters serve non-salty sediments of different origin with clay-loam horizon at the top and gravel rocks at the bottom.
Profile is characterized by visible carbonate alluvial horizon located below grey humus horizon A and grey-brown horizon B. Comparing to light sierozems, usual sierozems have higher total organic C 1.01-1.1 %, N- 0.07 %, and C/N ratio 8.08-8.1. CEC 5.35-8.68 meq per 100 g. Calcium dominates among exchangeable cations. Top horizon is rubbly. Fine sand and coarse dust particles dominate among fine particles.

Grey-brown soils are located on the slopes of low hills in foothills of south-west Karzhantau. These soils are developed on tertiary carbonate sediments with sagebrush-boyalych vegetation. Pebbles and graves are observed in the profile. The top horizon is grey coloured, horizon B is brownish or grey-brown and the deepest horizon is brown. Spots of carbonates are met from 25-30 cm with gypsum in the deepest layers. These soils have light mechanical composition. Grey-brown soils are poor of nutrients, percentage content of organic C <1

Takyr similar soils are identical with those in Shieliysky massif.
Takyr soils are located within old alluvial plain Dryalyk-Takyra together with takyr similar soils. These soils are developed in desert zone in depressions of relief under conditions of periodical flooding with melting and rain waters. These soils were formed with delluvial material, salinization events and due to the activity of green-blue algae on surface. Soil forming matters are clay and clay-loam covering layered old alluvial sediments. Soil bulk density is higher at the surface and lower in deeper horizons. Takyres have porous crust, heavy texture, low salinity level (0.4-0.8 %) with domination of chlorides. Total organic C <0.7 %, C/N ratio 5.2-5.6, CEC 8.9-13.9 meq per 100 g with prevailing Ca in top horizon and Mg in horizons deeper then 20 cm.

Alluvial-meadow soils are developed in valleys of Syr-Darya and Sarysu rivers on alluvium of different mechanical composition. Ground waters are shallow, 1-2 m deep, not saline or sometimes with low mineralization level 3-4 g/L. The description of the profile and main properties of the soils are similar with those concerning alluvial meadow soils in basin of Keles river.

Meadow-bog soils are specific hydromorphic soils and represent the main area of irrigated agriculture in pre-delta of Syr-Darya river. They represent a deposits of matters of different ages. They are divided on: 1) non-treated (virgin) meadow-bog soils with reed vegetation; 2) meadow-bog soils under crops of of temporal irrigation; 3) desertifying meadow-bog soils. These soils are located in central part of pre-delta in wide and flat depressions of relief. Together with bog soils they form a stable complexes and represent dynamic system of transition depending on hydrological regime. Ground waters are shallow 2-3 m deep, not saline or having low salinity. The profile and main properties are similar to those of meadow-bog soils in Golodnaya steppe.

Solonchaks are located in pre-delta of Syr-Darya valley and low flow of Sarysu. Solonchaks are divided on typical, ‘shor’ and meadow solonchaks. Typical solonchaks are located at higher parts of relief and in complex with alluvial-meadow and meadow-bog

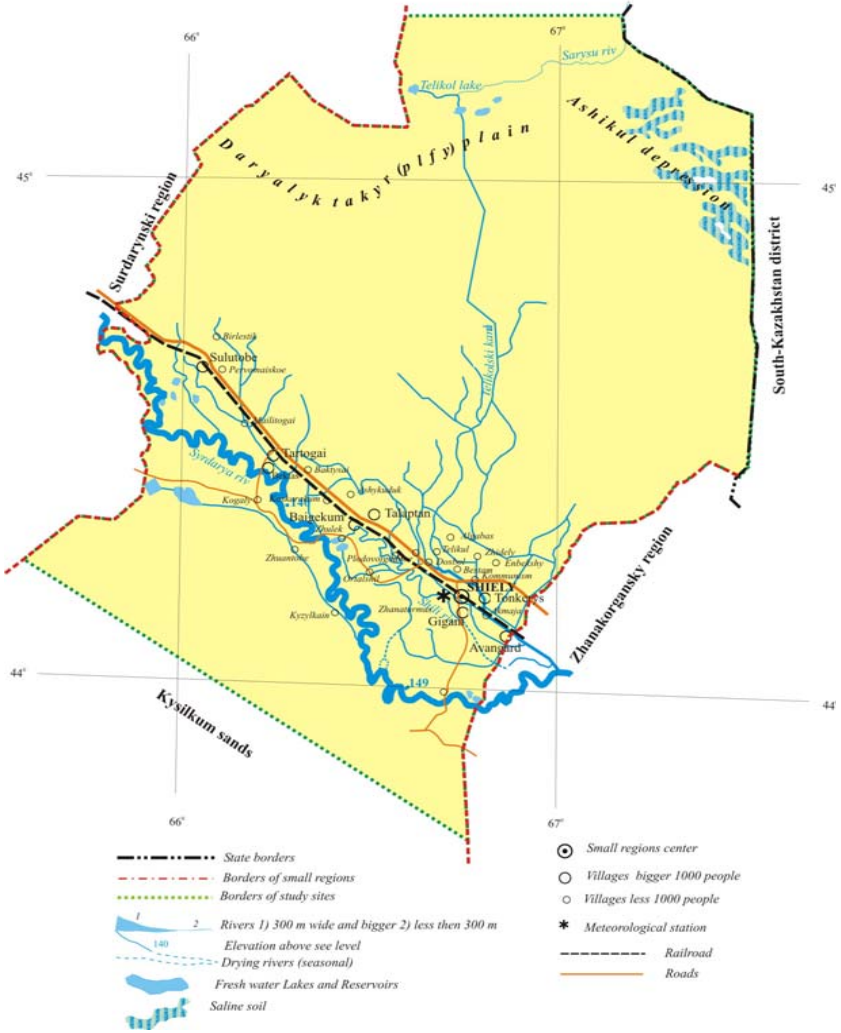
soils. Ground waters at 3-4 m depth are saline with chloride and sodium ions 8-10 g/L, sometimes slightly higher. The profile is layered. 'Shor' Solonchaks are located mostly in wide depressions of relief on salt rocks. Ground waters are located at 1m depth and have salinity up to 90 g/L (chloride and sodium). Maximum level of salinity is detected at the top and the bottom with lowest salinity in mid horizon. Gypsum is also detected throughout the profile. Meadow Solonckaks are located in moistened zones of Syr-Darya valleys and low flow of Sarysu river and at the peripheries of lakes. Texture is varying with prevailing light composition. Sulphates and sodium dominate among ions particularly from the top of soils down to 50 cm depth. Total organic C >2 %. This type of solonchaks can be treated to involve in cropping system.

Sands comprise huge territories and represent a part of Eastern Kyzyl-kum sand massif and islands of sands Aral-kum. These sands are located in old alluvial plain Dryalyk-Takyr. Characteristics of sands was given above (Shardarinsky massif).

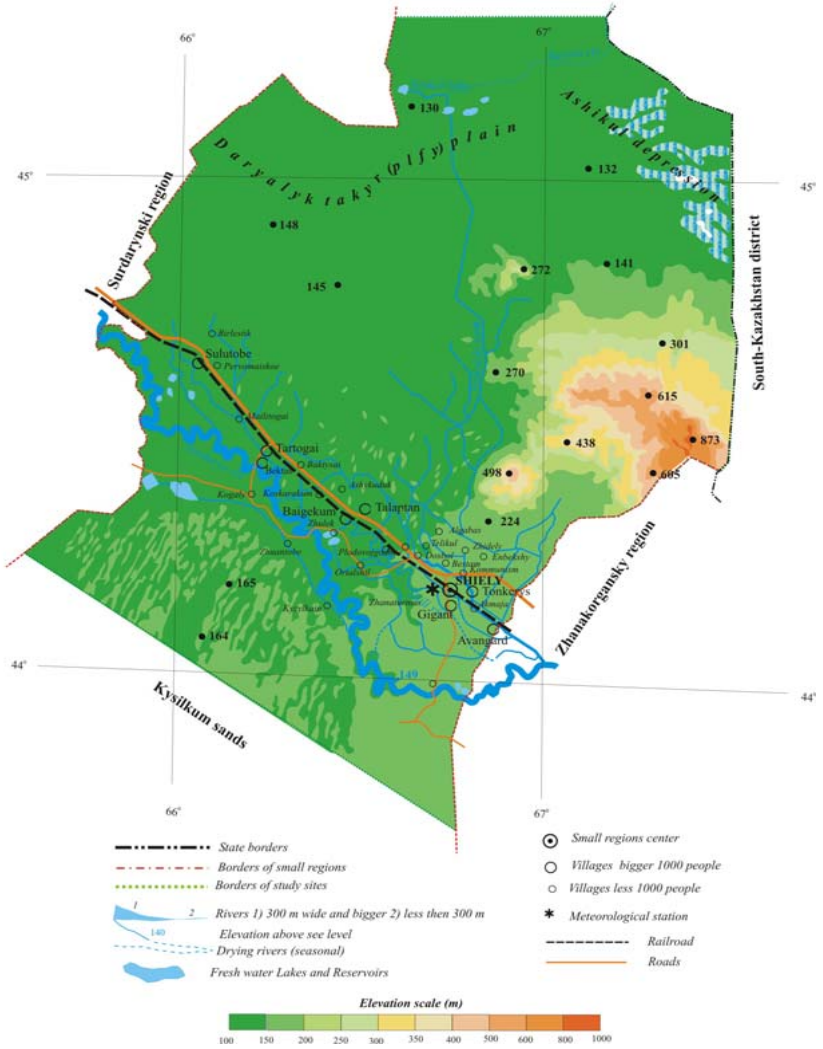
B.4.6 Natural landscapes.

The natural landscapes of Shieli massif have a great variety of species due to contrast natural conditions, presence of mountain ridge and Syr Darya River. The natural landscapes of the mountain part are represented by low mountain steppe and piedmont desert types of landscapes. Plain landscapes are represented by the desert type of the raised and lowered plains. An azonal valley type of landscape represented by a river plain, consisting of clays, loams and sands with tugai, meadow, and halophytic-meadow vegetation, is distributed in the conditions of hydromorphic regime on both banks of the river Syr Darya.

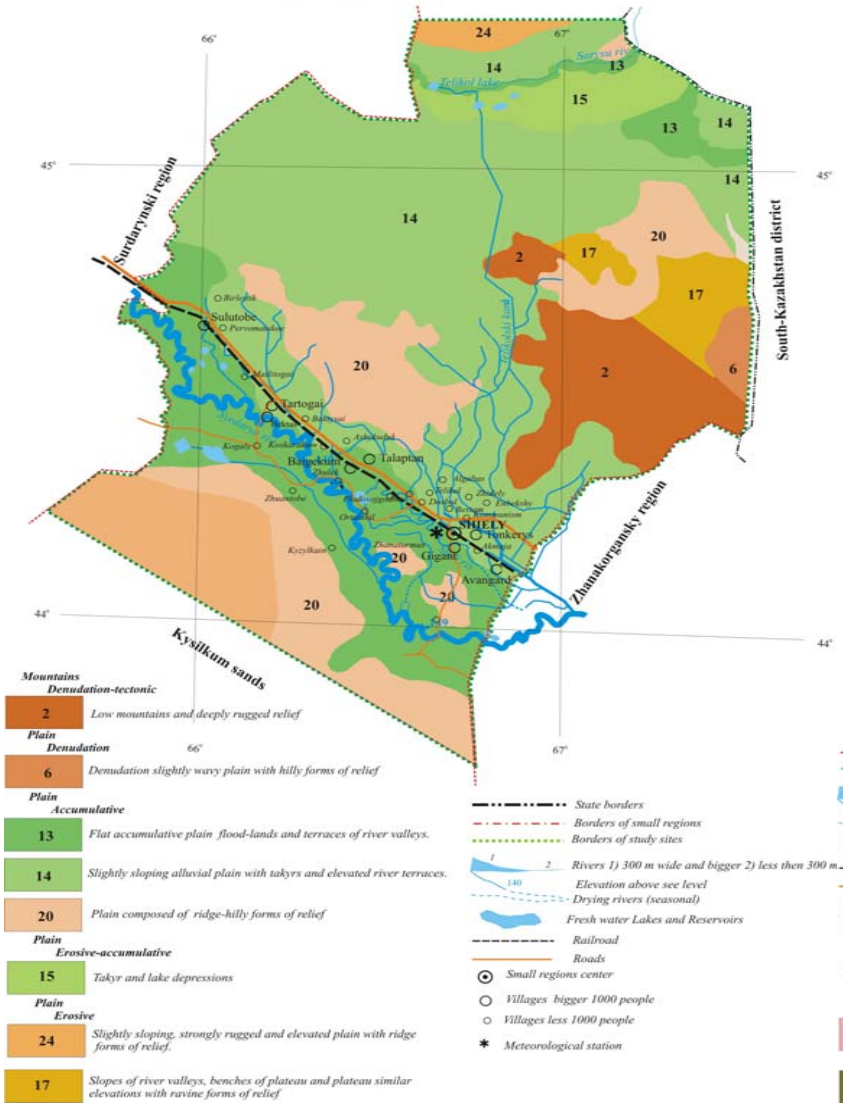
Administrative map of Shieli massiv



Physical map of Shieli massiv



Geomorphological map of Shieli massiv



Mountains

Denudation-tectonic

2 — Low mountains and deeply rugged relief

Plain

Denudation

6 — Denudation slightly wavy plain with hilly forms of relief

Plain

Accumulative

13 — Flat accumulative plain flood-lands and terraces of river valleys.

14 — Slightly sloping alluvial plain with takyrs and elevated river terraces.

20 — Plain composed of ridge-hilly forms of relief

Plain

Erosive-accumulative

15 — Takyr and lake depressions

Plain

Erosive

24 — Slightly sloping, strongly rugged and elevated plain with ridge forms of relief.

17 — Slopes of river valleys, benches of plateau and plateau similar elevations with ravine forms of relief

State borders

Borders of small regions

Borders of study sites

Rivers 1) 300 m wide and bigger 2) less then 300 m

Elevation above see level

Drying rivers (seasonal)

Fresh water Lakes and Reservoirs

Railroad

Roads

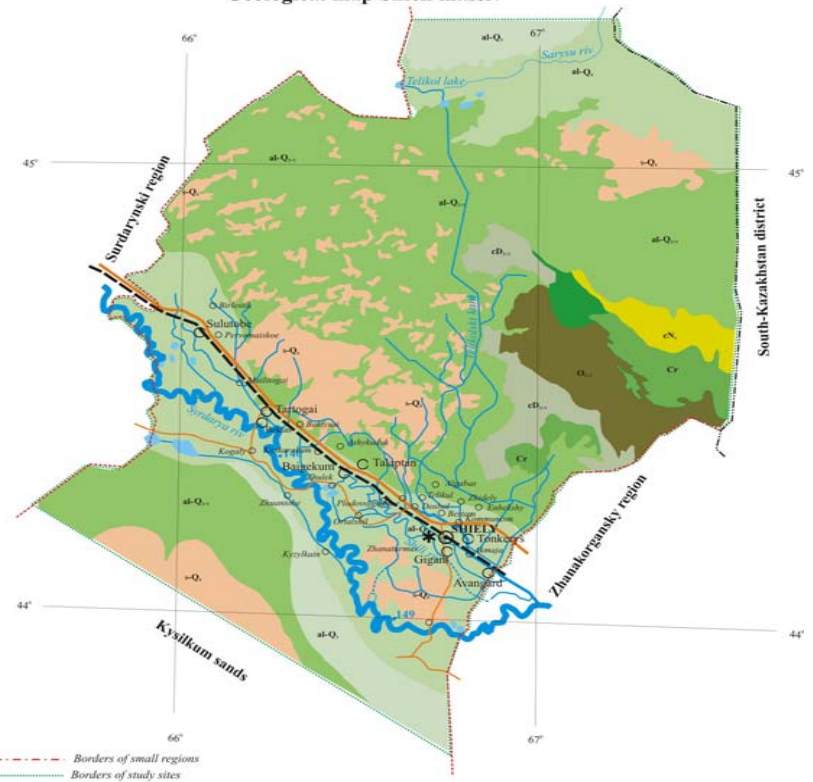
Small regions center

Villages bigger 1000 people

Villages less 1000 people

Meteorological station

Geological map Shieli massiv



Borders of small regions

Borders of study sites

Rivers 1) 300 m wide and bigger 2) less then 300 m

Elevation above see level

Drying rivers (seasonal)

Fresh water Lakes and Reservoirs

Railroad

Roads

Small regions center

Villages bigger 1000 people

Villages less 1000 people

Meteorological station

Cambrian system

Cm_1 — Older Cambrian deposits. Karoyt measure.

Ordovician system

O_{2-3} — Mid and younger departments. Sandstones, shale and limestones.

Quaternary system

$al\text{-}Q_3$ — Younger quaternary alluvial deposits (flood-lands and elevated flood-land terraces)

$al\text{-}Q_4$ — Modern alluvial solonchaks and takyrs

$al\text{-}Q_{2-3}$ — Mid and younger alluvial deposits

$v\text{-}Q_4$ — Aeolian deposits

Cretaceous system

Cr — Non-separable cretaceous deposits

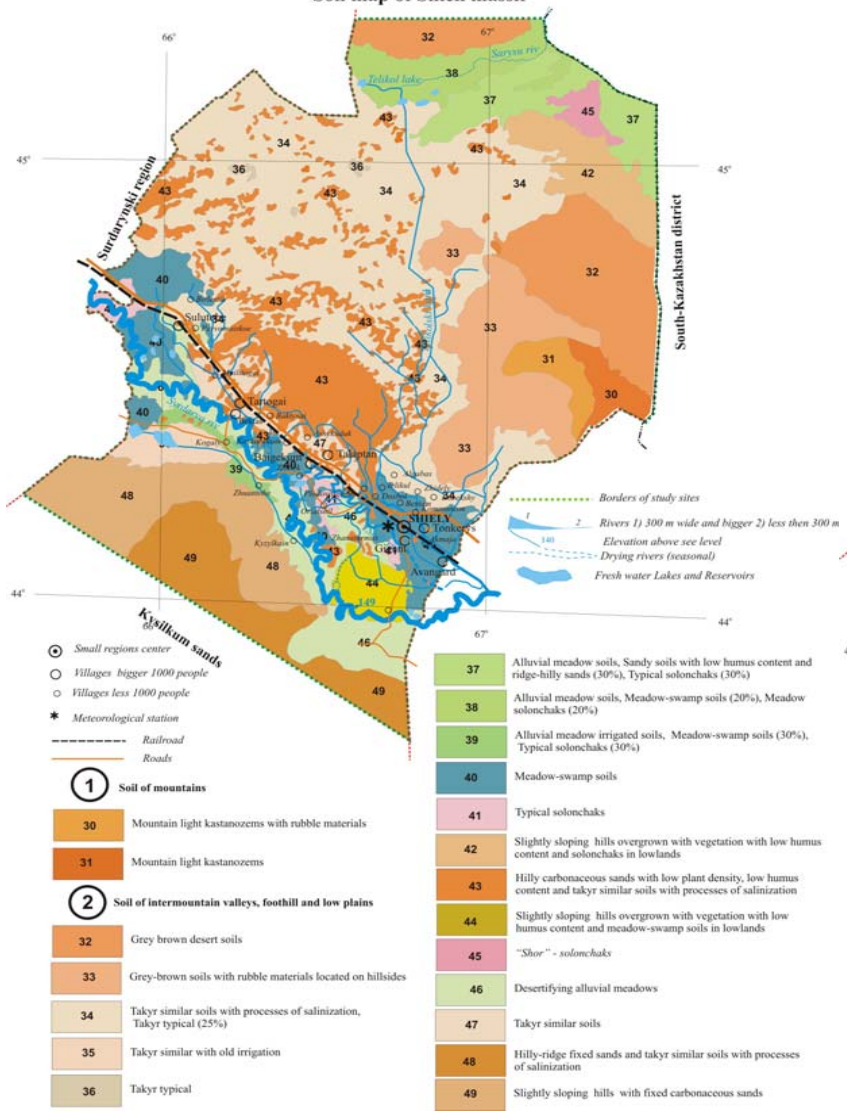
Tertiary system

cN_1 — Continental neogene brown and sandy clays

Devonian system

cD_{2+3} — Non-separable younger and older continental departments

Soil map of Shieli massif



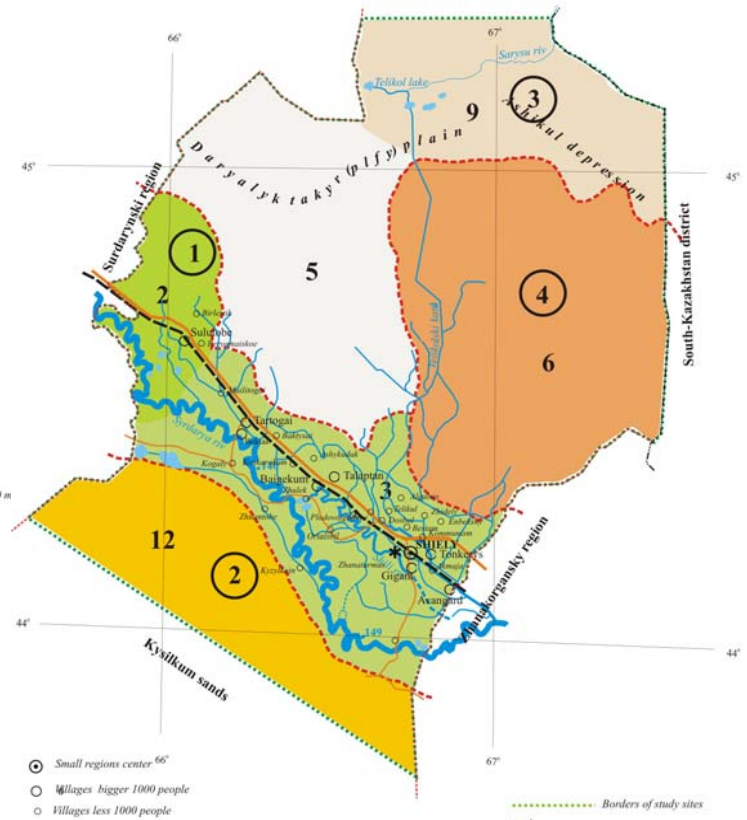
1 Soil of mountains

- 30 Mountain light kastanozems with rubble materials
- 31 Mountain light kastanozems

2 Soil of intermountain valleys, foothill and low plains

- 32 Grey brown desert soils
- 33 Grey-brown soils with rubble materials located on hillsides
- 34 Takyr similar soils with processes of salinization, Takyr typical (25%)
- 35 Takyr similar with old irrigation
- 36 Takyr typical
- 37 Alluvial meadow soils, Sandy soils with low humus content and ridge-hilly sands (30%), Typical solonchaks (30%)
- 38 Alluvial meadow soils, Meadow-swamp soils (20%), Meadow solonchaks (20%)
- 39 Alluvial meadow irrigated soils, Meadow-swamp soils (30%), Typical solonchaks (30%)
- 40 Meadow-swamp soils
- 41 Typical solonchaks
- 42 Slightly sloping hills overgrown with vegetation with low humus content and solonchaks in lowlands
- 43 Hilly carbonaceous sands with low plant density, low humus content and takyr similar soils with processes of salinization
- 44 Slightly sloping hills overgrown with vegetation with low humus content and meadow-swamp soils in lowlands
- 45 "Shor" - solonchaks
- 46 Desertifying alluvial meadows
- 47 Takyr similar soils
- 48 Hilly-ridge fixed sands and takyr similar soils with processes of salinization
- 49 Slightly sloping hills with fixed carbonaceous sands

Natural zones of Shieli massif



4 Foothills and low mountains desert zone of Karatau

- 6 Karatau Foothills and low mountains district of grey-brown stony soils, light sierozems and takyr similar soils.

3 Desert zone on right side

- 9 Sarysu district of deserted solonchaks in delta.
- 5 Daryalyk old alluvial plains with takyrs, solonchak similar takyrs and Aeolian hilly sands.

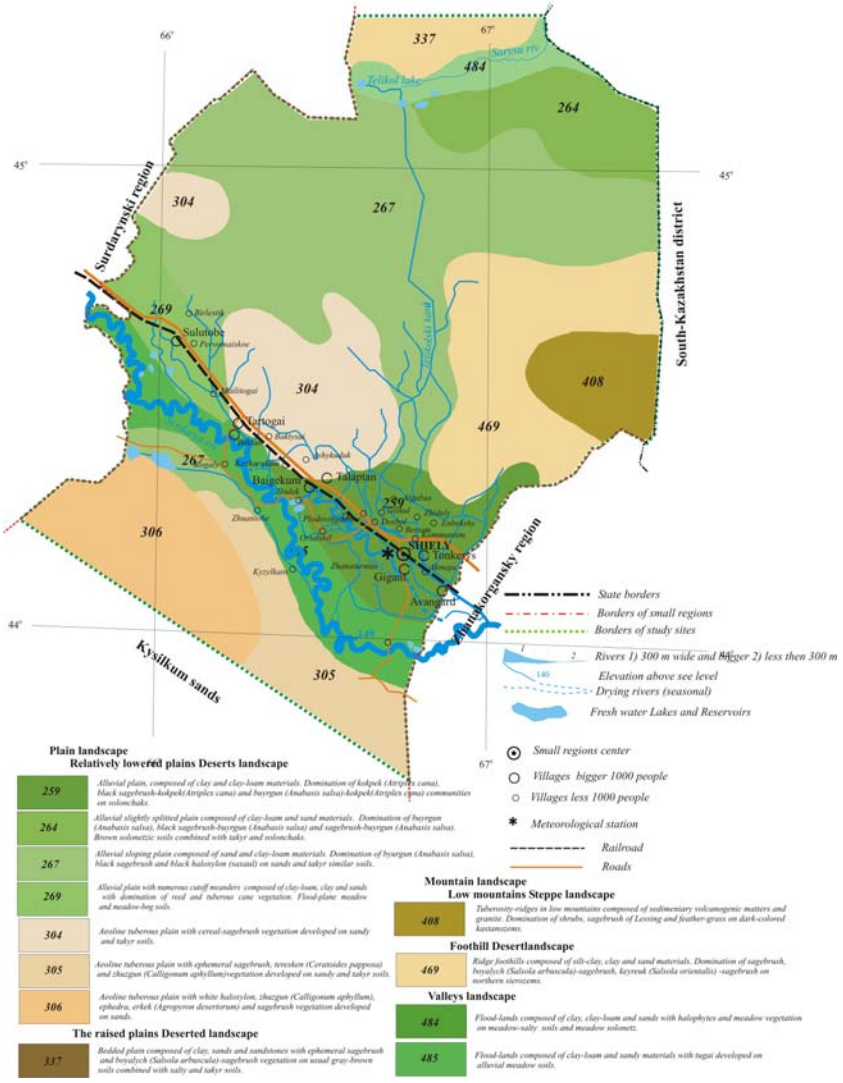
1 Central agricultural zone

- 2 District of Kyzyl-Orda oasis with interzonal hidromorphic soils and solonchaks.
- 3 District of Shieliysky oasis with interzonal hidromorphic soils and solonchaks.

2 Desert zone on left side

- 12 Kyzylkum district of ridge-hilly fixed sands with spots of weakly fixed and drifting free sands.

Landshape map of Shieli massiv



Plain landscape

Relatively lowered plains Deserts landscape

259 — Alluvial plain, composed of clay and clay-loam materials. Domination of kokpek (Atriplex cana), black sagebrush-kokpek(Atriplex cana) and buyrgun (Anabasis salsa)-kokpek(Atriplex cana) communities on solonchaks.

264 — Alluvial slightly splitted plain composed of clay-loam and sand materials. Domination of buyrgun (Anabasis salsa), black sagebrush-buyrgun (Anabasis salsa) and sagebrush-buyrgun (Anabasis salsa). Brown solonettzic soils combined with takyr and solonchaks.

267 — Alluvial sloping plain composed of sand and clay-loam materials. Domination of buyrgun (Anabasis salsa), black sagebrush and black halostylon (saxaul) on sands and takyr similar soils.

269 — Alluvial plain with numerous cutoff meanders composed of clay-loam, clay and sands with domination of reed and tuberous cane vegetation. Flood-plane meadow and meadow-bog soils.

304 — Aeoline tuberous plain with cereal-sagebrush vegetation developed on sandy and takyr soils.

305 — Aeoline tuberous plain with ephemeral sagebrush, teresken (Ceratoides papposa) and zhuzgun (Calligonum aphyllum)vegetation developed on sandy and takyr soils.

306 — Aeoline tuberous plain with white halostylon, zhuzgun (Calligonum aphyllum), ephedra, erkek (Agrogyron desertorum) and sagebrush vegetation developed on sands.

The raised plains Deserted landscape

337 — Bedded plain composed of clay, sands and sandstones with ephemeral sagebrush and boyalych (Salsola arbuscula)-sagebrush vegetation on usual gray-brown soils combined with salty and takyr soils.

Mountain landscape

Low mountains Steppe landscape

408 — Tuberosity-ridges in low mountains composed of sedimentary volcanogenic matters and granite. Domination of shrubs, sagebrush of Lessing and feather-grass on dark-colored kastanozems.

Foothill Desertlandscape

469 — Ridge foothills composed of silt-clay, clay and sand materials. Domination of sagebrush, boyalych (Salsola arbuscula)-sagebrush, keyrouk (Salsola orientalis) -sagebrush on northern sierozems.

Valleys landscape

484 — Flood-lands composed of clay, clay-loam and sands with halophytes and meadow vegetation on meadow-salty soils and meadow solonetz.

485 — Flood-lands composed of clay-loam and sandy materials with tugai developed on alluvial meadow soils.

B.5. Climatic data

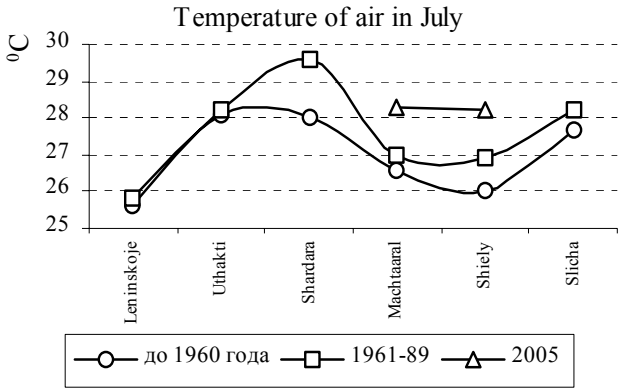
The data, concerning time before 1960, show that the mid-annual temperatures, determined at the stations, located on the studied territories, varied from 8,5 to 12,4 ^{0} C. The coldest month is January (monthly average temperature ranges from -11, 1^0 (meteorological station Zlikha) to -3, 5^0 (meteorological station Uchakty).

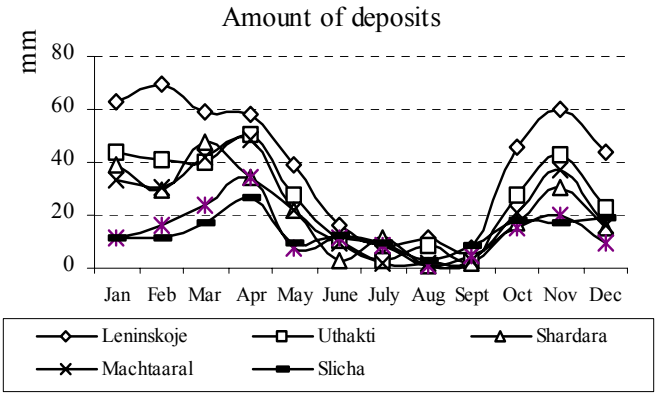
An intensive rise of air temperature begins from February to March, maximum of air temperature is observed in July and ranges from +25,6 (meteorological station Leninskoe) to +28,12^0 (meteorological station Uchakty).

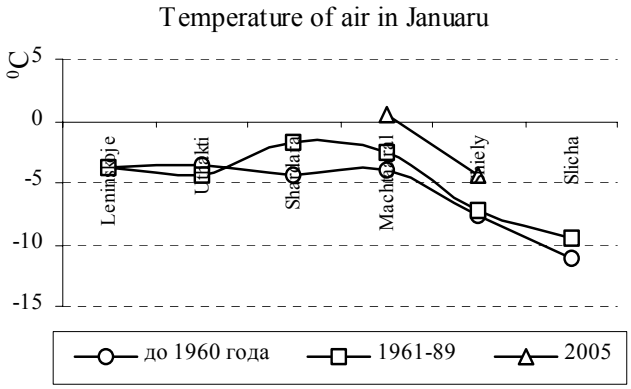
Air temperature from March to October, i.e. the major part of the year, is positive at all meteorological stations. As it is seen from the data, air temperature gradually decreases, beginning from August, though it is still high in September. It is still positive in November. Its minus value is observed only in December.

The same tendency of annual temperature fluctuations was in between 1961 and 1990. But the temperature values icreased to some extend (it is seen from the diagram). The data of 2005 were received only from the meteorological stations Makhtaaral and Shieli. It is seen from the data that the temperature is higher than the average long-term data of the previous years.

Figure 1 -Temperature and precipitation in meteorological stations







It is known that the difference between the monthly average temperature of the warmest and the coldest months, i.e. annual amplitude is one of the parameters, which characterize continental climate. Annual amplitude of temperatures (1961-1990) is high, varying from 26, 3 to 37, 7^0. The decrease of annual amplitude can be presented in the following sequence: Zlikha > Chiili>Uchakty>Chardara>Makhtaaral>Leninskoe.

The highest evaporation is also observed in July, except meteorological station Makhtaaral, where it is higher in June.

The data analysis shows that more than 50% of precipitation falls in warm time of the year. The greatest amount of precipitation was fixed by meteorological station Leninskoe – 481,3 mm, located in a lowland (575 m above sea level), and the smallest – Shieli and Zlikha – 164,3 and 163, 4 mm respectively, located in a desert zone (152 and 243 m over the sea level respectively). Maximum precipitation (data from all meteorological stations, except Leninskoe) is observed in March, April (14 - 60 mm), minimum – June, July, August, September (1 - 11 mm), specifying clear and dry weather of the year.

Annual amount of precipitation reaches only 164,3 - 265,6 mm at the plain part, 322,3 mm at piedmonts, 481,3 mm at low mountains. Annual distribution of precipitation at the desert (Chardara massif, Golodnaya Steppe and Shieli massif) is the same as at piedmonts (basin of the river Keles). It is seen from the diagram that there are two maximums of precipitation in spring and autumn.

B.6. Hydrological data

B.6.1. Characteristics of hydrographical network and water resources of the study areas.

Hydrographical network. Syr Darya and Keles rivers are the main sources of surface waters on the study areas. River network is the most developed on the territory of the basin fo Keles river. The hydrographical network of Chardara and Shieli massifs is presented only by the river Syr Darya. The length of the river on the territory of Chardara massif is 194 km, and 198 km – on the territory of Shieli massif. River network is absent on the territory of Kazakhstan part of Golodnaya Steppe (see map). 679 rivers and small rivers with the total length 3194 km (Table 2) are located on the territory of the Keles river basin. The length of the river Keles is 241 km and catchment's area is 3310 km^2.

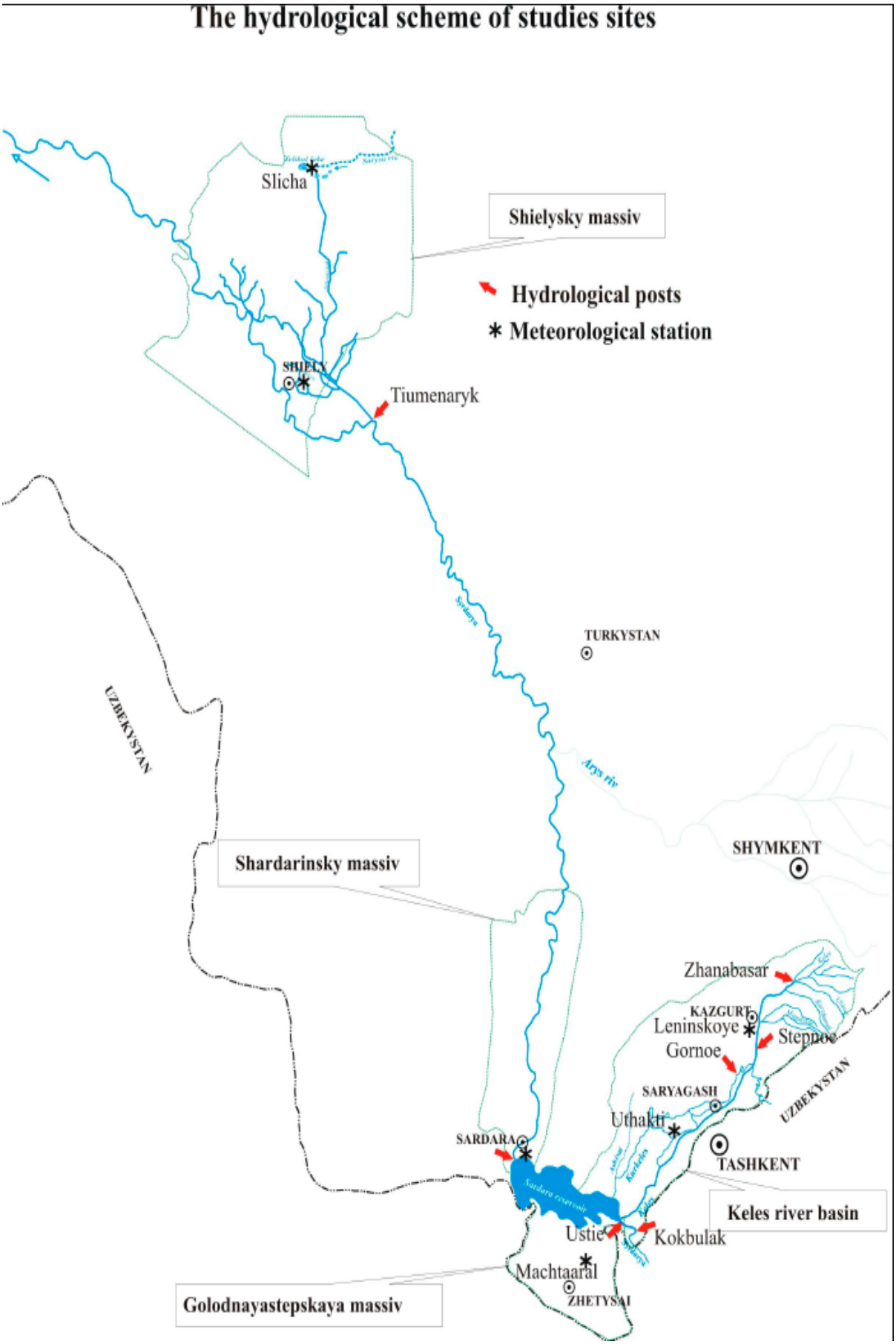
Table 2. The characteristics of rivers in the Keles and Kurkeles[1] basin.

River length		Number of rivers	Total length, km	% from total	% from total length
The smallest	< 10	619	1412	91,1	44
	10-25	38	559	5,6	18
Small	26-50	14	451	2,1	14
	51-100	6	428	0,9	13
Average	101-200	1	103	0,15	3
	201-300	1	241	0,15	8
	301-500	-	-	-	-
Big	501-100	-	-	-	-
	> 1000	-	-	-	-
Total		679	3194	100	100

Syr Darya is a trans-boundary river. It is the second river by water submission and the first by its length in Central Asia. The river head is outside the territory of Kazakhstan. It is in Central Tyan-shan. The basin is located in three zones – mountainous, piedmont, and lowland. The river is fed by glaciers and snow. Spring precipitation together with spring snow melting, form the main spring flood in the river. Maximum runoff is observed in June. The main runoff of Syrdarya River is formed on the territory

[1] Resources of superficial waters of the USSR. A hydrological level of scrutiny. That - 14. Pools of the rivers of Central Asia. Release - 1. Pool p. Syr-Darya. Leningrad, Publishing house, « Gidrometeoizdat», 1965

of Kyrgyzstan. Then Syr Darya crosses the territory of Uzbekistan and Tajikistan and runs into the Aral Sea on the territory of Kazakhstan. The total length is 2212 km, within Kazakhstan – 1400 km.



On the territory of Kazakhstan, Syr Darya river was regulated by Chardara reservoir, built in 1965 (useful volume is 5200 mln.m^3 and the area about 400 km^2). All large irrigated massifs of southern oblasts in Kazakhstan and the Aral Sea are fed from it.

The ramified networks of irrigation and tail-drain canals are built on the territory of the study areas. Among them, Bolshoi Keles, Kysylkum, Novoshieli and the canal "Dostyk" are the largest.

Lake system is not developed within the study areas. Several small lowland lakes do not represent any economic interest. They occupy low parts of the relief and have a constant or temporary inflow of surface or underground waters. Piezometric lakes are also met in depressions around the irrigation systems. It will be possible to transfer such lakes into the category of especially protected natural territories as water-swamp lands, for conservation of biodiversity of the region under corresponding scientific research.

The hydrometric survey of the river Syr Darya was organized at the beginning of XX century. Monitoring system was the most developed in the middle of 1980s; it degraded from early 1990a due to unstable economy. The majority of hydrological posts were closed. Only 37 hydrological posts work in Kazakhstan part of the Aral Sea basin now (Table 3).

Table 3 - The network of hydrometric supervision over surface waters in the Kazakhstan part of Aral sea basin [2].

years	Number of hydrometric stations				
	Total on rivers	Outflow measure		Water level measure	
		water	Suspended particles	On rivers	On reservoirs
1985	80	77	21	80	6
2000	37	37	0	37	0

The basic hydrological parameters of the Syr Darya river on the territory of Chardara massif are determined by the hydrologic post Chardara, and hydrologic post Tomenyaryk – on the territory of Shieli massif (see map). Keles River is characterized by the data of the hydro post of the village Zhanabazar, village Stepnoye and Keles river mouth. The main parameters of hydro posts are presented in Table 4. The surface water resources of the study areas are formed due to the runoff of the rivers in the Keles basin and trans-boundary runoff of Syr Darya River. The volume of the both rivers runoff is greatly subjected to a highly pronounced vertical zonality of climatic factors on the territory of their drainage area. Economic activities basically influence on the volume of runoff in the lower part of the basin.

The following references: "Resources of the USSR surface waters" and "Hydrological year-books", issued in Soviet time, were used for the calculation of surface water resources volume. It is necessary to note that the majority of "Year-books" are absent in the libraries now. Besides, these series are not issued from the late 1980s and these data practically are not available for a wide range of readers. Therefore, the available copies of "Year-books" and the materials, generalized in manuscripts and reports of SIC ICWC were used for the calculations.

Thus, the long-term parameters of the rivers runoff were calculated according to the real survey. Before 1960, the runoff volumes of Syr Darya river between the hydrologic post Chardara (23,084 km^3/year) and Tomenaryk post (24,9 km^3/year), located 637 km one from another and taking into account the runoff of the rivers Arys and Bugunya (1,183 km^3/year), were approximately equal. By the beginning of 1990s, the

[2] The design document under project Aral-HYCOS, 2000.

difference between them became more than 3, 0 km^3 a year as a result of quick development of irrigated lands and increase of water intake. At present there are 14 diversion canals and 2 pumping stations. The reduction of the river runoff was not observed for the analogous period, judging by the runoff of the river Keles at the closing hydro post "Keles- river mouth". The difference makes up only 0,007 km^3/year. It can be explained by a slight increase of the irrigated lands area and constant additional charging of the river Keles by the waters of the river Chirchik, canals Zakh and Khanym. The water resources of the river Keles are estimated at 0,293-0,300 km^3/year.The obtained figure slightly exceeds the established by SIC ICWC average long-term runoff of the river Keles (0, 247 km^3/year). We explain it by the absence of data after 1988. Despite of some discrepancies, the calculations of the resources on the objects of the researches can be considered as satisfactory.

Table 4 - The Characteristic of hydrological posts[3]

)bject of research	The river, post	Distance from a mouth, km	The area of a basin, km^2	Year of commissioning	The module of a drain, l/sek*km^2
Keles river basin	Keles, with. Zhanabasar 200 m. higher than a confluence of river Uyasai	206	292	1974	
	Keles, in Steppe, village	145	1960	1963	3,11
	Keles, item. Mountain, lower than dump of channel Ramadan	127	2490	1925	2,73
	Keles the Mouth r. Keles	0	3060		
Chardara massif	Chardara, 2 km from Chardara reservoir in middl;e flow of Syr Darya	1633	174000	1959	
Shieli massif	Syr-Darya, Tomenaryk, 2,2 km WSW from railway station Tomenaryk	996	219000	1913	3,02

The analysis of the data of annual runoff made possible (for SIC ICWC) to determine six 12-year cycles of water volumes, beginning from 1928 to 1997. The conventional value of average long-term runoff is 37, 203 km^3/year. It is a result of data calculations from 1951 to 1974. This estimation is comparable with analogous calculations, given in the "Scheme of complex use and protection of Syr Darya river water resources", compiled by "Sredazgiprovodkhlopok" in 1987 (37, 1 km^3/year). As a whole the mid-annual parameters of Syr Darya river water resources at the border with Uzbekistan (h/p Kokbulak) changed from 23, 6 km^3 in "dry" years (95% supply) to 39 km^3 in "wet" years (25% supply). It is caused by water volume fluctuation.

The cycling of runoff fluctuations was also determined by the State Hydrological Institute (Leningrad) for the rivers Chirchik, Akhangaran of Keles basin, exemplified by the river Chirchik (h/p Khodzhikent), the longest period of observation (from 1901). The long-term fluctuations of the river Chirchik annual runoff are typical for the rivers of the studied part of Syrdarya river basin. Their synphase with the runoff change of other rivers in the region testifies to it. That is why, the period from 1936 to 1969 (34 years of duration) is accepted as a rated period for the calculation of the river hydrological parameters in the examined basin.

[3] Superficial waters of Southern Kazakhstan (Dzhambul, Chimkent and Kyzyl - Ordinskaya areas). I.V.Volftsuna, etc., Leningrad, Publishing house " Gidrometeoizdat ", 1976, 411 with.

According to a year distribution of runoff, the rivers of South Kazakhstan refer to two basic types: 1) Kazakhstan, with spring flood and low runoff at the rest time of a year and, 2) Tyan-Shan, characterized by flood during a warm period of a year, forming as a result of high mountain snow and glaciers melting. Two types of thawed snow dominate in runoff formation: 1) melting of seasonal snow, glaciers and permanent snow. The dynamics of the rivers runoff, where thawed seasonal snow dominates, depends on the snow stock by the beginning of melting, and it depends on the sum of positive temperatures where thawed permanent snow and glaciers dominate. As it is seen from the pictures 4 and 5, the maximum flood of the first is observed in spring months (river Keles), and the maximum flood of the second is observed in summer months with maximum of positive temperatures (river Syr Darya). In summer the discharge of all the basin Keles sources and the river Keles itself extremely decreases. Therefore, Keles River is fed by the water of the river Chirchik through the canals Zakh and Khanym in summer.

B.6.2 Basic information on irrigation system

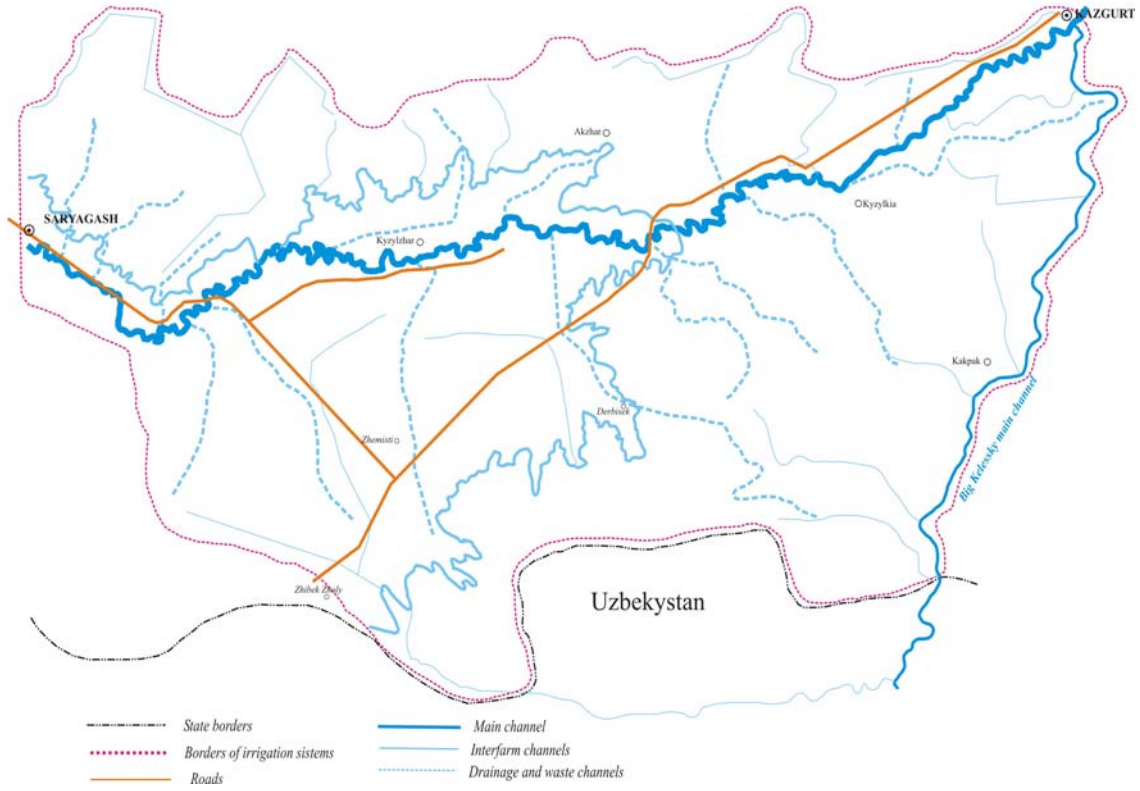
Keles massif of irrigation. The rivers Keles and Kurkeles are the sources of irrigation waters. Water is delivered through the divertive canals – Bolshoi Keles, Bolshoi Kesken, Oshakty, Shoshym, Oimauyt, Ashinau and others. Besides, there are two large canals Zakh and Khanym, feeding the river Keles by water from the river Chirchik. The total volume of delivered water by the canals can make up 300 mln.m^3 for a season. The canals have earthen beds in general. There is a rare open tail-drain network. also 325 wells of vertical drainage at the massif. But now the whole system of vertical drainage is not suitable for exploitation.

Kyzylkm massif of irrigation. Syr Darya River is a source of irrigation waters. Water moves along the Kyzylkum divertive canal. The length of the canal is 116 km, the speed of the water movement of the canal is 200 m^3/sec. The canal is built in earthen bed. The interfarm water supplying network is presented by the irrigators of various open types, built in natural ground. All the canals do not have anti filtration coverage. The total length of open tail-drain is 3182 km. There are

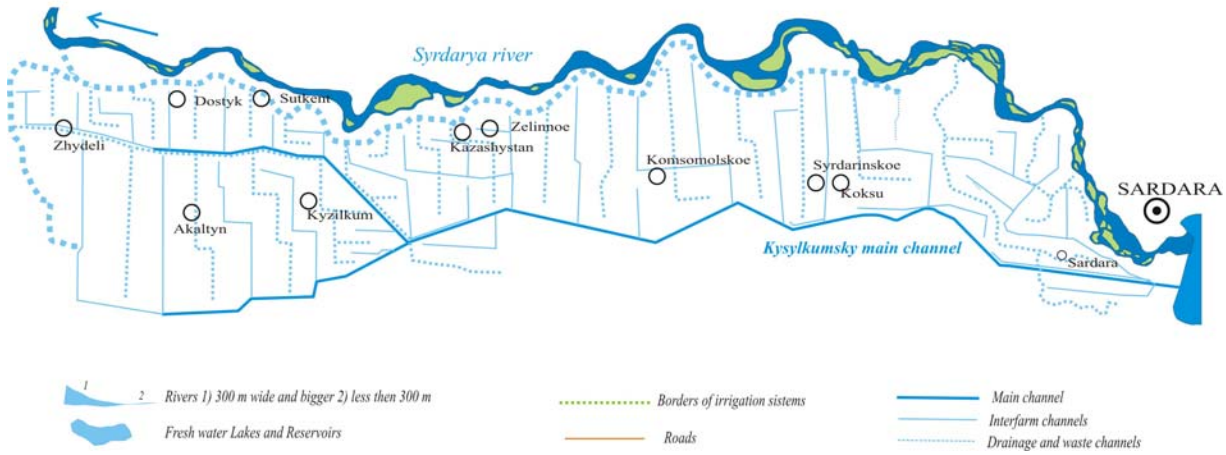
Golodnaya Steppe massif of irrigation. Syr Darya river is also a source of irrigation waters at the massif. Water moves along the divertive canal "Dostyk" (former name – Kirov) with the annual calculated water intake equal to 260 m^3/sec. The canal is built in earthen bed. The total extent of the intereconomic value allocators makes up 240, 75 km, interfarms – 2292, 27 km. 83% of intereconomic and 77% of interfarm canals are built in earthen beds without anti filtration coverage. The total length of open tail drain network is 1000, 4 km, 82% of them are in unsatisfactory condition. Besides, there are 838 wells of vertical drainage at the massif, built in 1960-70. At present the whole system of vertical drainage is not suitable for exploitation.

Shieli massif of irrigation. Syr Darya is also a source of irrigation waters here. Water moves in Novoshieli divertive canal with the speed 122 m^3/sec. It is built in earthen bed. The total length of the canals (all types) makes up 760 km. The off take of drainage-waste is realized by 5 tail-drains and Telikul bypass canal. There are 140 wells of vertical drainage but none of them works now.

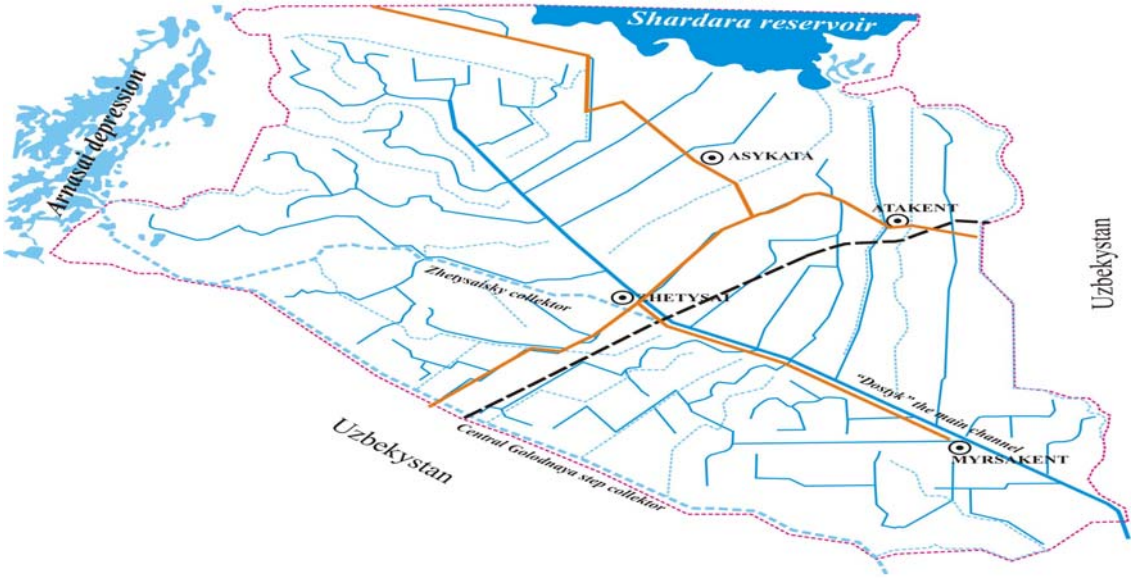
The scheme of irrigationel network Keles massive

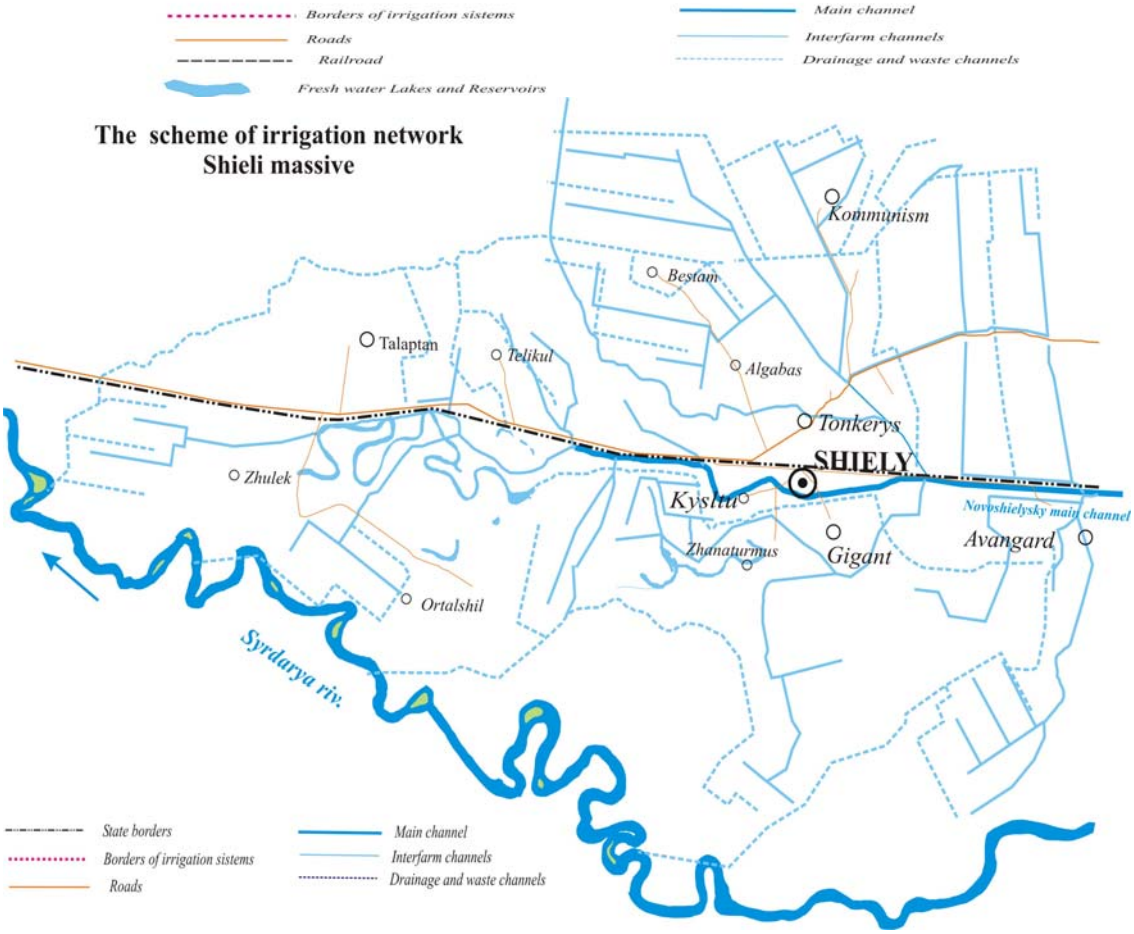


The scheme of irrigational network Shardarynskogo massive



The scheme of irrigational nenetwork Golodnaya step massive





B.6.3 Exploitation of irrigation and drainage-waste waters

South Kazakhstan is a traditional region of irrigation agriculture due to its climatic peculiarities. The intensive exploitation of land and water resources began in 1960s of the last century. As a whole, the irrigation agriculture consumes about 90% of the total water intake.

The water of the river Keles was completely allocated for irrigation before (1960), the period of intensive land use. Therefore, the river Keles was replenished from the river Chirchik by the canals Zakh and Khanym. The total volume of annual water intake made up 920. 48 mln.m^3 (table). The water intake increased up to 1345. 93 mln.m^3 after 1960, due to the intensive development of new irrigated lands and increase of water submission to the existing areas. At present, the aggravation of soil-ameliorative condition of lands, their alienation from the agricultural activity, the adoption of new forms of farms and their poor financial position and some other reasons caused the decrease of water intake up to 469. 94 mln. m^3.

Table 5 - Volumes of a water-fence irrigated files of study areas

Study site	The river, the main channels	Volume of a water-fence (million m^3)		
		till 1960	1961-1970	2001-2006 гг
Kelesky	Keles - 10 channels	293.78	533,43	469.4
	Chirchik - Khanym, Zakh	626.70	812,50	
Chardarinsky	Syrdarya - Kysylkumsky	0	0	1223.50
Golodnosnepsky	Syrdarya - Dostyk	1500.85	2705.18	2295.09
Shielisky	Syrdarya - Novoshielisky	395.0	751.66	329.45
	Total	2816.93	4802.77	4317.98

The same regularity of water intake rise and recession is observed at the other massifs where Syr Darya River is a source of water intake. The smaller recession was observed at Golodnaya Steppe massif, South Kazakhstan region. It is the most densely populated region.

The difference between water intake from rivers and water-submission to the fields reaches significant values – from 13. 8% to 35. 1%. The absence of anti filtration screens leads to the considerable loss of water through the bottom and boards of the canals. Thereof, the specific values of water intake and water-submission are unfairly high (Table 6).

Table 6 – Sizes of a water-fence and water-submission per 1 ha of the area (mean values for years 2004-05)

Study site	Irrigation the area, ha	Volume, (million m^3)				Specific water-fence, m^3/há	Specific water-submission, m^3/há
		water-fence	water-submission	difference			
				one million in m^3	%		
Kekessky	64501	469.94	305.14	164.80	35.1	7286	4731
Shardarinsky	52064	710.73	597.68	113.05	15.9	13651	11480
Golodnosnepsky	137805	856.33	738.34	117.99	13.8	6214	5358
Shielisky	27571	323.45	242.37	81.08	25.1	11732	8791

As a whole the annual total water intake was equal to 2816. 93 mln. m^3 before 1960 at the objects of researches. It reaches 4802. 77 mln. m^3 or it increased by 1. 7 times in the period of water-economic works amplification. A tendency of water intake decrease is observed now. But this decrease is mostly connected with the problems of transition period. Besides, the weakening of measures on the state control has led to the decrease of statistic data reliability on the annual volumes of water intake and water-submission. In part, it is supposed, that actual water intake is higher in the countries with the regime of paid water use in comparison with the data of statistical reporting.

Our data also correspond with the official data of SIC ICWC, where the analogous tendency of intake volume decrease for irrigation was demonstrated (retrospective analysis of the parameters on water-land resources use as a whole for the basin of the Aral Sea), (Table 7).

Table 7 - The basic parameters of use of water-soils resources in Aral Sea basin

Parameter	Unit of measurement	1960	1970	1980	1990	2000
The area of the irrigated soils	one thousand ha	4510	5150	6920	7600	7990
Total water-fence	km^3/year	60.61	94.56	120.69	116.27	105.0
Including an irrigation	km^3/year	56.15	86.84	106.79	106.4	94.66
Specific water-fence on 1 hectare of an irrigation	km^3/ha	12450	16860	15430	14000	11850

Source: SIC ICWC, 2000 .

Delta alluvial plains and river plains were used for irrigation in South Kazakhstan. These regions are an area of a final geochemical runoff; they have an initial relic nature of salinization. The worse drainage of the territory and weak outflow of ground waters are typical for them. Besides, the aridity of the climate causes the sharpest deficiency of moisture including fresh irrigation water. Open horizontal drainages and wells of vertical drainage were mainly built for water softening of soil-grounds of aeration zone during the development of the territories. Now, the major part of open tail-drain system is in unsatisfactory condition, intereconomic tail-drain network requires reconstruction. The beds of tail-drains were subjected to deformation during the long-term exploitation; they are overgrown by weed vegetation and water is unable to move fast. Besides, there are 1332 wells of vertical drainage, built in 1960-70 at the massifs. At present, the whole system of vertical drainage is not suitable for exploitation.

A tendency of tail-drain volume increase is observed at all the massifs last years. The greatest volumes of runoff are formed at Golodnaya Steppe (350.78 mln.m^3) and Chardara (350.78 mln. m^3) massifs. Now, up to 679.85 mln.m^3 (on the average per year) of tail-drain waters are formed on the territory of research objects.

Table 8 - The drain of collector-drainage waters on study areas

Study site	Drain of drainage-waste waters on years, million m^3.					
	2001	2002	2003	2004	2005	average
Kelessky	36.4	25.6	48.6	51.5	54.5	43.32
Chardarinsky	160.1	294.5	131.6	134.8	104.2	165.04
Golodnosnepsky	223.5	469.4	340.7	400.7	319.6	350.78
Shielisky	151.54	112.05	112.89	112.05	115.01	120.708
Total	2572.54	2903.55	2636.79	2703.05	2598.31	679.85

The actual value of tail-drain runoff made up from 2.40% to 46.66% of the water-submission volume in 2005. It is known that the territory of the massifs is not characterized by high drainage ability and favorable amelioration condition. It is largely caused by errors in hydrometric works, absence of fixed beds in tail-drains and other.

Table 9 –The relation of volume of a collector-drainage drain to volume of water-submission 2004 - 05

Study site	Drainage-waste a drain, million m^3.		Water-submission, one million in m^3		Attitude Drainage-waste to water-submission, %	
	2004	2005	2004	2005	2004	2005
Kelessky	51.5	54.5	2344.33	2274.95	2.20	2.40
Shardarinsky	134.8	104.2	674.2	521.15	19.99	19.99
Golodnosnepsky	400.7	319.6	791.73	684.95	50.61	46.66
Shielisky	112.05	115.01	2703.05	2598.31	4.15	4.43

It is necessary to note that the increase of irrigated areas and the increase of their water submission during the years of "great amelioration" have either positive or negative sides. It caused an increase of irrevocable water consumption, general increase of ground waters and as a result – worsening of soil-ameliorative conditions and decrease of crops yielding ability.

Trans-boundary sources of water at the study areas should be marked as a peculiarity of water resources exploitation. The water resources of the rivers Keles and Kurkeles are not enough for the irrigation of Keles massif lands. So, the water of the river Chirchik is additionally used. There are problems with the time table of water release from Toktogul reservoir (water use of Syr Darya river waters). Kazakhstan and Uzbekistan are interested in irrigation regime of the reservoir work, and Kyrgyzstan, partially Tajikistan – in energetic regime of work. Table 10 demonstrates the data.

Table10 – Dynamics of inflow and outflow in Toktogul hydrounit

Parameters	Annually on the average	1985 -1991		1992 -1999	
		winter	summer	winter	summer
Inflow to a water basin, км^3	12.06	2.77	9.29	2.98	10.18
Flow augmentation from a water basin, km^3	11.6	3.53	7.93	7.59	5.73
Water balance, km^3	+0.6	-0.76	+1.36	-4.61	+4.45

Beginning from early 1990s, the regime of work at Toktogul cascade changed into extreme increase of water accumulation in summer and water release in winter period for the sake of hydroelectroenergy production by Kyrgyzstan. It creates additional problems for Kazakhstan and Kyrgyzstan. The overflowing and threat of break of Chardara reservoir and flooding of the river low reaches – for Kazakhstan. The overflowing of Arnasai depression caused by compelled releases of water from Chardara reservoir, results in flooding of adjacent settlements, agricultural lands and the subsequent ecological problems.

International Coordination Water-economic Commission of Central Asia on the problems of water resources regulation, rational use and protection was set up in 1993 as a result an agreement among 4 Central Asia republics (Kazakhstan, Uzbekistan, Kirgizstan and Tajikistan). But the problems are still not solved.

B.7. Land use data

B.7..1. . Land use

The study areas are agricultural regions. The total area of research objects within the administrative regions made up 6064.7 thousand ha in 2005. The agricultural lands occupy 2595 thousands ha of them or 42. 8%. Approximately the same area (2593.6 thousand ha) are covered by forests. The following lands are presented in decreasing order: 7.8% - stock lands, 3.3% are occupied by towns, villages, settlements, 1.9%- water fund, 1.3% especially protected natural territories and 0.2% - industry, transport, means of communication. The major share of agricultural lands is located in Kazakhstan part of Golodnaya Steppe (88.9%) and in the basin of the Keles river (643.3). The share of agricultural lands decreases at Chardara and Shieli massifs due to vast areas, occupied by saxaul forests of Kyzylkum sand massif (Table 11).

Table 11 - Structure of land use in the study areas (thousand hectares)

Land use	Study area								Total	
	Kelessky massif		Chardarinsky massif		Golodnaya Steppe massif		Shielisky massif			
	ha	%	ha	%	ha	%	ha	%	ha	%
Agricultural	749.0	64..3	248.7	19.2	159.5	88.9	1437.8	42.0	2595.0	42.8
Cities, settlements and rural settlements	116.5	10.0	6.4	0.5	15	8.4	61.9	1.8	199.8	3.3
The industries, transport and communication	7.9	0.7	1.5	0.1	2.2	1.2	3.3	0.1	14.9	0.2
Especially protected natural territories	76..6	6.6	0	0	0	0	0	0	76.6	1.3
Wood fund	3.0	0.3	927.3	71.7	0	0.0	1663.3	48.5	2593.6	42.8
Water fund	1.9	0.2	96.9	7.5	2.7	1.5	12	0.4	113.5	1.9
Stock land	210.4	18.1	12.3	1.0	0	0	248.6	7.3	471.3	7.8
Total	1165.3	100.0	1293.1	100.0	179.4	100.0	3426.9	100.0	6064.7	100.0

B.7.2. The agricultural soils

The total area of agricultural lands at the study areas within the administrative regions made up 3750 thousand ha. in 2005. The main area (88.2%) is occupied by pastures (Table 12). The pastures occupy 376.5 thousand ha or 10.5%, hay lands – 1.2% other lands – 0.6%. The retrospective analysis shows that the area of the arable lands increased during the years of intensive use of irrigated lands in comparison with the beginning of 1970s by 1.02 times. The economic well-being and ecological condition of the region are connected with these areas. At present the area of arable lands decreased by 1.09 times in comparison with the beginning of 1980s and occupies 375 thousand ha. It is caused by the deficiency of irrigation waters and aggravation of amelioration conditions.

Table 12 - Rate of agricultural land use types

Class	years					
	1971		1981		2005	
	ha	%	ha	%	ha	%
Arable land	484.2	12.1	542.0	13.3	376.5	10.0
Long-term plantings	10.6	0.3	11.8	0.3	6.9	0.2
Deposits	43.4	1.1	40.1	1.0	14.4	0.4
Haymakings	63.6	1.6	46.8	1.2	45.9	1.2
Pastures	3391.8	84.9	3421.7	84.2	3306.3	88.2
Total	3993.6	100.0	4062.4	100.0	3750.0	100.0

The areas of arable lands decreased variously at the study areas. The greatest decrease of arable lands areas in comparison with the beginning of 1980s was in the basin of Keles river. They decreased by 2.0 times (Table 12). At Shieli and Chardara massifs, they decreased by 1.4 and 1.3 times correspondingly. The increase of arable lands areas was observed at Golodnaya Steppe massif by 1.2 times. It can be explained by the high density of population massif. The prosperity of the population depends on the area of an allotment and level of soil fertility. The decrease of arable lands area is caused by the aggravation of amelioration conditions and decrease of soil fertility. For example, at Keles massif, it is caused by the erosion processes of the main soil areas. There are abandoned lands (extreme erosion loss and outwash of soils) in the region of piedmonts and low mountains border. Secondary salinization causes the rise of soil salinization and high mineralized ground waters are observed at the other massifs.

B.7.3 Basic information on industry.

There are no large industrial objects on the territory of study areas.

B.8 Conservation activities data

B.8.1. Existing natural reserves, national parks, etc.

B.8.1. Existing natural reserves, national parks, etc.

There are two objects within the basin of the Keles river. These objects belong to the category of especially protected areas. They are:
1. **Sairam-Ugam reservation.** Mountainous. The mountainous part of the territories (basin of the Keles river) is a part of Sairam-Ugam state complex of natural reservation. The whole territory of the reservation occupies 28300 ha. 76532 ha of it are located on the territory of the basin. It was set up by RK Government Decree in 2001. It is under the authority of Forest and Hunting Department in Ministry of Agriculture.
2. Saryagash balneological area. It is situated 130 km from Shymkent city, 15 km from Tashkent city on the left bank of the river Keles. The territory occupies 68 ha of garden-park massif. The well-known source of mineral water “Saryagash” is located near it.
The third object is **Kargala State Zoological Natural Reservation** located on the territory of Shieli and Zhanakorgan regions. Deserted. The whole territory of the reservation occupies 13300 ha. It was set up by RK Government Decree in 2001. It is under the authority of Forest and Hunting Department in Ministry of Agriculture.

Conclusion for the section B

The extensive development of irrigated agriculture in the basin of the Syr Darya Region, especially in the middle flow of the river, has led to a considerable reduce of water resources volume in the region. The volume of the runoff decreased to 3.0 km^3 during the years of intensive land development between the hydro posts Chardara and Tomenaryk. The water resources of the Keles river were highly decreases in 1960s. Therefore, the influence of Keles massif on the reduction of Syr Darya river runoff was estimated by the increase of water intake volume from the river Chirchik by the canals Zakh and Khanym. The volume increased by 1.5 times during this period of time.

The irrigation systems of our study areas were rebuilt and adapted in exploitation during these years. The areas of arable lands have increased by 1.02 times. It, of course, has led to the improvement of water submission and to the increase of water intake, respectively. The total volume of water intake by the objects of researches has increased by 1.7 times and made up 4802.77 mln m^3 according to the data for these years. The annual water intake has reduced by 1.1 times and makes up 4317.98 mln m^3. It is caused by the reduction of arable lands areas (by 1.09 times), aggravation of their amelioration conditions and non-use of some lands in agriculture.

Rivers runoff formation depends on trans-boundary factors. The runoff of Syr Darya river depends on the time-table of water release from Toktagul reservoir. The water supply of the irrigated lands at Keles massif depends on the volume of feeding from the river Chirchik (Keles river is shallow).

The major part of irrigation and tail-drain network is now in unsatisfactory condition. It has led to the increase of water loss now. The difference between the water intake from the rivers and water supply of the fields achieves significant values – from 13.8% to 35.1%. A tendency of tail-drain runoff volume increase is observed. The volume of tail-drain waters made up 679. 85 mln.m^3 in 2005. The maximum volume of drainage runoff achieved 46.7% of water-submission volume.

The period of transition economy is a difficult time for water economy. Water-users do not have enough financial means for the payment of water-submission service, for the conducting of exploitation and repair-rehabilitation works. The given budgetary funds are insufficient. These cause the technical condition of irrigation and drainage network unsatisfactory. The network does not meet the current requirements of exploitation. The insufficient organization of hydrometric works, absence of modern devices for water control, as well as shortage of communication and transport resources should be taken into consideration.

Summarizing the above-stated, it is possible to make a conclusion that the increase of irrigated areas and their water-supply during the years of “great amelioration” had both positive and negative sides. It resulted in the increase of irrevocable water-consumption, rise of ground water level, aggravation of soil-ameliorative conditions and decrease of crops yielding ability.

C. Data base of threats

C.1. Soil degradation

C. 1.1. Erosion

a. deflations. The degree of soil deflation and current nature of wind erosion development were chosen for selection of the regions, subjected to wind erosion. The group of regions was described according to the degree of deflation: not subjected, weakly, moderately, strongly, and very strongly subjected. The map was compiled on the basis of materials, obtained in soil researches of land use in oblasts, by Soil Science Institute and Kazgiprozem Institute of RK.

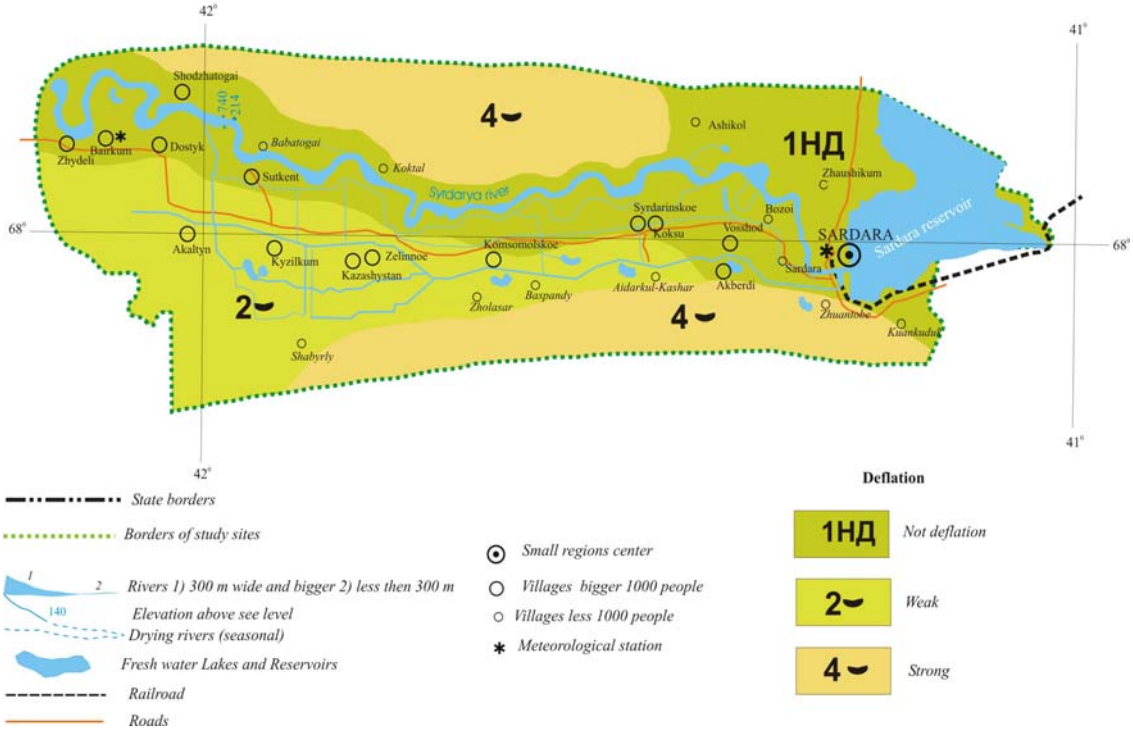
The soils of two research objects: Shardara and Shieli, were subjected to wind erosion in the region of the researches. 806. 8 thousand ha or 47.7% of the whole researched area (1693.3 thousand ha) were subjected to wind erosion. The strongest wind erosion is observed in the west of both massifs, where the weakly fixed sands of the vast Kyzylkum sandy massif prevail. The soils of Izakum sandy massif are also deflated in the east part of the object (Chardara massif). The takyr-like soils of Daryalyk takyr (central part of Shieli massif) and the left bank of Chardara massif are also subjected to soil deflation.

Table 13 - The areas deflation soils [ha]*

Study site		Degree of deflations					total
		not subjected	weak	moderate	strong	very strong	
Chardarinsky Massiv	Total area [ha]	315000	185100	-	26890	-	769000
	Percent	41.0	24.0		35.0		
Shielisky Massif	Total area [ha]	571490	-	51470	301280	-	924240
	Percent	61.80		5.6	32.6		

** in territory Kelessky and Golodnaya Steppe massif wind erosion is absent*

Deflation soils of Shardara massif



State borders

Borders of study sites

1 2 Rivers 1) 300 m wide and bigger 2) less then 300 m

140 Elevation above see level

Drying rivers (seasonal)

Fresh water Lakes and Reservoirs

Railroad

Roads

Small regions center

Villages bigger 1000 people

Villages less 1000 people

Meteorological station

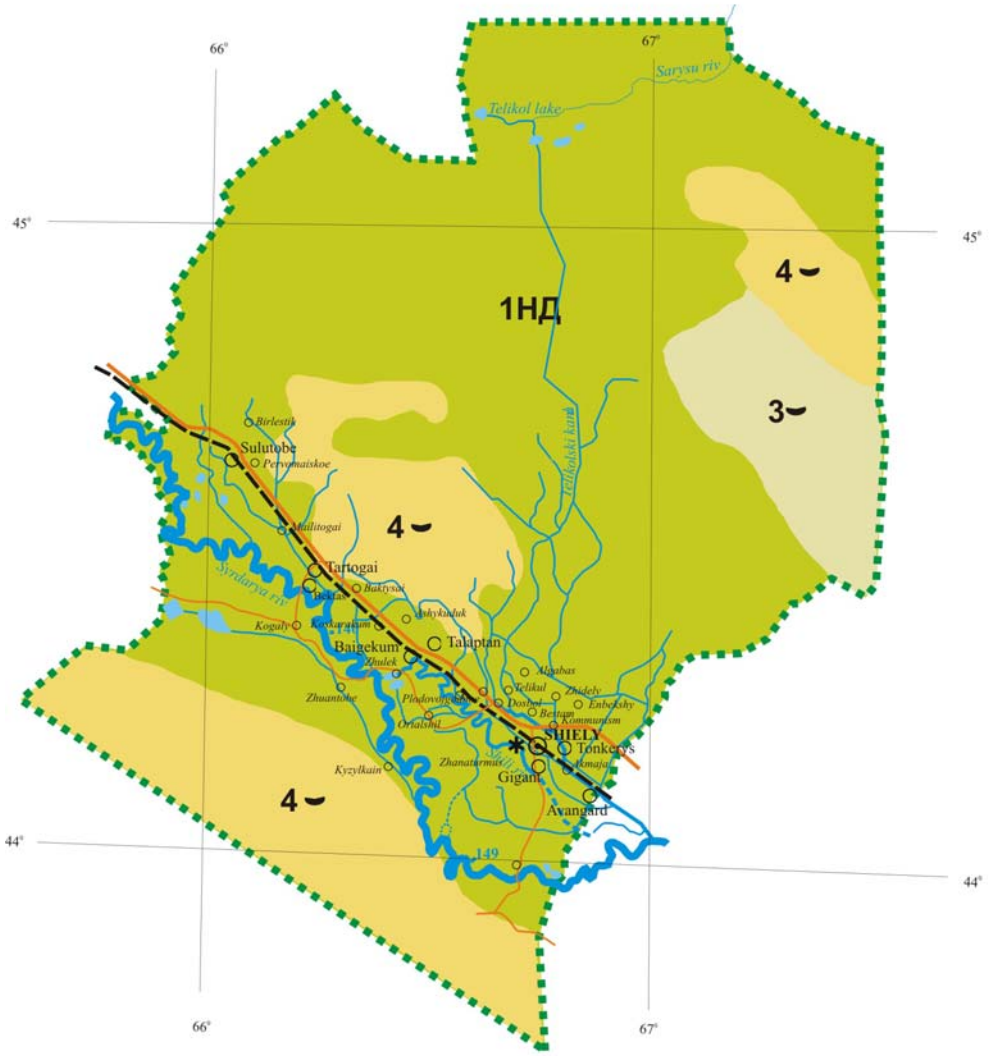
Deflation

1НД Not deflation

2 Weak

4 Strong

Deflation soils of Shieli massif



Deflation

- Small regions center
- Villages bigger 1000 people
- Villages less 1000 people
- Meteorological station
- Railroad
- Roads

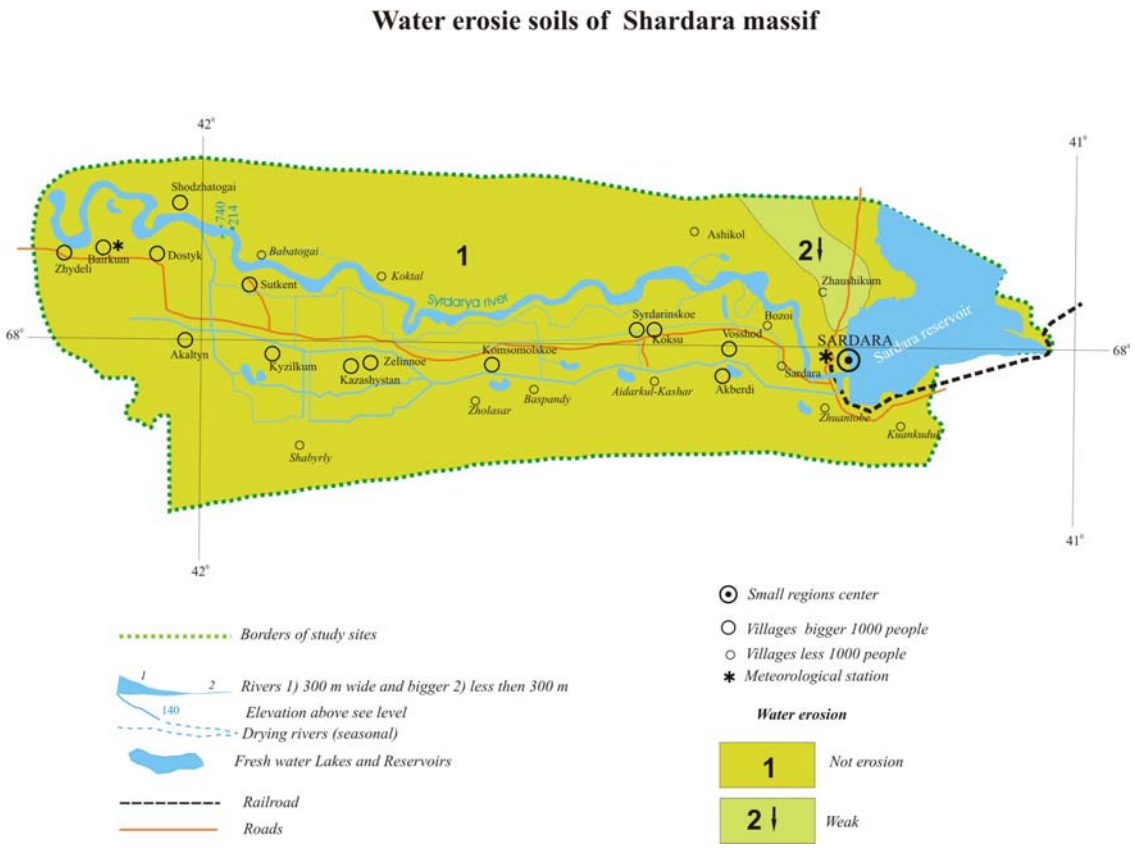
- 1НД — Not deflation
- 3 — Weak
- 4 — Strong

- Borders of study sites
- Rivers 1) 300 m wide and bigger 2) less then 300 m
- 140 — Elevation above see level
- Drying rivers (seasonal)
- Fresh water Lakes and Reservoirs

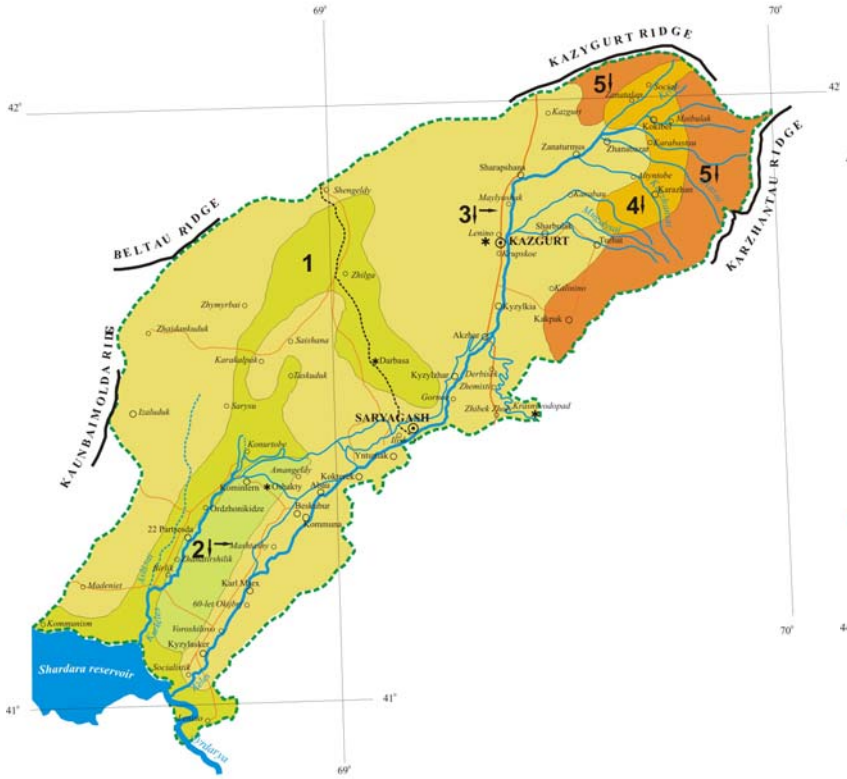
b. water erosion. The degree of soil erosion and the modern nature of water and irrigation erosion are chosen for the selection of erosion-amelioration regions. The group of regions was described according to the degree of water erosion: not subjected, weakly, moderately, strongly, and very strongly subjected. The map was compiled on the basis of materials, obtained in soil researches of land use in oblasts by Soil Science Institute and Kazgiprozem Institute of RK. The contours of the lands with different degrees of water erosion were determined on it.

The studied region refers to West-Tyanshan (Keles and Chardara massifs) and Karatau (Shieli massif) by erosion-amelioration regionalization (Mirzakeev E.K., Alimbaev A.K. Erosion-amelioration regionalization of piedmont plains of Kazakhstan Tyanshan and measures on soil protection from irrigation erosion. Vestnik KazSU. Ser. Geographical. N1(10), 2000, p.109-117. West-Tyanshan oblast occupies the northern-west piedmonts of Karzhantau and Kazgurt ranges, consisting of Cretaceous, Oligocene and Miocene deposits at the bottom. From the surface they are blocked by a thickness of loess loams and loesses, serving as soil formation rocks. Soils: grey-cinnamonic, sierozems usual and light, meadow-sierozemic. 348.2 thousand ha or 83.0% of irrigated lands' total area at the massif are eroded to different degrees. The territory of the massif was intensively developed for irrigation agriculture. It leads to the progressive development of irrigation erosion without an appropriate control. Almost the whole area of old irrigated lands has a "ragged" nature. There are abandoned lands due to the strong erosion loss and outwash of soils, in the region of piedmonts and lowlands border. Thus, a complex of anti-erosion measures is necessary here: rearrangement of the old irrigation network according to an engineer type, normalized irrigation with the least inclination, application of high doses of organo-mineral fertilizers, etc.

Slight water erosion is displayed in the south-east part of the massif only on 2.9% of the area (Chardara massif).



Water erosion soils of Keles and Kurkeles river basins



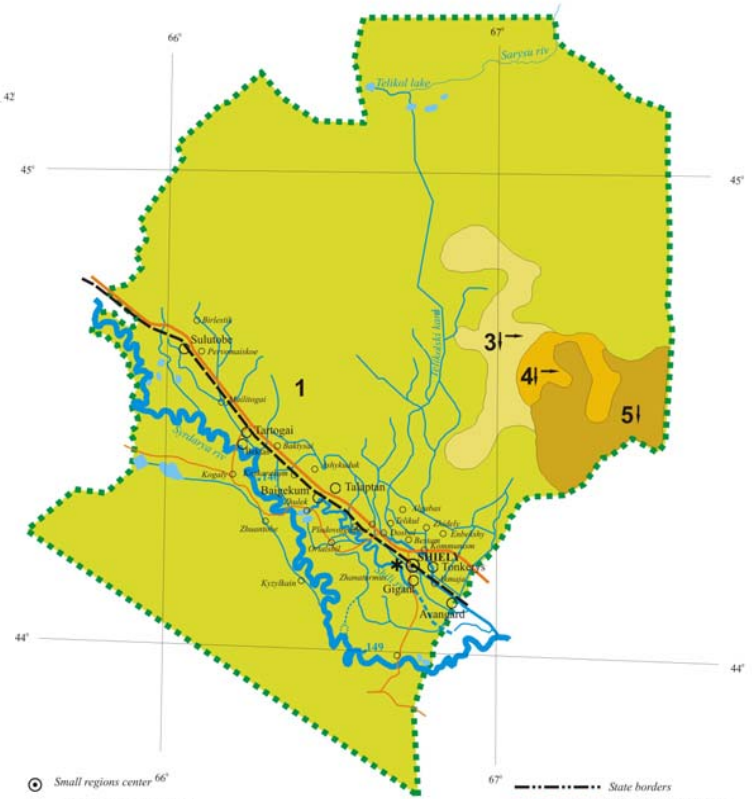
State borders
Borders of small naturel zones
Borders of study sites
Rivers 1) 300 m wide and bigger 2) less then 300 m
Elevation above see level
Drying rivers (seasonal)
Fresh water Lakes and Reservoirs
Railroad
Roads
Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station

Water erosion

1 Not eroded
2 Weak
3 Average
4 Strong
5 Veri strong

Shared display of water and irrigational erosion

Water erosion soils of Shieli massif



Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station
Railroad
Roads

State borders
Borders of small regions
Borders of study sites
Rivers 1) 300 m wide and bigger 2) less then 300 m
Elevation above see level
Drying rivers (seasonal)
Fresh water Lakes and Reservoirs

Water erosion

1 Not erosion
3 Average
4 Strong
5 Veri strong

Shred display water and irrigationai erosion

Table 14 - The areas soils subject water erosion [ha]*

Study site	Degree of water erosion					total
	not subject	weak	moderat	strong	very strong	
Kelessky Massif	57563	20303	217703	17063	35608	348240
Shardarinsky Massif	746900	22180	-	-	-	769080
Shielisky Massif	834900	-	36680	14400	38450	924430

**in territory Golodnaya step water and wind erosion is absent*

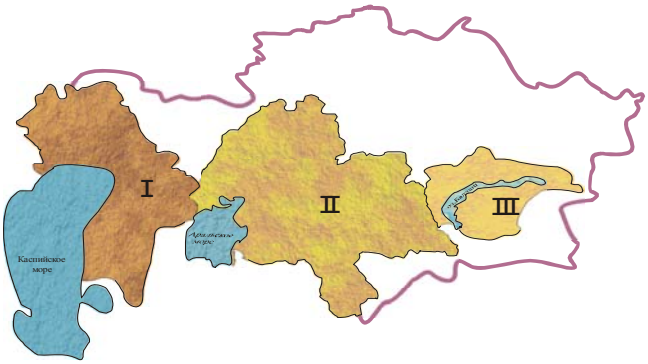
The eroded soils of the Shieli massif are located on alluvial piedmonts of Karatau ranges, consisting of Tertiary-Cretaceous, alluvial-delluvial and alluvial-prolluvial deposits. The soils are sierozems usual and light (different degrees of salinity), meadow-sierozemic. Irrigation erosion occurs everywhere on the irrigated sites. 36.7, 14.4 and 38.5 thousand ha of the whole surveyed area are occupied by moderately, strongly and very strongly eroded soils, respectively.

As a whole 402.5 thousand ha or 19.7% of all surveyed territories of the region (2041.9 thousand ha) are subjected to water erosion.

The reduction or absence of anti-deflation measures promote the development of wind and water erosion alongside with the natural factors last years.

C.1.2 Soil salinization, level and mineralization of ground waters.

Kazakhstan is a drought area. Evaporation exceeds the amount of precipitation everywhere (except some mountainous regions): in the north – by 2-3 times, in the south – by 10-20 and more times. It is caused by the long, hot and dry summers. It promoted a wide distribution of saline soils what is strengthen by the prevailing plain nature of the district and its total weak ability to drainage .



Galogeochemical provinces of Kazakhstan
I-pool of a drain of Caspian sea, II-pool of a drain of Aral sea. III-pool of a drain lake Balkhash

The south part of the Republic is subdivided into three vast intercontinental depressions with their closed basins of runoff and large lake hollows. These are: Pricaspian lowland with the Caspian Sea, Turan lowland with the Aral Sea and Balkhash-Alakul and Ili basins with the Lake Balkhash. The increase of soil salinity and ground waters in the direction of geochemical runoff movement to the final place of salt accumulation is typical for all three basins. Our objects are located on the territory of chloride-sulphate province of the Aral Sea runoff basin. The development of salt accumulation in ground waters is accompanied by the increase of chlorides level (mainly, Na), sulphates – in soils (mainly Na_2SO_4).

The map of salinization was compiled on the basis of the materials, obtained in the course of large scale soil surveys, held in the oblast by hydrogeo-amelioration expeditions. Unfortunately the maps of soil salinity were compiled only for 2 massifs – Golodnaya Steppe and Chardara. The other massifs are presented by numerical data. The contours of soils with different levels of salinity are shown on the map. More than half of the surveyed soil areas (158.6 thousand ha) are saline. 96.9 thousand ha are weakly saline, 44.9 thousand ha – moderately saline and 1638 thousand ha – strongly and very strongly saline (Table 15).

The soils of Keles massif of irrigation are the least saline. Only 3.9 thousand ha (6.0%) of soils, located in the river basins with a weak outflow of ground waters, are saline. The saline soils of Chardara massif occupy 50.6% and 62.8% of irrigated area - at Golodnaya Steppe massif. The worst amelioration condition on salinization is observed at Shieli massif, where the soils of the irrigated area (100. 0%) have different degrees of salinization.

Table 15 - Degree of soil salinity in the layer 0-100 cm, [1000 ha]

Objects of research	The area of the surveyed lands	Including							
		not salted		Poorly salted		Average salted		strongly- and very much strongly salted	
		га	%	га	%	га	%	га	%
Kelessky	64.6	60.7	94.0	3.9	6.0	0.0	0.0	0.0	0.0
Chardarinsky	66.5	33.0	49.6	21.1	31.7	7.5	11.3	4.9	7.4
Golodnostepsky	138.8	51.6	37.2	53.1	38.3	30.8	22.2	3.3	2.3
Shielisky	33.7	0.0	0.0	18.5	55.0	6.6	19.5	8.6	25.5

The soils of the area refer, mainly, to sulphate type, less often to chloride-sulphate. The soils of characterized by various salinization as it is seen from the map. It complicates the conduction of amelioration measures. The space heterogeneity of soils on salinization is in direct dependence on the level of occurrence and mineralization of ground waters. Besides this main regularity, the different irrigation also influenced greatly during last years. For example, one farmer carries out irrigation according to the regime of irrigation, another one reduces the number of irrigations facilities due to poor financial opportunities, the third one does not use land. The absence of capital and current leveling of fields' surface, decrease of common culture of crop producing and some other causes promote motley salinization of soils. But the main causes are: level, mineralization and chemism of ground waters.

Table 16 - Distribution of the irrigated lands on depth burial subsoil waters, (thousand ha)

Objects of research	The area of the surveyed lands	Depth burial subsoil waters, m				
		0-1	1-2	2-3	3-5	> 5
	64.6	0.0	0.0	7.4	19.1	38.1
Kelessky	66.5	0.0	7.1	43.4	16.0	0.0
Chardarinsky	138.8	0.6	30.9	83.8	21.4	2.1
Golodnostepsky	33.7	0.0	13.6	20.1	0.0	0.0

The map of ground waters occurrence depth was compiled on the basis of large scale surveys, carried out in the oblast by hydrogeo-amelioration expeditions. The total area of the surveyed lands makes up 303. 6 thousand ha. The lands (52. 2 thousand ha or 17.2% of the surveyed area) have the level of ground waters above the critical depth. More than the half of the area (154.7 thousand ha) is occupied by the lands with the ground water depth 2-3 meters.

The lands of Keles massif have the best amelioration condition measured by the depth of ground waters occurrence. Here, the lands with the depth of ground water occurrence exceeding the critical depth are absent. The lands of Shieli massif have the worst amelioration condition, where more than 40% of lands have the level of ground waters higher the critical one. Then Golodnaya Steppe and Chardara massifs follow where the lands with the level higher than the critical one, occupy 22,3% and 10,7% respectively.

Table 17 - Distribution of the irrigated lands on a mineralization of subsoil waters, ha

Objects of research	The area of the surveyed lands	Mineralization of subsoil waters				
		0-1	1-3	3-5	5-10	> 10
	64568	7089	43744	6008	7726	-
Kelessky	66521	896	64770	530	325	-
Shardarinsky	138767	70	49589	42495	39541	7072
Golodnostepsky	33717	-	18509	6647	6817	1744

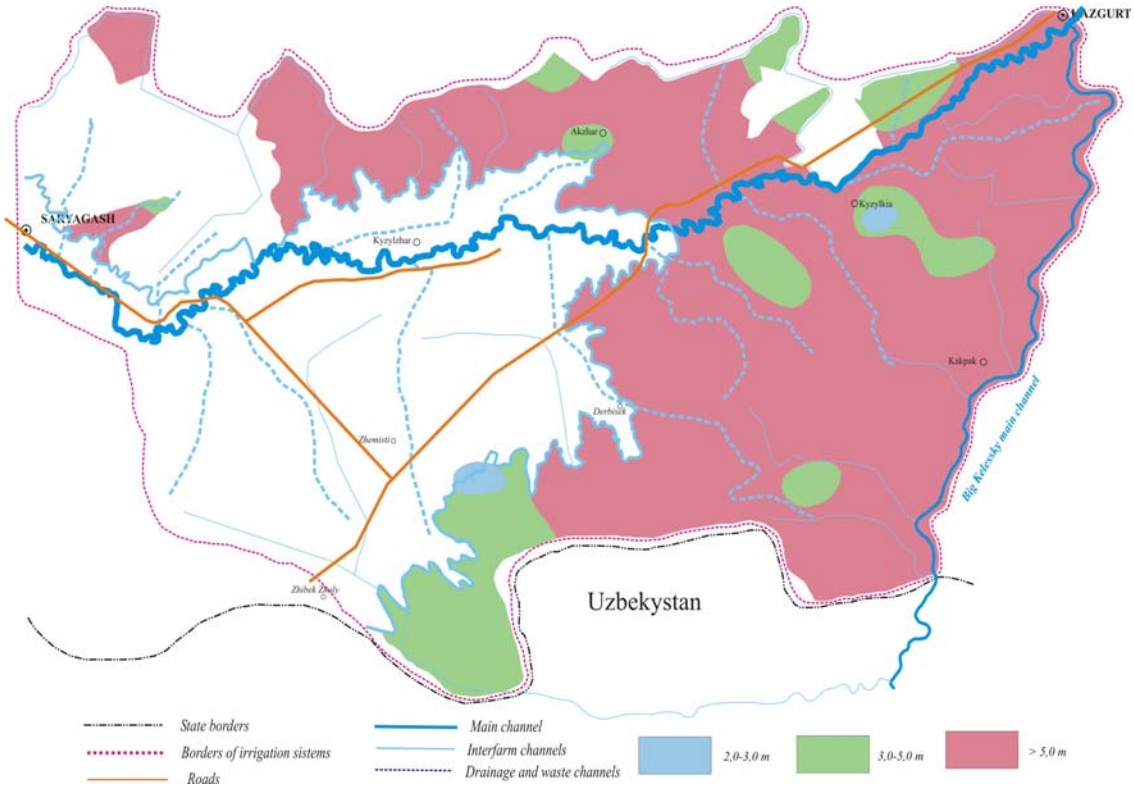
The degree of ground waters mineralization essentially influences on the salt regime and degree of soil salinization. The level of ground water mineralization is always determined under the monitoring of irrigated soils. The map of ground waters minerali-

zation was compiled on the materials of large scale surveys on the irrigated lands of the massifs. The ground waters of the research objects have different mineralization. More than the half of the surveyed area (54.9%) has ground waters with mineralization 1-3 g/l. The ground waters with mineralization 3-5 g/l occupy 18, 4% of the surveyed area, and 5-10 g/l – 17, 9%. The ground waters with minimum and maximum mineralization occupy approximately equal areas (2.7% and 2.9%).

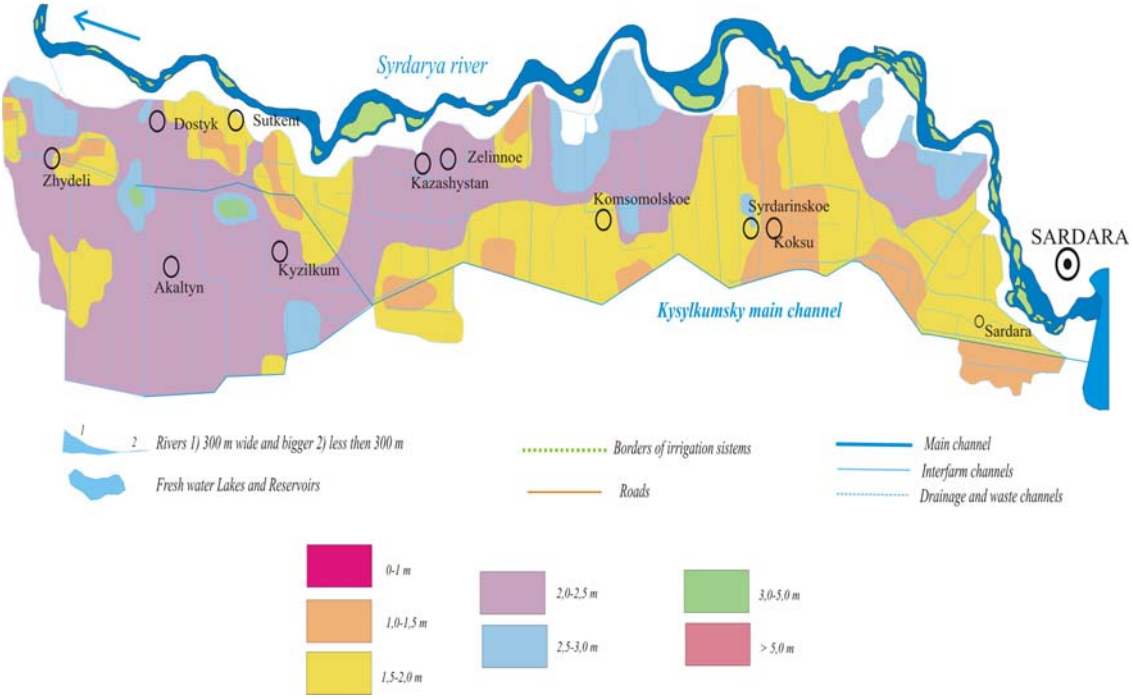
The lands of Keles massif have the best amelioration condition on mineralization of ground waters. Here the main part of the area (50.8 thousand ha or 78.6%) is occupied by the lands with the mineralization of ground waters lower than the critical level (up to 3-2 g/l). They are mainly of hydro carbonate-calcium type of chemism. The ground waters with mineralization more than 3 g/l, which causes secondary salinization, prevail on the territory of Golodnaya Steppe (89.1 thousand ha or 64.2%) and Shieli (15.2 thousand ha or 45.1%) massif. The most favorable condition on mineralization of ground waters is at Chardara massif, the mineralization of ground waters does not exceed 3 g/l practically on the whole area of the massif.

The dependence of ground waters on the degree of their mineralization is typical for three massifs. Hydrocarbonate-sulphate type is typical for the ground waters with low mineralization. Sulphates, then chlorides gradually prevail by anions and Na by cations with the increase of mineralization.

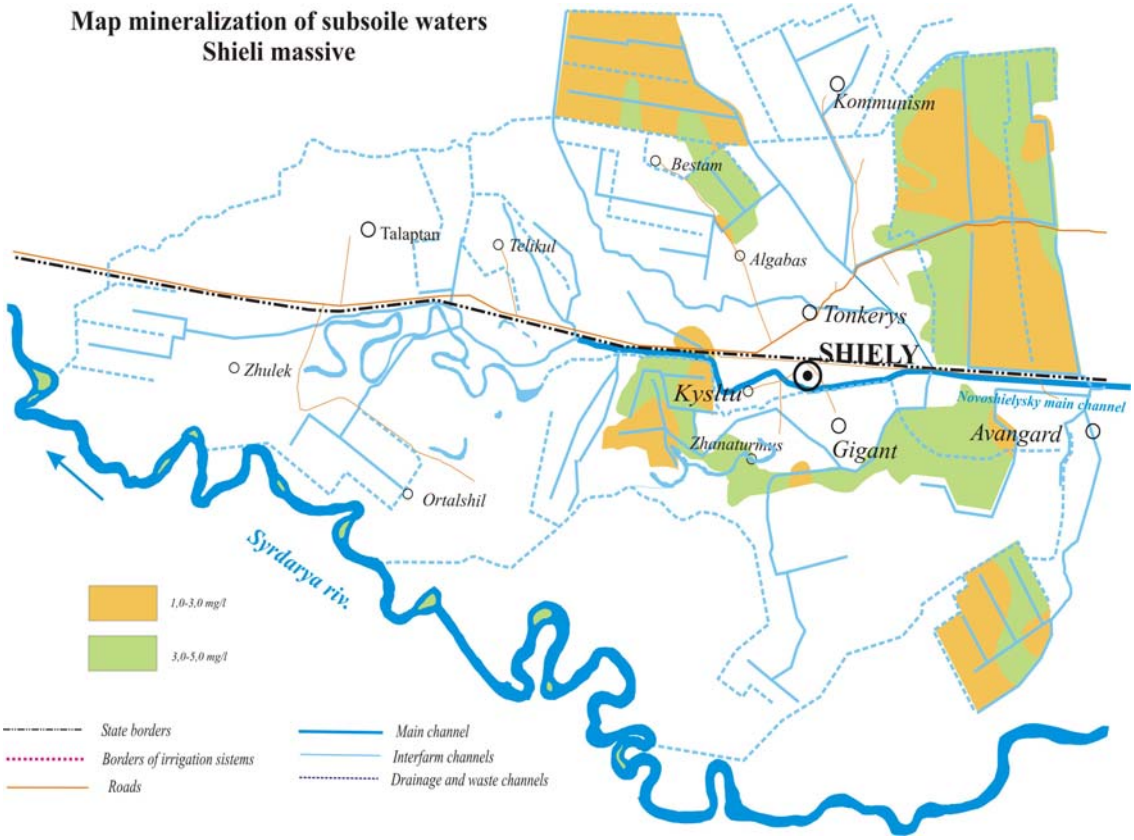
Level subsoil waters Keles massive



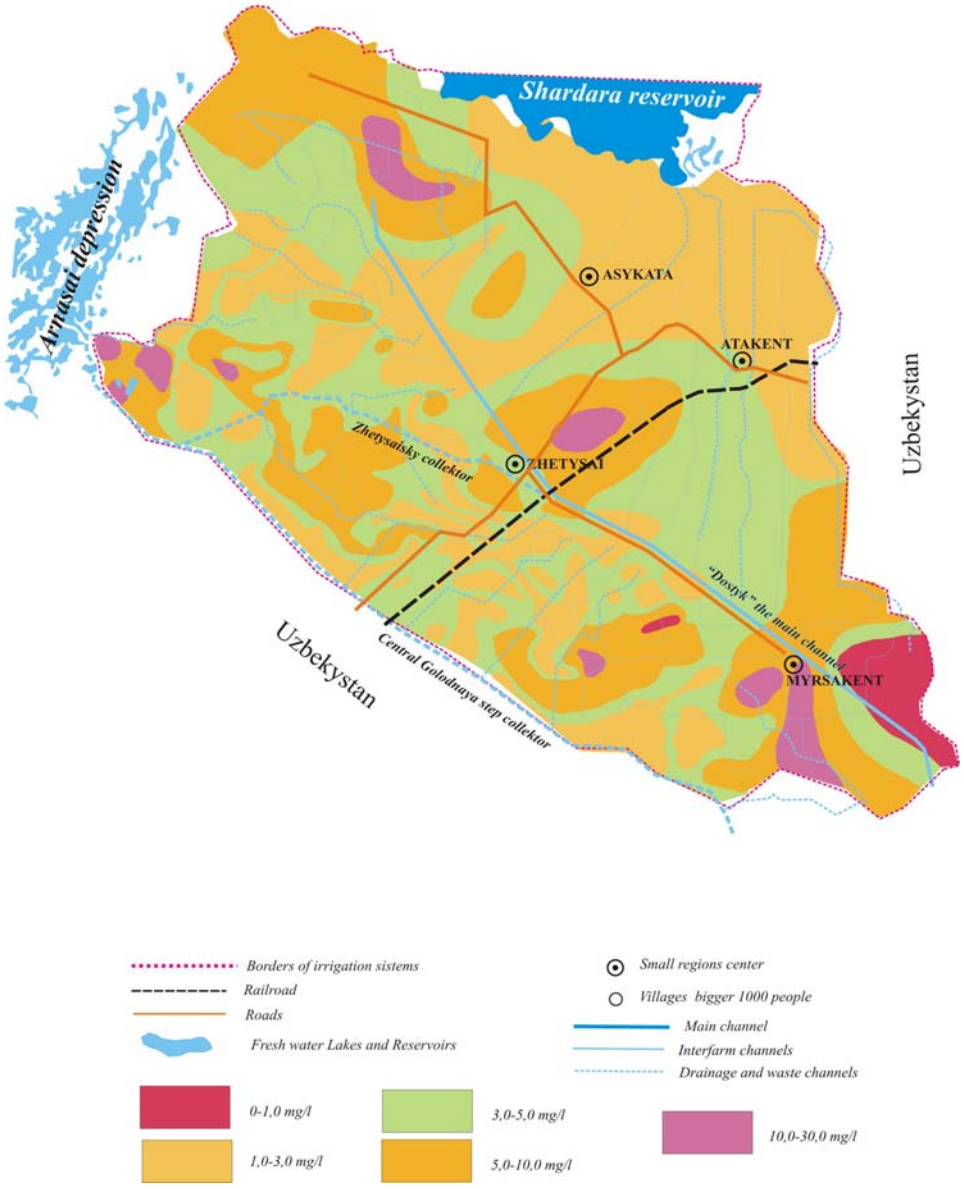
Map of a level of subsoil waters Shardarynskogo massive



Map mineralization of subsoile waters Shieli massive



Map mineraliziations of subsoil waters Golodnaya step massive



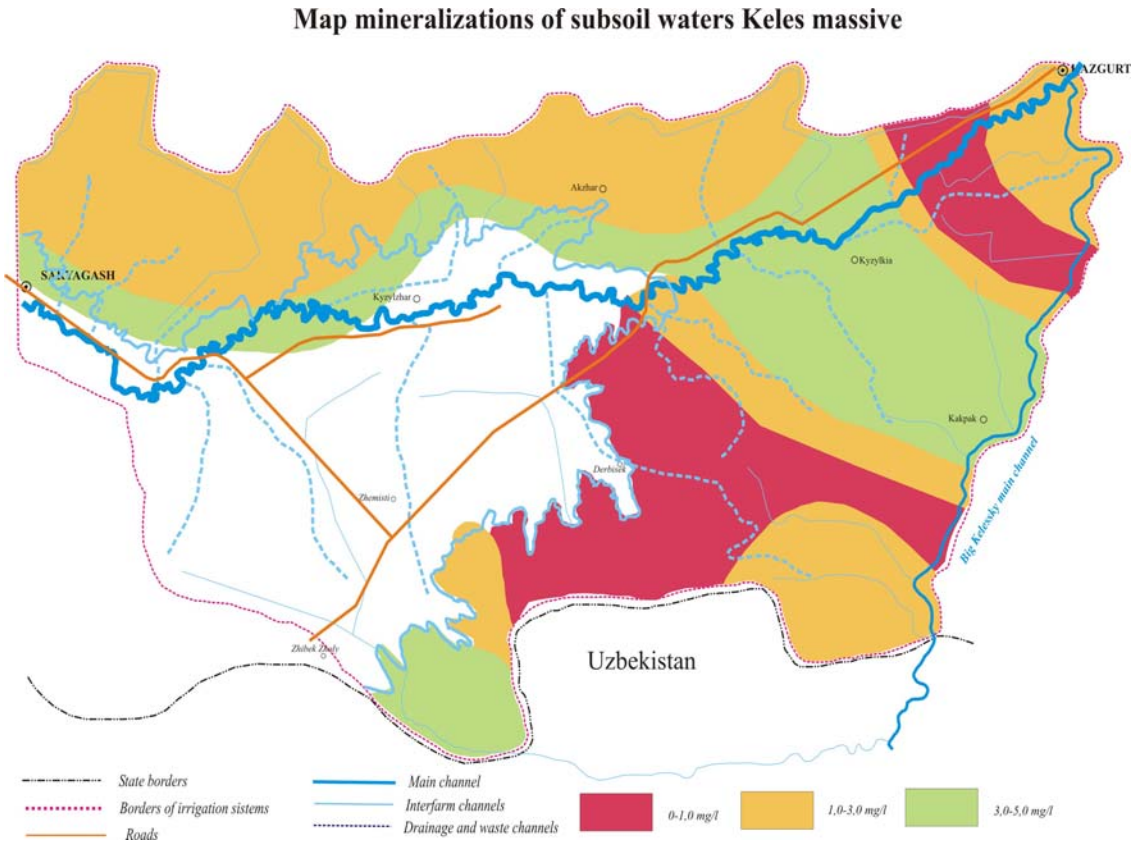


Table 18 - Presence of observant chinks

Study area	The area, рф	Amount of chinks, piese			The actual area on 1 chink, ha
		on norm	real		
			presence	from them workers	
Kelessky	64548	430	132	117	552
Chardarinsky	66521	443	145	85	783
Golodnostepsky	138767	925	881	695	200
Shielisky	33717	225	139	101	334

A network of wells was built for the monitoring of amelioration condition of the irrigated massifs. Not less than 2000 of wells for observation are required (according to norms) for the whole area of research objects. There are only 1297 wells, 998 wells are used (table). The amount of the area, served by one well, has increased by 2 times. The real situation with the insufficient number of wells negatively influence on the quality of the fulfilled works on the control of the massifs' amelioration condition.

The analysis of soil-amelioration conditions at the main irrigated massifs of the middle flow of Syr Darya river has shown that the amelioration condition of the irrigated soils in the region is being now worsened catastrophically. More than the half (52.2%) of all surveyed area of soils (303.6 thousand ha) has saline soils. Approximately, the same share is occupied by the area with the ground waters, occurring higher than critical depth and mineralization degree. It led to the appearance of lands which are not used, because of their salinization and bogging (Table 19). 6664 ha of the surveyed area are not used due to salinization and bogging.

Table 19 - The areas of not used lands on the end of 2005, (thousand ha)

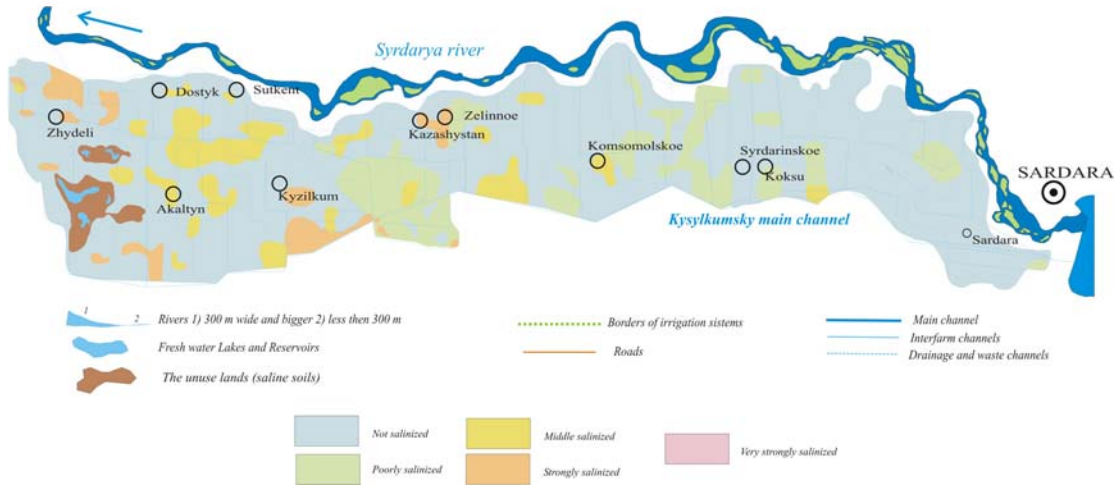
Study area	From the general area agriculture land it was not used			
	in total	owing to salination, boggings	not security water	the other reasons
	2034	-	-	2034
Kelessky	14666	6470	3250	4946
Shardarinsky	4392	194	937	3261
Golodnostepsky	X	X	X	X
Shielisky	X	X	X	X

X lack of data

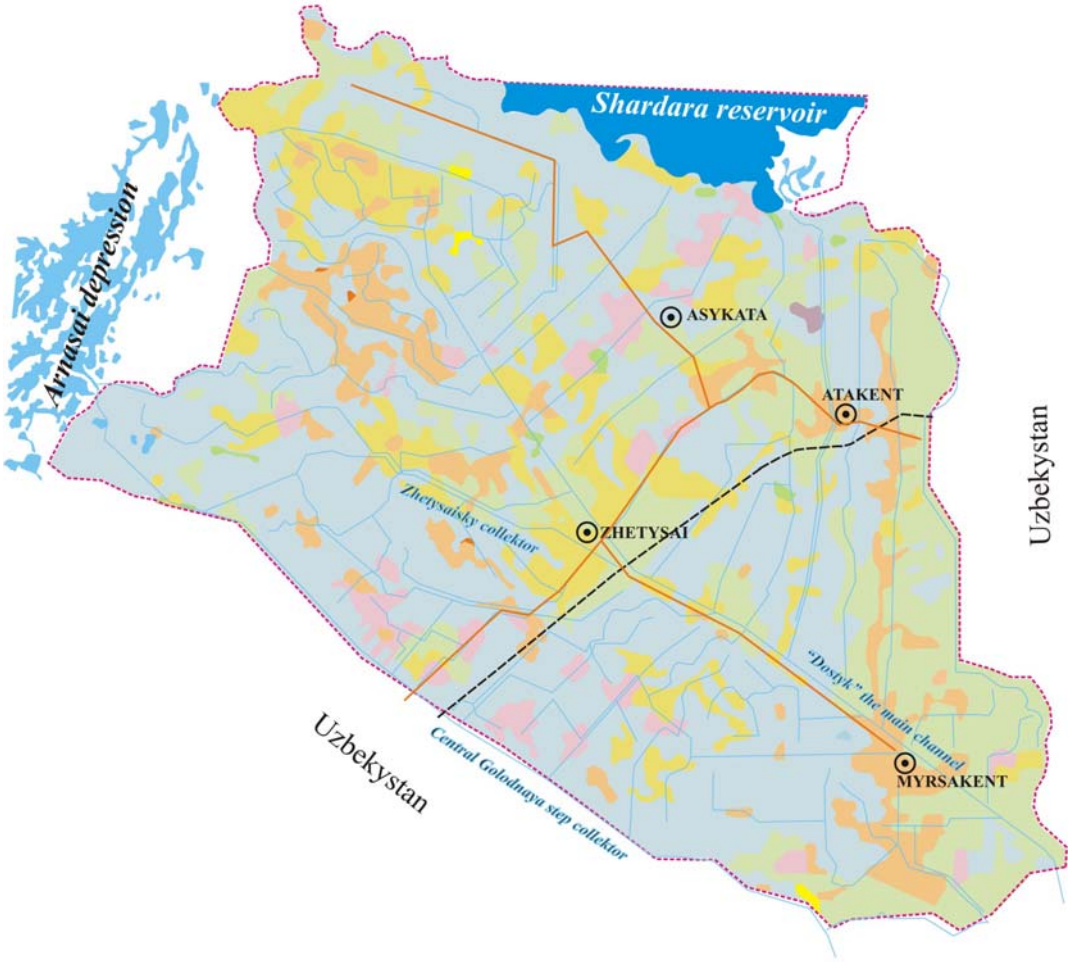
In conclusion we should note that there is a tendency of the increase of the areas with higher mineralization of ground waters under the conditions of low quality exploitation of irrigation systems and bad functioning of drainage systems. Such a situation can negatively affects the salt regime of soil, as the intensity of salt accumulation depends either on the depth of ground waters or their mineralization.

It is seen from the long-term data of observations that the irreversible soil degradation is in progress on the irrigated lands. It leads to a complete loss of their fertility and transformation of fertile oases into vast saline deserts.

Map of salinity soil Shardarynskogo massive



Map of salinity soil Golodnaya step massive



C.1.3 Contamination (heavy metals and pesticides)

There are data on contamination of soils, products of rice processing, surface waters. They were obtained in local researches, carried out by the Soil Science Institute. Pb and Ni with high, exceeding 1, coefficients of danger and Cu with K_0 close to 1.0 in the paddies of Kazakhstan present a definite danger. The increase of Pb and Ni higher than MAC (maximum allowable concentration) from irrigation to ground water is typical for the waters of Kyzylorda massif. The increased content of Pb and Ni is also observed in the products of rice processing. The content of Pb and Ni in rice flour and husk at Shieli processing plant exceeds MAC by 1.8 and 2.8 times, respectively. At Kyzylorda plant – by 2 and 2.8 times. Zn in rice flour exceeds MAC by 1.1-1.3 times at these two plants. Special alarm is caused by the increase of Pb in rice of Kyzylorda plant, exceeding MAC by 1.6 times.

Therefore, it is necessary to continue the advance research of ecological conditions at rice massifs of the Republic on the estimation of current conditions and development of measures on soil detoxication and reduction of heavy metals in plants.

C.2 Water

C.2.1 Stations of surface water control and periodicity of sampling

The control of soil quality was realized by 5 stations on the territory of the study areas: 1. station. Zhanabazar 200 m higher of the river Uyasai confluence. Small river head, the region of sheep breeding farms. 2. station Stepnoye, at a village. Middle flow of a small river, the region of irrigated agriculture and cattle breeding. 3. station Kokbulak, higher than 5.0 km from Chardara reservoir, at the border with Uzbekistan. Middle flow of a large river, the region of the developed irrigated agriculture. 4. station Chardara, 2 km lower than Chardara reservoir. Middle flow of a large river, the region of the developed irrigated agriculture. 5. Tomenaryk, 2, 2 km West-South-West from the railway station Tomenaryk. Middle flow of a large river, the region of the developed irrigated agriculture.

Table 20 - The Characteristic of stations of the control of qualities of superficial waters

river	Station, the location	Category and number	Distance from a mouth, km	Presence of the organized dump of sewage
Keles	v. Zhanabasar 200 m. are higher than a confluence r. Uyasai. the small river, area of sheep-breeding facilities(economy).	4; 1	206	no
	v. Steppe, in feature village. Average current of the small river, area of irrigated agriculture and animal industries.	4; 1	145	no
Sir Darya	v. Kokbulak, 5,0 kms from Chardara reservoir, on border with Uzbekistan. Middle flow of the big river, area of the advanced irrigated agriculture.	2; 1	1723	no
	s. Chardara, lower 2 km Chardara reservoir. Middle flow of the big river, area of the advanced irrigated agriculture.	4; 1	1633	no
	Tomenaryk, 2.2 km. WSW from railway station Tomenaryk. Average current of the big river, area of the advanced irrigated agriculture.	4; 1	996	no

C.2.2 Quality of the surface waters.

The purpose of the monitoring of the quality of surface waters is systematic and complex control of anthropogenic influence, as well as obtaining and transfer of the information. Practically, this system of modern monitoring is not carried out. For example, in comparison with the monitoring of hydrological parameters, the monitoring of hydrochemical regime does not have precise specifications, according to the calendar time table of sampling; it speaks about the absence of any system in these works. It means that it is possible to give an approximate picture in dynamics of surface waters chemical composition at the objects of researches. Thus the quality of waters is given according to the official generalized materials.

The chemical composition of the Syr Darya waters at study areas is formed mainly under the influence of contaminating substances, getting into the river on the territory of Uzbekistan. According to the data of Burlibaev (2001), the mineralization of water at Kokbulak station is lower than at the hydro posts, located lower and makes up 1270 mg/l during the period between flooding, 828 mg/l under flooding. The value of mineralization changes from 1070 to 1260 mg/l in the well of Chardara reservoir. The mineralization values at the hydro posts, located lower are more stable and they are within the values 1300-1400 mg/l. They decrease up to 830-900 mg/l in April. The chemical composition of the water along the whole river length refers to sulfate class, Ca and Na group.

The mineralization of the Keles river depends on the fluctuation of the runoff value. Maximum mineralization 644-889 mg/l is observed between the periods of flooding, during the period of flooding it decreases up to 350-400 mg/l. The chemical composition of water is often hydrocarbonate, rarely – sulfate. It can be referred to Ca and Na group by cations.

According to the data of Kazhydromet (1969-71), the content of the soluble oxygen in the water of Syrdarya and Keles rivers ranged within 7, 60-10, 1 mg/l, the percentage of saturation – 82.4 -100%. The ingredients, exceeding MAC are not found. (Hydrological year-book. Volume 5. Issue 3. 1969, 1971)

In 1981, at the border post Kokbulak (r. Syr Darya), the content of nitrites exceeded the norm by 2 times by the end of July, the concentration of Cu was 8 MAC, the content of oil products exceeded MAC by 1.5 -2 times in the majority of samples. The content f soluble oxygen in water was within 7.6 – 11.3 mg/l and only in one case it decreased to 5.56 mg/l. Besides, phenol was determined equal to 10 MAC at the same period of time. At the hydro post Tomenaryk (Syr Darya river), the contamination of waters by oil products is maximal, their content exceeds MAC by 3-5 times in more than the half of samples. The maximum content of phenols is observed in April (12-15 MAC), nitrites in March, June (7.2-10 MAC). The content of Zn in 1/3 samples was within 1.5 – 2.4 MAC, Cu (in individual tests) – 6-8 MAC (Observation of surface waters quality on the lands of Kazakh SSR for 1981. Alma-Ata 1981).The content of ammonium ions and oil products in the upper reaches of Keles River slightly exceeded the norm – up to 1.2 MAC. Nitrites were found in the amount 3-6 MAC; phenols made up 30 MAC in the region of Zhanabazar station in March and not more than 15 MAC in other periods of time. Their content at the river head exceeded the norm by 4 times only in one sample. In 2005, the index of water contamination in Syrdarya river made up 1.47 – 1.78 (3 class- “moderately contaminated”) at the hydro posts of South-Kazakhstan oblast. Sulphates exceeded MAC up to 3.8 and Cu – up to 5MAC. The water of the river Keles corresponded to the 4^{th} class “contaminated” by its quality. The index of water contamination is 2.59. Sulfates (6, 7) and Cu (5) exceeded MAC.

C.2.3 Sources of contamination.

The main sources of surface waters contamination (Keles river) are the wastes of tail-drain waters from the agricultural fields and wastes from cattle breeding farms. Industrial wastes are absent.

The main sources of surface waters contamination in Syr Darya river from the border post to the confluent of the river Arys are the wastes of tail-drain waters from agricultural fields and wastes from cattle-breeding farms. Industrial wastes are absent. The waste waters of Shymkent industrial complex (lower the Arys River confluent) are added to the given above sources of contamination.

There are also trans-border contaminants of Syr Darya water. Heavy contaminated waters come from the territory of Uzbekistan. Phenols and nitrates, exceeding MAC by 4 times, nitrites (25 MAC), phenols (6 MAC), and oil products (5 MAC) ad other are determined in trans-border hydro post Kokbulak.

C.2.4 Irrigational quality of waters

The chemical content and irrigational qualities of waters are the main factors, providing the amelioration conditions of irrigated soils. The estimation of irrigational water qualities in the main rivers and diversion canals at the study areas was carried out according to the materials of South-Kazakhstan hydrogeology-amelioration expeditions, according to the methods of Antipov-Karatayev, Priklonsky and SAR. The general estimation of waters suitability in all the sources is “suitable”. Despite of apparent good quality, taking into consideration the rise of Na and Cl levels (by Priklonsky method) and constant increase of water mineralization in Syr Darya river, there is a real threat of irrigation waters negative influence on the salt regime and balance of irrigated soils.

Conclusion for section C

The modern condition of study areas are provided by two main factors – natural and anthropogenic, and their combination. Now the structure of natural landscapes is changed at the considerable areas, cultural irrigated landscapes are created. Under the conditions of irrigated agrocoenoses, anthropogenic activity is a powerful factor of development not only for a cultural landscape, but it greatly influences on the condition of natural system of the whole region.

806.8 thousand ha or 47.7% of the whole surveyed territory are subjected to wind erosion. Wind erosion is greatly displayed in the west of Chardara and Shieli massifs, where the weakly fixed sands of the vast Kyzylkum sandy massif prevail. 402.5 thousand ha or 19.7% of the whole surveyed territory of the region 2041.9 thousand ha are subjected to water erosion. Water and irrigation erosion are greatly developed in the basin of the Keles river.

The analysis of soil-ameliorative conditions at the main irrigated massifs has shown that a catastrophic worsening of ameliorative condition of irrigated soils took place in the region. More than the half of all surveyed soil areas (303.6 thousand ha) have saline soils (52.2%).Approximately the same share is occupied by the areas with ground waters, occurring higher than the critical depth and mineralization. It caused the appearance of un-used lands, subjected to salinization and bogging. 6665 ha are not used because of their salinization and bogging.

In conclusion it can be noted that the irreversible degradation of soils is in process on the irrigated lands of the region, leading to the full loss of their fertility and transformation of fertile oases into vast saline deserts. The main threatening factors in the researched region: reduction of the rivers runoff volume and as a result the deficit of fresh irrigation water; menacing scales of salinization and bogging of soils at the irrigated massifs and adjacent territories; development of wind and water erosion including irrigational one; worsening of irrigation water; reduction of arable lands areas due to soil cover degradation; the beginning of local soils and agricultural products contamination by heavy metals and as a result the reduction of qualitative and quantitative composition of flora and fauna, reduction of biodiversity.

REPORT

Proposal No 26199 - Syr Darya

Co-ordination of scientific activities towards elaboration of common strategy for environmental protection and sustainable management in Syr Darya River Basin, in Uzbekistan and Kazakhstan.

Participant 6
Kazakh-Turkish University - Kazakhstan

Authors: Saken Kurbaniazov

In the southern regions of Kazakhstan are located in the subzonal areas of arid and semi-arid climate. Karatau Mountains serve as a natural border between middle and southern deserts. West Tyan Shian bounds zonal landscapes from south-eastern landscapes.
Thus, zonal-belt spectrum of vegetation of research areas include:

- South Turan deserts;
- Deserts of foothills of Karatau and West Tyan Shan;
- Low grass ephemeral- ephemeroid and ephemeral-ephemeroid savannoids (semi-savannas);
- Vegetation of river valleys and pre-delta of Syrdaria River;
- Mountain vegetation.

South deserts of the valleys of South Turan province are less typical for research sites due to barrier influence on the atmosphere circulation of the average mountain and high mountain ridges of Karatau and West Tyan Shian. They include small areas of sandy deserts in combination with the series of sedge *Haloxydon* communities of hilly sands with domination of white *Haloxydon* and sedge or ilak (*Carex physodes*) in Kyzylkum. Besides sedge and *Haloxydon* in these communities the wormwood (*Artemisia diffusa, A. songarica*) are common, mausoleum (*Mausolea eriocarpa*) and a number of ephemeroid species.

Foot hills and low mountain deserts occupy vast areas within the research areas. Being under the conditions of high precipitation level in comparison with zonal lowland species, they are characterized by high quantity of ephemerals, ephemeroids and cereals. Habitats are home to sedge (*Carex pachystylis*), variety of feather grass (*Stipa sareptana, S.caspia, S.caucasica, S.hohenackeriana, S.richterana*) and representatives of ephemeral grasses from genera *Tulipa, Merendera, Eremurus, Juno, Eremostachys, Phlomis, Cousinia* etc.

The content of dominating and typical species include mainly the same species that are common for outside of foothills and low mountain areas. They are worm wood (*Artemisia terrae-albae, A.turanica, A.semiarida*), biurgun and keireuk on loam and sandy soils- tasbiurgun and black boyalich on stone-ballast; white haloxylon, zhusgun, sandy acacia (*Ammondendron conollyi*), selin (*Stipagrostis pannata*) etc. on sands.

Low grass ephemeral and ephemeroid savannoids and semi savannas occupy intermediate location between mountain and lowland vegetation and represent the most xerophyte version of special type of the pre-mountain and mountain vegetation on brown soils and sierozems. It is characterized by prevailing amount of ephemerals and ephemeroids in the structure of grass level. Low grass semi-savannas occupy big areas in so called Tashkent areas on the right bank of the Syr Darya River between Karatau and West Tyan Shian.

The cover is based on *Poa bulbosa* and rang (*Carex pachyslis*) with a small quantity of bulb barley (*Hordeum bulbosum*), couch grass (*Elytrigia trichophora*), *Botriochloa ischaemum* and *Cynodon dactylon*. The ephemeral grasses are diverse and abundant, among them *Taeniatherum crinitum, Anysantha tectorum, Bromus japonicus* etc., egilops (*Aegilops cylidrica, A.triuncialis*), mortuks (*Eremopyrum orientalis, E.triticeum, E. bonaepartis*), *Phleum paniculatum* and species of ephemeral –ephemeroid grasses, most common is *Phlomis salicifolia*, bindweed (*Convolvulus subhirsutus*), *Alyssum dasycarpum, Eremostachys speciosa, Capparis herbacea,* etc. On stony sites in hilly slopes relief grow the xerophyl bushes of almond (*Amygdalus spinosissima*), cherry (*Cerasus tyanschanica, C.verrucosa*). In the places of unlimited grazing grows (*Psoralea herbaceaa*), cornflower (*Centaurea squarrosa*), wormwood (*Artemisia scoparia*) and other weeds. Big areas

are occupied by secondary human production communities where *Talniatherum crinitum* prevails. *Colchicum luteum* and *Crocus korolkovi* grow at low grass ephemeral-ephemeroid semi savannas.

Vegetation of river valleys on the lowlands represent rows of meadow and tree-bush (tugai) communities that change according to the changes of moisture and salinization of soils, depending on the distance from river bed and flood regime.

The highest diversity of flood lands is displayed in the valley of Syr Darya river. Alongside the river bed there are tugai forests and bushes of willow (*Salix alba, S.songorica, S. tenujulis*), loch and djigda (*Elaeagnus oxycarpa*) and turang poplars (*Populus pruinosa, P.diversifolia*). The trees are covered with lianas (*Clematis orientalis, Calystegia sepium*). In the edgings grow big cereals (*Phragmites australis, Erianthus raveimae, Imperata cylindrical*) and liquorice grass (*Glycyr-rhiza glabra*), kengir (*Trachomitum lancifolium*), *Alhagi pseudoalhagi* etc. The other components of the community are bushes of tamarisk and chingil.

Valley of Syr Darya river and adjoining areas are mainly rice cultivated. Along irrigation channels grow galophit grasses with predominating *Karelinia caspica, Zygophyllum fabago, Limonium otopelis, L.gmelinii, L.mirianthum* in combination with reed.

Mountain vegetation. Mountain landscapes have complex vegetation cover. Relatively isolation of mountain from surrounding territories create conditions for existence of endemic and relict plant species- one of the main reason to identify specially protected natural territories (SPNT) such as reserves, natural parks.

Spectrum of types represented in mountains that are included into research areas are as follows:

- grass –big cereal semi-savannas;
- xerophyl thin forests and bushes;
- leaf fruit forests;
- flood lands bushes and forests (tugais);
- juniper forests and thin forests;
- mountain steppes;
- bushes- rosaries etc.

Most of the above mentioned ecosystems don't have analogues in the lowlands and depend on destroying impact of human factor.

Mountain grass -big cereal semi savannas are located higher than 600 m above sea level. Height of grass is more than 1 m. Dominant base of phytocenoses include couch grass, barley bulb (*Hordeum bulbosum*) and borodach, with combination of meadow cereals such as orchard grass (*Dactylis glomerata*), brome grass (*Bromopsis inermis*) and couch grass (*Elytrigia repens*). In the upper level of grass usually the samples of big grasses are common: *Ferula tenuisecta* and *F. penninervis*), prangos fodder (*Prangos pabularia*), *Stubendorffia orientalis, Megacarpaea orbiculata*, rhubarb core (*Rheum cordatum*), *Alcea nudiflora*, *Inula macro-phylla*, sharish (*Eremurus robustus, E.sogdianus*), esparcetus (*Onobrychis grandis*), sage (*Salvia sclarea*) etc. In the second level there are *Origanum titanthum*, astragal (*Astragalus xantomeloides*), *Helichrysum maracandicum, Pterium polygamum, Cousinia microcarpa, C.alberti, C. umbrosa, C. minkwitziae*, Asyneuma argunum etc. At lower altitudes grow ephemerals and ephemeroids which content is similar with ephemeral-ephemeroid savanna. Bushes – dog rose (*Rosa kokanica, R.hissarica, R. nanothamnus*), Tyan Shian honeysuckle (*Lonicera Tyanschanica*), *Atraphaxis pyrifolia*), cherry (*Cerasus tyanschanica*). Communities of grass - big cereal semi savannas are distinguished by big floristic richness, species diversity exceeds 50 species per 100 m^2.

Xerophyl thin forests and bushes within research objects are located in the low mountain area Kazygurt. Mentioned communities as a rule are extended in the

mountain gorges and canyons, with mild micro climate and unreachable for economic activity. They occupy slopes. Main formation is thin forests of hawthorn (*Crataegus pontica*), besides *Pistacia vera* form independent communities – relict species for flora of Kazakhstan, introduced into Red Book of Kazakhstan that overgrows warm and wet southern and south-western slopes. Xerophyl plants such as groups of thorn almond (*Amygdalus spinosissima*) grow on dry stony slopes. Here amongst trees-bushes plants grow representatives of Red Book of Kazakhstan such as apple tree (*Malus sieversii*), apricot (*Armeniaca vulgaris*), *Spiraeanthus schrenkianus, Celtis caucasica* and endemic maikaragan (*Calophaca tyanschanica*) and Lipsky astragal new (*Astragalus neolyskyanus*). Floristic diversity of xerophyl thin forests includes 75 species per 100 m^2. In grass level grow *Phaphydophyton regelii*, species of the class *Lepidolopha karatavica, L.filifolia,* Pskem onion (*Allium pskemense*), Greg tulip, blue Juno (*Juno coerulea*), white stripe ferula (*Ferula leucographa*).

Leaf fruit forests are stretched on the Northern slopes of water collecting channels, temporary water streams and water divisions. Main forest forming trees are Turkestan hawthorn and Sivers apple tree. As addition to the predominant trees grow apricot, Djungar hawthorn (*Crataegus songarica*), *C. korolkovii* and Semenov maple, wild *Moras nigra* and *Juglans fallax.*

Juniper thin forests and forests are the emblem of vegetation of west Tyan Shian and mountains of Central Asia. In South Kazakhstan they are represented by formation of three species of juniper introduced into Red Book of Kazakhstan: *Juniperus seravschanica, J. semiglobosa* and *J. turkestanica*) – kara archa, another species, forms bushes in sub-alp belt. Main mass plantations of juniper grow in reserve Aksu-Djabagly and slopes of Karzhantau and Ugam.

Mountain steppes are widely represented in many belts of vegetation of Karatau and West Tyan Shian. Structure of steppe communities determine domination of xerophyl microterm dense-turf cereals from *Festuca* family, *Stipa, Helictotrichon, Koeleria* etc. Steppe elements penetrate into communities of mountain semi savannas of shibliak and juniper.

Impact of human activity on vegetation cover at research objects

South regions of Kazakhstan belong to regional development of the ancient centres of culture in Middle East. Its territory has traces of long impact of civilization. Main factors of influence on vegetation in assimilation of desert areas in Central Asia include: destruction of tree-bush vegetation for fuel and construction purposes, pasture load, land cultivation, irrigation system, road digression, planting of trees in the towns and planting forests along channels and roads. At present period to these traditional factors the extracting of fossils and construction of railway, roads, pipe lines, electricity lines is added.

Economic activity during thousands years caused development of a whole class of cultural landscapes with a special floristic complex which representatives can serve as indicators of various breaks of the natural vegetation and are able to form secondary human activity influenced plant communities. Cultural landscapes within research objects are developed in the basins of rivers Syr Darya, Keles and Kurkeles.

Plant species of natural flora that sharply increase their number during human influence (grazing, tillage, irrigation, road construction etc.) comprise the most part of the considered group of plants and consists of ephemerals, annual and perennial plants, long root and pivot rooted plants.

Natural vegetation since early periods was subject to the impact of grazing of livestock. During intensive grazing the composition of vegetation gradually perennial grasses disappear that are replaced by annual grasses and poison species.

Secondary phytocenoses are being formed that is caused by rangeland digression. In the foothills of Karatau and West Tyan Shian on the place of natural vegetation appear: *Vexibia alopecuroides, V.pachycarpa, Artemisia scoparia, Psoralea drupacea*, cornflower (*Centaurea squarrosa*) etc. Cornflower is always abundant even when intensive grazing is finished and natural vegetation is partially restored. In desert zonal vegetation communities with dominating wormwood (*Artemisia salsa*), tasbiurgun (*Napophyton erinaceum*) and keireuk (*Salsola orientalis*) are replaced by the groups of annual plants: ebelek (*Ceratocarpus utriculosus*), torgaiot (*Climacoptera brachiata*), balik koz (*C.crassa*), kanbak (*Salsola paulsenii*) etc. Indicators of long term grazing of livestock *is Descuraina sophia, Chenopodium album*, goose-foot (species of class *Atruplex*) and other nitrophyles. To the thorn plants that are not eatable belong gultemia (*Hultemia persica*), *Acanthophyllum pungens, Onopordon acanthium*.

Unlike other types of agricultural production, land cultivation is radically forming natural landscape. On significant areas the natural vegetation is destroyed and replaced by artificial agrocenoses that include species of cultivated crops and accompanying weeds. In the fields of cereals the yellow aspect of the fields is formed by groups of wild cabbage (*Brassica juncea*), mustard (*Sinapis arvensis*) and other *Cruciferae*. From other weeds grow *Cynodon dactylon*, henbane (*Hyoscyamus niger*), spurge (*Euphorbia syrdariensis*), *Sonchus oleraceus*. In the orchards grow intensively annual wormwood (*Artemisia annua*), burdock (*Arctium tomentosum*), *Cousinia umbrosa, Setaria viridis*. In irrigated plots and rice hectares grow *Pycreus korshynskyi, P.nilagirius, P.globosus*, Juncellus *serotinus, Ehinochloe crus-galli*, *Panicum miliaceum*, thorn apple (*Datura stramonium*) etc..

Positive results of human assimilation of nature include creation of trees plantations in the towns and along the roads. The assortment of trees and bushes include species which are representatives of native flora of Kazakhstan and Central Asia and plants from different regions introduced into culture. Most common are karagach (*Ulmus pumila*)- in wild form it grows in the upper part of the basin of Ili River, apricot (*Armeniaca vulgaris*)- mountain plant, haloxylon (*Haloxylon aphyllum*), tamarix (*Tamarix ramosissima*), piramide poplar (*Populus uzbekistanica*). Introduced plants include robinia (*Robinia pseudoacacia*), mulberry tree (*Morus alba*), catalpa (*Catalpa bignonioides*).

REPORT

Proposal No 26199 - Syr Darya

Co-ordination of scientific activities towards elaboration of common strategy for environmental protection and sustainable management in Syr Darya River Basin, in Uzbekistan and Kazakhstan.

Proposal No 26199 - Syr Darya Participant 4
Ministry of Education and Science - Kazakhstan

Author: Kairat Uteulin

The present condition of ecological education of population of South Kazakhstan region was studied from May 1 st 2006 to October, 30 th 2007. The massifs Golodnaya Steppe (Maktaral region), Shiieli massif (Shiieli region), Keless massif (Sary-Agash and Kazgurtsky regions), Chardara massif (Chardara region) were also tested.
The main objective of the study was to create data base containing infrastructure of education and environmental knowledge in South Kazakhstan.

The tasks set for studying:

a) data on nature protection and threat to the environment collected from questionnaires and interviews at different organizations (schools, governmental institutions, non-governmental organizations);
b) proecological education programmes;
c) activity of educational institutions concerning environment (schools, universities, etc.)

CONTENTS

Report concerning tasks:

a) data on nature protection and threat to the environment collected from questionnaires and interviews at different organizations (schools, governmental institutions, non-governmental organizations).

Results of questionnaires elaboration are presented in summarized form according to the points of a questionnaire. Statistic data in the form of diagrams are given in the appendix.

1. Interest in environmental protection.

The interviewed population of Golodnaya Steppe, Shieliisky, Kelessky and Chardara massifs revealed a medium level of interest on environmental protection. This moderate interest is irrespective of age, sex or place of living (town or countryside).

2. Source of information about ecology

The interviewed population of Golodnaya Steppe, Shieliisky, Kelessky and Chardara massifs has the knowledge from the following sources: folk pedagogic (parents stories, wise folk stories about environmental problems in general and in some particular cases), school and TV. The majority of the population is not well informed. Radio, newspapers and Internet are hardly ever used.

3. Who should continue environmental education?

The answers received from interviewed population depend on age.

Pupils of lower classes answered that it should be school. Older pupils are of opinion that institutes and universities are adequate for this. Adults from age 31 to 50 are convinced that it is the role of ecological organizations and local authorities. People over 50 think that local authorities are responsible for environmental education.

4. Types of land use

Most of he interviewed people know the types of the land use which are carried out by them. All massifs have pastures and irrigated lands. Marshland are mainly found in Golodnaya Steppe, Shiellisky and Chardarinsky massifs, and tugais are located along Syr-Darya (Chardarinsky massif).

5. Environmental problems of the region

Most of interviewed population know environmental problems of the region. The problem of water deficit and its quality holds the first place in all tested massifs. The problem of soil protection and salinization can be placed second. We should note that the problem of salinization is not acute for Kelesskii massif if compare to other massifs. The urban population points out the problems of water protection, waste utilization, noise protection and air protection. It is important to note that 80% of the interviewed did not mention the problem of biodiversity protection. It is obvious that the population does not know that numerous species of plants and animals are endangered. People just worry about the condition of the environment (water, soil, atmosphere) which affects their every day life and practical activity.

6. Did you learn about environmental threats in your region at school?

Children from 7 to 19 y. often say "Yes", whereas the adult population answers "No".

7. Which activities protecting the environment were performed in your region?

In general, the population gives negative answers to these questions. The population of all massifs does not get enough drinking water of high quality. The problem of water protection is not solved. The urban population points out that the problem of waste utilization is still quite serious. 90% of the interviewed do not speak about fight with poachers.

8. Which forms of environmental protection exist in your region?

Reserves:

The are no reserves on the territory of South Kazakhstan area, where Golodnaya Steppe, Shiieli, Keless and Chardara massifs are located. The interviewed population knows about it. At the same time local people heard about two or three reserves.
In Kazakhstan there are 8 reserves: Aksu-Dzhabagly (South Kazakhstan area), Almatisky (Almaty area), Barsa-Kelmes (Kyzylordinskay area), Kurgaldginsky (Akmolinnskya area), Naurzumsky (Kostanai area) Markakolsy (East Kazakhstan area), Usturtsky (Magistauskaya area), West-Altaisky (East Kazakhstan area).

National Parks:

There are no national parks on the territory of South Kazakhstan area. The interviewed population does not know anything about national parks. National parks present a new type of protected landscapes in Kazakhstan. They have not been organized yet, though it is no doubt that they should be created.

Natural monuments:

There are no natural monuments on the territory of South Kazakhstan area. The interviewed population does not know anything about them .
Kazakhstan has three unique natural monuments:
"Goose migration" – pale ontological burial in north-west of Kazakhstan
"Charynskaya ask-tree grove" and "Chinturgenskie fir-groves" in Almatinskay area.

Wildlife sanctuaries (Zakazniki):

The interviewed population stated the absence of wildlife sanctuaries. A majority of people do not now anything about such wild live sanctuaries. However, there are two wildlife sanctuaries – Kargalinsky state (zoological) in Shieliisky and Bairam-Ugumsky wildlife sanctuary in Kelesky massif.

9. 10. Which species of plant and animals are endangered and protected in your region?

Some specially protected plants and animals can be found in Golodnaya Steppe, Shieli, Keless and Chardara massifs on the territory of South Kazakhstan area.
Animals: wild sheep (arkhar), mountain goat, deer-maral, roe deer, lynx, snow leopard, wolf, fox, brown bear, porcupine, stone marten, ermine and others.
Plants: Greag tulip, Kauffman tulip, Neodzvetsky apple-tree, wild grape, apricot, Rhaphidophyton regally, Lepidolopha karatavica and others.

The interviewed population named correctly the following species of endangered animals: white heron, arkhar, bear and falcon baloban.

The larger part of the interviewed population does not know endangered species of plants and animals or can name only few of them.

11. Do you think that in your region the environmental protection program should exist?

90 % of the interviewed population replied "Yes" and 10% (pupils of primary school) answered "I do not know"

General questionnaire results.

Sex dependence

Answers to the questions do not depend on sex (male or female)

Age dependence

Ecological knowledge increases as follows 7-12 <13-19 <20-30 ≤ 31-50 ≤ over 50.

The level of eco-education is almost equal among the people aged over 25.

Dependence on the place of residence: village, town

Villagers and town population display almost equal eco-knowledge. There is slight difference in the answers about environmental problems of their area. Town inhabitants often speak about waste utilization and air protection. Village population worries about soil and water protection.

Dependence on education

It was found that eco-knowledge directly depends on the education of the interviewees. The level of eco-knowledge increases as follow: primary school, secondary school, high education, nongovernmental eco-organization, administrative staff, ministries staff.

Questionnaires do not give a total picture of environmental problems of the region. The interviewees do not show great interest in environmental problems, they often answer but do not understand the question. The population is not interested in problems of their region. So only specific researches will give a real assessment of eco-situation in the region.

Questionnaires and their results should also be used as well as other sources of information.

The following conclusions from the investigation report shoul be taken into consideration:

- creation of date base containing infrastructure on environmental education in Kazakhstan;
- creation of pro-ecological educational programmes;

- improvement of activity of educational establishments (schools, universities etc.)

Condition, perspectives and ways of development of eco-education in tested regions according to questionnaires results and other sources of information.

Preliminary results of research achieved from questionnaires and other sources of information have allowed to define the following problems of further development of eco-education in some regions of South Kazakhstan.

Pre-school eco-education

Results:

- the main component of pre-school eco-education in South Kazakhstan area, like in any other country of Central Asia, is folk pedagogies with its teaching stories, fairy tales, legends, myths, customs, sacrified animals and plants;
- all pre-school educational programs contain "Eco-education" and "Introduction into environment". Unfortunately, only few pre-school establishments carry out such work;
- there is a real deficit of training appliances and hand books, popular-scientific literature for children, as well as video- and audio programmes;
- there is a great need in purposeful support of eco-education from government, local authorities, regional structures of Ministry of Environment Protection.

Eco-education in a secondary school

None of the tested regions of South Kazakhstan area has specially oriented program on eco-education that could cover all age groups of middle grades.

School courses of middle grades: – "Natural History" (4-5 grades), "Botany" and "Zoology" (6-8 grades) are basic educational courses in the countries of Central Asia. They provide general knowledge about the world of animals and plants.

Pupils do not have enough knowledge of flora and fauna species which should be protected. Course books and handbooks, published in Soviet time, do not reflect specific features of the nature and environmental problems of the region.

Practically, a special course "Ecology" is not yet included in school curricula as a separate course.

The level of integration of ecological knowledge into other subject is still low.

Only 5 % of all secondary schools carry out systematic work on eco-education. These schools use programmes worked out in Russia. One of such programmes – "Ecology and dialectics"- was widely used in late 90s years, but at present it is not popular because of expensive course books.

Eco-education at universities

The youth of tested regions of South Kazakhstan get higher education in different parts of Kazakhstan. According to data of the Ministry of Science and Education 15 universities in Kazakhstan have faculties related to ecology studying. About 1300 student do these courses. They study "Ecology and monitoring", "Industrial ecology", "Chemistry and ecology", "Biology and ecology", "Geography and ecology". Students of all departments get general eco-education, whereas students doing

Chemistry, Biology and Ecology courses get extended and more complex eco-knowledge. Such faculties train qualified ecologists for nature protection spheres – Ecology, Ecology and use of natural resources. Some universities provide courses for engineers for industry ("Applied ecology", "Agroecology"). At Kazakh State University named al-Farabi there was worked out and introduced a complex program of eco-education for students of all departments for the whole period of studying. Asian University named L. Gumilev, Kazakh State Architecture Academy, Kazakh National Technical University named K. Satpaev, Kazakh National Agricultural University and Almaty Institute of Energy and Communication, as well as at all regional universities train young qualified specialists in bio-ecology, chemical ecology, nature protection, environmental protection and monitoring.

Teaching Institute for Further Training , Public universities, Institute of Ecology and Sustainable Development (Almaty), Independent University of ecology named M. Shokai (Kysyl-orda), International University named Kh.A. Yassavi (Kentau), and South Kazakhstan State University prepare specialists in environmental protection. But only 5 % of qualified specialists can find job.

Experts do not define this work satisfactory.

Problems concerning ecological education at universities:

- course books and hand books deficit especially in Kazakh language;
- absence of modern programmes in teaching in the range of ecological education;
- the absence of modern devices (audio- and video equipment, computers, e.mail. Internet) at faculties training specialists;
- laboratory base of many universities does not meet modern requirements;
- few projects with foreign countries including the exchange of teachers and students;
- poor contacts between universities and schools;
- lack of financing for creating material and technical basis and training appliances (manuals, course books, handbooks).

Non-Government Organization contribution into ecological education in tested regions and South Kazakhstan regions

The history of activity of Non-Government Organization (NGO) specializing in the sphere of ecological education in Kazakhstan goes up to 10 years. Education and ecological organizations work in all regions of Kazakhstan. They perform as clubs, summer camps, "green" patrols, etc.

More than 170 NGOs function in Kazakhstan. Founded in 1988 Forum of NGO has a section of ecological education. This section is the most numerous, more than 20 organizations take part in its work. NGOs in South Kazakhstan perform well on the problem of Aral sea, but the number of them is less than in Maktaralsky, Shieliisky, Sary-agashsky and Kazyrgurtsky regions.

Eco-society "Wild Life" carries out sufficient work in the tested regions of South Kazakhstan. It was registered in 1995 as an independent NGO with financial support of ISAR\USAID as well as "Urpak".

Goals and program of "Wild Life"

- to find out rare species of animals in South Kazakhstan which are endangered;
- to work out the programme of protecting and renewing list of endangered species of animals;
- to draw public attention to solving ecological problems;

- to arrange nature-protecting acts in order to save rare animals, which are in danger of extinction;
- to help government and NGOs in working out national strategy on saving and rational use of bio-resources;
- to inform schoolchildren and adult population of the region about international acts on nature protection;
- to welcome national traditions on caring attitude to nature;
- to use mass media to highlight youth activity;
- to develop extra ecological education at secondary schools.

There are some problems in NGOs activity:

- NGOs do not have much experience, so government structures do not take them seriously and do not believe they can contribute into the development of ecological education;
- poor material base of NGOs because they do not get any financial support from government;
- in most case NGOs do not function in faraway countryside;
- NGOs are not welcomed to take part to adopt ecologically important resolutions, though exists a legal support in the form of Orkhus convention, which was ratified by several countries of Central Asia, including Kazakhstan;
- lack or absence of co-ordination between different ecological organizations in content of programmes and methods of teaching;
- poor use of mass media for carrying out eco-education;
- the system of experience exchange has not been tested (NGOs + government structures).

State policy in the sphere of ecological education

Ecological education is founded on the long-term strategy of the Republic of Kazakhstan till 2030 “Ecology and natural resources”. Articles 73 and 74 of the low “environment protection” from 15.07.97 specifies total and continuous eco-education of junior and senior staff.

However, realization of ecological education has defected:

- absence of strategy in ecological education on governmental level;
- poor contacts between NGOs and governmental structures;
- lack of information in the forming state policy;
- low standards of living especially among villagers.

Recommendations on the development of ecological education in tested regions

Development of ecological education (EE) in tested regions is closely connected with the same problem in Kazakhstan, central Asia and in the whole world.

At the present stage the main purpose is to integrate Central Asia with the world process of EE. This demands:

- to study international experience in EE;
- adaptation of methods of foreign countries in the sphere of EE to the system of education of Central Asia countries;
- creation of data base on present day teaching programmes, manuals, teaching appliances;
- development of distance systems of EE;
- making inventory of terminological apparatus of education, defining subject area of ecological education, which is much wider than environmental protection (ecology of dwelling houses and home appliances, development of ecological needs, formation of eco-thinking);

- certification subject area of close-related directions-eco-economics, eco-tourism, sustainable land- and forest usage, steady architecture and design, eco-art, eco-ethic, etc;
- formation of programmes of training experts on working out local and national strategies on ecology;
- formation of teaching and testing programmes for experts on voluntary certification of consumer goods and eco-marking, introduction of ISO standards, etc;
- arranging teaching courses and training of specialists on eco-base knowledge and Internet technologies to support\provide sustainable development (virtual resource centers, hosting, eco-advertising, multilingual phrase logical e-translator on SD topics);
- creation of Internet libraries and date base available for all educational institutions and programmes;
- development of educational TV and its integration with Internet;
- arranging teaching courses on eco-journalism;
- realization of continuous education for retraining teachers and experts working in eco-sphere;
- defining new ways of assessment for process and results of teaching;
- to draw attention to the need of learning English as a tool leading to the world of knowledge, Internet, as an instrument of financial management of grant programmes and as a way leading to the activity of world institutions;
- make effort to pass a low on eco-education either in the form of separate law act or as an addition to existing laws on education.

Infrastructure of ecological education in tested regions and in Kazakhstan

Ecological education (EE) in tested regions and in Kazakhstan is performed for sustainable development and should be continuing. Consequent components of continuous EE should contain: folk pedagogies → pre-school education → secondary education→ vocational and technical education → higher (university) education → Non-Governmental Organizations → Governmental structures → International cooperation.

EE of tested regions can be put into two large groups: formal and informal eco-education. Formal education is provided at comprehensive and vocational schools with final awarding of diplomas and qualification. Informal education does not any diplomas.

The main problem of EE of tested regions lies in the fact that a lot of resolutions are still on paper.

Recommendations on the development of infrastructure of EE in tested regions, in Kazakhstan and other countries of Central Asia

1. There are good reasons to create a common methodical centre of eco-education in Central Asia to accumulate programmes, handbooks and methodical papers for all levels. It is useful to form a united system of eco-education for all age groups using new teaching methods of different countries through adaptation them to national eco-conditions.
2. It is necessary to found intersectoral, many-sided methodical councils (commissions) including representatives of Ministry of Environmental Protection, Ministry of Education, Non- Governmental Organizations, International Organizations and Certificate Institutions.

3. At this stage it is possible to create Central Asia office on the base of Regional Ecological Centre with is planning to include educational component in its activity.
4. To organize national and local centers of eco-education in countries, cities and region.
5. To think of the program of regional financial support of eco-education.
6. To develop the engagement of worldwide NGOs in environmental education

ANNEXES

Data about threats environmental ambience, collected as a result series questioning

Massive				
№	Golodnaia steppe	Shiieli massiv	Shardara massiv	Keless massiv
1	Water deficit, drinking water quality	Water deficit, drinking water quality	Water deficit, drinking water quality	Water deficit, drinking water quality
2	all are ploughed	Erosion of soil	Erosion of soil	Water and irrigation erosion of soil.
3	Salinization	Salinization	Salinization	Salinization, much little
4	Bog	Bog	Bog	
5		flooding	flooding	
6	contamination of atmos-phere for city	contamination of atmosphere for city	contamination of atmosphere for city	contamination of atmosphere for city
7	. Much nitrates in graund water. Contamination pesticides, herbicide	Contamination heavy metals, pesticides, herbicide	Contamination heavy metals, pesticides, herbicide	Contamination heavy metals, pesticides, herbicide
8	Waste utilization, it is not enough	Waste utilization, it is not enough	Waste utilization, it is not enough	Waste utilization, it is not enough
9	Sewage system, it is not enough.	Sewage system, it is not enough.	Sewage system, it is not enough.	
10	Low knowledges about species of plants and animals are endangered.	Low knowledges about species of plants and animals are endan-gered.	Low knowledges about spe-cies of plants and animals are endangered.	Low knowledges about species of plants and animals are endangered.
11	disease of the pat		disease of the pat	disease of the pat

Kazakh classification (Distribution of natural zones and belts in sites selected for study in Kazakhstan)

Geo-morphological regions	**Zone**	**Belt**	**Study site***
Mountains of western Tian-Shan	High-mountains medow-steppe zone	alpine medow-steppe belt	No in Kaakhstan. Chatkalsky reserve in Uzbekistan
	Mountain and foothill meadow-steppe zone of sparse growth of juniper, shrubs and tall-grass	high-mountain sub-alpine meadow-steppe belt	2. Karazhantau ridge
Foothill plains	cereal meadow-steppe zone in foothills		3. Kaskelen massif
	short-grass desert-steppe zone in foothills	Belt of short-grass ephemeroids	3. Kaskelen massif
		Belt of short-grass ephemeres and ephemeroids	3. Kaskelen massif
		Desertifying short-grass mountains and foothills belt*	no site
		Mountains and foothills desert belt*	no site
Clay and sandy plains	sagebrush and sagebrush-saltwort desert zone		5. Shardarinsky massif
Pre-delta of Syr-Darya river (delta-alluvial plain)	Zone of northern desert	Belt of Syr-Darya valley	6. Shieliysky massif
		Belt of foothils alluvial-prolluvial plain	6. Shieliysky massif
Syr-Darya valley	Nitrozonal		5. Shardarinsky massif 6. Shielysky massif

Distribution of soil types in each study site				
Geo-morphological regions	**Zone**	**Belt**	**Soil type**	**Study site***
Western Tian-Shan maountais	High-mountains meadow-steppe zone	High-mountains meadow-steppe alpine zone	mointains meadow-steppe alpine	No in Kazakhstan. Chatkalsky reserve in Uzbekistan
			mountain steppe alpine	
		High-mountain meadow-steppe subalpine belt	mountain meadow-steppe subalpine	
			mountain subalpine dark-colored subalpine	
			mountain-steppe-subalpine	
	Mountain and foothill meadow-steppe zone of sparse growth of juniper, shrubs and tall-grass		brown mountain soils	2. Karazhantau ridge
			mountain grey-brown soils	3. Kaskelen massif
			mounatain-forest dark-colored soils	
			mountain gre-brown redly soils	
Foothill plains	cereal meadow-steppe zone in foothills		grey-brown	3. Kaskelen massif
	short-grass desert-steppe zone in foothills	Belt of short-grass ephemeroids	Grey soils, usual southern sierozems (sierozems typical according to Uzbek classification)	3. Kaskelen massif
		Belt of short-grass ephemeres and ephemeroids	light southern sierozems (grey soils)	3. Kaskelen massif
		Desertifying short-grass mountains and foothills belt*	sierozems usual northern (grey-soils)	no site
		Mountains and foothills desert belt*	mountain usual sierozems	no site
			light northern sierozems	

			solonchaks (alkali soils)	
Clay and sandy plains	sagebrush and sagebrush-saltwort desert zone		takyr (clay coated soils) solonchaks (alkali soils)	5. Shardarinsky massif
Pre-delta of Syr-Darya river (delta-alluvial plain)	Zone of northern desert	Belt of Syr-Darya valley	alluvial meadow tugai alluvial meadow Marshes, bogs rice paddy soils (bogs) solonchaks (alkali soils)	6. Shieliysky massif
		Belt of foothils alluvial-prolluvial plain	clay-coated soil (takyr) rice field paddy soils solonchaks (alkali soils)	6. Shieliysky massif
Syr-Darya valley	Nitrozonal		Alluvial-meadow tugai soils	5. Shardarinsky massif
			alluvial meadow bog, marshes solonchaks (alkali soils)	6. Shielysky massif
	* *these cells can be removed in fututе*			

+Legend to geological map
Filling → Homogeneous filling → Palettes→ Spektra Master®

N	On the map		
	color Spektra Master®	on a map[4]	
Basin of Keles river			
			Quaternary system
1	YS 581	pr-al-Q_1	Ancient quaternary deluvial, proluvial and alluvial sediments
2	BS 081	al-Q_2	Modern alluvial sediments (flood-lands and elevated flood-land terraces)
			Tertiary systems
3	YS 378	N+Pg_3	Tertiary continental sediments (brick clay)
4	YS 195	Pg	Non-separable palaeogene deposits
			Cretaceous systems
5	GS 193	Cr	Non-separable cretaceous deposits
6	GS 195	Cr_1	Older cretaceous deposits, red and green clays
7	LS 033	P_1+C_3	Older permian and younger carboniferous deposits
			Carboniferous systems
8	DS 017	C_{3+2}	Non-separable older and younger departments
9	DS 209	C_2	Mid department
10	DS 118	C_1v	Vizei layer
11	DS 123	C_1n	Carbon-Jurassic layer
12	RS 545	V_2+γ	Acid intrusive matters
Shardarinski massif			
			Quaternary system
1	YS 581	pr-al-Q_1	Ancient quaternary deluvial, proluvial and alluvial sediments
2	YS 579	pr-al-Q_2	Younger delluvial, proluvial and alluvial sediments of elevated terraces of Syr-Darya (3, 4th terraces)
3	BS 081	al-Q_2	Modern alluvial deposits (flood-lands and elevated flood-land terraces)
4	YS 186	s-Q	Aeolian deposits
			Tertiary systems
5	YS 378	N+Pg_3	Tertiary continental sediments (brick clay)
6	YS 195	Pg	Non-separable Palaeogene deposits
			Cretaceous systems
7	GS 193	Cr	Non-separable cretaceous deposits
8	GS 195	Cr_1	Older cretaceous deposits, red and green clays
Hungry steppe			
			Quaternary system
1	YS 579	pr-al-Q_2	Younger quaternary deluvial, proluvial and alluvial sediments of elevated terraces of Syr-Darya (3, 4th terraces)

[4] The state geological card(map) of the USSR. î-í 1:1000000. A sheet **To – 42** (Tashkent) and **L-42** (Karsakpay). Main editor Pogrebitsky E.O. Moscow, the State publishing house of the geological literature, 1948.

Shieliysky massif			
			Quaternary system
1	GS 109	al-Q_3	Younger quaternary alluvial deposits (flood-lands and elevated flood-land terraces)
2	GS 112	al-Q_4	Modern alluvial solonchaks and takyrs
3	GS 137	al-Q_{2+3}	Mid and younger alluvial deposits
4	YS 186	s-Q	Aeolian deposits
			Tertiary system
5	YS 474	cN_1	Continental neogene brown and sandy clays
			Cretaceous system
6	GS 193	Cr	Non-separable cretaceous deposits
			Devonian system
7	GS 038	cD_{2+3}	Non-separable younger and older continental departments
			Ordovician system
8	YS 458	O_{2+3}	Mid and younger departments. Sandstones, shale and limestones.
			Cambrian system
9	RS 430	Cm_1	Older Cambrian deposits. Karoyt measure.
			Proterozic system
10	RS 609	Pt_2	Younger proterozoic metamorphic sediments

Legend to geomorphologic map of Keles rive basin[5]

Complex	Number	Age	Класс рельефа (описание рельефа) Class of a relief (the description of a relief)	Color on a map Spektra Master®
A Mountains				
Denudation-tectonic	2	PN	Low mountains and deeply rugged relief	YS 138
B Foothills				
Accumulative	18	Q_2-Q_3	Slightly sloping and middling- and weakly rugged deluvial and deluvial proluvial plain with flat and slightly wavy watersheds.	YS 181
C Plain				
Erosive	24	PN	Slightly sloping, strongly rugged and elevated plain with ridge forms of relief.	YS 186
Accumulative	13	Q	Flat accumulative plain – flood-lands and ter-races of river valleys.	GS 204

Legend to geomorphologic map of Shiili massif

A Mountains				
Denudation-tectonic	2	PN	Low mountains and deeply rugged relief	YS 138
B Plain G				
Denudation	6	PN	Denudation slightly wavy plain with hilly forms of relief	YS 123

[5] Литолого-геоморфологическая a card(map) Kazakh CCP. Scale 1:1000000. Sheets **L-42, K-42.** Gapich V.A.'s com-posers, Ким Р.И. Almaty, Institute " Казгипрводхоз ". 1973.

Accumulative	13	Q	Flat accumulative plain – flood-lands and terraces of river valleys.	GS 204
	14	Q_2-Q_4	Slightly sloping alluvial plain with takyrs and elevated river terraces.	GS 117
	20	Q, N_2-Q_3	Plain composed of ridge-hilly forms of relief	YS 186
Erosive-accumulative	15	Q	Takyr and lake depressions	GS 098
Erosive	24	PN	Slightly sloping, strongly rugged and elevated plain with ridge forms of relief.	YS 195
	17	Q	Slopes of river valleys, benches of plateau and plateau similar elevations with ravine forms of relief	YS 380

Legend to geomorphologic map of Shardarinsky massif

B Foothills				
Accumulative	18	Q_2-Q_3	Slightly sloping, average and strongly rugged deluvial and deluvial-proluvial plain with flat slightly wavy watersheds.	YS 181
C Plain				
Accumulative	13	Q	Flat accumulative plain – flood-lands, terraces of river valleys	GS 204
	14	Q_2-Q_4	Slightly sloping alluvial plain composed of takyrs – elevated terraces of river valleys	GS 117
	20	Q, N_2-Q_3	Plain with ridge and hilly forms of relief	YS 186
Erosive	24	PN	Slightly sloping, strongly rugged elevated plain with hilly forms of relief	YS 195

Legend to geomorphologic map of Hunger Steppe

C Plain				
Accumulative	13	Q	Flat accumulative plain – flood-lands, and terraces of river valleys	GS 204

Legend of a map of natural zones

Geomorphologic regions	Zone	Prov-ince	Belt	Districts	On Map	
					Color	No
Bassin of Keles river						
Mountains of West Tyan-Shyan	**3** Mountain and foothills zone of juniper shrubs and shrubs-tallgrass savannas		As zone	Jabagly-Ugamsky average and low-mountains region of mountain brown and grey-brown soils formed on eluvial-delluvial rubbly-loamy materials: a. north sub-district	YS 179	6a
Foothill plains	**4** Foothill zone of gramineous plant semisa-vannas		As zone	Boraldai-Karazhantau ridge-wavy foothill plain district of grey-brown soils formed on loamy and clay materials mostly loess-like with tertiary and cretaceous spots.	YS 489	12
				Bogulminsky ridge-wavy hills in foothill plains district of grey-brown soils formed on loamy and clay materials mostly tertiary and cretaceous with loess-like spots.	YS 482	13
	5 Foothill zone of short grass semisavannas	South-ern	**A** Foothill zone of ephemeral short-grass semisavannas	Keless ridge-wavy hills in foothill plains district sierozems usual normal formed on loess-like loamy materials.	YS 387	15
				Jylginsky ridge-wavy hills in foothill plains district of sierozems usual normal formed on loamy and rarely clay, loamy sand and pebble matters mostly tertiary and cretaceous with loess-like spots.	YS 393	16
			B Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: **a**-heavy soils	Arys-Syrdaryinsky old alluvial plains (terraces) with meadow-sierozem salty soils and meadow-sierozem solochaks formed on layered old alluvial materials with prevailing heavy loamy and clay materials.	YS 293	28

Shardarinsky massif						
Foothill plains	**5** Foothill zone of short grass semisavannas		**B** Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: **a**-heavy soils	Pre-Aralkumsky ridge-wavy foothill plains district of light lumpy sierozems formed light loamy materailas with spots of sandy materials.	YS 293	24
				South Chardara old alluvial plains (terraces) with takyr similar, takyr solonchaks and meadow-sierozem solochaks formed on layered materials with prevailing heavy loamy materials with spots of hilly weakly fixed sands.	YS 381	27
			B Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: b-sands	South Kyzylkum district of ridge-hilly of fixed, weakly fixed and free (drifting dunes) sands.	YS 903	29
				Aralkum district of ridge-hilly fixed sands.	YS 473	30
	7 Interzonal			Syr-Darya valley interzonal district of flood-land meadow-swamps and forest meadow mostly saline soils and solonchaks formed on layered loamy alluvial materials.	GS 008	54
Hunger Steppe						
Foothill plains	**5** Foothill zone of short grass semisavannas		**B** Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: **a**-heavy soils	Golodnaya steppe foothills belt of ephemeroidal and ephemeral short-grass semisavannas		
Shieliynsky massif						
	4 Foothills and low mountains desert zone of Karatau			Karatau Foothills and low mountains district of grey-brown stony soils, light sierozems and takyr similar soils.	YS 192	6
	3 Desert zone on right side			Sarysu district of deserted solonchaks in delta.	YS 293	9
				Daryalyk old alluvial plains with takyrs, solonchak similar takyrs and Aeolian hilly sands.	LS 001	5
	1 Central agricultural zone			District of Kyzyl-Orda oasis with interzonal hidromorphic soils and solonchaks.	GS 009	2
				District of Shieliysky oasis with interzonal hidromorphic soils and solonchaks.	GS 008	3
	2 Desert zone on left side			Kyzylkum district of ridge-hilly fixed sands with spots of weakly fixed and drifting free sands.	YS 903	12

The areas of natural zones of Shardarinsky massiv

Geomorphologic regions	Zone	Belt	Districts	Numbers of contours on a map	Area	
					km^2	%
Foothill plains	**5** Foothill zone of short grass semisavannas	**B** Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: **a**-heavy soils	Pre-Aralkumsky ridge-wavy foothill plains district of light lumpy sierozems formed light loamy materailas with spots of sandy materials.	24,0	1035,0	13,5
			South Chardara old alluvial plains (terraces) with takyr similar, takyr solonchaks and meadow-sierozem solochaks formed on layered materials with prevailing heavy loamy materials with spots of hilly weakly fixed sands.	27,0	1230,0	16,0
		B Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: b-sands	South Kyzylkum district of ridge-hilly of fixed, weakly fixed and free (drifting dunes) sands.	29,0	2390,0	31,1
			Aralkum district of ridge-hilly fixed sands.	30,0	2769,0	36,0
	7 Interzonal		Syr-Darya valley interzonal district of flood-land meadow-swamps and forest meadow mostly saline soils and solonchaks formed on layered loamy alluvial materials.	54,0	269,0	3,5
Total					7693	100,0

The areas of natural zones of Hunger Steppe

Geomorphologic regions	Zone	Belt	Districts	Numbers of contours on a map	Area	
					km^2	%
Foothill plains	**5** Foothill zone of short grass semisavannas	**B** Foothill belt of ephemeroidal and ephemeral short-grass semisavannas: **a**-heavy soils	Golodnaya steppe foothills belt of ephemeroidal and ephemeral short-grass semisavannas		125,0	100,0
Total					125,0	100,0

The areas of natural zones of Shielisky massif

Geomorphologic regions	Zone	Belt	Districts	Numbers of contours on a map	Area	
					km^2	%
Delta-alluvial plains	Northern deserts	**4** Foothills and low mountains desert zone of Karatau	Karatau Foothills and low mountains district of grey-brown stony soils, light sierozems and takyr similar soils.	6	2500	27,2
		3 Desert zone on right side	Sarysu district of deserted solonchaks in delta.	9	1234	13,5
			Daryalyk old alluvial plains with takyrs, solonchak similar takyrs and Aeolian hilly sands.	5	1935	21,1
		1 Central agricultural zone	District of Kyzyl-Orda oasis with interzonal hidromorphic soils and solonchaks.	2	548,4	6,0
			District of Shieliysky oasis with interzonal hidromorphic soils and solonchaks.	3	1696	18,5
		2 Desert zone on left side	Kyzylkum district of ridge-hilly fixed sands with spots of weakly fixed and drifting free sands.	12	1261	13,7
Total					9174,4	100,0

The areas soil of river basins Keles and Kurkeles

Numbers of contours on a map	1st component	% 2 and 3 components		Area	
		2nd component	3rd component	ha	%
1	Mountain brown dark soils with dry shrubs	Mountain brown dark soils with dry juniper shrubs (up to 10 %)	Mountain grey-brown soils (up to 30%)	12000	3,5
2	Mountain grey-brown soils	Mountain brown		2222	0,6
3	Taupe carbonaceous non-irrigated soils	Taupe eroded soils (up to 30%)		4511	1,3
4	Taupe carbonaceous non-irrigated soils	Taupe weakly developed soils on tertiary matters (up to 30%)		9872,2	2,8
5	Taupe leached soils			878,5	0,3
6	Taupe carbonaceous non-irrigated soils	-10%		64595,7	19,5
7	Taupe carbonaceous non-irrigated soils	Taupe soils with deep carbonates (up to 10%)	Taupe weakly developed soils on tertiary matters (up to 30%)	11380	3,3
8	Sierozems usual southern (typical)			45156,4	13,1
9	Sierozems usual southern (typical)	Sierozems usual southern weakly developed soils on tertiary matters (up to 10%)		34785,3	11,0
10	Sierozems usual southern (typical)	Sierozems usual southern weakly developed soils on tertiary matters (up to 30%)		2741,7	0,8

11	Sierozems usual southern (typical)	Sierozems usual southern weakly developed soils on tertiary matters (up to 50%)		10462	0,8
12	Sierozems usual southern weakly developed soils on tertiary matters			895,9	0,3
13	Sierozems usual southern irrigated			5076	1,5
14	Meadow sierozems			60700	17,5
15	Sierozems usual southern normal			74539	21,4
16	Sierozems usual southern normal	Light southern sierozems eroded		7087	2,0
17	Alluvial meadow soils irrigated			1340	0,4
Total				348242,7	100,0

The areas soil of Shardarinsky massif

Numbers of contours on a map	1st component	% 2 and 3 components		Area	
		2nd component	3rd component	ha	%
18	Sierozems lights southern	Hilly fixed sands (up to 10%)		27834	3,6
19	Hilly fixed sands			146900	19,1
20	Alluvial meadow salty soils	Meadow solonchaks (up to 30%)		132200	17,2
21	Meadow-sierozems similar to solonchaks	Weakly fixed hilly sands (up to 30%)		83100	10,8
22	Desert solonetz similar to solonchak with crust	Takyr similar soils with processes of salinization (up to 10%)	Meadow sierozems soils with processes of salinization (up to 10%)	180609	23,5
23	Takyr similar soils with processes of salinization	Desert solonetz with crust (up to 30%)	Weakly fixed hilly sands (up to 10%)	66600	8,7

24	Ridge-hilly sands weakly fixed	Fixed ridge-hilly sands (up to 50%)	Free sands (up to 30%)	131795	17,1
Total				769038	100,0

The areas soil of Golodnayastepski massiv

Numbers of contours on a map	1st component	% 2 and 3 components		Area	
		2nd component	3rd component	ha	%
25	Meadow swamp			2500	2,0
26	Typical solonchaks			1826	1,5
27	Light southern sierozems similar to solonchaks			42670	34,1
28	Light southern sierozems			71320	57,1
29	Takyr similar soils with processes of salinization			6693	5,4
Total				125009	100,0

The areas soil of Shieliysky massif

Numbers of contours on a map	1st component	% 2 and 3 components		Area	
		2nd component	3rd component	ha	%
30	Mountain light kastanozems with rubble materials			1040	0,1
31	Mountain light kastanozems			12050	1,3
32	Grey brown desert soils			72140	7,8

33	Grey-brown soils with rubble materials located on hillsides			63617	6,9
34	Takyr similar soils with processes of salinization (75%)	Takyr typical (25%)		210200	22,7
35	Takyr similar with old irrigation			13170	1,4
36	Takyr typical			2080	0,0
37	Alluvial meadow soils (40%)	Sandy soils with low humus content and ridge-hilly sands (30%)	Typical solonchaks (30%)	32930	3,7
38	Alluvial meadow soils (60%)	Meadow-swamp soils (20%)	Meadow solonchaks (20%)	27990	3,0
39	Alluvial meadow irrigated soils (40%)	Meadow-swamp soils (30%)	Typical solonchaks (30%)	6187	0,7
40	Meadow-swamp soils			55545	6,0
41	Typical solonchaks			88846	9,6
42	Slightly sloping hills overgrown with vegetation with low humus content and solonchaks in lowlands			27620	3,0
43	Hilly carbonaceous sands with low plant density, low humus content and takyr similar soils with processes of salinization			95606	10,3
44	Slightly sloping hills overgrown with vegetation with low humus content and meadow-swamp soils in lowlands			14070	1,5
45	“Shor”- solonchaks			6756	0,7
46	Desertifying alluvial meadows			60340	6,6
47	Takyr similar soils			19340	2,1

48	Hilly-ridge fixed sands and takyr similar soils with processes of salinization			64480	7,0
49	Slightly sloping hills with fixed carbonaceous sands			50130	5,4
Total				924137	100,0

ENDAGERED FLORA OF KAZAKHSTAN (Description of species)

***Amygdalus petunnikowii* Litv.-Petunnikov's Almond**
Status 1(E), rare species.
Distribution: Syr Darya Karatau and West Tyan Shian.
Habitats: on the fine land-crashed stone mountain slopes up to 1400-1800 m.
Limiting factors: commercial activity.
Measures of protection: it is partly protected in the nature reserve Aksu-Zhabagly. It is necessary to establish Karatau nature reserve to preserve the species.

***Aflatunia ulmifolia (Franch.) Vass.* Aflatunia elm leave, ordinary stone nut.**
Status 3(R), rare relict, decreasing in number.
Distribution: Zhongar Alatau, North and West (Talas Alatau) Tyan Shian.
Habitats: On the open fine land slopes of all expositions, on the mountain black-earths and chest nut soils among wood-bushes plants, as well as stony-crushed stony soils at the altitude of 800-2500 m above the sea level.
Limiting factors: commercial activity.
Measures of protection: The species was registered in the Red Book of Kazakhstan (1981).

***Armeniaca vulgaris* Lam. Apricot ordinary.**
Status 3(R) rare, decreasing in number. Endemic in Tyan-Shian.
Distribution: West Tyan-Shian North Tyan-Shian (Zailiski Alatau, Ketmen).
Habitats: southern slopes, rocks and on the well drained soils at the altitude of 500 to 1900 m above the sea level.
Limiting factors: commercial activity, pasturage, tourism.
Measures of protection: species was registered in the Red Book (1981,1984). Partly protected in Almaty nature reserve.

Fabaceae Lindl.- leguminous plants.
***Medicago tianschanica* Vass. (M. ochroleuca M. Kult)- Lucerne Tyan-Shian.**
Status 1(E), rare endemic species.
Distribution: Jabaglytau Mountains in the west spurs of Talass Alatau.
Habitats: xerophyte, stony southern slopes and glades among spreading arches in the sub alpine belt.
Limiting factors: population declines due to pasturage and commercial activity.
Measures of protection: the species was registered in the Red Book of Kazakhstan (1981) and is protected in the nature reserve Aksu- Zhabagly.

***Colophaca tianschanica* (B.Fetsch). Boris.-Maikaragan Tyan- Shian.**
Status 1(E), rare species.
Distribution: Syr Darya, Karatau, West Tyan-Shian.
Habitat: mezophyte, on the stony steppe, crushed stony slopes, among the various grasses.
Limiting factors: intensive pasturage.
Measures of protection: it is partly protected on the territory of the nature reserve Aksu-Zhabagly. It is necessary to preserve the species on the territory of the future Karatau nature reserve.
***Chesneya karatavica* R.Kam.Chesneya Karatauskaya.**
Status 1(E), rare endemic species.
Distribution: Syr Darya, range Karatau: ravine of the river Uchuzen..
Habitat: on the stony slopes.
Limiting factors: intensive pasturage.
Measures of protection: it is necessary to study population status and protect areas of growing.
***Astragalus abolonii* M.Pop. Astragal Abolina.**
Status 2(U), rare species.
Distribution: Talass Alatau ranges, ravine of river Aksu.

Habitat: xerophyte, on the rocks of steppe belt.
Measures of protection: protected on the territory of the nature reserve Aksu-Zhabagly.

***Astragalus bada mensis* M. Pop Astragal Badamski.**

Status. 1(E), rare endemic species.
Distribution: West Tyan-Shian: Karzhantau ranges (Akbash mountains, near the village Dorofeevka) and Ugam ranges.
Habitat: xerophyte, on the stony slopes of the mountains.
Limiting factors: commercial activity.
Measures of protection: necessary to study population status of the species in the nature, to establish the Ugam botanic reserve for its protection.

***Astragalus karataviensis* Pavl.Astragal karatauski.**

Status 3(R) rare, decreasing in number, endemic species.
Distribution: Syr Darya Karatau ranges; the lower reaches of the river Bugun, environs of Atabaeva village, plateau near Turlan.
Habitat: on the foothills, among the worm-wood ephemerid vegetation.
Limiting factors: commercial activity.
Measures of protection: to study the population status of the species in the Ure. It is offered to register in the Red Book of Kazakhstan.

***Astragalus mokeevae* M.Pop. Astragalus Mokeevoi.**

Status 1(E), are endemic species.
Distribution: Syr Darya Karatau ranges. Mountains Chokpak and Karzhantau (Mountains Akbash).
Habitat: xerophyte, on the stony, crushed stony slopes of the mountains.
Limiting factors: commercial activity.
Measures of protection: necessary to control the status of the species and its reintroduction into the restricted area of the future Karatau nature reserve.

***Astragalus subternatus* Pavl. Astragal triple.**

Status 2(U), rare, endemic species.
Distribution: Syr Darya Karatau: the lake Kainarkul.
Habitat: xerophyte, stony crushed, stony steppe slopes of lower mountain belt.
Limiting factors: increasing pasturage.
Measures of protection: necessary to control the status of the species and protect in the future Karatau nature reserve.

***Astragalus tecutjevii* Gontsch.Atragal Tekutev.**

Status 1(E) rare , endemic species.
Distribution: Syr Darya Karatau ranges.
Habitat. Xerophyte. On the stony and crashed stony slopes of the mountains.
Measures of protection. It is necessary to study the location of the species and to watch the status of the population.

***Astragalus transnominantus* Abdull.Astragal renamed.**

Status 1(E), rare endemic species.
Distribution. Syr Darya Karatau ranges, environs of the Kizilcol lake and Chu –Iliski mountains.
Habitat. Xerophyte. On the loam and crashed stone slopes foothills and plains
Limiting factors. Human commercial activity.
Measures of protection. Learning the status of the species population in the nature.

***Asatragalus trichantus* Golosk. Asatragal hairy flowerings.**

Status 1(E), rare species.
Distribution: Talas Alatau; Kara-koin ravine.
Habitat: xerophyte, on the stony slopes.
Limiting factors: human commercial activity.
Measures of protection: the species was registered in the Red Book (1981). It necessary to study the population status and determine the protection measures.

***Oxytropis echidna V*ved.**

Status 2 (U), endemic species.

Distribution: Syr Darya Karatau ranges: Mountain-mass Mynzhylky.
Habitat: xerophyte, on the stony slopes and plateau, mountain hills.
Limiting factors: the species can disappear, because of the limited natural habitat.
Measures of protection: the species was registered in the Kazakhstan Red Book.

***Oxytropis karataviensis* Pavl.**

Status 1 (E), rare endemic species.
Distribution: Syr Darya Karatau ranges.
Habitat: xerophyte, on the stony and crushed stone slopes.
Limiting factors: intensive pasturage.
Measures for the protection: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish the botanical reserve in the northern part of the Ugam ranges.

***Glycyrrhiza glabra* L.-Liquorice bare**

Status 3(R), rare relict species.
Distribution: it is widely spread species in Kazakhstan
Habitat: in the steppe, deserts and semi deserts.
Limiting factors: medicinal use.
Measures of protection: it is necessary to license collection, and establish nature reserves.

***Hedysarum karstaviense* B.Fedtsch.**

Status 1(E), very rare endemic species.
Distribution: Syr Darya Karatau ranges, mountain mass Big Aktau .
Habitat: xerophyte, on the stone crushed slopes of the mountains.
Limiting factors: anthropogenic factors.
Measures of protection: the species was registered in Kazakhstan Red Book (1981). It is necessary to protect it in the future Karatau nature reserve together with many other relicts and endemic plants

***Hedisarum mindshil* Kense Bajt.**

Status 1(E), rare endemic species.
Distribution: Syr Darya Karatau ranges; mountain massif Mynzhylky
Habitat: on the stone slopes of middle mountains.
Limiting factors: anthropogenic factors.
Measures of protection: the species was offered to be registered in the Kazahkstan Red Book. It is necessary to establish Karatau nature reserve to protect the species.

***Zygophyllaceae R.Br.*-Conjugated leaves**

Zygophyllum Karatyavicum. Boriss.

Status 1(E), rare endemic species.
Distribution. Syr Darya Karatau ranges; Kyzylnaiza , to the North-West from lake Bilikol.
Habitat:.on the stone dry slopes.
Limiting factors: commercial factors.
Measures of protection: the species was registered in the Kazakhstan Red Book (1981). It is necessary to protect the species on the territory of the future Karatau nature reserve.

Paganaceae (A.Engler) Tieghem ex. Takhtajan

***Peganum harmala* L. –Harmala**

Status 3(R), rare relict species.
Distribution: In all districts of Kazakhstan, except high mountains.
Habitat. In the deserts, semi deserts and steppe on the saline soils.
Limiting factors: collection by local population
Measures of protection: it is necessary to regulate licensed collection, establishing reserves.

Rutaceae Juss. Riths

***Haplophylum eugenii-korovinii* Pavl.**

Status 1(E), very rare endemic species.
Distribution: Syr Darya Karatau ranges: natural boundary Kzylnaiza.
Limiting f actors: commercial activity.
Protection measures: The species was included in the Red Books (1975,1981,1984). It is necessary to study the population status of the species and to protect it.

Anacardiaceae Lindl.-

Pistacia vera L.- pistachio real.

Status 3(R), are relict species.

Distribution: Syr Darya Karatau ranges (Boroldaitau). West spurs of Talass Alatau (Mashattau, Daubaba); Kirghiz Alatau (west).

Habitat: xerophyte, on the stony slopes of the lower belt of the mountain and hills.

Limiting factors: commercial activity.

Protection measures: The species was registered in the Red Book of Kazakhstan (1981). It is necessary to control the status of the population and protect the places of growing of the species.

Celastraceae R. Br. –

***Euonymys koopmannii* Lauch-**

Status 2(U), very rare relict species.

Distribution: West spur of Talass Alatau, Ugam ranges

Habitat: mezophyte, on the shadowed stony slopes, in the forests and river flood lands, as well as among bushes.

Limiting factors: the dynamics of population is not researched.

Protection measures: the species was registered in the Red Book (1978, 1981). The part of the natural habitat is located in reserve zone Aksu-Zhabagly. It is necessary to study the status of the population and to establish the Ugam botanical reserve.

Vitaceae Juss. Grapes.

Vitis vinifera L.- wild grape.

Status 3(R), very rare species.

Distribution: Syr Darya Karatau ranges (Boroldai mountains, Natural boundary Bostorgai, Bugun, Kok Bulak, Kairchakty), west spur Talass Alatau: Mashat and Zailisky Alatau.

Habitat: mezophyte, in the forests and thickets as well as on the rocks and stony slopes

Limiting factors: anthropogenic factors.

Protection measures: the species was registered in the Red Books(1975,1981).

Elaegnaceae Juss.

***Hippophae rhamnoides* L- see buckthorn.**

Status 3(R), species decreasing in number.

Distribution: Central, South East and South Kazakhstan- Syr Darya Karatau, West Tyan – Shian.

Habitat: on the sand and single river banks.

Limiting factors: the population is small because of the mass collection

Protection measures: it is partly protected on the territory of the nature reserve Aksu Zhabagly.

Apiaceae Lindl.- Celery (umbellate)

***Erygium karatavicum* Iljin- Karatau blue head**

Status 3(R), rare endemic species.

Distribution: Syr Darya Karatau ranges: central and north parties.

Habitat: on the stone-crushed stony slopes, on the screens, pebbles, dry channels, outcrops of tertiary loam, at the altitude of 500-2000 m.

Limiting factors: commercial activity

Protection measures: it is necessary to establish the Karatau nature reserve to protect the species.

***Kosopoljanskia turkestanic*a Korov.- Turkestan Kozopolyanskia**.

Status 2(U), rare relict species, endemic plant of the West Tyan Shian.

Distribution: Syr Darya Karatau ranges, Talass Alatau ranges and Kirghiz Alatau.

Habitat: on the dry eroded slopes, salty screens, at the altitude of 700-1500 m.

Limiting factors:. small population, intensive pasturage.

Protection measures: the species was registered into the Red Books (1975, 1981,1984, 1985). It is necessary to limit the pasturage in the Karatau area and control the status of the population.

Sclerotiaria pentaceros (Korov) Korov.

Status 1(E), rare species.

Distribution: West spurs of Talass Alatau; canyon of the river Koksai.

Habitat: on the stony and crushed stone slopes of sub alpine belt.

Limiting factors: intensive pasturage.
Protection measures: The species was registered in the Red Book of Kazakhstan (1981).

***Schtschurowskia margaritae* Korov.**

Status 2 (U), rare endemic and relict species.
Distribution: Syr Darya Karatau ranges. Two places of their location are known: Berkara canyon and plateau near the river Ulken-Artabas.
Habitat: on the stony slopes, screens, rock outcrops, at the altitude of about 1500 m.
Limiting factors: intensive pasturage.
Protection measures: the species was registered in the Red Books (1975, 1978, 1981, 1984). It is necessary to enlarge the Berkara reserve and to establish the control of the population.

***Shrenkia kultiassovii* Korov.**

Status 2(U), very rare, relict and endemic species.
Distribution: West spurs of Talass Alatau: mountains Mashattau, Daubaba Zhabaglysu, Aksu
Habitat: on the stony, crushed stone slopes.
Limiting factors: local population uses it for heating.
Protection measures: the species was registered in the Red Books (1975,1978,1981,1984). It is partly protected on the Mashat reserve.

***Prangos equisetoides* Kuzmina Prangos- hours tail**

Status 1(E), rare endemic species.
Distribution: Syr Darya Karatau ranges.
Habitat: on the stony and crushed stone mountain slopes.
Limiting factors: commercial activity.
Protection measures: it is necessary to establish Karatau nature reserve to protect the species and control the population. It was offered to register in the Red Book of Kazakhstan.

***Prangos lachnantha* (Korov.) V. Pimen. Et Kljuynkov.**
(Schrenkia lachnantha Korov.)

Status 2(U), very rare endemic species.
Distribution: Syr Darya Karatau
Habitat: on the mountains east slopes of Karatau, in the worm wood communities.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Book (1981). It is necessary to control the population status.

***Karatavia kultiassovii* (korov. Ex. Schischk.) M. Pimenet Lavrova.**

Status 3(R), rare endemic and relict species.
Distribution: Syr Darya Karatau ranges (Mynshylky, Biresek, Akbastau), west spurs of Talass Alartau (ravine of the river Aksu, Zhabaglysu, Mashattau, Duanytau).
Habitat: on the stony and crushed stone slopes, on the brake screens, under the rocks, on different grass meadows, in the thickset bushes.
Limiting factors: commercial activities, road construction.
Protection measures: the species was registered in the Red Books (1975, 1981). It is partly preserved in the territory of the Aksu Zhabagly nature reserve. It is necessary to establish Karatau nature reserve.

***Aulacospermum popovii* (korov) Kljuykov, M.Pimen, et V. Tichomirov**.

Status 2(U), very rare endemic species.
Distribution: West Tyan Shian: Ugam ranges .
Habitat: on the cracks of steep lime-stone rocks, at the altitude of 1500-2500 m above the sea level.
Protection measures: the species was registered in the Red Book (1981). It is necessary to study the population status.

***Mediasia macrophylla* (Regel et Schmalh.)**

Status 2(U), rare species.
Distribution: Syr Darya Karatau ranges (Boroldaitau), Talass Alatau.

Chenopadiaceae Vent

***Physandra halimochimis* (Bosch) Botsch**

Status 2(U), very rare relict and endemic species.
Distribution: the south part of the South Kazakhstan region, on the right bank of the river Syr Darya
Habitat: on the salt-marshes, on the slopes of low hills.
Limiting factors: small population.
Protection measures: it is necessary to study the population status and to protect the areas of growing.

***Rhaphidophyton regelii* (Bunge) Iljin.**

Status 1(E) rare endemic species.
Distribution: Syr Darya Karatau ranges, Talass Alatau .
Habitat: xerophyte, on the stony and crashed stone slopes of the lower and middle belt mountains.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Books (1978, 1981, 1984). Partly the species was protected in the Karatau part of the nature reserve Aksu Zhabagly. It is necessary to study the population status and to protect the species on the most of the territory, which can be realized only by the establishment of the Karatau nature reserve.

Caryphyllaceae Juss.

***Arenarica turlanica* Bajt.**

Status 1 (E), rare endemic species.
Distribution: Syr Darya Karatau ranges: canyon Turlan.
Habitat: rocks and plateau-shaped peaks of the lower belt mountains.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to study out the status and dynamics of population. It is necessary to establish the natural reserve in Turlan Canyon of Karatau ranges.

***Silene jaxartica* Pavl.**

Status 1(E), rare endemic species.
Distribution: Karatau ranges
Habitat: mezophyte, saline places, on the river banks and along channels.
Limiting factors: commercial activity, it is decreasing because of the intensive pasturage in the growing places.
Protection measures: it is necessary to determine the population status, to establish the natural reserve in the mountains of Karatau. It was offered to register in the Red Book of Kazakhstan.

***Coronaria coriacea* (Moench) Schischk . et Gorschk**

Status 1(E) rare species.
Distribution: West Tyan Shian; Karzhantau and Ugam ranges,
Habitat: xerophyte, on the dry steppe and meadow slopes of middle belt mountains among different grass and wood-bushes vegetation.
Limiting factors: commercial activity, it is decreasing because of the intensive pasturage.
Protection measures: The species was registered in the Red Books(1975,1981). It is necessary to study the population status, to reduce pasturage in the growing places of the species.

***Gypsophila aulieatensis* B. Fedtsch.**

Status 1(E) rare relict and endemic species.
Distribution: Syr Darya Krartau ranges and in Moinkum .
Habitat: xerophyte, on the crushed-stone and steppe slopes of hills and foothills, especially on the gypsum slopes of tertiary plateau.
Limiting factors: deserting processes and commercial activity. It is decreasing because of the intensive pasturage and open-cast mining of phosphorus.
Protection measures: It was registered in the Red Books (1975, 1981). It is necessary to establish the nature reserve in Karatau mountains.

***Allocrusa gypsophiloides* (Regel) Schischk**

Status 3(R) rare species.

Distribution: Syr Darya Karatau ranges, Talass Alatau, Kazygurt Kirghiz Alatau.
Habitat: xerophyte, mountain ephemeral, semi desserts and semi-savannas; light, dark-grey earths at the altitude of 400-1300 m above the sea level.
Limiting factors: uncontrolled collection of the plant, commercial activity.
Protection measures: the species was registered in the Red Books (1978,1981,1984). It is necessary to limit the plant collection, to control the renewal status.

Ranunculaceae Juss.

***Aquilegia karatavica* Mikesh.**

Status 2(U) rare endemic species.
Distribution: Syr Darya Karatau ranges.
Habitat: mezophyte, on the rocks, shadowed mountain canyons, up to 2000 m above the sea level.
Limiting factors: population dynamics is not researched, the species can easily disappear, its natural habitat is small, and the number is decreasing.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish Karatau nature reserve.

***Delphinium confusum* M.Pop.**

Status 1(E) rare species.
Distribution: West Tyan Shian; Ugam range (upper reaches of Nauvali-Saya).
Habitat: on the stony slopes of sub-alpine belt.
Limiting factors: commercial activity.
Protection measures: it is necessary to control the population status. It is necessary to establish Ugam botanical reserve to protect the species.

***Aconifum talassiaum* M.Pop.**

Status 3(R) rare species with the decreasing number.
Distribution: Talass Alatau ranges, Ugam, Karzhantau, Kirghiz Alatau.
Habitat: mezophyte, on the wet meadows and pebbles of the mountain rivers, water meadow forests, slopes of shadowed rocks, among bushes.
Limiting factors: digging out the roots to get a medicinal preparation, commercial activity.
Protection measures: the species was registered in the Red Books (1975,1981,1984). Partly protected in the territory of Aksu Zhabagly nature reserve.

Paeoniaceae F Rudolphi-Peongy.

***Paenia hybrida* Pall.**

Statru 3(R) rare species, with shrinking natural habitat.
Distribution: West Tyan Shian and North Tyan Shian, West and North Altai, Zhungar Alartau, Tarbagatai.
Habitat: on the steppe meadows, among the bushes, on the plains and in the mountains, on the open stony slopes of the lower belt of mountains.
Limiting factors: the population number is decreasing because of the decorative and medicinal use of the plant, commercial activity.
Protection measures: the species was registered in the Red Books (1975, 1981), protected on the territory of Almaty, Markakol nature reserve. It is necessary to control the population status of the species.

Fumariaceae D.C

Corydalis sewerzowi

Status 1 (E) rare species.
Distribution: Syr Darya Karatau (upper rechears of river Arys), west spurs of Talass Alatau
Habitat: on the loam slopes of foothills.
Protection measures: the species was registered in the Red Book (1975). Partly it is protected on the territory of the nature reserve Aksu Zhabagly. It is necessary to control the status of the population.

Brassicaceae Burnett.

***Neotorularia karatavica* (Myrzakulov et Bajt).**

Status 2(U) rare endemic species.

Distribution: Syr Darya Krartau ranges; canyon Jolonur
Habitat: within loam valleys.
Limiting factors: it suffers from the pasturage.
Protection measures: it is necessary to control the population status of the species in the nature and register it in the Red Book of Kazakhstan. It is necessary to protect the places of growth of the species.

*N**eotorularia subtilissima*** **(M. Pop).**
Status 2(U) rare species.
Distribution: Syr Darya Karatau.
Habitat: xerophyte, on the stone-fine land slopes in the middle belt mountains.
Limiting factors: small population, commercial activity.
Protection measures: it is necessary to establish Karatau nature reserve to protect the species.

***Arabis mindschilkensis* Bajt et Myrz.**
Status 2(U) rare endemic species.
Distribution: Syr Darya Kratau ranges: Mynzhylky
Habitat: xerophyte, in the rock cracks of the middle belt mountains.
Limiting factors: small population.
Protection measures: it is necessary to control the population status, to protect the territory of the future Karatau nature reserve, to register the species in the Red Book of Kazakhstan.

***Arabis popovii* Botsch. Et Vved.**
Status 2(U) very rare endemic species.
Distribution: Karzhantau ranges: valley of the river Aktash .
Habitat: xerophyte, it grows in the rock cracks, on the stony places.
Limiting factors: Not enough moisture and mining work.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish the natural reserve in the Karzhantau mountains in order to protect the species.

***Botschanzovia karatavica* (Lipsch) Nabiev.**
Status 2(U) rare endemic species.
Distribution: Syr Darya Karatau: Boroldaitau .
Habitat: xerophyte, on the stony slopes and rocks of mountains.
Limiting factors: limited distribution and small population.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981).

***Leiospora excapa* (C.A. Mey) Dvorak**.
Status 2(U) rare endemic species.
Distribution: West Tyan Shian . Zailiski and Kungei Alatau, Altai, Saur.
Habitat: xerophyte, on the stone-crushed slopes, in the rock cracks, in the alpine meadows of the upper belt mountains.
Limiting factors: small population.
Protection measures: it is necessary to study the population status and to protect the places of growth of the species.

***Draba talassica* Pohle**.
Status 1(E), rare species.
Distribution: Talass Alatau ranges and Kirghiz Alatau.
Habitat: on the stony and crushed stone slopes in the alpine belt of mountains.
Limiting factors: commercial activity.
Protection measures: the part of population is protected on the territory of Aksu Zhabagly nature reserve. It is necessary to control the population status.

***Strogonowia cardiophylla* Pavl**.
Status 1(E) relict rare species.
Distribution: Syr Darya Karatau and west spurs of Talass Alatau: mountains Mashattau, Daubaba
Habitat: mezophyte, stony and crushed stone slopes, different grass steppe meadows, bushes thicket.

Limiting factors: the natural habitat is decreasing because of the human commercial activity.
Protection measures: the species was registered in the Kazakhstan Red Book (1981). Partly the species is protected on the territory of Aksu Zhabagly. It is necessary to protect the growing places of the species.

***Strogonowia robusta* Pavl.**

Status 1(E) endemic, disappearing species.
Distribution: Syr Darya Karatau ranges: mountains Kulan, Irgaily
Habitat: mezophyte, on the stony slopes and peaks of the mountains.
Limiting factors: not enough moisture, commercial activity.
Protection measures: the species was registered in the Red Books (1975, 1981, 1984). It is necessary to study the population status of the species.

***Stubendorffia gracilis* (N.Pavl.) Botsch. Et Vved.**

Status 1(E) relict and endemic species.
Distribution: Syr Darya Karatau ranges; Chu-Iliskie mountains. Known from several points.
Habitat: mezophyte, on the stony and crushed stone slopes, in the cracks of the rocks
Limiting factors: not enough moisture, commercial activity.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish the nature reserve in Karatau.

***Clypeola jonthlaspl* L.**

Status 2(U) very rare species, which is in the north-eastern part of its natural range.
Distribution: Karzhantau, Syr Darya Kratau ranges Kirghiz Alatau; Aral and Caspian-sides desserts.
Habitat: xerophyte, in the south, south-west dry stony slopes, in the rock cracks, along the pebbles, on the loam outcrops and lime stones.
Limiting factors: commercial activity, intensive pasturage.
Protection measures: it is necessary to establish the protection of the species on the territory of the future Karatau nature reserve and register it in the Kazakhstan Red Book.

Crassulaceae DC.

***Pseudosedum karatavicum* Boriss.**

Status 1(E) rare endemic species.
Distribution: Syr Darya Karatau ranges: central part.
Habitat: mezophyte, on the stony and crushed stone soils
Limiting factors: not enough moisture.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to protect the places of growth of the species.

Saxifragaceae DC.

***Bergenia ugamica* V.Pavl.**

Status 2(U) rare endemic species.
Distribution: Ugam range, near the river Maidantal .
Habitat: in the cracks of rocks, at the altitude of 2500 m. above sea level.
Limiting factors: the existence of the species is under threat because of small number and relict nature.
Protection measures: it was registered in the Red Books(1981,1984). It is necessary to establish a strong control of the population, cultivate in the botanical garden, establish the nature reserves to protect its places of growth.

Grossulariaceae DC.

***Ribes janezewskii* Pojark.**

Status 1(E) rare species.
Distribution: West spurs of Talass Alatau and Nortyh Tyan Shian.
Habitat: mezophyte, on the stony slopes, screens, along the rives, in the fir-tree forests.
Limiting factors: commercial activity.
Protection measures: it is necessary to protect the places of growth, and control the population status.

Rosaceae Juss.

***Dryopteris mindshelkensis* Pavl.**

Status 1(E) very rare endemic and relict species which is on the verge of isappearance.

Distribution: Syr Darya Karatau ranges: Mynzhylky, canyon Kosbulak

Habitat: mezophyte, on the shadowed stone parts and cracks of the rocks in the middle belt mountains.

Limiting factors: commercial activity, intensive pasturage

Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to protect it in the future Karatau nature reserve together with other endemic plants of Karatau flora.

***Tulipa alberti* Regel.**

Status- 3(R) rare endemic and disappearing species.

Distribution: Syr Darya Karatau, desert Betpakdala, Pribalhashe (Targyl), Zhongar Alatau, (Cholaktau), Chu-Iliiski mountains. Everywhere except Chu-Iliiski mountains it is found rarely.

Habitat: ephemeroid, on the crushed-stone fine land slopes, low hills.

Limiting factors: the mass collection of the flowers and digging out the bulbs.

Protection measures: the species was registered in the Red Books(1978, 1981, 1984). It is necessary to forbid the collection of flowers and bulbs, to establish the nature reserves, because this species is preserved only in Aksu-Zhabagly nature reserve.

***Tulipa borszczowii* Regel.**

Status- 2(U) rare species.

Distribution: sands of Kyzylkum, Aral side sand masses, not abundant, disappearing.

Habitat: On the sands, dessert hills.

Limiting factors: intensive pasturage, commercial activity.

Tulipa dasystemonoides Vved.

Status 2(U) rare endemic species.

Distribution: West Tyan Shian, Talass Alatau .

Habitat: ephemeroid, in the alpine belt of mountains.

Limiting factors: small population.

Protection measures: it is protected in Aksu-Zhabagly nature reserve. It is necessary to control the population status.

Tulipa greigii Regel.

Status 3(R) rare species, with decreasing number.

Distribution: Syr Darya Karatau ranges, Karzhantau, Talass Alatau, Kirghiz Alatau.

Habitat: mezophyte ephemeroid, on the grey soils of low hills, mountain foothill valleys.

Limiting factors: commercial activity. The species is very popular because of its beauty, so its exterminated very much.

Protection measures: the species was registered in the Red Books (1978, 1981, 1984, 1985). It is necessary to forbid the practice of procurement of the tulip.

Tulipa kaufmanniana Regel.

Status 3(R), rare species, with shrinking natural habitat.

Distribution: Syr Darya Karatau ranges, Talass Alatau, Ugam, Karzhantau

Habitat: ephemeroid, on the stony and crushed stone slopes, at the banks of mountain streams in sub alpine belt.

Ferula gypsacea Korov.

Status 2 (U), rare endemic and relict species

Distribution: hills of the South Kazakhstan: mountain hills Alymtau, Beltau, Aigyryshgan

Habitat: on the gypsum slopes.

Limiting factors: commercial activity.

Protection measures: it is necessary to study the population status, to establish natural reserve in the South Kazakhstan region. It was offered to register in the Red Book of Kazakhstan.

Ferula Leucographa Korov. – Ferula whitestriped.

Status 2 (U), rare endemic species.
Distribution: Syr Darya Karatau ranges (south – east part of the mountains Ulkun – Burul and Aktau), west spurs of Talass Alatau: mountains Mashat .
Habitat: on the crushed stone slopes, at the altitude of 700 – 1100 m above the sea level.
Limiting factors: commercial activity.
Protection measures: The species was registered in the Red Book (1981). It is necessary to control the population status.

Ferula malacophylla M.Pimen. et J.Baranova.
Status 2 (U), rare endemic species.
Distribution: Syr Darya Karatau ranges (east slopes) Moinkum sands.
Habitat: on the lake shores.
Limiting factors: offered to register in the Red Book of Kazakhstan.

Ferula xeromorpha Korov.
Status 2 (U), very rare endemic species.
Distribution: mountains of Alimtau, area between the rivers Keles and Syr Darya.
Habitat: on the crushed - stone steppe slopes..
Limiting factors: limited number of the natural habitats, anthropogenic factors.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish in the Almaty Mountains the botanical reserve.

Dorema Karataviense **Korov. Dorema karatauskaya.**
Status 0 (Ex). Rare endemic species, perhaps extinct.
Distribution: Syr Darya Karatau ranges: north – east part .
Habitat: on the loam – crushed stone slopes of the low hills.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Books (1981,1984). It is necessary to study the population status of the species in the nature and to determine its protection measures.

Primulaceae vent – Primroses.
Primula minkwitziae **w.w. smith. – Primrose Minkvitsa.**
Status 2 (U), rare endemic species.
Distribution: west spurs of Talass Alatau; west part of Kirgiz Alatau
Habitat: splits of rocks, alpine meadows, snow spots in the upper belt of the mountains.
Limiting factors: the is decreasing in numbers because of the natural reasons and anthropogenic factors.
Protection Measures: the species was registered in the Red Book of Kazakhstan (1981). The part of the natural habitat is in the protection zone of the territory of Aksu – Zhabagly nature reserve. It is necessary to study the population status.

Acantholimon linczevskii **Pavl.**
Status 2 (U), rare endemic species.
Distribution: Syr Darya Karatau: Minzhylky .
Habitat: xerophyte of the stone peaks and slopes of the mountains.
Limiting factors: commercial activity.
Protection measures: The species was registered in the Red book of Kazakhstan (1981). It is necessary to establish urgently the Karatau nature reserve to protect the whole range of rare and endemic species of plants.

Acantholimon mikeshini
Status 1 (E), rare endemic species.
Distribution: Syr Darya Karatau ranges; Akchetau canyon.
Habitat: xerophyte, on the stony slopes of the low hills and plateau, up to 1000 m. above the sea level.
Limiting factors: commercial activity.

Protection measures: it is necessary to control the population status and to protect it on the territory of the future Karatau nature reserve.

***Chaetolimon setiferum* (Bunge) Lincz.**

Status 1(E), rare species in Kazakhstan.
Distribution: Karzhantau range, Alimtau mountains.
Habitat: on the stone – fine land and forest slopes of foothills.
Limiting factors: intensive pasturage.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish the reserve in the mountains Karzhantau and Alimtau.

Oleacea Hoffmgg. Et link. – Olives.

***Fraxinus sogdiane* bung. – Ashtree**

Status 3 (R), rare, decreasing its number, relict species.
Distribution: Syr Darya Karatau (central part); north – west spurs of Talass Alatau; basing of the river Ily.
Habitat: on the terraces of the river valleys, rarely on the slopes in the low hills.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red book of Kazakhstan (1981). Prohibition of the felling and establishment of the protection regime.

Boraiginaceac juss.

***Paracaryum integerrimum* Myrzakulov**

Status, 2(U), rare endemic species.
Distribution: Syr Darya Karatau ranges. North – west part of the river Zhylandy. 2-3 location places are know.
Habitat: on the parts of stone slopes.
Limiting factors: small population, intensive pasturage.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish the control the population status.

***Paracaryum karataviense* Part.**

Status 2 (U), rare endemic species.
Distribution: North – west part of the Syr Darya Karatau ranges .
Habitat: on the stony slopes and the peaks of the middle belt mountains.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Book of Kazakhstan (1981). It is necessary to establish urgently the Karatau nature reserve to protect the species.

***Trachelantus korolkowii* Lipsky.**

Status 2 (U), rare relict species.
Distribution: Syr Darya Karatau ranges. Talass Alatau, Ugam ranges.
Habitat: in the middle belt mountains on the stony slopes of the canyons, in the ravines of the river among the trees and bushes.
Limiting factors: small population, commercial activity.
Protection measures: it is necessary to protect the species and to study out the population status.

Lamiaceac Lindl.

***Scutellaria Karatavice* Juz.**

Status 2 (U), rare endemic species.
Distribution: Syr Darya Karatau: Canyon Berkara .
Habitat: on the stony slopes and in the cracks of rocks.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Book (1981). The establishment of the Karatau nature reserve.

Scutellaria Karatavica side by side with other many rare speciess.

***Scutellaria subcae spitosa* Pavl.**
Status 2 (U), rare endemic species.
Distribution: Syr Darya Karatau ranges, west spurs of Talass Alatau; Mashattau mountains.
Habitat: on the stony slopes, in the rock cracks of the lower belt mountains
Limiting factors: weak competitive ability of the species.
Protection measures: the species was registered in the Kazakhstan Red Book (1981). It is necessary to establish the Karatau nature reserve in order to protect the species.

***Dracocephalum Karataviense* Pval. Et Roldug. Karatau snackhead.**
Status 2 (U), rare endemic species.
Distribution: low hills of Talass Alatau and Syr Darya Karatau: environs of Mynzhylky .
Habitat: xerophyte, on the stony slopes and rocks.
Limiting factors: limited natural habitat and small population.
Protection measures: the species was included into the Kazakhstan Red Book (1981)

***Pseudoeremostachys severzowii* (Herd.) M.Pop.**
Status 1 (E), rare species.
Distribution: Syr Darya Karatau ranges, west spures of Talass Alatau and Kirghiz Alatau. Habitat: it grows on the stony and rock slopes, crushed stone peaks, in the steppe belt of mountains.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Books (1978,1981,1984).
It is necessary to control the population status and to establish Karatau nature reserve.

***Pseudomarrubium eremosfachydioldes* M. Pop.**
Status 1 (E), rare, relict and endemic species.
Distribution: Syr Darya Karatau ranges: west and south parts.
Habitat: xerophyte, on the crushed – stone slopes of the mountains. The species has very limited natural habitat: known only from several points.
Limiting factors: commercial activity.
Protection measures: the species was registered in the Red Books (1978,1981,1984). It is necessary to establish a natural reserve on the territory of Karatau to protect the species.

***Salvia trautvetteri* Regel – sage of Trautfetter**
Status2 (U), rare endemic species.
Distribution: Syr Darya Karatau (central part), Talass Alatau (Daubaba, between Sairamsu and Saryaigyr).
Habitat: on the steppe stony and crushed – stone slopes.
Limiting factors: small population, commercial activity.
Protection measures: it is necessary to study the population status and establish Karatau nature reserve.

Scophulariaceae Juss.

***Scrophularia nuranlae* Tzagolova.**
Status. 2 (U)rare, endemic species.
Distribution: Talass Alatau ranges: Mashat mountains .
Habitat: xerophyte, on the stony slopes, rocks and conglomerate outcrops of the mountain belts.
Limiting factors: small population.
Protection measures: the species was registered in the Kazakhstan Red Book (1981). It is necessary to study the population status and to establish the natural reserves.

Rubiaceae Juss.

***Rubia pavlovii* bajt. Et Myrz.**
Status 1 (E) rare endemic species.
Distribution: Syr Darya Karatau ranges.
Habitat: on the crushed – stony slopes and screens.
Limiting factors: intensive pasturage.
Protection measures: it is necessary to establish Karatau nature reserve to protect the species

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Caprifoliaceae Juss.

***Lonicera Karataviensis* Pavl. – Karatau honeysuckle**

Status 1 (E), rare endemic species.

Habitat: mezophyte, on the crushed - stony slopes, rocks and screens of the lower belt mountains.

Limiting factors: commercial activity.

Protection measures: the species was registered in the Kazakhstan Red Book (1981). It is necessary to study the population status and extend the natural boundary of "Berkara" reserve.

Valerianaceae Batsh.

***Valeriana Chionophilk* M.Pop et Kult**

Status 4 (I) species not well studied.

Distribution: Syr Darya Karatau, west spurs of Talass Alatau; Ile and Kungei Alatau, Chu – Ile mountains, Betpakdala desert.

Habitat: on the crushed - stone slopes.

Limiting factors: intensive pasturage.

Protection measures: the part of the natural habitat is located in the protection zone of the natural reserve Aksu – Zhabagly. It is necessary to study the population in nature as a medicinal plant. It was offered to register in the Red Book of Kazakhstan.

Morinaceae rafin.

Morina kokanica.

Status 1 (E), rare endemic species.

Distribution: Syr Darya Karatau ranges, Ugam, Karzhantau, Talass Alatau .

Habitat: mezophyte, on the crushed - stone slopes, among the different grasses.

Limiting factors: the population number is decreasing because of the intensive pasturage.

Protection measures: the species was registered in the Red Book of Kazakhstan (1981).

The part of the natural habitat is located on the territory of Aksu – Zhabagly nature reserve.

Cem. Cucurbitaceae Juss. – Gourd family

Bryonia melanocarpa Nabiev.

Status 2 (U), rare, relict, endemic species.

Distribution: in the South of Turkestan, sands of Kyzylkum.

Habitat: psammophyte, on the fixed sands, under halaxyon and zhuzgun.

Limiting factors: commercial activity. The population number is decreasing because of plan collection as medicinal material.

Protection measures: the species was registered in the Red book of Kazakhstan (1975, 1981). It is necessary to study the natural habitat of the species, and the population status.

***Companulacea magnifica* Real**

Status 2 (U) rare relict species, with the limited natural habitat. Endemic in the mountains Middle Isia.

Distribution: south-west part of Ugam ranges: north, north-east slopes of the canyon Makbalsai, Almatysai, Piyazlysai

Habitat: on the stony slopes, among different grass vegetation.

Limiting factors: extermination of the plant at the time of flowering, small population. Protection measures: the species was registered in the Red Books (1978, 1981, 1984). It is necessary to establish the Ugan botanical reserve, and to forbid the digging of the root.

Cryplocodon monocephalus (Trautv.) Fed.

Status 2 (U), rare, disappearing, relict species.

Distribution: Syr Darya Karatau ranges.

Habitat: stony slopes, cracks of rocks, conglomerate outcrops of the lower belt mountains.

Limiting factors: commercial activity of human.

Protection measures: the species was registered in the Red Books (1975, 1978, 1981). It is necessary to establish in the future Karatau nature reserve.

Asteraceae Dumort

***Anaphalis race mifera* Franch.**

Status (U), rare species, with the limited natural habitat.

Distribution: West Tien-Shian: Syr Darya Karatau , Kirghiz, Talass Alatau ranges.
Habitat: on the stone slopes, stone screens, along the river channels in the middle mountain belts.
Limiting factors: commercial activity, small population.
Protection measures: the species was registered in the Red Book (1981), partly protected in the territory of the nature reserve Aksu Zhabagly. It is necessary to control the population of the species.

***Trichanthemis aulieatensis* (B. Fedtsch) Krasch.**
Status 2 (U), rare species.
Distribution: mountain range of Syr-Darya, western spur of Tallas Alatau.
Habitat: On stony slopes and rocks.
Limiting factors: small populations, intensive grazing.
Measures of protection: it is partially protected in territory of reserve Aksu -Djabagly. Is registered on in the Red Books (1978; 1981; 1984; 1985).

***Trichanthemis radiata* Krasch. et Vved.**
Status 1 (E), rare species.
Distribution: mountain range of Syr-Darya, western western spur of Tallas Alatau: Mashattau mountains, Aksu-Djabagly reserve.
Habitat: on dry stony and slopes, rocks, at altitude 1500-2500 m. above sea level.
Limiting factors: commercial activity.
Measures on protection: The part of the area is within territory of reserve Aksu-Djabagly. The control of a status of a population in Karatau and its protection is necessary.

***Ugamia angrenica* (Krasch). Tzvel.**
Status 2 (U), rare species.
Distribution: Western Tien-Shian: Talas Alatau and Ugam mountain range.
Habitat: on stony and detritus slopes, rocky crests.
Limiting factors: small populations intensive grazing.
Measures on protection: the species is registered in the Red Book (1981). It is partially protected in territory of Aksu-Djabagly reserve. The supervision over a status of a population of a species is necessary. Preservation of a species needs establishment of reserve on Ugam mountain range.

***Lepidolpha filifolia* Pavl.**
Status. 1 (E), rare species.
Distribution: mountain range of Syr-Darya.
Habitat: xerofyte, on stony and detritus slopes.
Limiting factors: commercial activity.
Measures on protection: the species is registered on in the Red Book of Kazakhstan (1981).

***Tanacetopsis pjataevae* (Kovalevsk).**
Status 2 (U), rare species.
Distribution: mountain range of Syr-Darya.
Habitat: mezophyte, on stony slopes and in cracks of rocks.
Limiting factors: small population.
Measures on protection**:** the species is registered in the Red Book of Kazakhstan (1981). The study of a status of a population is required. The establishment of Karatau reserve for preservation of a species is necessary.

***Artemisia cina* Berg.**
Status 1 (E), 3 (R), the rare species, under threat of extinction.
Distribution: from foothills Karatau to Leninabad.
Habitat: on grey - brown soil.
Limiting factors: commercial activity.
Measures on protection: the species is registered in the Red Books (1975, 1981, 1984).

***Artemisia mucronulata* Poljak.**
Status. 1 (E), very rare species.
Distribution. Western spur of Talas Alatau: Karaberek canyon. (map 27).

Habitat. Xerophyte. On dry mountain slopes. Blossoms in June.
Limiting factors. Commercial activity.
Measures on protection. It is necessary to study a status of a population in a nature, to collect cypselas for introduction in culture.

***Ligularia pavlovii* (Lisch). Cretz. (Senecio pavlovii Lipsch.)**

Status. 1 (E), rare species.
Distribution: mountain range of Syr-Darya of Karatau: (map 28).
Habitat: xerophyte, on stony-detritus slopes of the bottom belt(zone) of mountains.
Limiting factors: commercial activity.
Measures on protection: the species is registered on in the Red Books (1975; 1981). The part is in a security zone of territory Aksu-Djabagly of reserve.

***Echinops kasakorum* Pavl.**

Status 1 (E), rare species.
Distribution: mountain range of Syr-Darya of Karatau: Mynzhyki tract.
Habitat: on stone-detritus rocky slopes, among bushes and on both sites of the bottom belt(zone) of mountains.
Limiting factors: commercial activity.
Measures on protection: the species is brought in the Red Book of Kazakhstan (1981). In Mynzhyki tract it is necessary to establish reserve for protection.

***Cousinia alberti* Regel et Schmalh.**

Status. 1 (U), rare species.
Distribution: Western spur of Talas Alatau (map 28); Kyrgyz range (western part).
Habitat: xerophyte, on stone-detritus slopes, on the average belt(zone) of mountains.
Limiting factors: commercial activity.
Measures on protection: the species is registered on in the Red Book of Kazakhstan (1981). Is partially protected in territory of reserve Aksu-Djabagly. The studying - out of a status of a population is necessary

***Saussurea mikeschinii* Iljin.**

Status. 1 (E), rare species.
Distribution: mountain range of Syr-Darya of Karatau: Mynzhylki tract.
Habitat: on stony slopes, looses, tops.
Limiting factors: commercial activity.
Measures on protection: the species is registered on in the Red Book of Kazakhstan (1981). The studying of a status of a population is required. It is necessary to establish Aksu-Djabagly reserve for preservation and rare plants.

***Saussurea vvedenskyi* Lipsch.**

Status. 1 (E), rare species which is taking place under threat of disappearance.
Distribution: Karzhantau range:Akbastau mountains
Habitat: xerophyte, on stony and ditrutis slopes of average and top belts(zones) of mountains.
Limiting factors: commercial activity.
Measures on protection: It is necessary to study out a status of a population, to develop measures of protection.

***Jurinea cephalopoda* Iljin**

Status. 1 (E), seldom meeting species.
Distribution: mountain range of Syr-Darya, Karatau.
Habitat: on slopes of mountains.
Limiting factors: commercial activity.
Measures on protection: the species is registered on in the Red book of Kazakhstan (1981). It is necessary to study out a status of a species for definition of measures on his(its) protection.

***Jurinea eximia* Tek.**

Status 1 (E), rare species.
Distribution: Mountain range of Syr-Darya, Karatau: Dzholsai tract.
Habitat: on stony slopes, in cracks of rocks.

Limiting factors: commercial activity.
Measures on protection: the species is registered on in the Red Books (1975; 1981; 1984). It is necessary to study out a status of a population of a species for definition of measures on its protection..

***Jurinea karatavica* Iljin**

Status, 1 (E), rare species.
Distribution: eastern part of Mountain range of Syr-Darya, Karatau
Habitat: on stony slopes, looses, tops.
Limiting factors: commercial activity.
Measures on protection: it is necessary to study a status of populations and to develop measures on its preservation.

***Rhaponticum aulieatense* Iljin.**

Status 2 (U), rare species.
Distribution: eastern part of Mountain range of Syr-Darya, Karatau.
Habitat: on stony slopes.
Limiting factors: commercial activity, small populations.
Measures on protection: the species is registered in the Red Books (1981; 1985). Study of the status of populations, establishment of Karatau reserve.

***Rhaponticum karatavicum* Regel et Schmalh.**

Status 1 (E), rare species.
Distribution: mountain range of Syr-Darya, Karatau: Mynzhylky tract.
Habitat: mezophyte, on stony slopes, in cracks of rocks, mainly on the average belt zone of mountains.
Limiting factors: commercial activity.
Measures of protection: the species is registered on in the Red Book of Kazakhstan (1981). It is necessary to protect in reserves.

***Centaurea kultiassovii* Iljin.**

Status 2 (II), rare species.
Distribution: western spur of Talas Alatau, (Mashat mountains) and Syr-Darya Karatau: pass Bosturgai.
Habitat: on stony slopes, in cracks of rocks, on tops of the mountains.
Limiting factors: commercial activity small populations.
Measures of protection: it is necessary study of a status of population and establishment of future Karatau reserves. Is recommended for the Red Book of Kazakhstan.

***Centaurea lasiopoda* M. Pop. Et Kult.**

Status 2 (IX), rare species.
Distribution: Western Tien-Shian, Alymtau, Karzhantau mountains, Mountain range of Syr-Darya, Karatau.
Habitat: on stony place, in cracks of rocks, on tops of mountains.
Limiting factors: small population, commercial development of territories.
Measures of protection: the species is registered on in the Red Book (1981). The study of a status of populations is necessary, establishment of botanical reserve in mountains Alymtau.

***Centaurea turkestanica* Franch.**

Status 2 (U), rare species.
Distribution: mountain range of Syr-Darya, Karatau.
Habitat: on stony slopes, in cracks of rocks, on tops of the mountains.
Limiting factors: commercial activity.
Measures of protection: the species is registred in the Red Book of Kazakhstan (1981). It is protected in territory of Mashat reserve and Aksu-Dzhabagly reserve.

***Scorzonera tau-sagyz* Lipsch. Et Bosse**

Status 2 (II), rare species.
Distribution: mountain range of Syr-Darya, Karatau and Western spur of Talas Alatau.
Habitat: on stony slopes, in cracks of rocks, on tops of the mountains.

The limiting factors: weak seed renewal, weak competitive ability and mass preparation.
Measures on protection: the species is registred in to the Red Books (1975; 1978; 1981: 1984). The protection of a species in territory of future of Karatau reserve is necessary.

***Lactuca mira* Pavl.**

Status 2 (U), rare species.
Distribution: Western Tien-Shian: Talas Alatau and Ugam range.
Habitat: on stony places, in cracks of rocks, on tops and slopes of the alpine belt zone, at altitude 3200-3500 m above the sea.
Limiting factors: commercial activity.
Measures on protection: the species is registered in the Red Books (1975; 1981). Is partially protected in territory of reserve Aksu-Dzhabagly, establishment of Ugam botanical reserve for its preservation.

The legend to the map of vegetation in Keles River Basin

Mountain region

I. Desert belt of Tyan Shian (sierozems)

40. Ephemeral deserts of West Tyan Shian. *Poa buibosa, Carex pashystillis* and other ephemerals. Spring rangelands, partially irrigated arable lands.

41. Ephemer-big grass deserts of west Tyan Shian . *Psoralea drupacea, Artemisia cinaberg, Ferula foetida* and other ephemerals. Spring pastures, irrigated arable lands.

III. Mountain steppe belt (mountain secondary and mountain grey-brown soils)

43. Coach grass and various grass mountain steppe of West Tyan Shian. *Agropyrum Ausheri, Ferula karatavica, Inula grandis, Parngosa uloplera*, ephemeral grasses. Dense stone soils with rare vegetation. Pastures and unsustainable dry arable lands.

49. Bushes (honeysuckle, dog rose, cherry etc.) with cereal big grasses (hairy coach grass, bulb barley), various grasses (*Ferulaeremurus*, zopnik etc. and ephemeral-ephemeroid grasses.

52. Dry Juniperus thin forests with bushes (barberry, currant, dog rose etc.) and meadow-steppe various grasses). Pastures and forests, mountain orchards.

Intrazonal groups in desert region

38. Tugai-saline complex of flood lands of southern rivers. Djigda-willow (*Elaegnus*-*Salix*) tugai forests, saline complexes, saline meadows, chi and tamarix bushes.

Legend to the map of vegetation in Shardara massif

Mountain region

40. Ephemeral deserts of West Tyan Shian. *Poa buibosa, Carex pashystillis* and other ephemerals. Spring rangelands, partially irrigated arable lands.

Intrazonal groups in desert region

38. Tugai-saline complex of flood lands of southern rivers. Djigda-willow (*Elaegnus-Salix*) tugai forests, saline complexes, saline meadows, chi and tamarix bushes.

36. Saline complexes of ancient Syr Darya valley. *Anabasis salsa, A. aphylla, Nanophyton erinaceum*. In the lowlands bushes of *Stipa splendens, Halochemum strobilacceum*. Pastures for small ruminants and camels, irrigated arable lands.

34. Vegetation of dune and hilly sands. Numerous species: Calligomum, Salsola, Aristida pennata, A. plumosa, Carex physodes, on slopes Tortual desertorum. In hollows saline plants and bushes of tamarix. Winter and early spring pastures.

Legend to the map of vegetation in Shieli massif

Vegetation of pre-mountain and low mountain deserts

50. Ephemeral deserts of Karatau. Cereal-ephemeral-wormwood community. Wormwood gray (*Artemisia terra-albea*) and Turan (*A. turanica*), Poa pretense, Brome grass, mortuk.

Vegetation of ancient delta plains

36. Reed (*Phragmites*) –azhrek (*Aelyropus*), - saline community, tamarix tugai, on sands zhuzgun (*Calligonum aphyllum*), wormwood (*Artemisia terra-albea*), sandy sedge.

35. Wormwood (*Artemisia*) – saline, haloxylon (*Haloxylon*), keireuk (*Salsola rigida*), biurgun (*Salsola*) community.

Vegetation of water delta plains

38. Tugai-saline complex of flood lands of southern rivers. Djigda-willow (*Elaegnus-Salix*) tugai forests, saline complexes, saline meadows, chi and tamarix bushes.

Vegetation of sandy areas of Kyzylkum

33. Kyzylkum district white wormwood (*Artemisia terra-albea*), rang (*Carex physodes*), haloxylon (*Haloxylon persicum*), zhuzgun (*Calligonum aphyllum*), sandy acacia (*Ammodendron bifolium*).

Legend to the map of vegetation in Golodnaya Steppe (Hunger Steppe)

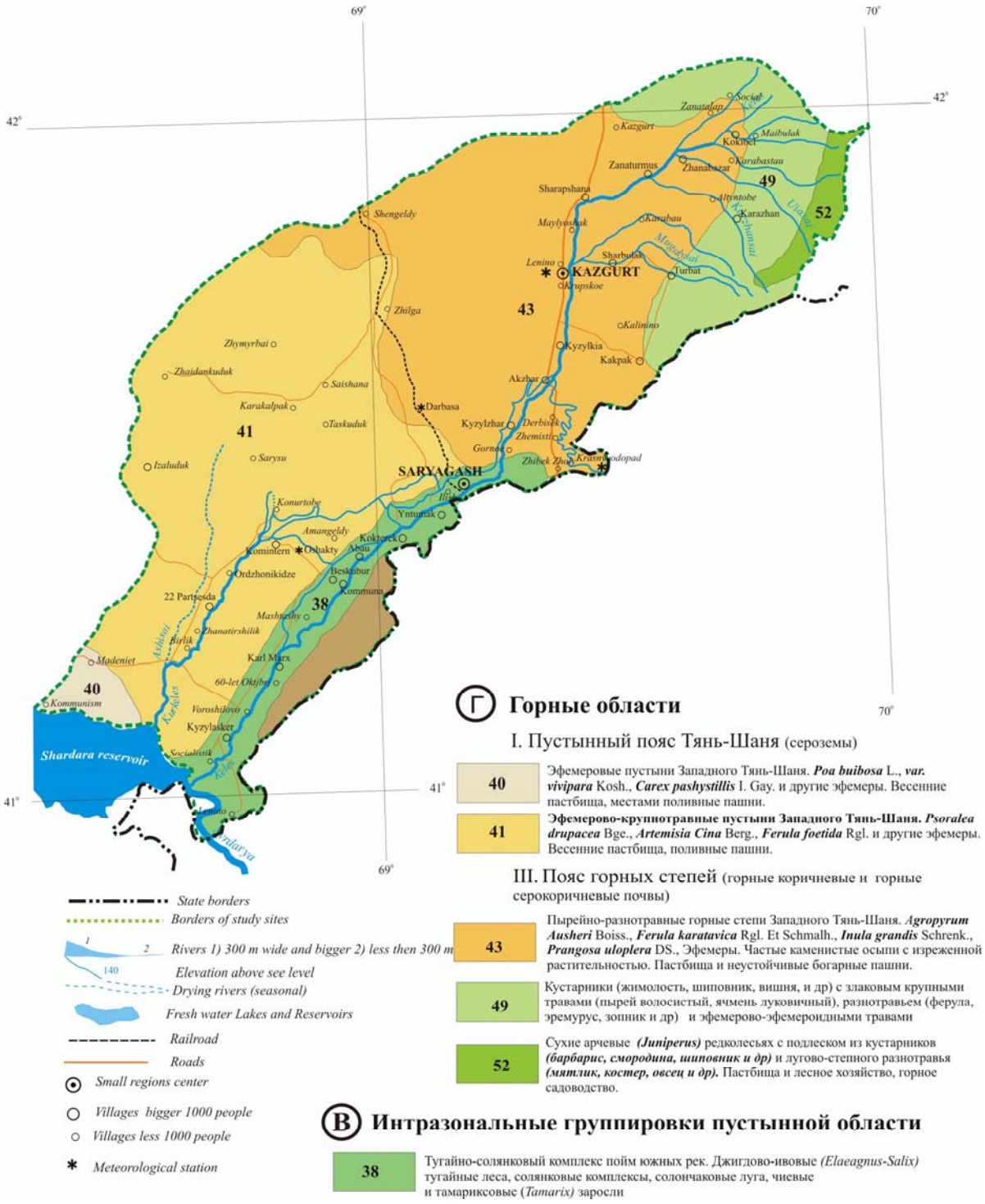
Mountain region

40. Ephemeral deserts of West Tyan Shian. *Poa buibosa, Carex pashystillis* and other ephemerals. Spring rangelands, partially irrigated arable lands.

Intrazonal groups in desert region

38. Tugai-saline complex of flood lands of southern rivers. Djigda-willow (*Elaegnus-Salix*) tugai forests, saline complexes, saline meadows, chi and tamarix bushes.

Vegetation of river basin Keles



State borders

Borders of study sites

Rivers 1) 300 m wide and bigger 2) less then 300 m

Elevation above see level

Drying rivers (seasonal)

Fresh water Lakes and Reservoirs

Railroad

Roads

Small regions center

Villages bigger 1000 people

Villages less 1000 people

Meteorological station

Г Горные области

I. Пустынный пояс Тянь-Шаня (сероземы)

40 Эфемеровые пустыни Западного Тянь-Шаня. ***Poa buibosa*** L., ***var. vivipara*** Kosh., ***Carex pashystillis*** I. Gay. и другие эфемеры. Весенние пастбища, местами поливные пашни.

41 **Эфемерово-крупнотравные пустыни Западного Тянь-Шаня. *Psoralea drupacea*** Bge., ***Artemisia Cina*** Berg., ***Ferula foetida*** Rgl. и другие эфемеры. Весенние пастбища, поливные пашни.

III. Пояс горных степей (горные коричневые и горные серокоричневые почвы)

43 Пырейно-разнотравные горные степи Западного Тянь-Шаня. ***Agropyrum Ausheri*** Boiss., ***Ferula karatavica*** Rgl. Et Schmalh., ***Inula grandis*** Schrenk., ***Prangosa uloplera*** DS., Эфемеры. Частые каменистые осыпи с изреженной растительностью. Пастбища и неустойчивые богарные пашни.

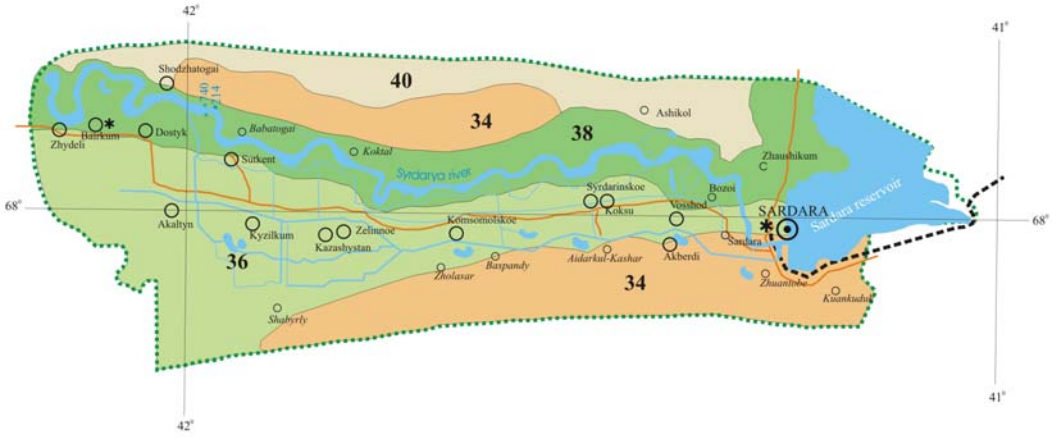
49 Кустарники (жимолость, шиповник, вишня, и др) с злаковым крупными травами (пырей волосистый, ячмень луковичный), разнотравьем (ферула, эремурус, зопник и др) и эфемерово-эфемероидными травами

52 Сухие арчевые ***(Juniperus)*** редколесьях с подлеском из кустарников ***(барбарис, смородина, шиповник и др)*** и лугово-степного разнотравья ***(мятлик, костер, овсец и др).*** Пастбища и лесное хозяйство, горное садоводство.

В Интразональные группировки пустынной области

38 Тугайно-солянковый комплекс пойм южных рек. Джигдово-ивовые *(Elaeagnus-Salix)* тугайные леса, солянковые комплексы, солончаковые луга, чиевые и тамариксовые (*Tamarix)* заросли

Vegetation of Shardara massif



State borders
Borders of small naturel zones
Borders of study sites
Rivers 1) 300 m wide and bigger 2) less then 300 m
Elevation above see level
Drying rivers (seasonal)
Fresh water Lakes and Reservoirs
Railroad
Roads

Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station

Г Горные области

I. Пустынный пояс Тянь-Шаня (сероземы)

40 Эфемеровые пустыни Западного Тянь-Шаня. ***Poa buibosa*** L., ***var. vivipara*** Kosh., ***Carex pashystillis*** I. Gay. и другие эфемеры. Весенний пастбища, местами поливные пашни.

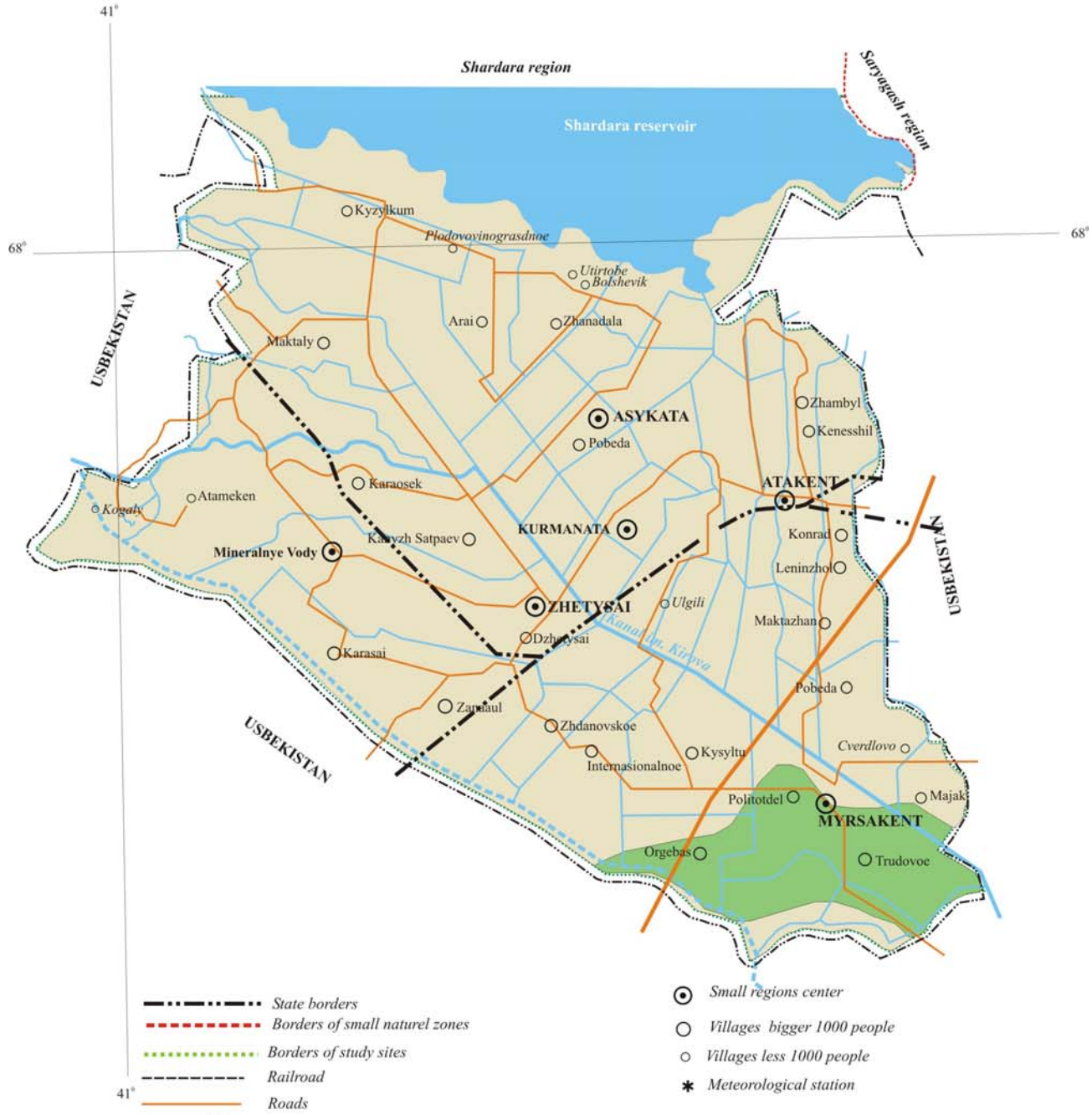
В Интразональные группировки пустынной области

38 Тугайно-солянковый комплекс пойм южных рек. Джигдово-ивовые ***(Elaeagnus-Salix)*** тугайные леса, солянковые комплексы, солончаковые луга, чиевые и тамариксовые ***(Tamarix)*** заросли

36 Солянковые комплексы древней сырдарьинской долины ***Anabasis salsa*** Benth., ***A. Eriopoda*** Benth.,. ***A. Aphylla*** L., ***Nanophyton erinaceum*** Bge. В понижениях заросли ***Stipa splendens*** Trin., и ***Halocnemum strobilacceum*** MB. Пастбища для мелкого рогатого скота и верблюдов, поливные пашни.

34 Растительность барханных грядовых и бугристых песков. Многочисленные виды ***Calligomum, Salsola Richteri*** Karel., ***Aristida pennata*** Trin., ***A. Plumosa*** L., ***Carex physodes*** MB, на уплотненных склонах бугров мох ***(Tortula desertorum)***. На останцах ***Artemisia terra albae*** H. Krasch.В котловинах солянковые заросли и кусты ***Tamarx.*** Зимние и ране-весенниепастбища.

Vegetation of Golodnaya step



Г Горные области

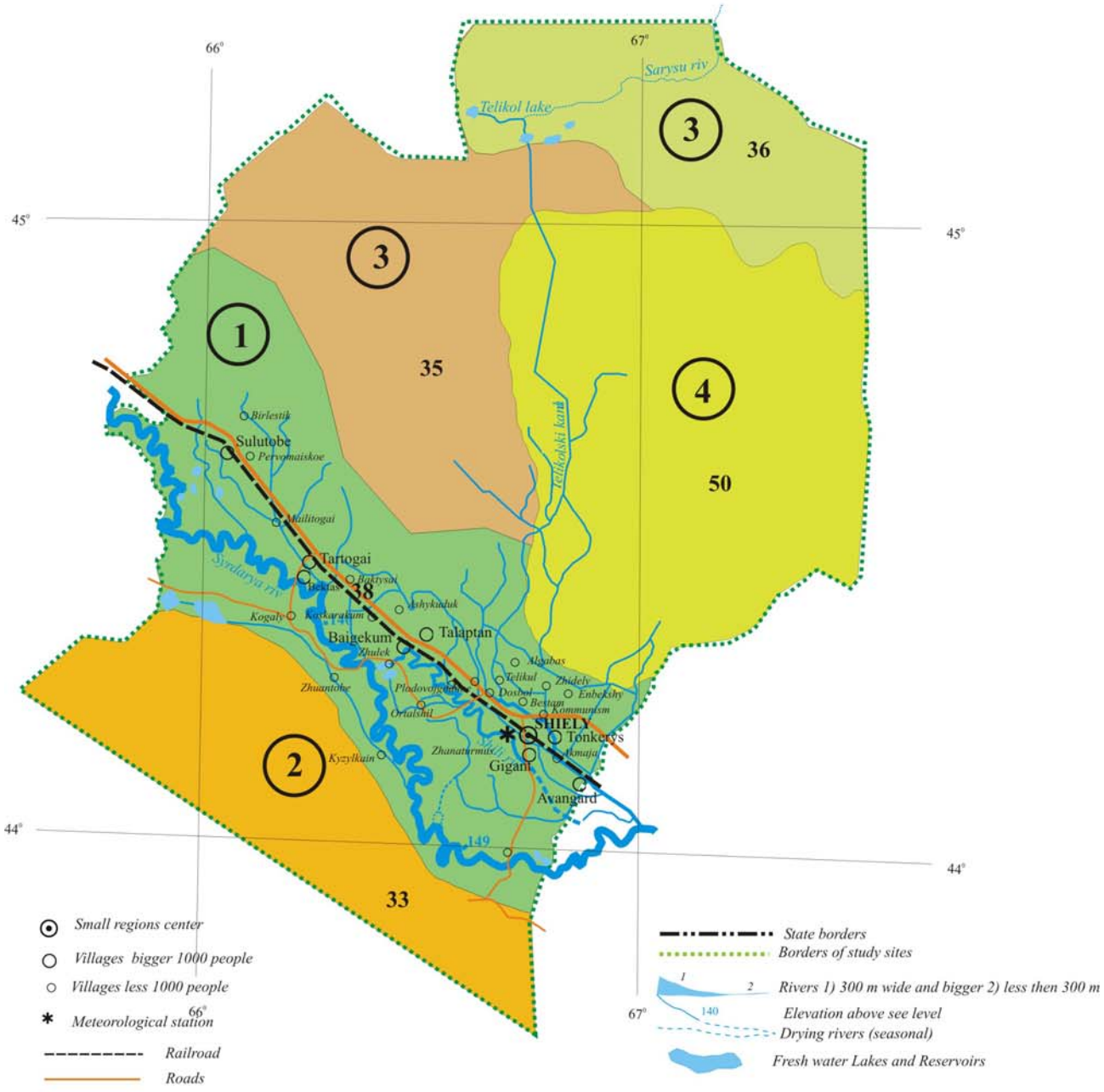
I. Пустынный пояс Тянь-Шаня (сероземы)

40 Эфемеровые пустыни Западного Тянь-Шаня. ***Poa buibosa*** L., ***var. vivipara*** Kosh., ***Carex pashystillis*** I. Gay. и другие эфемеры. Весенний пастбища, местами поливные пашни.

В Интразональные группировки пустынной области

38 Тугайно-солянковый комплекс пойм южных рек. Джигдово-ивовые *(Elaeagnus-Salix)* тугайные леса, солянковые комплексы, солончаковые луга, чиевые и тамариксовые (*Tamarix)* заросли

Vegetation of Shieli massif



Small regions center
Villages bigger 1000 people
Villages less 1000 people
Meteorological station
Railroad
Roads

State borders
Borders of study sites
Rivers 1) 300 m wide and bigger 2) less then 300 m
Elevation above see level
Drying rivers (seasonal)
Fresh water Lakes and Reservoirs

Б Пустынная область

4 Растительность предгорных и низкогорных пустынь

50 *Эфемеровые пустыни Каратау. Злаково-эфемерово-полынная сообщества. Полынь серый (Artemisia terra-albea) и туранский (A. turanica), мятлик (Poa pretense), костер, мортук*

3 Растительность древнедельтовых равнин

36 *Тростниково (Pragmitis)-ажреково (Aelyropus),-солянковая сообщества, тамариксовые (Tamarix) тугай, на песках жузгун (Calligonum aphyllum), полынь (Artenisia terra-albea), песчаная осока*

35 *Полынно (Artemisia)-солянковые, саксауловые (Holoxylon) , кейреуковые (Salsola rigida), и биюргуновые (Salsola) сообщества*

В Интразональные группировки пустынной области

1 Растительность обводненных дельтовых равнин

38 Тугайно-солянковый комплекс пойм южных рек. Джигдово-ивовые *(Elaeagnus-Salix) тугайные леса, солянковые комплексы, солончаковые луга, чиевые и тамариксовые (Tamarix) заросли*

2 Растительность песчаного массива Кызылкумов

33 *Кызылкумский район белая полынь (Artemisia terra-albea), ранг (Carex physodes), саксаул белый (Haloxylon persicum), жузгун (Calligonum aphyllum), песчаная акация (Ammodendron bifolium)*

Appendix
List of vertebrate species recorded in Hunger Steppe (Kazakhstan) study area

Species	**Family**	**Order**
Bufo viridis	Bufonidae	Anura
Rana ridibunda	Ranidae	Anura
Testudo horsfieldi	Testudinidae	Testudinata
Agama sanguinolenta	Agamidae	Sauria
Phrynocephalus interscapularis	Agamidae	Sauria
Varanus griseus	Varanidae	Sauria
Eremias velox	Lacertidae	Sauria
Eremias intermedia	Lacertidae	Sauria
Eremias arguta	Lacertidae	Sauria
Eremias grammica	Lacertidae	Sauria
Natrix tessellata	Colubridae	Serpentes
Coluber ravergieri	Colubridae	Serpentes
Coluber turia	Colubridae	Serpentes
Elaphe dione	Colubridae	Serpentes
Taphrometopon lineolatum	Colubridae	Serpentes
Vipera ursini	Viperidae	Serpentes
Ancistrodon halys	Viperidae	Serpentes
Podiceps ruficollis	Podicipedidae	Podicipediformes
Podi ceps cristatus	Podicipedidae	Podicipediformes
Pelecanus onocrotalus	Pelicanidae	Pelecaniformes
Pelecanus crispus	Pelicanidae	Pelecaniformes
Phalacrocorax carbo	Phalacrocoracidae	Pelecaniformes
Phalacrocorax aristotelis	Phalacrocoracidae	Pelecaniformes
Phalacrocorax pygmaeus	Phalacrocoracidae	Pelecaniformes
Botaurus stellaris	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Egretta alba	Ardeidae	Ciconiiformes
E gretta garzetta	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Cygnus olor	Anatidae	Anseriformes
Cygnus cygnus	Anatidae	Anseriformes
Tadorna ferruginea	Anatidae	Anseriformes
Tadorna tadorna	Anatidae	Anseriformes
Anas platyrhynchos	Anatidae	Anseriformes
Anas strepera	Anatidae	Anseriformes
Anas acuta	Anatidae	Anseriformes
Netta rufina	Anatidae	Anseriformes
Aythya ferina	Anatidae	Anseriformes
Aythya nyroca	Anatidae	Anseriformes
Aythya fuligula	Anatidae	Anseriformes
Hieraeetus leucoryphus	Aquilidae	Falconiformes
Falco naumanni	Aquilidae	Falconiformes
Falco tinnunculus	Aquilidae	Falconiformes
Crex crex	Rallidae	Gruiformes
Otis tarda	Otidae	Gruiformes
Charadrius dubius	Charadriidae	Gruiformes
Vanellus vanelus	Charadriidae	Charadriiformes

Vanellochettusia leucura	Charadriidae	Charadriiformes
Himantopus himantopus	Charadriidae	Charadriiformes
Haematopus ostralegus	Charadriidae	Charadriiformes
Larus ridibundus	Charadriidae	Charadriiformes
Gelochelidon nilotica	Charadriidae	Charadriiformes
Sterna hirundo	Charadriidae	Charadriiformes
Pterocles alchata	Pterocletidae	Pteroclidiformes
Streptopelia senegalensis	Columbae	Columbiformes
Cuculus canorus	Cuculidae	Cuculiformes
Cuculus saturatus	Cuculidae	Cuculiformes
Asio otus	Strigidae	Strigiformes
Otus scops	Strigidae	Strigiformes
Caprimuglus europaeus	Caprimulgidae	Caprimulgiformes
Caprimuglus aegyptus	Caprimulgidae	Caprimulgiformes
Hirundapus caudacutus	Apodidae	Apodiformes
Apus apus	Apodidae	Apodiformes
Apus melba	Apodidae	Apodiformes
Coracias garrulus	Coracidae	Coraciiformes
Alcedo atthis	Coracidae	Coraciiformes
Merops apiaster	Coracidae	Coraciiformes
Merops superciliosus	Coracidae	Coraciiformes
Upupa epops	Upupidae	Upupiformes
Riparia riparia	Hirundinidae	Passeriformes
Hirundo rustica	Hirundinidae	Passeriformes
Hirundo daurica	Hirundinidae	Passeriformes
Delichon urbica	Hirundinidae	Passeriformes
Galerida cristata	Alaudidae	Passeriformes
Calandrella cinerea	Alaudidae	Passeriformes
Calandrella acutirostris	Alaudidae	Passeriformes
Calandrella rufescens	Alaudidae	Passeriformes
Calandrella cheleensis	Alaudidae	Passeriformes
Melanocorypha calandra	Alaudidae	Passeriformes
Melanocorypha bimaculata	Alaudidae	Passeriformes
Eremophila alpestris	Alaudidae	Passeriformes
Alauda arvensis	Alaudidae	Passeriformes
Alauda gulgula	Alaudidae	Passeriformes
Anthus campestris	Motacillidae	Passeriformes
Anthus spinoletta	Motacillidae	Passeriformes
Motacilla feldegg	Motacillidae	Passeriformes
Motacilla lutea	Motacillidae	Passeriformes
Motacilla cinerea	Motacillidae	Passeriformes
Motacilla alba	Motacillidae	Passeriformes
Motacilla personata	Motacillidae	Passeriformes
Lanius phoenicuroides	Lanidae	Passeriformes
Lanius schach	Lanidae	Passeriformes
Lanius minor	Lanidae	Passeriformes
Lanius excubitor	Lanidae	Passeriformes
Saxicola rubetra	Turdidae	Passeriformes
Saxicola torquata	Turdidae	Passeriformes
Saxicola caprata	Turdidae	Passeriformes
Oenanthe oenanthe	Turdidae	Passeriformes

Oenanthe pleschanka	Turdidae	Passeriformes
Oenanthe picata	Turdidae	Passeriformes
Oenanthe finschii	Turdidae	Passeriformes
Oenanthe deserti	Turdidae	Passeriformes
Oenanthe isabellina	Turdidae	Passeriformes
Turdus merula	Turdidae	Passeriformes
Phoenicurus caeruleocephalus	Turdidae	Passeriformes
Phoenicurus phoenicurus	Turdidae	Passeriformes
Luscinia megarchynchos	Turdidae	Passeriformes
Luscinia luscinia	Turdidae	Passeriformes
Erinaceus auritus	Erinaceidae	Insectivora
Hemiechinus hypomelas	Erinaceidae	Insectivora
Myotis mystacinus	Vespertilionidae	Chiroptera
Vespertilio pipistrellus	Vespertilionidae	Chiroptera
Vespertilio serotinus	Vespertilionidae	Chiroptera
Lepus tolai	Leporidae	Lagomorpha
Citellus pugmaeus	Sciurdae	Rodentia
Allactaga elater	Dipodidae	Rodentia
Allactaga major	Dipodidae	Rodentia
Cricetulus migratorius	Cricetidae	Rodentia
Rhombomus opimus	Cricetidae	Rodentia
Meriones tamariscinus	Cricetidae	Rodentia
Meriones meridianus	Cricetidae	Rodentia
Canis lupus	Canidae	Carnivora
Cuon alpinus	Canidae	Carnivora
Vulpes vulpes	Canidae	Carnivora
Meles meles	Mustelidae	Carnivora
Mustela eversmanni	Mustelidae	Carnivora
Mustela nivalis	Mustelidae	Carnivora
Felis libyca	Felidae	Carnivora

List of vertebrate species recorded in Chardara study area

Species	**Family**	**Order**
Bufo viridis	Bufonidae	Anura
Rana ridibunda	Ranidae	Anura
Testudo horsfieldi	Testudinidae	Sauria
Mediodactilus russovi	Gekkonidae	Sauria
Teratoscinus scincus	Gekkonidae	Sauria
Crossobamon eversmanni	Gekkonidae	Sauria
Agama sanguinolenta	Agamidae	Sauria
Phrynocephalus interscapularis	Agamidae	Sauria
Phrynocephalus versicolor	Agamidae	Sauria
Varanus griseus	Varanidae	Sauria
Eremias velox	Lacertidae	Sauria
Eremias intermedia	Lacertidae	Sauria
Eremias arguta	Lacertidae	Sauria
Eremias scripta	Lacertidae	Sauria
Eremias grammica	Lacertidae	Sauria

Eryx tataricus	Boidae	Serpentes
Eryx miliaris	Boidae	Serpentes
Natrix tessellata	Colubridae	Serpentes
Coluber ravergieri	Colubridae	Serpentes
Coluber turia	Colubridae	Serpentes
Elaphe dione	Colubridae	Serpentes
Taphrometopon lineolatum	Colubridae	Serpentes
Vipera ursini	Viperidae	Serpentes
Ancistrodon halys	Viperidae	Serpentes
Podiceps ruficollis	Podicipedidae	Podicipediformes
Po diceps nigricollis	Podicipedidae	Podicipediformes
Podi ceps cristatus	Podicipedidae	Podicipediformes
Podices griseigena	Podicipedidae	Podicipediformes
Gavia stellata	Gaviidae	Gaviformes
Gavia arctica	Gaviidae	Gaviformes
Pelecanus onocrotalus	Pelicanidae	Pelecaniformes
Pelecanus crispus	Pelicanidae	Pelecaniformes
Phalacrocorax carbo	Phalacrocoracidae	Pelecaniformes
Phalacrocorax aristotelis	Phalacrocoracidae	Pelecaniformes
Phalacrocorax pygmaeus	Phalacrocoracidae	Pelecaniformes
Botaurus stellaris	Ardeidae	Ciconiiformes
Nycticorax nycticorax	Ardeidae	Ciconiiformes
Ardeola ralloides	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Egretta alba	Ardeidae	Ciconiiformes
E gretta garzetta	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Platalea leucorodia	Ibididae	Ciconiiformes
Plegadis falcinellus	Ibididae	Ciconiiformes
Ciconia ciconia	Coconiidae	Ciconiiformes
Ciconia nigra	Coconiidae	Ciconiiformes
Anser anaer	Anatidae	Anseriformes
Anser albifrons	Anatidae	Anseriformes
Anser erithropus	Anatidae	Anseriformes
Chen caerulescens	Anatidae	Anseriformes
Cygnus olor	Anatidae	Anseriformes
Cygnus cygnus	Anatidae	Anseriformes
Tadorna ferruginea	Anatidae	Anseriformes
Tadorna tadorna	Anatidae	Anseriformes
Anas platyrhynchos	Anatidae	Anseriformes
Anas strepera	Anatidae	Anseriformes
Anas falcata	Anatidae	Anseriformes
Anas penelope	Anatidae	Anseriformes
Anas acuta	Anatidae	Anseriformes
Netta rufina	Anatidae	Anseriformes
Aythya ferina	Anatidae	Anseriformes
Aythya nyroca	Anatidae	Anseriformes
Aythya fuligula	Anatidae	Anseriformes
Clangula hyemalis	Anatidae	Anseriformes
Bucephala clangula	Anatidae	Anseriformes

Oxyura leucocephala	Anatidae	Anseriformes
Mergus albellus	Anatidae	Anseriformes
Mergus serrator	Anatidae	Anseriformes
Mergus merganser	Anatidae	Anseriformes
Hieraeetus leucoryphus	Falconidae	Falconiformes
Falco naumanni	Falconidae	Falconiformes
Falco tinnunculus	Falconidae	Falconiformes
Coturnix coturnix	Gruidae	Gruiformes
Phasianus colchicus	Gruidae	Gruiformes
Grus leucogeranus	Gruidae	Gruiformes
Grus grus	Gruidae	Gruiformes
Grus vipio	Gruidae	Gruiformes
Anthropoides virgo	Gruidae	Gruiformes
Rallus aquaticus	Rallidae	Gruiformes
Porzana porzana	Rallidae	Gruiformes
Porzana parva	Rallidae	Gruiformes
Porzana pusilla	Rallidae	Gruiformes
Crex crex	Rallidae	Gruiformes
Otis tarda	Otidae	Gruiformes
Chlamydotis undulata	Otidae	Gruiformes
Burhinus oedicnemus	Otidae	Gruiformes
Charadrius dubius	Charadriidae	Charadriiformes
Vanellus vanelus	Charadriidae	Charadriiformes
Vanellochettusia leucura	Charadriidae	Charadriiformes
Himantopus himantopus	Charadriidae	Charadriiformes
Haematopus ostralegus	Charadriidae	Charadriiformes
Tringa ochropus	Charadriidae	Charadriiformes
Tringa glareola	Charadriidae	Charadriiformes
Numenius arquata	Charadriidae	Charadriiformes
Limosa limosa	Charadriidae	Charadriiformes
Larus ridibundus	Charadriidae	Charadriiformes
Gelochelidon nilotica	Charadriidae	Charadriiformes
Sterna hirundo	Charadriidae	Charadriiformes
Pterocles alchata	Pterocletidae	Pteroclidiformes
Streptopelia senegalensis	Columbae	Columbiformes
Cuculus canorus	Cuculidae	Cuculiformes
Cuculus saturatus	Cuculidae	Cuculiformes
Asio otus	Strigidae	Strigiformes
Otus scops	Strigidae	Strigiformes
Otus brucei	Strigidae	Strigiformes
Caprimuglus europaeus	Caprimulgidae	Caprimulgiformes
Caprimuglus aegyptus	Caprimulgidae	Caprimulgiformes
Hirundapus caudacutus	Apodidae	Apodiformes
Apus apus	Apodidae	Apodiformes
Apus melba	Apodidae	Apodiformes
Coracias garrulus	Coracidae	Coraciiformes
Alcedo atthis	Coracidae	Coraciiformes
Merops apiaster	Coracidae	Coraciiformes
Merops superciliosus	Coracidae	Coraciiformes
Upupa epops	Upupidae	Upupiformes
Jinks torquilla	Picidae	Piciformes

Dendrocopos leucopterus	Picidae	Piciformes
Riparia riparia	Hirundinidae	Passeriformes
Ptyonoprogne rupestris	Hirundinidae	Passeriformes
Hirundo rustica	Hirundinidae	Passeriformes
Hirundo daurica	Hirundinidae	Passeriformes
Delichon urbica	Hirundinidae	Passeriformes
Galerida cristata	Alaudidae	Passeriformes
Calandrella cinerea	Alaudidae	Passeriformes
Calandrella acutirostris	Alaudidae	Passeriformes
Calandrella rufescens	Alaudidae	Passeriformes
Calandrella cheleensis	Alaudidae	Passeriformes
Melanocorypha calandra	Alaudidae	Passeriformes
Melanocorypha bimaculata	Alaudidae	Passeriformes
Eremophila alpestris	Alaudidae	Passeriformes
Alauda arvensis	Alaudidae	Passeriformes
Alauda gulgula	Alaudidae	Passeriformes
Anthus campestris	Motacillidae	Passeriformes
Anthus spinoletta	Motacillidae	Passeriformes
Motacilla feldegg	Motacillidae	Passeriformes
Motacilla lutea	Motacillidae	Passeriformes
Motacilla cinerea	Motacillidae	Passeriformes
Motacilla alba	Motacillidae	Passeriformes
Motacilla personata	Motacillidae	Passeriformes
Lanius isabellinus	Lanidae	Passeriformes
Lanius phoenicuroides	Lanidae	Passeriformes
Lanius schach	Lanidae	Passeriformes
Lanius minor	Lanidae	Passeriformes
Lanius excubitor	Lanidae	Passeriformes
Bombycilla garrulus	Cinclidae	Passeriformes
Cinclus cinclus	Cinclidae	Passeriformes
Cinclus pallasii	Cinclidae	Passeriformes
Troglodites troglodites	Troglodytidae	Passeriformes
Terpsiphone paradisi	Muscicapidae	Passeriformes
Ficedula parva	Muscicapidae	Passeriformes
Muscicapa striata	Muscicapidae	Passeriformes
Muscicapa ruficauda	Muscicapidae	Passeriformes
Saxicola rubetra	Turdidae	Passeriformes
Saxicola torquata	Turdidae	Passeriformes
Saxicola caprata	Turdidae	Passeriformes
Oenanthe oenanthe	Turdidae	Passeriformes
Oenanthe pleschanka	Turdidae	Passeriformes
Oenanthe picata	Turdidae	Passeriformes
Oenanthe finschii	Turdidae	Passeriformes
Oenanthe deserti	Turdidae	Passeriformes
Oenanthe isabellina	Turdidae	Passeriformes
Monticola saxatilus	Turdidae	Passeriformes
Monticola solitarius	Turdidae	Passeriformes
Turdus ruficollis	Turdidae	Passeriformes
Turdus atrogularis	Turdidae	Passeriformes
Turdus pilaris	Turdidae	Passeriformes
Turdus merula	Turdidae	Passeriformes

Turdus iliacus	Turdidae	Passeriformes
Turdus viscivorus	Turdidae	Passeriformes
Phoenicurus caeruleocephalus	Turdidae	Passeriformes
Phoenicurus phoenicurus	Turdidae	Passeriformes
Phoenicurus ochruros	Turdidae	Passeriformes
Phoenicurus erythronotus	Turdidae	Passeriformes
Phoenicurus erythrogaster	Turdidae	Passeriformes
Luscinia megarchynchos	Turdidae	Passeriformes
Luscinia luscinia	Turdidae	Passeriformes
Luscinia pectoralis	Turdidae	Passeriformes
Luscinia svecica	Turdidae	Passeriformes
Irania gutturalis	Turdidae	Passeriformes
Myophonus caeruleus	Turdidae	Passeriformes
Enicurus scouleri	Turdidae	Passeriformes
Erinaceus auritus	Erinaceidae	Insectivora
Myotis mystacinus	Vespertilionidae	Chiroptera
Vespertilio pipistrellus	Vespertilionidae	Chiroptera
Vespertilio serotinus	Vespertilionidae	Chiroptera
Lepus tolai	Leporidae	Lagomorpha
Citellus pugmaeus	Sciuridae	Rodentia
Allactaga elater	Dipodidae	Rodentia
Allactaga severtzovi	Dipodidae	Rodentia
Allactaga major	Dipodidae	Rodentia
Cricetulus migratorius	Cricetidae	Rodentia
Rhombomus opimus	Cricetidae	Rodentia
Meriones tamariscinus	Cricetidae	Rodentia
Meriones meridianus	Cricetidae	Rodentia
Ellobius talpinus	Cricetidae	Rodentia
Canis lupus	Canidae	Carnivora
Cuon alpinus	Canidae	Carnivora
Vulpes vulpes	Canidae	Carnivora
Meles meles	Mustelidae	Carnivora
Mustela eversmanni	Mustelidae	Carnivora
Mustela nivalis	Mustelidae	Carnivora
Felis libyca	Felidae	Carnivora
Sus scrofa	Suidae	Artiodactyla

List of vertebrate species recorded in Keles study area

Species	**Family**	**Order**
Bufo viridis	Bufonidae	Anura
Rana ridibunda	Ranidae	Anura
Testudo horsfieldi	Testudinidae	Testudinata
Mediodactilus russovi	Gekkonidae	Sauria
Phrynocephalus mystaceus	Lacertidae	Sauria
Varanus griseus	Varanidae	Sauria
Eremias velox	Lacertidae	Sauria
Eremias arguta	Lacertidae	Sauria
Eremias scripta	Lacertidae	Sauria
Eremias grammica	Lacertidae	Sauria
Natrix tessellata	Colubridae	Serpentes
Coluber ravergieri	Colubridae	Serpentes

Elaphe dione	Colubridae	Serpentes
Taphrometopon lineolatum	Colubridae	Serpentes
Vipera ursini	Viperidae	Serpentes
Ancistrodon halys	Viperidae	Serpentes
Podiceps ruficollis	Podicipedidae	Podicipediformes
Po diceps nigricollis	Podicipedidae	Podicipediformes
Podi ceps cristatus	Podicipedidae	Podicipediformes
Podices griseigena	Podicipedidae	Podicipediformes
Gavia stellata	Gaviidae	Gaviformes
Gavia arctica	Gaviidae	Gaviformes
Pelecanus onocrotalus	Pelicanidae	Pelecaniformes
Pelecanus crispus	Pelicanidae	Pelecaniformes
Phalacrocorax carbo	Phalacrocoracidae	Pelecaniformes
Phalacrocorax aristotelis	Phalacrocoracidae	Pelecaniformes
Phalacrocorax pygmaeus	Phalacrocoracidae	Pelecaniformes
Botaurus stellaris	Ardeidae	Ciconiiformes
Nycticorax nycticorax	Ardeidae	Ciconiiformes
Ardeola ralloides	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Egretta alba	Ardeidae	Ciconiiformes
E gretta garzetta	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Ardea purpurea	Ardeidae	Ciconiiformes
Platalea leucorodia	Ibididae	Ciconiiformes
Plegadis falcinellus	Ibididae	Ciconiiformes
Ciconia ciconia	Coconiidae	Ciconiiformes
Ciconia nigra	Coconiidae	Ciconiiformes
Anser anaer	Anatidae	Anseriformes
Anser albifrons	Anatidae	Anseriformes
Anser erithropus	Anatidae	Anseriformes
Anser fabalis	Anatidae	Anseriformes
Chen caerulescens	Anatidae	Anseriformes
Cygnus olor	Anatidae	Anseriformes
Cygnus cygnus	Anatidae	Anseriformes
Tadorna ferruginea	Anatidae	Anseriformes
Tadorna tadorna	Anatidae	Anseriformes
Anas platyrhynchos	Anatidae	Anseriformes
Anas strepera	Anatidae	Anseriformes
Anas falcata	Anatidae	Anseriformes
Anas penelope	Anatidae	Anseriformes
Anas acuta	Anatidae	Anseriformes
Anas clypeata	Anatidae	Anseriformes
Anas angustirostris	Anatidae	Anseriformes
Netta rufina	Anatidae	Anseriformes
Aythya ferina	Anatidae	Anseriformes
Aythya nyroca	Anatidae	Anseriformes
Aythya fuligula	Anatidae	Anseriformes
Clangula hyemalis	Anatidae	Anseriformes
Bucephala clangula	Anatidae	Anseriformes
Oxyura leucocephala	Anatidae	Anseriformes
Mergus albellus	Anatidae	Anseriformes

Mergus serrator	Anatidae	Anseriformes
Mergus merganser	Anatidae	Anseriformes
Circus aeruginosus	Falconidae	Falconiformes
Buteo rufinus	Falconidae	Falconiformes
Circaetus gallicus	Aquilidae	Falconiformes
Hieraaetus pennatus	Aquilidae	Falconiformes
Hieraaetus fasciatus	Aquilidae	Falconiformes
Aquila nipalensis	Aquilidae	Falconiformes
Aquila chrysaetos	Aquilidae	Falconiformes
Haliaeetus albicilla	Aquilidae	Falconiformes
Haliaeetus leucoryphus	Aquilidae	Falconiformes
Gypaetus barbatus	Aquilidae	Falconiformes
Neophron percnopterus	Falconidae	Falconiformes
Aegypius monachus	Accipitridae	Falconiformes
Gyps fulvus	Accipitridae	Falconiformes
Falco cherrug	Falconidae	Falconiformes
Falco peregrinus	Falconidae	Falconiformes
Falco subbuteo	Falconidae	Falconiformes
Falco tinnunculus	Falconidae	Falconiformes
Tetraogallus himalayensis	Phasianidae	Galliformes
Alectoris chukar	Phasianidae	Galliformes
Perdix perdix	Phasianidae	Galliformes
Coturnix coturnix	Phasianidae	Gruiformes
Grus leucogeranus	Gruidae	Gruiformes
Grus grus	Gruidae	Gruiformes
Grus vipio	Gruidae	Gruiformes
Anthropoides virgo	Gruidae	Gruiformes
Rallus aquaticus	Rallidae	Gruiformes
Porzana porzana	Rallidae	Gruiformes
Porzana parva	Rallidae	Gruiformes
Porzana pusilla	Rallidae	Gruiformes
Crex crex	Rallidae	Gruiformes
Fulica atra	Rallidae	Gruiformes
Otis tarda	Otidae	Gruiformes
Tetrax tetrax	Otidae	Gruiformes
Chlamydotis uggulata	Otidae	Gruiformes
Charadrius leschenaultii	Charadriidae	Charadriiformes
Charadrius alexandrinus	Charadriidae	Charadriiformes
Vanellus vanelus	Charadriidae	Charadriiformes
Vanellochettusia leucura	Charadriidae	Charadriiformes
Tringa ochropus	Charadriidae	Charadriiformes
Actitis hypoleucos	Charadriidae	Charadriiformes
Gallinago gallinago	Tringidae	Charadriiformes
Gallinago solitaria	Tringidae	Charadriiformes
Sterna hirundo	Sternidae	Charadriiformes
Pterocles orientalis	Pterocletidae	Pteroclidiformes
Pterocles alchata	Pterocletidae	Pteroclidiformes
Columba palumbus	Columbidae	Columbiformes
Columba eversmanni	Columbidae	Columbiformes
Columba livia	Columbidae	Columbiformes
Columba rupestris	Columbidae	Columbiformes

Streptopelia turtur	Columbidae	Columbiformes
Streptopelia orientalis	Columbidae	Columbiformes
Streptopelia senegalensis	Columbidae	Columbiformes
Cuculus canorus	Cuculidae	Cuculiformes
Cuculus saturatus	Cuculidae	Cuculiformes
Asio otus	Strigidae	Strigiformes
Otus scops	Strigidae	Strigiformes
Athene noctua	Strigidae	Strigiformes
Strix aluco	Strigidae	Strigiformes
Caprimulgus europaeus	Caprimulgidae	Caprimulgiformes
Caprimulgus aegyptus	Caprimulgidae	Caprimulgiformes
Hirundapus caudacutus	Apodidae	Apodiformes
Apus apus	Apodidae	Apodiformes
Apus melba	Apodidae	Apodiformes
Coracias garrulus	Coracidae	Coraciiformes
Alcedo atthis	Coracidae	Coraciiformes
Merops apiaster	Coracidae	Coraciiformes
Merops superciliosus	Coracidae	Coraciiformes
Upupa epops	Upupidae	Upupiformes
Jynx torquilla	Picidae	Piciformes
Dendrocopos leucopterus	Picidae	Piciformes
Riparia riparia	Hirundinidae	Passeriformes
Ptyonoprogne rupestris	Hirundinidae	Passeriformes
Hirundo rustica	Hirundinidae	Passeriformes
Hirundo daurica	Hirundinidae	Passeriformes
Delichon urbica	Hirundinidae	Passeriformes
Galerida cristata	Alaudidae	Passeriformes
Calandrella cinerea	Alaudidae	Passeriformes
Calandrella acutirostris	Alaudidae	Passeriformes
Calandrella rufescens	Alaudidae	Passeriformes
Calandrella cheleensis	Alaudidae	Passeriformes
Melanocorypha calandra	Alaudidae	Passeriformes
Melanocorypha bimaculata	Alaudidae	Passeriformes
Eremophila alpestris	Alaudidae	Passeriformes
Alauda arvensis	Alaudidae	Passeriformes
Alauda gulgula	Alaudidae	Passeriformes
Anthus campestris	Motacillidae	Passeriformes
Anthus spinoletta	Motacillidae	Passeriformes
Motacilla feldegg	Motacillidae	Passeriformes
Motacilla lutea	Motacillidae	Passeriformes
Motacilla cinerea	Motacillidae	Passeriformes
Motacilla alba	Motacillidae	Passeriformes
Motacilla personata	Motacillidae	Passeriformes
Lanius isabellinus	Lanidae	Passeriformes
Lanius phoenicuroides	Lanidae	Passeriformes
Lanius schach	Lanidae	Passeriformes
Lanius minor	Lanidae	Passeriformes
Lanius excubitor	Lanidae	Passeriformes
Oriolus oriolus	Oriolidae	Passeriformes
Sturnus vulgaris	Sturnidae	Passeriformes
Sturnes roseus	Sturnidae	Passeriformes

Acridotheres tristis	Sturnidae	Passeriformes
Pica pica	Corvidae	Passeriformes
Corvus monedula	Corvidae	Passeriformes
Corvus frugilegus	Corvidae	Passeriformes
Corvus cornix	Corvidae	Passeriformes
Bombycilla garrulus	Bombycillidae	Passeriformes
Cinclus cinclus	Cinclidae	Passeriformes
Cinclus pallasii	Cinclidae	Passeriformes
Troglodytes troglodytes	Troglodytidae	Passeriformes
Acrocephalus dumetorum	Sylviidae	Passeriformes
Acrocephalus scirpaceus	Sylviidae	Passeriformes
Acrocephalus stentoreus	Sylviidae	Passeriformes
Sylvia nana	Sylviidae	Passeriformes
Leptopoecile sophiae	Regulidae	Passeriformes
Terpsiphone paradisi	Muscicapidae	Passeriformes
Ficedula parva	Muscicapidae	Passeriformes
Muscicapa striata	Muscicapidae	Passeriformes
Muscicapa ruficauda	Muscicapidae	Passeriformes
Saxicola rubetra	Turdidae	Passeriformes
Saxicola torquata	Turdidae	Passeriformes
Saxicola caprata	Turdidae	Passeriformes
Oenanthe oenanthe	Turdidae	Passeriformes
Oenanthe pleschanka	Turdidae	Passeriformes
Oenanthe picata	Turdidae	Passeriformes
Oenanthe finschii	Turdidae	Passeriformes
Oenanthe deserti	Turdidae	Passeriformes
Oenanthe isabellina	Turdidae	Passeriformes
Monticola saxatilus	Turdidae	Passeriformes
Monticola solitarius	Turdidae	Passeriformes
Turdus ruficollis	Turdidae	Passeriformes
Turdus atrogularis	Turdidae	Passeriformes
Turdus pilaris	Turdidae	Passeriformes
Turdus merula	Turdidae	Passeriformes
Turdus iliacus	Turdidae	Passeriformes
Turdus viscivorus	Turdidae	Passeriformes
Phoenicurus caeruleocephalus	Turdidae	Passeriformes
Phoenicurus phoenicurus	Turdidae	Passeriformes
Phoenicurus ochruros	Turdidae	Passeriformes
Phoenicurus erythronotus	Turdidae	Passeriformes
Phoenicurus erythrogaster	Turdidae	Passeriformes
Luscinia megarchynchos	Turdidae	Passeriformes
Luscinia luscinia	Turdidae	Passeriformes
Luscinia pectoralis	Turdidae	Passeriformes
Luscinia svecica	Turdidae	Passeriformes
Irania gutturalis	Turdidae	Passeriformes
Myophonus caeruleus	Turdidae	Passeriformes
Enicurus scouleri	Turdidae	Passeriformes
Erinaceus auritus	Erinaceidae	Insectivora
Sorex araneus	Soricidae	Insectivora
Sorex asper	Soricidae	Insectivora
Sorex minutus	Soricidae	Insectivora

Rhinolophus bocharicus	Rhinolophidae	Chiroptera
Myotis oxygnatus	Vespertilionidae	Chiroptera
Plecotus auritus	Vespertilionidae	Chiroptera
Vespertilio murinus	Vespertilionidae	Chiroptera
Vespertilio serotinus	Vespertilionidae	Chiroptera
Tadarida teniotis	Molossidae	Chiroptera
Ochotona rutila	Ochotonidae	Lagomorpha
Lepus tolai	Leporidae	Lagomorpha
Marmota menzbieri	Sciuridae	Rodentia
Marmota caudata	Sciuridae	Rodentia
Citellus maximus	Sciuridae	Rodentia
Hystrix indica	Hystricidae	Rodentia
Dyromys nitedula	Myoxidae	Rodentia
Cricetulus migratorius	Cricetidae	Rodentia
Rhombomus opimus	Cricetidae	Rodentia
Meriones tamariscinus	Cricetidae	Rodentia
Meriones erythrourus	Cricetidae	Rodentia
Meriones meridianus	Cricetidae	Rodentia
Ellobius talpinus	Cricetidae	Rodentia
Alticola roylei	Cricetidae	Rodentia
Clethrionomys frater	Cricetidae	Rodentia
Microtus socialis	Cricetidae	Rodentia
Microtus orvalis	Cricetidae	Rodentia
Mus turkestanicus	Muridae	Rodentia
Mus sylvaticus	Muridae	Rodentia
Ursus arctos	Ursidae	Carnivora
Canis lupus	Canidae	Carnivora
Vulpes vulpes	Canidae	Carnivora
Meles meles	Mustelidae	Carnivora
Martes foina	Mustelidae	Carnivora
Mustela eversmanni	Mustelidae	Carnivora
Mustela erminea	Mustelidae	Carnivora
Mustela nivalis	Mustelidae	Carnivora
Felis lynx	Felidae	Carnivora
Felis uncia	Felidae	Carnivora
Sus scrofa	Suidae	Artiodactyla
Capreolus capreolus	Cervidae	Artiodactyla
Capra ibex	Bovidae	Artiodactyla
Ovis ammon	Bovidae	Artiodactyla

List of vertebrate species recorded in Shieli study area

Species	**Family**	**Order**
Bufo viridis	Bufonidae	Anura
Rana ridibunda	Ranidae	Anura
Emys oricularis	Testudinidae	Testudines
Testudo horsfieldi	Testudinidae	Testudines
Mediodactilus russovi	Gekkonidae	Sauria
Teratoscinus scincus	Gekkonidae	Sauria
Crossobamon eversmanni	Gekkonidae	Sauria

Alsophylax pipiens	Gekkonidae	Sauria
Agama sanguinolenta	Agamidae	Sauria
Phrynocephalus heliscopus	Phrynocephalidae	Sauria
Phrynocephalus mystaceus	Lacertidae	Sauria
Phrynocephalus interscapularis	Agamidae	Sauria
Eremias velox	Lacertidae	Sauria
Eremias arguta	Lacertidae	Sauria
Eremias scripta	Lacertidae	Sauria
Eremias grammica	Lacertidae	Sauria
Eryx tataricus	Boidae	Serpentes
Eryx miliaris	Boidae	Serpentes
Natrix tessellata	Colubridae	Serpentes
Coluber karelini	Colubridae	Serpentes
Coluber ravergieri	Colubridae	Serpentes
Coluber turia	Colubridae	Serpentes
Elaphe dione	Colubridae	Serpentes
Taphrometopon lineolatum	Colubridae	Serpentes
Ancistrodon halys	Viperidae	Serpentes
Podiceps ruficollis	Podicipedidae	Podicipediformes
Po diceps nigricollis	Podicipedidae	Podicipediformes
Podi ceps cristatus	Podicipedidae	Podicipediformes
Podices griseigena	Podicipedidae	Podicipediformes
Gavia stellata	Gaviidae	Gaviformes
Gavia arctica	Gaviidae	Gaviformes
Pelecanus onocrotalus	Pelicanidae	Pelecaniformes
Pelecanus crispus	Pelicanidae	Pelecaniformes
Phalacrocorax carbo	Phalacrocoracidae	Pelecaniformes
Phalacrocorax aristotelis	Phalacrocoracidae	Pelecaniformes
Phalacrocorax pygmaeus	Phalacrocoracidae	Pelecaniformes
Botaurus stellaris	Ardeidae	Ciconiiformes
Nycticorax nycticorax	Ardeidae	Ciconiiformes
Ardeola ralloides	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Egretta alba	Ardeidae	Ciconiiformes
E gretta garzetta	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Ardea cinerea	Ardeidae	Ciconiiformes
Platalea leucorodia	Ibididae	Ciconiiformes
Plegadis falcinellus	Ibididae	Ciconiiformes
Ciconia ciconia	Coconiidae	Ciconiiformes
Ciconia nigra	Coconiidae	Ciconiiformes
Anser anaer	Anatidae	Anseriformes
Anser albifrons	Anatidae	Anseriformes
Anser erithropus	Anatidae	Anseriformes
Chen caerulescens	Anatidae	Anseriformes
Cygnus olor	Anatidae	Anseriformes
Cygnus cygnus	Anatidae	Anseriformes
Tadorna ferruginea	Anatidae	Anseriformes
Tadorna tadorna	Anatidae	Anseriformes
Anas platyrhynchos	Anatidae	Anseriformes
Anas strepera	Anatidae	Anseriformes

Anas falcata	Anatidae	Anseriformes
Anas penelope	Anatidae	Anseriformes
Anas acuta	Anatidae	Anseriformes
Netta rufina	Anatidae	Anseriformes
Aythya ferina	Anatidae	Anseriformes
Aythya nyroca	Anatidae	Anseriformes
Aythya fuligula	Anatidae	Anseriformes
Clangula hyemalis	Anatidae	Anseriformes
Bucephala clangula	Anatidae	Anseriformes
Oxyura leucocephala	Anatidae	Anseriformes
Mergus albellus	Anatidae	Anseriformes
Mergus serrator	Anatidae	Anseriformes
Mergus merganser	Anatidae	Anseriformes
Pandion haliaetus	Falconidae	Falconiformes
Milvus migrans	Falconidae	Falconiformes
Circus cyaneus	Falconidae	Falconiformes
Circus macrourus	Falconidae	Falconiformes
Circus pygargus	Falconidae	Falconiformes
Circus aeruginousus	Falconidae	Falconiformes
Accipiter nisus	Falconidae	Falconiformes
Accipiter badius	Falconidae	Falconiformes
Buteo lagopus	Falconidae	Falconiformes
Buteo rufinus	Falconidae	Falconiformes
Circaetus gallicus	Aquilidae	Falconiformes
Aquila clanga	Aquilidae	Falconiformes
Aquila heliaca	Aquilidae	Falconiformes
Aquila chrysaetos	Aquilidae	Falconiformes
Hieraeetus albicilla	Aquilidae	Falconiformes
Hieraeetus leucoryphus	Aquilidae	Falconiformes
Neophron percnopterus	Falconidae	Falconiformes
Aegypius monachus	Accipitridae	Falconiformes
Falco cherrug	Falconidae	Falconiformes
Falco subbuteo	Falconidae	Falconiformes
Falco columbarius	Falconidae	Falconiformes
Falco naumanni	Falconidae	Falconiformes
Falco tinnunculus	Falconidae	Falconiformes
Ammopedix griseogularis	Phasianidae	Galliformes
Phasianus colchicus	Gruidae	Gruiformes
Grus leucogeranus	Gruidae	Gruiformes
Grus grus	Gruidae	Gruiformes
Grus vipio	Gruidae	Gruiformes
Anthropoides virgo	Gruidae	Gruiformes
Rallus aquaticus	Rallidae	Gruiformes
Porzana porzana	Rallidae	Gruiformes
Porzana parva	Rallidae	Gruiformes
Porzana pusilla	Rallidae	Gruiformes
Crex crex	Rallidae	Gruiformes
Otis tarda	Otididae	Gruiformes
Tetrax tetrax	Otidae	Gruiformes
Chlamydotis undulata	Otidae	Gruiformes
Burhinus oedicnemus	Otidae	Gruiformes

Charadrius dubius	Charadriidae	Gruiformes
Charadrius leschenaultii	Charadriidae	Gruiformes
Charadrius asiaticus	Charadriidae	Gruiformes
Charadrius alexandrinus	Charadriidae	Gruiformes
Vanellus vanelus	Charadriidae	Charadriiformes
Vanellochettusia leucura	Charadriidae	Charadriiformes
Himantopus himantopus	Charadriidae	Charadriiformes
Recurvirostra avosetta	Charadriidae	Charadriiformes
Haematopus ostralegus	Charadriidae	Charadriiformes
Tringa ochropus	Charadriidae	Charadriiformes
Tringa glareola	Charadriidae	Charadriiformes
Tringa totanus	Charadriidae	Charadriiformes
Actitis hypoleucos	Charadriidae	Charadriiformes
Phalaropus lobanus	Charadriidae	Charadriiformes
Numenius arquata	Charadriidae	Charadriiformes
Limosa limosa	Charadriidae	Charadriiformes
Glareola pratincola	Charadriidae	Charadriiformes
Glareola nordmanni	Charadriidae	Charadriiformes
Larus ridibundus	Laridae	Charadriiformes
Larus cachinnans	Laridae	Charadriiformes
Chlidonias niger	Laridae	Charadriiformes
Chlidonias hybridus	Laridae	Charadriiformes
Gelochelidon nilotica	Laridae	Charadriiformes
Hydroprogne caspia	Laridae	Charadriiformes
Sterna hirundo	Laridae	Charadriiformes
Sterna albifrons	Laridae	Charadriiformes
Pterocles orientalis	Pterocletidae	Pteroclidiformes
Pterocles alchata	Pterocletidae	Pteroclidiformes
Syrrhaptes paradoxus	Columbidae	Columbiformes
Columba eversmanni	Columbidae	Columbiformes
Streptopelia turtur	Columbidae	Columbiformes
Streptopelia senegalensis	Columbidae	Columbiformes
Cuculus canorus	Cuculidae	Cuculiformes
Cuculus saturatus	Cuculidae	Cuculiformes
Bubo bubo	Strigidae	Strigiformes
Asio otus	Strigidae	Strigiformes
Otus brucei	Strigidae	Strigiformes
Athene noctua	Strigidae	Strigiformes
Caprimuglus europaeus	Caprimulgidae	Caprimulgiformes
Caprimuglus aegyptus	Caprimulgidae	Caprimulgiformes
Hirundapus caudacutus	Apodidae	Apodiformes
Apus apus	Apodidae	Apodiformes
Apus melba	Apodidae	Apodiformes
Coracias garrulus	Coracidae	Coraciiformes
Alcedo atthis	Coracidae	Coraciiformes
Merops apiaster	Coracidae	Coraciiformes
Merops superciliosus	Coracidae	Coraciiformes
Upupa epops	Upupidae	Upupiformes
Jinks torquilla	Picidae	Piciformes
Dendrocopos leucopterus	Picidae	Piciformes
Riparia riparia	Hirundinidae	Passeriformes

Ptyonoprogne rupestris	Hirundinidae	Passeriformes
Hirundo rustica	Hirundinidae	Passeriformes
Hirundo daurica	Hirundinidae	Passeriformes
Delichon urbica	Hirundinidae	Passeriformes
Galerida cristata	Alaudidae	Passeriformes
Calandrella cinerea	Alaudidae	Passeriformes
Calandrella acutirostris	Alaudidae	Passeriformes
Calandrella rufescens	Alaudidae	Passeriformes
Calandrella cheleensis	Alaudidae	Passeriformes
Melanocorypha calandra	Alaudidae	Passeriformes
Melanocorypha bimaculata	Alaudidae	Passeriformes
Eremophila alpestris	Alaudidae	Passeriformes
Alauda arvensis	Alaudidae	Passeriformes
Alauda gulgula	Alaudidae	Passeriformes
Anthus campestris	Motacillidae	Passeriformes
Anthus spinoletta	Motacillidae	Passeriformes
Motacilla feldegg	Motacillidae	Passeriformes
Motacilla lutea	Motacillidae	Passeriformes
Motacilla cinerea	Motacillidae	Passeriformes
Motacilla alba	Motacillidae	Passeriformes
Motacilla personata	Motacillidae	Passeriformes
Lanius isabellinus	Lanidae	Passeriformes
Lanius phoenicuroides	Lanidae	Passeriformes
Lanius schach	Lanidae	Passeriformes
Lanius minor	Lanidae	Passeriformes
Lanius excubitor	Lanidae	Passeriformes
Bombycilla garrulus	Cinclidae	Passeriformes
Cinclus cinclus	Cinclidae	Passeriformes
Cinclus pallasii	Cinclidae	Passeriformes
Troglodites troglodites	Troglodytidae	Passeriformes
Terpsiphone paradisi	Muscicapidae	Passeriformes
Ficedula parva	Muscicapidae	Passeriformes
Muscicapa striata	Muscicapidae	Passeriformes
Muscicapa ruficauda	Muscicapidae	Passeriformes
Saxicola rubetra	Turdidae	Passeriformes
Saxicola torquata	Turdidae	Passeriformes
Saxicola caprata	Turdidae	Passeriformes
Oenanthe oenanthe	Turdidae	Passeriformes
Oenanthe pleschanka	Turdidae	Passeriformes
Oenanthe picata	Turdidae	Passeriformes
Oenanthe finschii	Turdidae	Passeriformes
Oenanthe deserti	Turdidae	Passeriformes
Oenanthe isabellina	Turdidae	Passeriformes
Monticola saxatilus	Turdidae	Passeriformes
Monticola solitarius	Turdidae	Passeriformes
Turdus ruficollis	Turdidae	Passeriformes
Turdus atrogularis	Turdidae	Passeriformes
Turdus pilaris	Turdidae	Passeriformes
Turdus merula	Turdidae	Passeriformes
Turdus iliacus	Turdidae	Passeriformes
Turdus viscivorus	Turdidae	Passeriformes

Phoenicurus caeruleocephalus	Turdidae	Passeriformes
Phoenicurus phoenicurus	Turdidae	Passeriformes
Phoenicurus ochruros	Turdidae	Passeriformes
Phoenicurus erythronotus	Turdidae	Passeriformes
Phoenicurus erythrogaster	Turdidae	Passeriformes
Luscinia megarchynchos	Turdidae	Passeriformes
Luscinia luscinia	Turdidae	Passeriformes
Luscinia pectoralis	Turdidae	Passeriformes
Luscinia svecica	Turdidae	Passeriformes
Irania gutturalis	Turdidae	Passeriformes
Myophonus caeruleus	Turdidae	Passeriformes
Enicurus scouleri	Turdidae	Passeriformes
Hemiechinus hypomelas	Erinaceidae	Insectivora
Diplomesodon pulchellum	Soricidae	Insectivora
Myotis mystacinus	Vespertilionidae	Chiroptera
Nyctalus noctula	Vespertilionidae	Chiroptera
Vespertilio pipistrellus	Vespertilionidae	Chiroptera
Vespertilio murinus	Vespertilionidae	Chiroptera
Vespertilio serotinus	Vespertilionidae	Chiroptera
Vespertilio ognevi	Vespertilionidae	Chiroptera
Lepus tolai	Leporidae	Lagomorpha
Citellus maximus	Sciuridae	Rodentia
Citellus pugmaeus	Sciuridae	Rodentia
Allactaga elater	Dipodidae	Rodentia
Allactaga severtzovi	Dipodidae	Rodentia
Allactaga major	Dipodidae	Rodentia
Dipus sagitta	Dipus	Rodentia
Cricetulus migratorius	Cricetidae	Rodentia
Rhombomus opimus	Cricetidae	Rodentia
Meriones tamariscinus	Cricetidae	Rodentia
Meriones erythrourus	Cricetidae	Rodentia
Meriones meridianus	Cricetidae	Rodentia
Ellobius talpinus	Cricetidae	Rodentia
Ondatra zibethica	Arvicolidae	Rodentia
Canis lupus	Canidae	Carnivora
Canis aureus	Canidae	Carnivora
Vulpes vulpes	Canidae	Carnivora
Vulpes corsac	Canidae	Carnivora
Meles meles	Mustelidae	Carnivora
Mustela eversmanni	Mustelidae	Carnivora
Mustela nivalis	Mustelidae	Carnivora
Vormela peregusna	Mustelidae	Carnivora
Felis libyca	Felidae	Carnivora
Felis manul	Felidae	Carnivora
Felis margarita	Felidae	Carnivora
Sus scrofa	Suidae	Artiodactyla
Gazella subgutturosa	Bovidae	Artiodactyla
Saiga tatarica	Bovidae	Artiodactyla

Species in red are registered Kazkhs Red Book.