4.1. Natural and economic conditions of the pilot plots

4.1.1 Climatic conditions

Pilot plots cover almost all soil-climatic zones of Central Asian region from Shoulder scheme (Syrdarya river basin) in the Northern Kazakhstan (C-II-Á) to Bairamali scheme (Amudarya river basin) in the south (Þ-I-A). Out of total 39 pilot plots 19 plots are located in Syrdarya river basin and 20 plots - in Amudarya river basin (Appendix 4.2).

The Aral Sea basin, located in the very center of Eurasia, cover area of subtropical latitudes and southern border of temperate latitudes. Location in the zone of inland deserts and remoteness from seas and oceans cause continental climate.

Peculiarities of air temperature regime in the region are shown in graph (fig. 4.1) through average values over the whole region based on meteorological data (the same value is estimated for other climatic parameters). The coldest period lasts from December to February, while the hottest one lasts from June to July. By average long-term data the minimum average monthly temperature was in January, while the maximum one was in July.

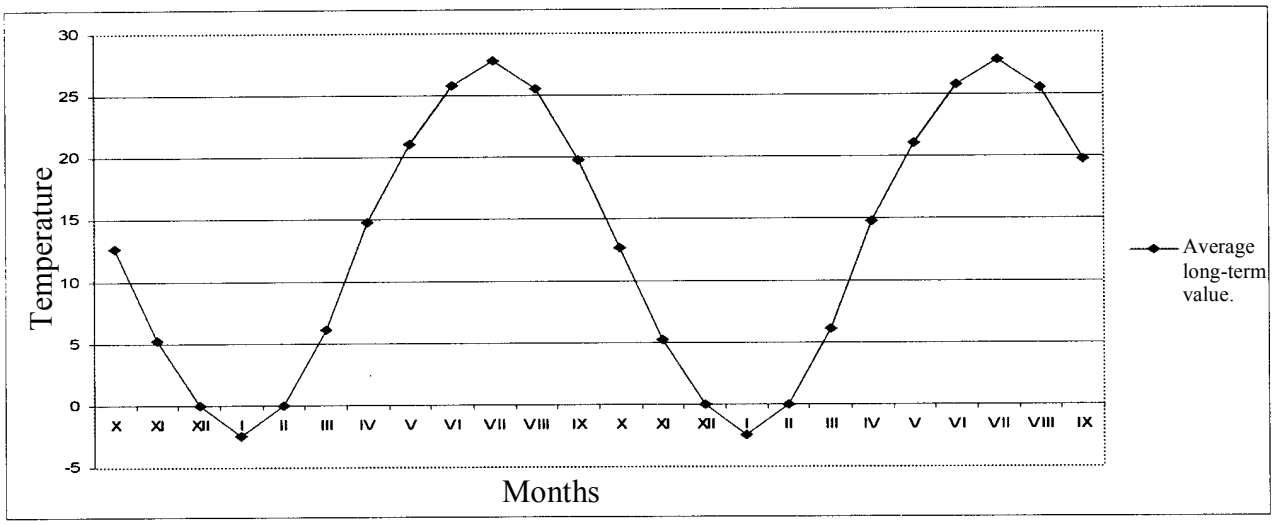

Fig. 4.1 Seasonal changes in air temperature by long-term data (average values of 11 weather stations)

The range of average monthly air temperatures for northern and southern climatic zones of the region is characterized by graph (Fig.4.2).
Seasonal changes in relative air humidity by average long-term data are compared in graph (Fig.4.3.).
Character of seasonal changes in relative air humidity is similar to seasonal changes in air temperature. High humidity is observed in winter and low humidity is observed in summer. By average long-term data maximum humidity was in December-January, while minimum one was in July.

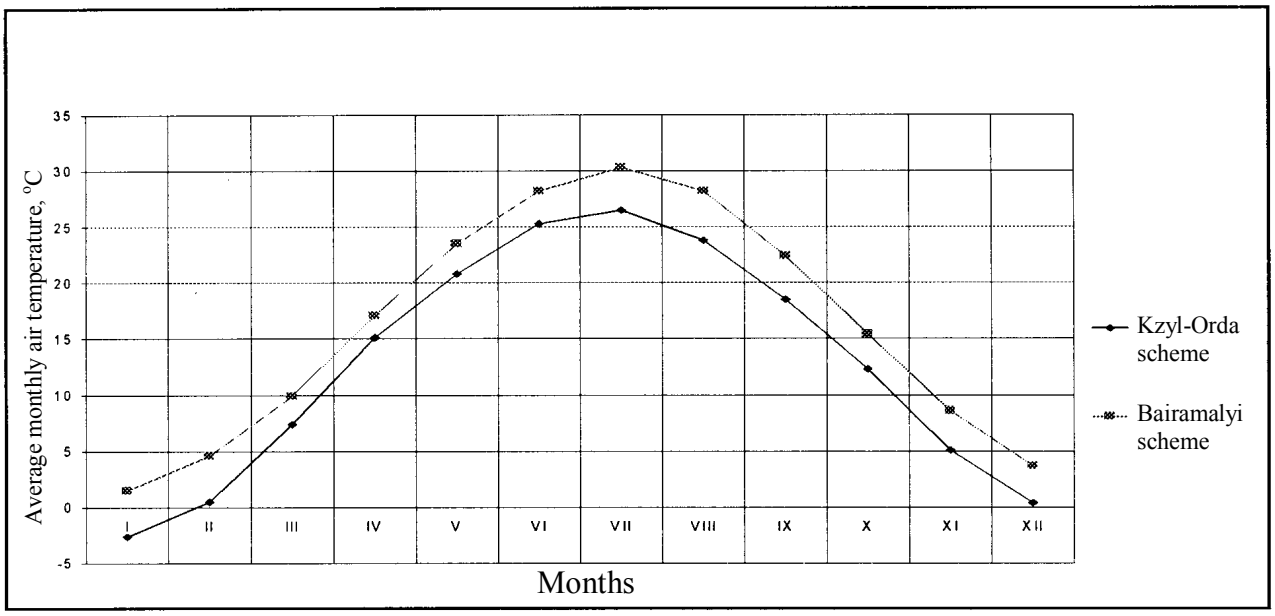

Fig. 4.2. Seasonal changes in air temperature for northern and southern zones of the region by average long-term data (average values by 11 weather stations)

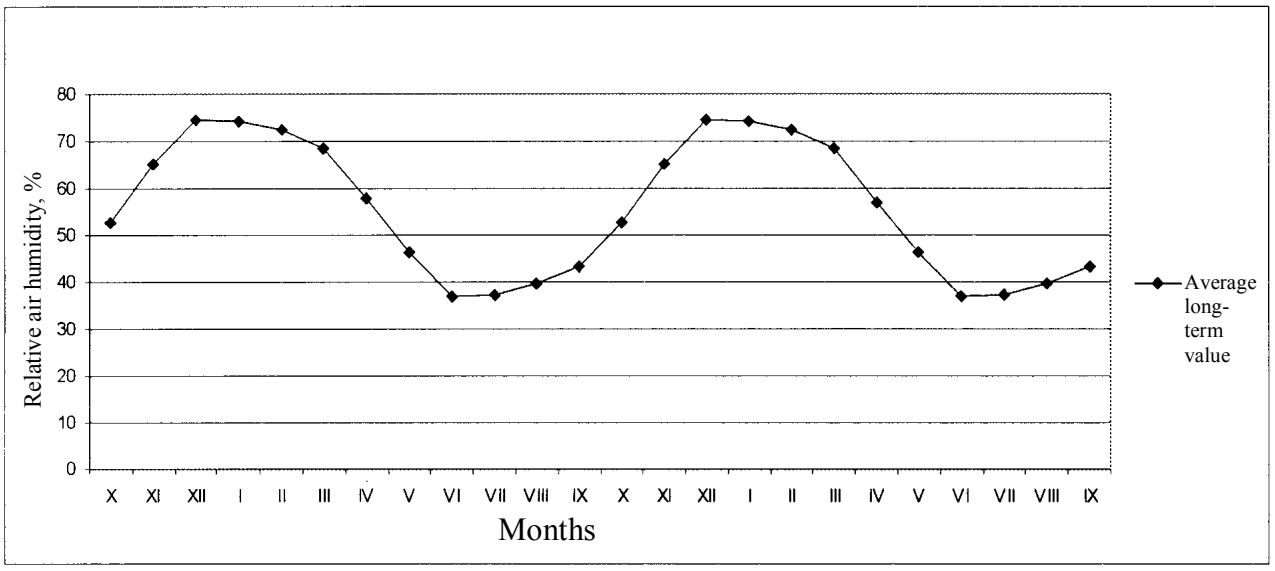

Fig. 4.3. Seasonal changes in relative air humidity by average long-term data (average values by 11 weather stations)

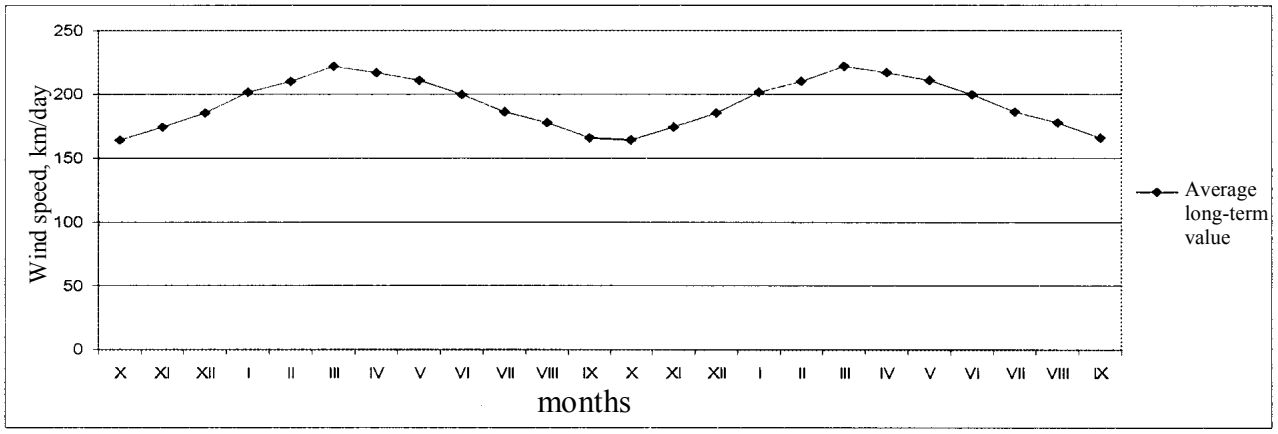

Fig. 4.4. Seasonal changes in wind speed by average long-term data (average value by 11 weather stations)

Given region is classified as a zone of moderate winds (175-425 km/day) by average monthly wind speed (Fig.4.4).

The most "calm" period from the point of wind activity is September-October. The most windy period is January-May.

The most rainy period in the region is March-April. The most "dry" period is August (Fig. 4.5-4.6).

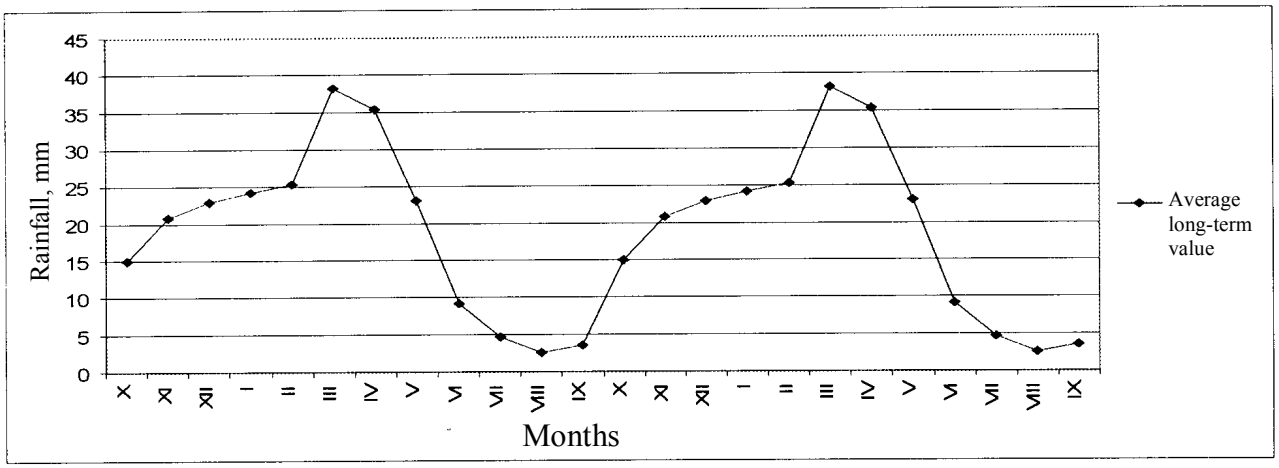

Fig. 4.5 Seasonal changes in rainfall by average long-term data (average values by 11 weather stations)

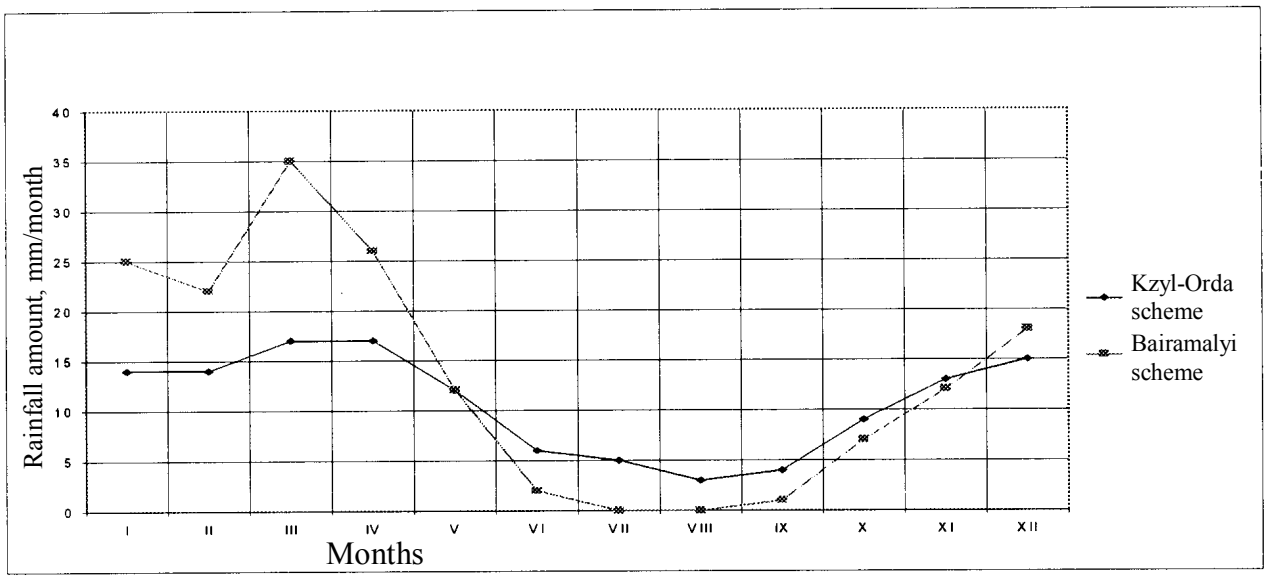

Fig. 4.6. Seasonal changes in rainfall for northern and southern zones of the region by average long-term data

Changes in solar radiation (Fig.4.7) are determined by seasonal duration of sunshine hours and the maximum values are reached in June-July, while minimum ones - in December. Reference crop evapotranspiration was calculated on a base of available data (latitudinal and altitude location of farms, average monthly air temperature, relative humidity, wind speed, duration of sunshine hours) by Penman-Monteith formula (issue #24, FAO) in CROPWAT program. Average long-term data show maximum evapotranspiration in July (Fig. 4.8-4.9). Minimum evapotranspiration is observed in December-January.

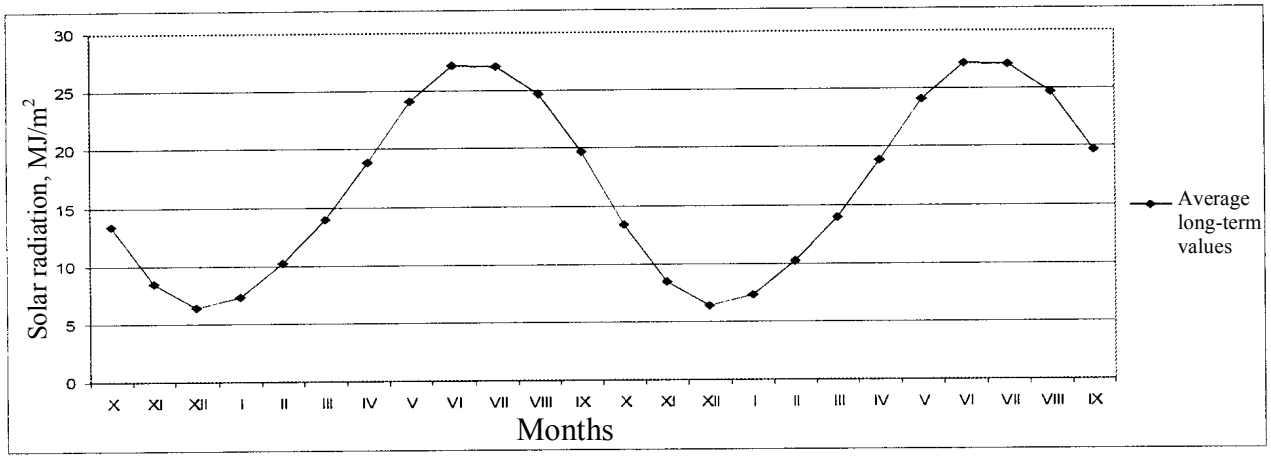

Fig. 4.7. Seasonal changes of solar radiation by average long-term data (average values by 11 weather stations)

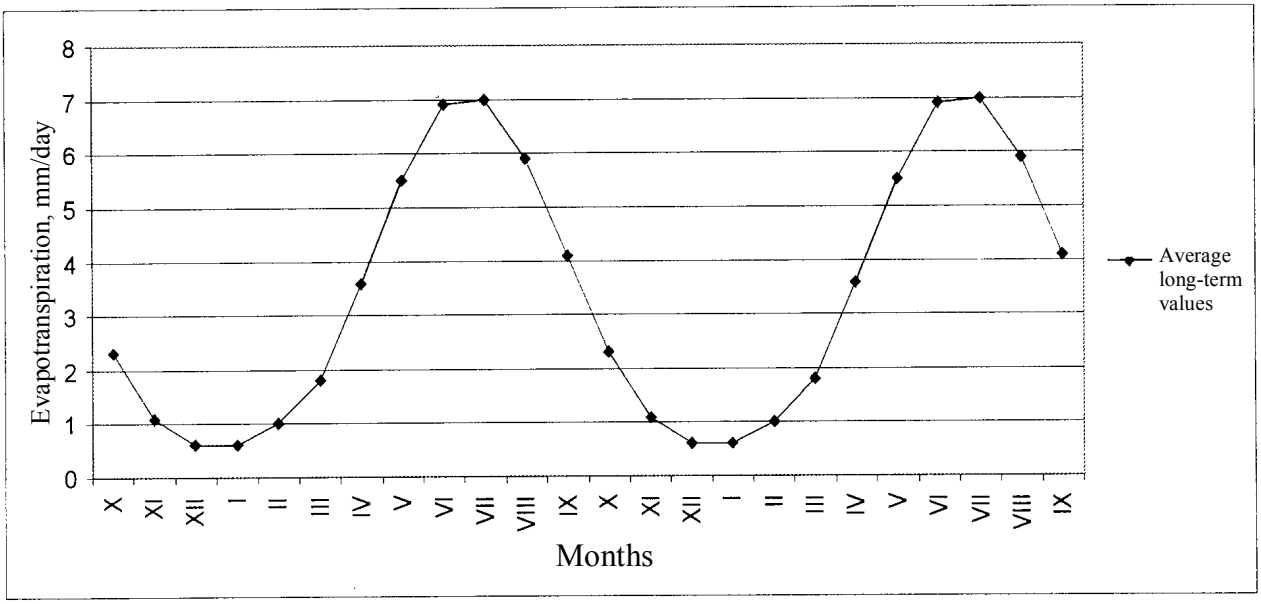

Fig. 4.8. Seasonal changes of reference evapotranspiration by average long-term data (average values by 11 weather stations).

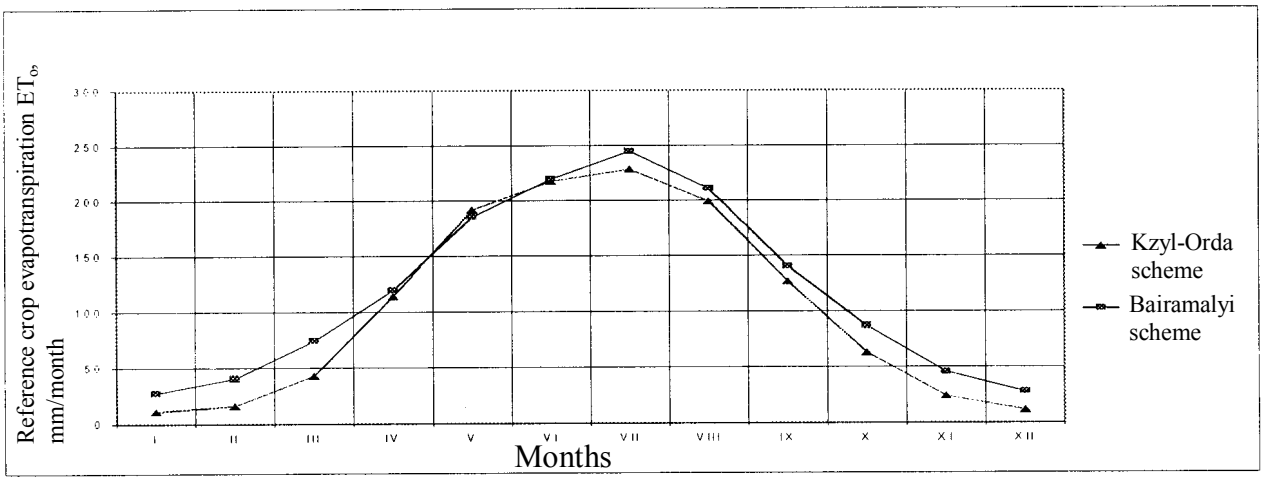

Fig.4.9. Seasonal changes of reference evapotranspiration for northern and southern zones of the region by average long-term data.

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4.1.2. Geomorphological and lithological conditions

Described plots are located in upper, middle and lower reaches of the Amudarya and the Syrdarya rivers. This determines specific irrigation conditions in each zone.

Selection of irrigation methods and relevant elements of irrigation technique is based on combinations of soil permeability and slopes of irrigated area. Classification of N.T. Laktayev describes these combinations. There are 5 main types of soil permeability: **A - high**

(sandy loam and light loam underlain by pebbles with thickness of fine-grained soils of not more than 1 m; fixed infiltration rate f_o = 0.015 m/hour); **B - increased** (light thick loam; f_o = 0.008 m/hour); **C - medium** (medium loam; f_o = 0.0045 m/hour); **D - low** (heavy loam with medium loam interlayers; f_o = 0.0025 m/hour); **E - poor** (clay and loam underlain by impermeable layer; f_o = 0.015 m/hour). N. Laktayev proposed 6 gradations to describe slope range: **I' - steep slope** (slope i>0.05 m/m); **I - very high slope gradient** (0.05 m/m >i>0.025 m/m); **II - high slope gradient** (0.025 m/m >i>0.0075 m/m); **III - medium slope gradient** (0.0075 m/m >i>0.0025 m/m); **IV - low slope gradient** (0.0025 m/m >i> 0.001 m/m); and **V - slopeless** (i<0.001 m/m).

Classification of considered descriptions of PP by combination "permeability-slope" is given in table 4.1 and Appendix 4.3.

Table 4.1

Quantitative distribution of the plots by combination "permeability-slope" (N. Laktayev classification).

Permeability	Slopes						**Total**
	I'	I	II	III	IV	V	
A	1	4	0	0	1	0	**6**
B	2	2	3	3	3	1	**14**
C	2	0	0	2	3	2	**9**
D	0	0	1	2	1	4	**8**
E	0	0	1	0	0	1	**2**
Total	**5**	**6**	**5**	**7**	**8**	**8**	**39**

Research of irrigation technique in the plots is related with 19 combinations. Moreover, out of 8 widely spread combinations, by N.Laktayev estimations, 7 ones are covered by the given plots (coloured in grey). Thus, we can affirm representativeness of studied plots.
Distribution of slopes in the plots is even: from steep slopes in upper reaches to slopeless plots in lower reaches.
Permeability over the plots is mainly high.

4.1. 3 Soil-climatic characteristics

Identification of the plots over the soil-climatic areas (Appendix 4.3) is done using V.Shreder zoning of Central-Asian region. According to this zoning the region is divided in latitudinal and altitude-zonal areas. Table 4.2 shows distribution of the plots over soil-climatic areas of Central-Asian region. Soil-climatic characteristics of the plots, located northward of 38^o parallel and southward of 45^o parallel of northern latitude, practically, cover the whole variety from lower reaches, represented by deserts, to upper reaches, represented by motley grass steppes with relevant soil types from desert to gray soils. Natural moistening of the area or coefficient of natural moistening (ratio of total average long-term precipitation over biologically active period and available water reserves in 1 m layer to evaporativity, which is approximately equal to reference crop evapotranspiration) ranges from 0.05 for high-altitude zone of deserts in lower and middle reaches to 0.30 for high-altitude zone of motley grass steppes in foothill.

Table 4.2.

Distribution of pilot plots over soil-climatic zones of Central Asia

Latitudinal zone	Altitudinal belt	Soil formation type	Index	North latitude	Moistening coef-ficient - K_0	Moistening zone	Pilot plots dis-tribution over zone
NORTH	Desert	Desert	***С-I-А***	To north from 44° 00’	0,05-0,10	Very dry	0
			С-II-А	44o00’ – 42°30’			1
	Ephemeral steppe	**Serozems** light grey soils	**С-I-Б**	To north from 44° 00’	0,05-0,10	Very dry	0
			С-II-Б	44o00’ – 42°30’			3
CENTRAL	Desert	Desert	**Ц-I-А**	42°30’- 41°00’	0,05-0,10	Very dry	3
			Ц-II-А	41°- 39°30’			2
	Ephemeral steppe	**Serozems** light grey soils	**Ц-I-Б**	42°30’- 41°00’	0,10-0,20	Very dry	0
			Ц-II-Б	41°- 39°30’			5
	Ephemeral steppe	**Serozems** typical grey soils	**Ц-I-В**	42°30’- 41°00’	0,20-0,25	dry	3
			Ц-II-В	41°- 39°30’			5
	Different grass steppe	**Serozems** dark grey soils	**Ц-I-Г**	42°30’- 41°00’	0,25-0,30	dry	0
			Ц-II-Г	41°- 39°30’			3

Latitudinal zone	Altitudinal belt	Soil formation type	Index	North latitude	Moistening coef-ficient - K_0	Moistening zone	Pilot plots dis-tribution over zone
SOUTH	Desert	Desert	**Ю-I-А**	39°30’- 38° 00’	0,05-0,10	Very dry	1
			Ю-II-А	To south from 38° 00’			0
	Ephemeral steppe	**Serozems** light grey soils	**Ю-I-Б**	39°30’- 38° 00’	0.10-0.20	Very dry	6
			Ю-II-Б	To south from 38° 00’			0
	Ephemeral steppe	**Serozems** typical grey soils	**Ю-I-В**	39°30’- 38° 00’	0.20-0.25	dry	1
			Ю-II-В	To south from 38° 00’			0
	Different grass steppe	**Serozems** dark grey soils	**Ю-I-Г**	39°30’- 38° 00’	0.25-0.30	dry	5
			Ю-II-Г	To south from 38° 00’			1

Table 4.3.

Pilot plots distribution over water allowance districts of Central Asia

Water allowance districts	Soil characteristic	plots distri-bution over districts	Including salinity degree			
			non-saline	slightly saline	medium saline	strongly saline
Automorphic soils (ground water table >3 m)		**23**	**20**	**2**	**1**	**0**
I	Low thickness (0,2-0,5 m) stony different fractions soils on sand-gravel deposits and gypsum, low thickness sands	5	5	0	0	0
II	Middle thickness, loamy soils on sand-gravel deposits and gypsum, high thickness loam	12	11	1	0	0
III	High thickness, middle and heavy loamy and clayey	6	4	1	1	0
***Half-hydromorphic (ground water* level 2-3 m)**		**10**	**3**	**2**	**4**	**1**
IV	High thickness loamy and sandy loamy	1	1	0	0	0
V	High thickness loamy and clayey	7	2	1	3	1
***Hydromorphic (ground water table* 1-2 m)**		**6**	**1**	**0**	**5**	**0**
VI	High thickness light loamy and sandy loamy	2	0	1	1	0
VII	High thickness loamy and clayey	6	1	0	5	0
TOTAL:		**39**	**24**	**4**	**10**	**1**

4.1.4 Soil-reclamation characteristics

Identification of the plots by soil-reclamation characteristics (Appendix 4.3) is based on water allowance scale connecting lithology with degree of hydromorphy, depending on groundwater table. According to gradation of the water allowance scale, the plots are divided by degree of groundwater influence on soil formation processes and aeration zone salinization (table 4.3).

Most plots (23 out of 39) were located in an area of automorphous soils (groundwater table >3m), i.e. have major problems connected with low irrigation water productivity at a level of irrigated fields. Less plots were located in another two areas: 10 plots in an area of semi-hydromorphous soils (GWT = 2-3 m) and 6 plots in hydromorphous soils (GWT = 1-2 m). Under automorphous conditions major plots were with non-saline soils, while in other two areas there were saline soils.