# Country Pasture/Forage Resource Profiles

# UZBEKISTAN

**by**

**Mukhiddin Makhmudovich**

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# 1. INTRODUCTION

The Republic of Uzbekistan, one of the newly independent states of Central Asia, lies between the Syr Darya and Amu Darya Rivers (see Figure 1). The total territory of the republic is 458 000 km$^2$, of which agricultural lands constitute 272 000; in size it is second among the republics of Central Asia. Structurally, it consists of 12 Provinces and the Republic of Karakalpakstan: the provinces are Andijon, Bukhara, Dzhizak, Kashkadarya, Nawoiy, Namangan, Samarkand, Syrdarya, Surkhandarya, Tashkent, Fergana, and Khorezm. The capital is Tashkent. Uzbekistan is located in the centre of the Region and is bordered on the northeast by the Republic of Kazakhstan, on the east and southeast by Kyrgyzstan, Tajikistan and Afghanistan and on the west by Turkmenistan (see Figure 1). The natural features of Uzbekistan are varied and terrains include a mixture of large valleys, foothills and mountain regions. The northwest and the west of the Republic are desert, while the south and southwest consist of foothills and mountains.

**Demography.** On the first of January 2001 Uzbekistan's population was 26 000 000. From 1985–2001 it changed in the following way: 1985 – 18 100 000; 1990 – 20 400 000; 1995 – 22 800 000; 2001 – 26 000 000 people. According to the World Factbook the July 2006 population was 27 307 134 with a growth rate of 1.7%. According to the World Bank forecast, the population in the near future (2025) will reach 42 000 000!

**Livestock.** In January 2000, the ruminant stock were: cattle 5 268 300 head, including 2 305 200 cows; 8 886 000 sheep and goats of all breeds, of which Karakul numbered 3 978 100 (Table 1). In 2004 these were 5.4 M cattle, 9.7 M sheep and goats, 145 000 horses, 90 000 pgs and 15M poultry. Currently, there are three types of livestock farms:

- public sector agricultural cooperatives
- *shirkat* farms,
- and *dehkan* (peasant) farms.

Eighty-five percent of cattle are concentrated in *dehkan* farms, 3.3% in shirkat farms and 11.7% in agricultural cooperatives.

Most Karakul sheep, 57.3% or 2 279 500 head, are in cooperatives; 40.1% (1 617 300 head) are in dehkan farms, and the rest, 2.6% (82 300) are on farms.

Annually the Republic produces on average 3.5-4.0 M mt of milk (4.3 M mt in 2005 according to FAOSTAT), 461 000–592 300 mt of meat (551 000 mt in 2005 according to FAOSTAT), 14 900-19 500


**Figure 1. Location of Uzbekistan**
*Source:The World Factbook*

**Table 1. Livestock dynamics in Uzbekistan for selected years in the period 1990–2005**

| Species | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | 1995 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| Total cattle nos. (,000) | 4 580 | 5 848 | 5 268 | 5 344 | 5 478 | 5 879 | 6 243 | 5 400 |
| (Including cows ,000) | 1 856 | 2 336.9 | 2 305.2 | 2 364 | 2 293.2 | 2 556.7 | 2 704 | 2 800 |
| Sheep and goats nos. (,000) | 9 230 | 10 049 | 8 886 | 8 930 | 9 234 | 9 929 | 10 580 | 10 500 |
| Horses nos. (,000) | 120 | 144.8 | 155.0 | 150.0 | 145.0 | 145.0 | 145.0 | 145.0 |
| Pigs nos. (,000) | 716 | 350.4 | 80.0 | 89.0 | 75.4 | 89.9 | 86.7 | 90.0 |
| Poultry nos. (,000) | 26 473 | 18 500 | 14 787 | 14 800 | 15 725 | 18 053 | 19 184 | 18 350 |

*(FAOSTAT, 2006)*

**Table 2. Volume of animal products in Uzbekistan in the period 1990–1999**

| Indicators | Years | | | 1990–1999 (% change)* |
|---|---|---|---|---|
| | 1990 | 1998 | 1999 | |
| Milk, thousand tonnes | 3 034.2 | 3 405.9 | 3 541.9 | 116.7 |
| Meat production, liveweight, thousand tonnes | 789.0 | 800.6 | 819.7 | 103.9 |
| Milk yield per cow, kg | 1685 | 1515 | 1536 | 91.2 |
| Average daily liveweight of one cow, kg | 371 | 248 | 247 | 66.6 |
| Milk production per capita, kg | 149 | 145 | 147 | 98.6 |
| Meat production per capita, kg | 21.5 | 18.9 | 18.9 | 87.9 |
| Number of cattle per 100 people, head | 112.3 | 127.9 | 129.1 | 114.9 |
| The number of cattle per 100 ha of arable lands, head | 743.7 | 834.8 | 868.1 | 116.7 |
| Meat production per 100 ha of arable lands, quintals | 193.4 | 196.2 | 200.9 | 103.9 |

** 1990 = 100%*

*Source: Nosirov* et al.*, 2000.*

tonnes of wool (16 000 tonnes in 2005) (Table 2 and FAOSTAT, 2006), also 712 000 Karakul pelts. Most livestock products are consumed locally and sold on local markets to procurement organizations, state and private enterprises. Until recently Karakul pelts were an export product, now the state order is cancelled; only a small number (40 000 pelts) are exported, and most are sold locally. Beef and veal imports have fallen from 127 000 tonnes in 1995 to only 4 535 tonnes in 2000 and less since, while milk equivalent imports have grown from 49 930 tonnes in 1995 to 96 016 tonnes in 2002 and then down to 50 767 tonnes in 2004.

Today, 291 428 people in Uzbekistan are engaged in crop production; 856 324 ha of land are allocated to them on 41 743 farms. There are about 20.5 ha of land and 4.2 small ruminants and 4.2 cattle per farm . Stock indicators on farms depend on the level of specialization and concentration of production. In specialized livestock farms the stock in terms of conventional sheep is about 3 000 head. Since independence, milk production increased by 57 700 tonnes or by 16.7%, meat production increased by 30 700 tonnes or 3.9%. The intensity of milk production increase is much higher than the average world indicator. However, the growth reserves are not fully used so far: the use of animals remains low. Over nine years the average lactation yield decreased by 149 kg (8.8%); the weight of slaughter cattle decreased by 124 kg or 33.4% . Uzbekistan is far behind other countries in these indicators. In future, the intensification of livestock production will primarily depend on strengthening the fodder base, increase in animal feeding level and a considerable increase in cattle productivity.

## 2. SOILS AND TOPOGRAPHY

**Soils.** Diversity of soil forming rocks, ecological regimes, vegetation, extreme continental climate, and vastness of the territory contribute to great diversity and complexity of soil cover in the republic. The expansion of a particular soil variant type in Uzbekistan is attributed to natural-zonal features. Thus on most plains with continental climate a desert type of soil prevails, while on contemporary river plains with their favourable soil moisture, there are as a rule hydromorphic soils – meadow-desert, meadow-swamp, swamp and solonchak soils. Of course, there are also numerous transitional forms of soil formation.

The soil cover of foothills and mountain ranges slightly differs from that of plains and has other irregularities. There is a vertical zonality of physical-geographic conditions typical of mountain

countries. A decisive factor in this natural environment is climate - changes occur with increase in height above sea level, including a decrease in air temperature and an increase of total precipitation up to certain limits, in other words, with the increase of absolute height, a gradual change of hydrothermal regime is observed. Also, climate and geomorphological conditions predetermine the direction in which wind blown erosion products from mountain rocks will move. In Uzbekistan, natural pasture dominates in the desert zone. Distinguishing features of the mostly widespread types of soil in this zone are:

Desert-brown-desert soils are found on the Ustyurt Plateau, residual low mountains, the Kizilkum plains, the Karnabchul and Malikchul foothill plains, pebbled adyrs (vertical belts above the desert zone, at 1 500–2 000 metres with typical zonal soils, sierozems, and vegetation of ephemeral-ephemeroid grass) of the western Fergana, and low mountains of the Surkhandarya Region.

Desert-sandy soils are spread in the Kizilkum desert, on the Amu Darya ancient delta plains and in low mountains of the Surkhandarya basin.

Takyr soils are developed in ancient deltas of the Amu Darya, the Zaravshan, the Kashkadarya, the Surkhandarya, and in the central part of the Fergana Valley.

General properties of desert zone soils are: very low in organic matter (1–1.5%), presence of carbonate in the profile, and solonchaks, extremely high degree of dehydration of the profile in the xerothermic period.

Brown-brown soils are the most widespread type of soils in the desert zone of Uzbekistan. A characteristic morphological feature of brown-brown soil is that it has a pronounced dichotomic structure: the upper part is less compressed and lighter in colour and the low part is a tighter and bedded soil intensely collared in brown or orange. The deeper horizons of this soil have bright carbonate formations below which the gypsum horizon lies; more often carbonate formations and gypsum lie in one and the same horizon. The most characteristic feature of brown-brown soil is the availability of a gypsum horizon in the form of veins, spots and crystals. The thickness and depth of the gypsum horizon varies from several centimetres up to one metre and more. The brown soil is very poor in humus and mineral nutrients. The humus content in the upper soil horizons is about 0.4-0.6%, while at a depth of 50 cm it is 0.2–0.3%. The content of fulvic acids in brown-brown soils is four times higher than that of humic acids.

Another morphological peculiarity of desert-brown-desert soils is the presence of a porous crust 2–4 cm thick on the surface; below the crust there is usually a thin layered pale-yellow-desert subcrustal horizon, below which lies a compressed crusty low ferruginous light collared horizon. Most of the carbonates in brown-brown soil are in the upper part of the profile. This widespread zonal type of desert soil is characterized by diversity of subtypes, genera and species characterized in turn by different water-physical and agrochemical properties.

Desert-sandy soils have a feebly marked soil profile and are characterized by great diversity. Their upper layers are loose soils or consolidated sands and less often - loamy sand. The crests of ranges and hills are as a rule weakly consolidated, drift sands. The desert-sandy soils of the Karakul sheep zone are mainly wind-blown ancient alluvial deposits or wind-blown sands. Soil forming rocks for these soils are proluvium and diluvium deposits, aeolian load and eluvium of bedrocks of different mechanical texture. Groundwater lies very deep and does not influence the soil formation process. The soil profile is not clearly divided into genetic horizons, with or without an almost invisible crust on the surface. Carbonates are spread through the profile almost uniformly or prevail in the upper horizons to a depth of 30 cm, below which lies a gypsum horizon.

In desert-sandy soils as well as in brown-brown soils the humus content is low (about 0.5%). More often, the humic horizon is formed at a certain depth (6 cm). There is no salinisation of upper soil horizons, or it is very low. The salinisation of bottom horizons of desert-sandy soils (at a depth of 60 cm and deeper) can reach 0.5–2%. The colloid content and absorbing capacity is low. The soil horizons' moisture capacity is low; however, precipitation can penetrate to a considerable depth. Consequently, in terms of phyto-reclamation of ranges, desert-sandy soils have a comparatively favourable water regime. In comparison with other soil types, their soil evaporation is also slightly lower.

Table 3 provides details of some water-physical soil characteristics from the arid zone of Uzbekistan.

**Topography.** The geomorphology of Uzbekistan is varied: most of the country is occupied by vast plains of different relief and age, and the rest by mountains with heavily dissected relief. The mountain region

is in the eastern and south-eastern parts and links with mountains in Kyrgyzstan and Tajikistan (the Tien Shan and the Altay Ranges) with hilly foothills and foothill slopes.

The main features of Uzbekistan's orography are closely connected with the peculiarities of the geological structure of the Turkestan, Zaravshan, Chatkal and Gissar ranges. Altitudinal soil gradation is represented in the following way: the low soil belt characterized by arid climate is formed from brown-brown soils and sierozems developed on tertiary plateaus and loess in the conditions of shrub-ephemeral and ephemeral vegetation. Sierozems also prevail on low, 1 200–1 800 m. high mountain ridges (on exposed slopes). Inside this belt, in accordance with the age of geomorphological regions and the altitudinal location, typically light and dark sierozems could be identified.

**Table 3. Water-physical characteristics of various soils and subsoil of the arid zone of Uzbekistan**

| Soil type | Depth, cm | VM, g/cm³ | SM, g/cm³ | Porosity, % | MG, % | WP, % | MW, % |
|---|---|---|---|---|---|---|---|
| Grey-dark brown soil | 0-14 | 1.33 | 2.59 | 49 | 2.13 | 2.85 | 11.5 |
| | 14-67 | 1.50 | 2.74 | 46 | 1.96 | 2.62 | 8.9 |
| | 67-94 | 1.50 | 2.58 | 42 | 2.21 | 2.96 | 17.3 |
| | 94-105 | 1.73 | 2.63 | 42 | 4.2 | 5.62 | 17.6 |
| | 105-115 | 1.60 | 2.77 | 43 | 6.29 | 8.42 | 16.4 |
| | 115-122 | 1.57 | 2.74 | 43 | 6.66 | 8.92 | 24.5 |
| | 122-157 | 1.57 | 2.76 | 44 | 6.83 | 9.15 | 22.5 |
| Desert sandy undeveloped | 0-18 | 1.38 | 2.61 | 46 | 1.11 | 1.48 | 8.7 |
| | 18-29 | 1.49 | 2.74 | 46 | 2.91 | 3.89 | 10.5 |
| | 29-51 | 1.54 | 2.77 | 45 | 2.79 | 3.73 | 9.8 |
| | 51-71 | 1.68 | 2.78 | 40 | 1.80 | 2.41 | 9.2 |
| | 71-76 | 1.41 | 2.76 | 49 | 3.83 | 5.13 | 11.2 |
| Small-hilly sands | 0-49 | 1.44 | 2.53 | 43 | 0.47 | 0.62 | 5.8 |
| | 49-87 | 1.46 | 2.76 | 47 | 0.46 | 0.61 | 9.5 |
| | 87-130 | 1.56 | 2.77 | 44 | 0.46 | 0.61 | 8.1 |
| | 130-171 | 1.52 | 2.55 | 40 | 0.46 | 0.61 | 10.6 |
| | 171-212 | 1.53 | 2.71 | 44 | 0.53 | 0.71 | 11.3 |

**VM** - *volume mass;* **SM** - *specific mass;* **MG** - *maximum hydroscopicity;* **WP**- *wilting point;* **MW**- *minimum water capacity*

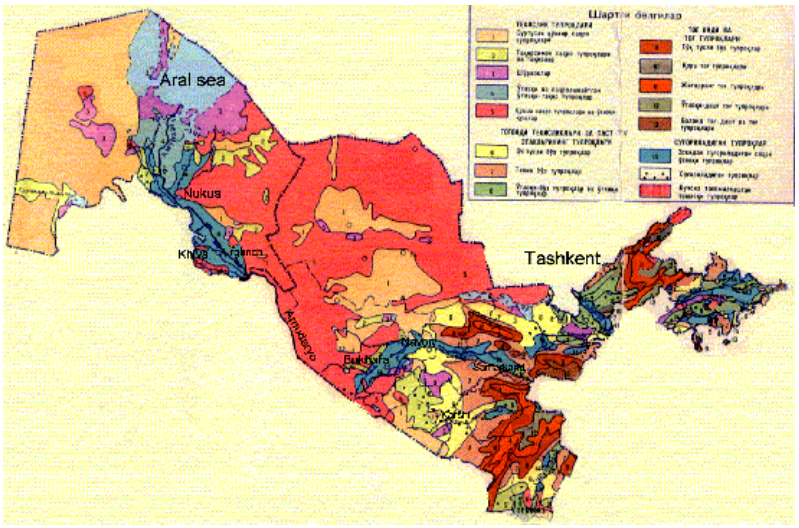
The next big belt is represented by brown soils spread on low foothills and mountains of average height (2 000–3 500 m). In comparison with sierozems they are very rich in humus and leached of lime carbonate. These soils develop in the more humid climate with shrub vegetation and sparse juniper forest. Depending on orography, (exposure, steepness, configuration), brown soils are characterized by great diversity in terms of profile thickness, humus content and leachability.

The highest soil belt is represented by light-brown meadow-steppe soils and highland soils. The higher brown and brown mountain forest soils occupy high mountain ridges and highland plateaus.

Hydromorphic soils (in the east of the republic) are spread in the sierozem belt and are represented by two genetically independent groups:

- alluvial soils of low river terraces and
- saz soils of foothill proluvium plains developed in the fan-like areas of mountain frontal groundwater flow.

In turn, owing to differences in the degree of hydrogenesis, alluvial and saz soils are subdivided into meadow, meadow-swamp and swamp soils. On the basis of the above-mentioned text, a scheme of soil




**Key**
**Soils of plains**
1) grey-brown soils of plains
2) takir-like soils of deserts and takirs
3) saline soils
4) meadow soils and marshy-meadow soils of desert zone
5) desert sandy soils
6) soils of foothill plains and lowlands
7) light sierozems
8) meadow and marshy-meadow soils of sierozems belt
**Sils of mountain-forest regions**
9) typical sierozems
10) typical dark sierozems
11) brown mountain soils
12) meadow-steppe mountain soils
13) light-brown soils of alpine meadow steps
**Irrigated soils**
14) irrigated sierozems not subjected to bogging up and salinisation

**Figure 2. Map of the soils of Uzbekistan**

classification for Uzbekistan is given below (where Roman numerals indicate types and Arabic numerals indicate subtypes):

| **Soils of latitudinal zone** | **Desert zone** |
|---|---|
| I. Brown-brown soils | |
| II. Takir soils | V Swamp soils of desert zone |
| 1) Takir | VI. Solonchak soils |
| 2) Takir | 1) Solonchaks |
| 3) Meadow-takir | 2) Meadow solonchaks |
| III. Desert sandy soils | 3) Swamp solonchaks |
| IV Meadow soils of desert zone | 4) Residual solonchaks |
| 1) meadow | |
| 2) Meadow-swamp soils | |
| **Soils of altitudinal belts** | |
| VII Sierozems | X. Solonetz |
| 1) Light sierozems | 1) sierozem Solonetz |
| 2) Typical sierozems | 2) meadow-sierozem Solonetz |
| 3) Dark sierozems | XI. Brown soils |
| VIII. Meadow soils of sierozem belt | 1) Brown slightly leached soils |
| 1) Meadow soils | 2) Typical brown soils |
| 2) Meadow-swamp soils | 3) Brown podzolized soil |
| IX. Swamp soils of sierozem belt | XII. Brown mountain forest soils |
| | XIII. Light brown soils of Alpine meadow steppes |

# 3. CLIMATE AND AGRO-ECOLOGICAL ZONES

**Climate.** Uzbekistan's geographical position in the centre of a large land mass, far from oceans, contributes to the dryness and continentality of its climate. Intrinsic to its climate are long, dry hot summers, cool and wet autumns, and cold winters with thaws (Glazirin *et al., 1999*). The continentality of the climate can be readily seen in the considerable and sudden changes of meteorological elements during the year and variations by years, etc. The peculiarity of the climate is also shown by the contrast when one season changes to another: in the cold six months the air masses of temperate latitudes prevail, while in the summer period there is a dominance of warm continental tropical air.

Having some features in common with the continental climates of neighbouring countries such as Iran and Afghanistan, Uzbekistan's climate has differences attributable to the peculiarities of relief; cold air masses of temperate and cold latitudes do not meet any obstacles to their penetration into its territory, while in the above-named countries air masses have to surmount a mountain barrier. In winter this contributes to a stronger influence of cold air masses on the republic's weather and the mountain barriers in the south and east ensure that these air masses are slow to move.

Where the plains are bounded by mountains spreading in a latitudinal direction and gradually declining from east to west, the territory is divided into plains, foothills and mountainous zones, the last being subdivided into foothill plains, foothills, average high mountains, and high mountains. In local dialect the plain belt is "*chul*", foothills "*adyr*", average high mountains "*tau*" and high mountains "*yaylau*". With increasing altitude, the climate, soil type and vegetation change. The territory of the republic is divided into:

DESERT BELT ("*chul*") is the zone of irrigated farming and Karakul sheep: annual precipitation is 100–250 mm; average annual temperature is about 15 °C. Vegetation types prevailing are desert, psammophytic shrub and ephemeral-semi-shrub vegetation. The zonal soil types are brown-brown, takir, meadow-takir and desert sandy soils.

FOOTHILL PLAINS BELT ("*adyr*") is the zone of rain-fed lands with a very low precipitation. Concentrated here are the main rain-fed areas and big oases of irrigated farming – the Tashkent, Golodnosteppe (Golodnaya steppe), Karshi oases and others. The yearly average temperature is 13 °C, in

the south it is 14-16 °C; annual precipitation is 200-545 mm; the prevailing soil type is light and typical sierozems with widely spread ephemeral vegetation.

AVERAGE HIGH MOUNTAINS BELT ("*tau*") is the rain-fed land with normal precipitation of the Tashkent, Samarkand, and Surkhandarya regions. The average annual temperature is 8-11 °C, annual precipitation is over 400 mm. Prevailing soil types are dark sierozems, brown soils with steppe, forest steppe and forest vegetation formations. Along with rainfed grain farming, the belt is extremely favourable for orchards and vineyards.

HIGH MOUNTAINS BELT ("*yaylau*") is characterized by light brown soils and meadow steppe vegetation. It is the zone of summer pastures; although vertical belts differ greatly in natural features, agriculturally, they complement each other (irrigated farming, rain-fed farming, forest-orchard zone, ranges of different seasonality) and are a good base for specialization of agricultural zones in the framework of a single agricultural complex.

**Agro-ecological zones.** Agro-ecologically, Uzbekistan is divided into eight regions: the Ustyurt, Nizhne Amudarya (Low Amu Darya), and Kizilkum regions in the plains, the other five regions, Sredne-Syr Darya, Fergana, Zeravshan, Lackaday and Surkhandarya, are in foothills and mountains.

**The Ustyurt zone** is a low plateau in the north-westernmost part of the republic which consist of Sarmatian limestones; its edges are separated from adjacent territories by steep scarps, sometimes by vertical slopes, while the surface is almost even, stony and gypsiferous. The climate is continental and characterized by the coldest winters in Uzbekistan. The summer is hot with low rainfall. There are no permanent surface watercourses. The soils are brown-brown desert, composite soils. The vegetation consists of *Anabasis salsa, Artemisia* and *haloxylon*. The zone is used as distant pastures.

**The Nizhne Amudarya region** is the Amu Darya delta (the eastern part of the ancient Sarykamish delta of the river, and a contemporary and ancient alluvial Akchadarya valley on the right bank of the Amu Darya). On the whole it is a vast lowland 60–150 m above sea level. The south is covered with a network of ancient and contemporary dry watercourses, overgrown in places with dense reeds and bushes and accompanied by tugai vegetation (the original type of vegetation cover consisting of thick growing woody-bush grass species on river terraces with swampy-meadow type of soil) and sometimes sand ridges. The landscape is characterized by chalk and tertiary rock ridges. The climate varies greatly; characteristic are low winter temperatures, low and unstable snow cover, and a hot, dry summers. The annual precipitation is the lowest in Uzbekistan. The soil cover in ancient alluvial valleys is composite. It is represented by takyr soils and residual solonchaks. Hydromorphic soil formations are widespread in the delta: meadow-desert, meadow-swamp, solonchak and meadow-takyr soils. The Amu Darya delta is one of the ancient centres of irrigated farming in Central Asia. Silt loads of irrigation water and plant remains as well as introduced fertilizers established a deep cultivated and irrigated horizon.

Vegetation is meadow-swamp type and tugai type - characteristic of river valleys. The tugai vegetation is composed of poplar, willow (*Salix)*, *djida* (local), wild rose (*Rosa canina*), and tamarisk (*Tamarix*). Prevailing herbs include sedge (*Carex*), reed (*Phragmites*), cattail (*Typha*), liquorice (*Glycyrrhiza)*), bush grass (*Calamagrostis epigeois*) and a very valuable fibre plant dogbane (*Apocynum*). Crops include cotton, lucerne and sorghum (joughara). Irrigated farming (cotton, rice, and vegetables) is developed on irrigated meadow and takyr soils; the rest of the zone is used as pastures.

**The Kizilkum region** is a vast valley of composite structure occupying the area from the shores of the Aral Sea in the north to the border of the Bukhara and Karakul oases in the south, and from the Amu Darya in the west to the Syr Darya in the east. The lowest northern part of the region is an ancient alluvial plain mainly formed from sands. The central part has the highest points above sea level, on a background of the tertiary chalk plateaus and sand masses, standing out by sharp contours are residual elevations (the Tamdytau, Jetymtau, Bukantau and others) and deep blind depressions (the Agitma, Karakata and others). The south-eastern part, south of the Kuldzhuktau range, in its southern part is an ancient plateau

washed out by the water of the ancient Zeravshan river. Vast areas are sands with takyr and residual-mountains spread among them.

On the whole, the climate of the Kizilkum is extreme continental with great variations in seasonal temperature. Rainfall (100–130 mm per year) is mostly in winter and spring. The summer is dry and hot with relatively low air humidity. There are no flowing rivers and water is available only in wells and springs. The soil cover is extremely varied. Also widespread here are non-soil formations in the form of young sand and loamy sand accumulations. The vegetation cover is diverse: Especially developed here are sand-loving shrubs such as Calligonum (*Calligonum*), *Ammodendron, haloxylon persicum* etc. The most characteristic ephemerals of the sandy desert are *Carex physodes* - the most valuable fodder plant; *Aristida karelini* - an excellent sand binder, various types of *Artemisia, Salsola, Ferula*, etc. These vegetation types grow at different seasons of the year; which makes it possible to use the Kizilkum as year round grazing for Karakul sheep.

**Sredne-Syr Darya region** mainly comprises the foothill plains, foothills and mountain slopes. In the east it is encircled by the western Tian Shan spurs, in the south and southwest by the Turkestan, Malguzar and Nuratau ranges. The climate differs from that of the Kizilkum by a shorter and milder winter. Summer temperatures are high and do not differ much from those in the southern parts of the Kizilkum. Rainfall is considerably higher than in the Kizilkum region and notably increases closer to the mountains, and temperatures decrease with altitude. Water resources are the Syr Darya with the system of irrigation canals as well as its tributaries, the Angren and Chirchiq Rivers. The soil cover is mainly light sierozems changing into typical sierozems on foothills and into dark sierozems in the mountains, and then changing into sod brown soils. Natural vegetation on foothill plains and in low mountains is characterized by an abundance of ephemeral plants, mainly *Poa bulbosa* and *Carex physodes*. Prevailing at places is *Artemisia*-ephemeral formation. In the mountains, the vegetation changes (transition from ephemerals to ephemeroids and to mixed grass) and higher in the mountains becomes shrub vegetation. Virgin landscapes of the region have been considerably altered by man; huge areas were ploughed, and canals cut; adyrs were also extensively developed. The region is one of the important cotton growing, silkworm breeding, vine growing, horticulture and melon-growing areas. Undeveloped parts of the virgin land are used as pasture.

**The Fergana Region** is the intermountain trough most favourable for the national economy of Uzbekistan. It is surrounded by mountain ranges. A characteristic feature of the region is the zone of adyrs - young elevations covered by loess and elongated along the edges of the Fergana Valley as a broken strip. Rivers flowing from the mountains cut the strip of adyrs and, entering the valley, form debris cones that form an important territory for irrigated farming. The central part of the Fergana Valley is formed of loamy sands and loams; it represents a totality of sand massifs and solonchaks. Climatic conditions of the Fergana Region are very peculiar and differ in various parts. Less variable weather and the absence of great variations in temperature distinguish the climatic conditions of the region from that in adjacent territories. Precipitation, especially in the western arid part of the region, is low. Also easily seen here is the dryness of foothill slopes. Heavy cloudiness in summer is typical of the Fergana region.

The region is rich in water resources. The main river is the Syr Darya with its numerous tributaries. A developed irrigation network successfully solves the problem of continuous water supply to the lands of the region. The soil cover is diverse. In oases of the foothill part of the Valley light and typical sierozems prevail. On the plains desert alluvial, meadow, and meadow takyr soils predominate, while in the mountains it is dark sierozems and brown soils. The vegetation cover of irrigated areas is mainly represented by cultivated plants. Parts of remaining natural vegetation belong to *Artemisia*- salty grass vegetation (solyanki) associations, while the north-eastern parts of the region are rich in trees. The region has 20 agro-pedological zones including 13 irrigated farming areas, 2 rain-fed farming areas, 4 areas of desert and foothill ranges and one forestry area. Consequently, irrigated farming is the main branch of agriculture; irrigated and rain-fed farming is underdeveloped, livestock breeding is based on irrigated lands and grazing is rented in Kyrgyzstan and Tajikistan.

**Zeravshan region.** In its eastern part the Zeravshan is bounded in the north by the Nurata Mountains, in the south by the Zeravshan Range, in the west by the Karatepa Mountains and low rocky Ziadin-

Zirabulak Mountains. The mountains are formed from Palaeozoic residual rocks and partially from unstratified rocks. The bottom of the Zeravshan depression is a flat plain with elevations from 280 m in the west to 900 m in the east. The depression is separated from the mountains circling it by a strip of slanting undulating plains on the left bank of the Zeravshan and more broken relief on the right bank. At the outlying part of the Bukhara oasis, the Zeravshan depression widens and its bottom merges with the areas of the south-western Kizilkum. On the whole, the Zeravshan Valley represents a blooming oasis sharply contrasting with the sandy clay areas surrounding it. The climate of the region is characterized by a short, changeable winter accompanied by frequent thaws; the summer is hot and dry. The precipitation is low for the western part of the region but as one approaches and climbs the mountains to the east, moisture levels increase and the summer temperature become lower. The vegetation cover consists of foothill xerophytic formations; ephemeredes and ephemeras occupying the low belt. The territory of the region is divided by 21 agro-pedological areas including irrigated farming areas (8), rain-fed farming areas (6), desert and arid grazing areas (6) and a forestry area (1).Along with well-developed irrigated farming on typical and light sierozems, there are larger areas of desert grazing, on which Karakul sheep and goats are kept.

**Lackaday region** occupies the area between the offshoots of the Zeravshan and Gissar Ranges. The eastern and east-southern part represents highlands, the central part is a loess undulating plain slanted to the west and broken by dry small flat-bottom areas and river valleys. The western part the territory is formed from ancient alluvial deposits of the Kasha, as well as takyrs, solonchaks and sands. The south-western part represents a parcel of old Pre-quaternary valleys, the so-called Dengizkul Plateau. The plateau relief is formed from deep basins and sands. The territory is characterized by a poor available water supply and resembles the southern edge of the Kizilkum desert. Closer to the mountains, in the Kitab-Shakhrisabz basin, the climatic conditions change sharply and the moisture levels are much higher. There are 18 agro-pedological zones in the region: irrigation farming areas (5), rain-fed farming areas (6), desert and adyr grazing areas (4), forestry areas (2) and high-mountain ranges (1). Both irrigated and rain-fed farming is widely developed in the region. Very popular also are Karakul sheep, based on desert natural grazing.

**Surkhandarya region**. In the north, the border of the region is a flat divide separating it from the Gissar Valley; in the east its border is the low (up to 2,000 m) Babatag Range formed from tertiary-chalk rocks. In the west it borders on the spurs of the Gissar Range separating the region from the neighbouring Kashkadarya region. The southern border of the region is the Amu Darya River. The main waterway is the Surkhandarya River. Geomorphologically, the Surkhandarya region resembles the Kashkadarya region. Traversing the valley one can notice a number of belts of different relief and age. Near the mountains there is a developed belt of foothills with rather dense dissection followed by the belt of undulating loess plains. The Surkhandarya Valley has a system of three-four accumulative terraces. In the southern part there are Karakum sands. Its climate distinguishes it from the other regions. On the whole it is the warmest part of Uzbekistan, the most favourable for growing fine-fibre cotton, sugar cane and other subtropical crops.

The region is characterized by the warmest winter and hottest and driest summer in Uzbekistan. With relatively low humidity, the air temperature in the daytime can reach almost 50o C. A strong wind, the so called “Afghan”, which suppresses both vegetation and animals is a characteristic feature of the region. The soil cover is represented by sierozems (light and typical) and sod-brown earth soils in the mountains. In lower parts various hydromorphic soils of the sierozem belt are observed. The vegetation cover of plains and adyrs is formed from ephemers and various grasses. The mountain steppe vegetation is characteristic of the high foothills. Of high value for the national economy are pistachios growing on the western slope of the northern Babataga.

Such are the characteristic features of Uzbekistan as an agricultural zone. As noted, climate is different in different regions of the country and is dependent on geomorphological and hydrogeological properties and other characteristics, which require recording and a different approach when solving agricultural problems in the various regions.

# 4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

Livestock production in Uzbekistan is distinguished by its richness and variety. Each animal type is characteristically distributed in its own agro-ecological zone. For example milk cattle are mainly found in irrigated croplands near industrial centres; beef cattle in mountain zone pasture areas; Karakul sheep production systems are mainly in deserts; meat-wool and ram production systems and horse breeding are concentrated in pre-and mountain zones of the Fergana valley, while pig and poultry production industries are near large cities and industrial centres.

The present conditions of cattle production have been discussed above and are further elaborated here. Various methods of cattle production have been used in Uzbekistan since independence; the main direction has been to increase the use of production potentials in the private sector, privatisation of animal production farms, re-organization of state-owned companies, saving of large corporate complexes and changing their status into joint-stock companies.

The distribution of animal production systems is dictated by feed availability and climate. For example, cattle are located in different pasture areas, poultry production is common where there is good production of plants such as *Medicago sativa* (lucerne), *Zea mays*, and *Beta vulgaris*; arid zones are the main food source for Karakul sheep, and horse and ram production. Lucerne is a fodder of very ancient cultivation locally, at least 2 500 years, Uzbekistan being in its zone of domestication.

The number of sheep and goats was 8 933 100 in 2001 and 2 716 000 (30.4%) were in shirkat complexes, 193 800 (2.2%) farms, 6 023 300 (67.4%) peasant farms. The highest portion of sheep that are going to be exported are Karakul (numbering 3 886 800) of which 2 149 400 (55.3%) are from shirkat complexes, 96 800 (2.5%) from farms and 1 640 600 (42.2%) are from peasant farms. Karakul are used for many materials such as wool, meat, milk and especially their skins.In more favourable pasture-fodder conditions the sheep of “jaidara” giving mutton, and fat-tailed “gizzar” also are reared. The average liveweight of jaidara is 60–65 kg, and gizzar 75 kg - the fleece weight about 2–2.5 kg. The number of these sheep are more than 3 000 000 head.

For more information on the sheep-breeding industry in CIS countries.

Goat production is also a major animal industry throughout the republic but is mainly concentrated in Samarkand, Syrhandarya and Namangan regions. The local (angor) goat weighs about 40 kg, produces about 400g of wool and 150–200 litres of milk per annum.

Camel production is a part of the Karakul industry and is concentrated in deserts. The number of camels is about 22 100 of which 17 100 (77.4%) are state owned.FAOSTAT suggests numbers of camels in 2005 were 25,000. Both species of camel are present; the breed distribution is: Arabian camels 15 - 20%; Bactrian camels consist of 35% Kazakh camels, 3–5% Mongolian and 10–15% Kalmyk Bactrians; the remainder are hybrids. The annual production of wool is 70–75 tonnes, 800–1 000 tonnes of milk and 2 000 skins.

Before Uzbekistan’s independence, animal production systems were specialized, intensive and industrial technologies of meat and milk production, especially in the poultry industry. There have, since, been some decreases in all animal production systems, with decreases in quality and quantity of meat and food production. Now, however, family farming is growing rapidly and has now become the leading producer of meat and milk.

# 5. THE PASTURE RESOURCE

The fodder base for Karakul sheep (which yield astrakhan pelts), the main branch of livestock production in arid zones, comes from three main sources:

1. natural grazing lands of deserts and foothills;
2. sown and improved pastures;
3. fodder saved or purchased for additional feeding in critical periods.

In turn, the distinguishing features of Karakul sheep-rearing are:

a. it is maintained year-round on natural grass with seasonal movements;

b. maintenance of livestock and grazing system depends on periodical variation of yield by year and season of the year;
c. provision and use of water supply in an area is important;
d. in some seasons and lean years the sheep may be driven beyond their base territory.

**Table 4. Pasture resources in Karakul production areas**

| Regions | Total grazing land, thousand ha | Including those without water supply | |
|---|---|---|---|
| | | Thousand ha | % |
| Republic of Karakalpakstan | 3 461.1 | 430.9 | 12.4 |
| Bukhara | 2 416.0 | 439.7 | 18.2 |
| Jizak | 582.9 | 205.5 | 35.2 |
| Kashkadarya | 1 011.9 | 122.5 | 12.1 |
| Navoi | 9 245.8 | 110.3 | 12.0 |
| Samarkand | 633.2 | 124.9 | 19.73 |
| Surkhandarya | 407.9 | 64.6 | 15.84 |
| Total in the republic | 17 758.8 | 2 498.4 | 14.0 |

Presently, the grazing land of the Republic of Uzbekistan is 23 600 000 ha, including 17 800 000 ha in the Karakul areas (Table 4). Of these grazing lands some 14% are not supplied with water.

Pastures in high zones are divided as follows: plains (arid) comprise 83.4%, foothills 12.8% , mountains 2.4% and alpine pastures 1.3%.

**Pasture types.** The vegetation used for Karakul grazing is represented by four types: ephemeral-ephemeroidal, shrub-grass, subshrub-ephemeral and salty grass vegetation (Amelin, 1943) and Morozova (1946).

Ephemeral-ephemeroidal pastures (about 1 500 000 ha). There are vegetation communities found among all types of arid grazing lands which consist of annual and perennial grasses covering loess foothills and plains in the the Central Asian republics. In Uzbekistan they are close to adyryof Surkhandarya, Kashkadarya, Samarkand and Jizak regions. *Carex pachystylis* and *Poa bulbosa,* forming a solid sward, are the basis of the vegetation cover of this type. In addition, in the herbage of ephemeral pastures *Anisanta tectorum*, *Bromus* spp*, Eremopyrum orientale, Trigonella noeana* grow. Among large plants *Alhagi pseudoalhagi, Cousinia resinosa,* and *Ferula asafoetida* are found.

In favourable years the height of the ephemeral herbage reaches 50–60 cm, and in normal years 20–30 cm; in lean years vegetation may not be higher than 8- cm. The fodder capacity of ephemeral-ephemeroidal grazing varies greatly by year and season of the year and on average is 400–700 kg of dry matter. The total number of ephemeras, long vegetating annual grasses, in years with different weather, can vary from some species up to 40–65 and more. However, the extent of development and specific weight of a particular fodder in the community differ depending on the weather conditions and spring period.

Shrub-grass pasture (about 9 000 000 ha), the most widespread type, which occupies a vast area is typical of sandy deserts. It occupies the greater part of the Kizilkum desert (most of the grazing lands of Bukhara, Navoi regions and the Republic of Karakalpakstan); here and there it prevails in Kashkadarya, Jizak and Samarkand regions. Shrub-grass lands of sandy desert areas are exceptionally valuable grazing. Variety of life forms (here there are all life forms of desert plants), different seasons and quite long growing period or absence of summer interruption in plant growth, the seasonal character of forage etc. allow them to be used for sheep grazing practically the whole year round.

The many-tiered formation of vegetative cover is common: trees and bushes make up the upper layer exceeding 2 m; sub shrubs and some perennial long vegetating grasses make up the middle layer (0.5–1.5 m high), and the lower layer often is formed of ephemeroids – *Carex physodes, Poa bulbosa* and a multitude of ephemerals. By the duration of vegetation the vegetative cover of this type is formed of ephemeras (annual and perennial) of spring-summer, summer-autumn, long vegetating kind and one evergreen kind. ha*loxylon persicum, haloxylon aphyllum, Salsola paletzkiana, Salsola richteri*, kinds of *Calligonum*, *Astragalus* (3 kinds), *Carex physodes, Poa bulbosa, Anisanta tectorum, Eremopyrum orientalis*, etc are the most valuable fodder plants of sandy deserts (Melnikova, 1973).

Schematically, the feed for sheep in shrub-grass grazing is as follows: spring – period of rapid growth and eating of ephemerals and ephemeroids; animals are provided with exceptionally vitamin-rich, green fodder. By summer due to cessation of growth of the grass layer, dry fodder from ephemerals, kinds of calligonums, and dry annual salty grass vegetation are the main components of feed for the sheep.

In autumn the available feed is slightly better owing to their eating shrub-subshrub fodder, dry *Carex physodes*, and small grasses. Shrub-subshrub pastures accumulate a stock of phytomass in summer;

ephemeras and ephemeroids in spring; and annual halophytes by the autumn. Ridges, hill tops and slopes are often low yielding while plains yield more; fixed areas of sands are not only easy to use, but are the highest yielding. Average yield of shrub-grass grazing varies by year from 200 to 700 kg/ha of dry mass.

Subshrub-grass type (total area 6 700 000 ha) prevails on sierozems, brown-brown soils, condensed sands in practically all the regions of the republic where the Karakul sheep are kept. The herbage of this type is usually two-tier: sub shrubs (kinds of *Artemisia, Salsola orientalis, halotamnus subophyllus, Salsola gemmascens, Astragalus willosissima*) are in the upper tier. In compacted sands in this area *Iris, Aristida, Ferula asafoetida*, etc. may grow. The lower tier is formed of ephemeras and ephemeroids, *Carex pachystylis, Poa bulbosa,* seldom *Carex physodes* and other ephemeras of crucifers, legumes and other genera. This economically important type is represented by a large number of options. But *Artemisia*-ephemeral and wormwood-halophyte-ephemeral options are the commonest. The forage capacity of these lands ranges from 300 to 600 kg of dry matter, per ha mostly from *Artemisia diffusa* and *Artemisia turanica (*65-70% ). The share of other kinds is about 30–35% : various grasses accumulate the most fodder in spring and sub shrubs in summer and autumn.Salty grass vegetation (halophyte) grazing with a total area of about 1 500 000 ha is localised, with small patches on almost all types of soil salinized to different extents. The vegetation cover is sparse and consists, in general, of: *Climacoptera lanata* (Pall.), *Gamanthus gamacarpus* (Mog.), *Salsola sclerantha*, etc. have a great importance (Akjigitova, 1982). The yield of salty grass vegetation grazing varies, within the limits of 50–600 kg/ha of dry mass. They are good grazing lands before and during mating (autumn) periods. The nutritive value of the main kinds of vegetation varies with the seasons of representative kinds of grass: in spring 23 fodder units; shrub-subshrub kinds 25–28; in summer 47–52; in autumn 36–38 and in winter 30–33 fodder units.

From the grazing point of view salty grass vegetation pastures are found on two types of land: annual salty grass vegetation and perennial salty grass vegetation. Of the annual halophyte, morphologically divided into rich and dry kinds, *Climacoptera lanata* and *Gamanthus gamocarpus*, etc. have great importance and prevail in Kizilkum. The above kinds alone or in a mixture with one another often grow in blind saline hollows, depressions, dried up lake beds, *takirs* (local), old river-beds, etc. Of the annual halophyte kinds *Agriophyllum latifolium, Galimoknemis* spp., *Salsola paulsenii,* and of shrub kinds – ha*loxylon persicum, Salsola richteri* mixed with annual halophyte groups prevail in the sandy part of deserts in the form of islets or larger areas. A distinguishing peculiarity of Kizilkum halophyte grazing is that more often subshrub are kinds of *Salsola orientalis, Salsola gemmescens, halothamnus subaphyllus* and shrub kinds of ha*loxylon aphyllum, haloxylon persicum, Salsola richteri, Salsola paletzkiana.*

The distinguishing biological peculiarity of salty grass vegetation, representing the main fodder in this type of land, is a quite long growing period of 200–236 days with only a few exceptions. The content of digestible protein per 1 kg of halophyte fodder ranges within the limits of 20–50 g. Fruit and leaves containing 7–13% of protein and a little cellulose (10–16% ) are deemed to be the most nutritive part of the fodder.

Most feed of *Climacoptera lanata* and other halophytes (70–80%) becomes available in autumn; the best season for their use is autumn and early winter. Alternation of sheep grazing on annual halophyte with other types of vegetation improves the effective use of the fodder. For camels halophyte lands can be used at all seasons as they eat halophyte practically the whole year round. The main reason for eating rich halophyte by other animals during the growing period is their high content (37.7–55%) of mineral salts.

In terms of seasons of use the pastures of the republic are distributed unequally: over 50% of them are good for all-the-year-round use, about 20% for spring-summer use; the rest can only be grazed only during a short season.

At the beginning of 1993 a farm had in average 209 300 ha of grazing land. However, depending on the region, the rangeland area also is distributed unequally. Thus, the number of farms having agricultural land area of up to 50 000 ha was 18; 50,100-10 000 ha – 23; 100 100–200 000 ha – 14; 200-500 000 ha – 18; over 500 000 ha – 12. Currently establishing organizational and economic structures of astrakhan sheep production have considerably changed such distribution of grazing land to farms, which now tend to break up into smaller farms.

The average weighted yield of rangelands of the republic is 121 kg/ha of fodder units. In years of average weather, provision of the stock with grass fodder is 80% , in lean years – 55–60% , in extremely dry, unfavourable years falls to 30–40% . In years unfavourable for the development of vegetation the farms have to buy concentrated fodder and emergency stocks of coarse fodder, or by first using their own laid-in stock in order to properly maintain the livestock population.

The low yield of natural grazing, the low and uneven pastoral water supply which causes a continuous shortage of water, the need for ecologically balanced land use are some of the key topics presently being discussed. Of course, effective use of natural pasture is the basis for maintaining and supporting the natural potential of arid grazing, the botanical variety of the herbage, as well as raising their productivity. As has been proven by science, in Karakul sheep production the main and determining element of effective use of arid zone pasture is seasonal and annual change of grazing areas with removal of annual growth of fodder mass not exceeding 65–70%. In this way the duration of using an area in time is achieved with an optimal load of sheep. Following a seasonal use pattern promotes the self-restoration and self-regulation of the vegetative cover.

**Table 5. Scheme of seasonal change of rotation fields for *Artemisia* – ephemeral pastures**

| Rotation fields | Seasons of use | Calendar grazing dates |
|---|---|---|
| **First rotation period (5 years)** | | |
| I. | Spring + Autumn | 16.II-15.V<br>IX-30.XI |
| II. | Summer + Winter | 16.V-30.IX<br>01.XII-15.II |
| **Second rotation period (5 years)** | | |
| I. | Summer + Winter | 16.V-30.IX<br>IX-30.XI |
| II. | Spring + Autumn | 16.II-15.V<br>01.XII-15.II |

Specific methods for effective use of pasture have been worked out and recommended for certain types. During the period of rapid plant growth, that is in spring, ephemeral-ephemeroidal pastures should be used at a moderate stocking rate not more than four years in succession, then the season of use should be changed to summer as a moderate grazing in this period as well as in autumn does not harm plants that have dried up and gone to seed. As shown by the practice of many years, for an effective use of *Artemisia*-ephemeral pasture, it is advisable to use a simplified two-field 10 years rotation. Here the change of only spring and summer seasons every 4-5 years is practiced. In other words these areas are used twice a year: the first time in spring owing to ephemeras and ephemeroids; and the second time in autumn or winter because of *Artemisia* and other sub shrubs (Table 5). Proceeding from biological and economical peculiarities of extensive grazing land other schemes of rotational grazing can also be used.

In the Karakul sheep zone, according to the current structure of organization of production, the pasture and land are state properties, and shirkat farms use them on a long-term lease. The role of state bodies includes organization and investment policy aimed at a systematic reconstruction and phyto-reclamation of lands of low productivity, maintenance and repair of water resources, and guaranteed water supply systems of the branch.

**Irrigated fodder**. As already mentioned, dairy cattle are concentrated in the irrigated zone, mainly in the suburbs of large cities and industrial centres; whereas beef production is largely in the foothill and mountainous zones of rain fed cultivation and in the floodplain of the lower Amudarya. Sheep production (Karakuls for astrakhan pelts) is found in the arid zone, whereas meat and wool sheep and goat-rearing are found in the foothill and mountainous areas of the Fergana Valley. Poultry and pig rearing is mainly concentrated near large cities and industrial centres.

Fodder for dairy stock is grown in irrigated areas. Dairy rations are composed of *Medicago sativa* for hay, haylage, green feed, *Zea mays* as silage, roots, as well as pulse crops (*Pisum sativa, Glycine hispida, Vicia* spp., *Vicia sativa,* as catch crops and repeated sowing. Intensive technologies for making*Medicago* hay (up to 15–18 tonnes/ha), *Zea mays* for silage yielding up to 40–45 tonnes/ha and *Beta vulgaris* yielding 80–100 tonnes/ha, have been developed.

With considerable expansion of the cereal (wheat, barley) areas a decrease of the areas of the main fodder crops in irrigated areas has been observed. Now the required bulk fodder is provided by straw and other residues of cereals as well as coarse and rich fodder (barley, brassicas, oats, triticale and, in summer, sorghum) grown after harvesting cereals.

# 6. OPPORTUNITIES FOR IMPROVEMENT OF FODDER RESOURCES

**Improvement of arid grazing land.** As a result of anthropogenic effects (unsystematic grazing, cutting down shrubs and sub shrubs for fodder and fire-wood) in a considerable part of the grazing land of the Central Asian region, the structure of desert ecosystems is disturbed, considerably decreasing their productive potential. Consequently, in conditions of unsteady yielding capacity caused by fluctuations in the natural environment as well as by negative anthropogenic factors, urgent action is needed for improving the forage resources for stock rearing.

As a result of the research over many years by a number of scientific institutions (UZSRISB, BI of AS, UzSRIF) in strengthening the forage resources for Karakul sheep-rearing, by the early 1960s a new branch of agriculture and a new branch of agricultural production, as well as a new direction of science -arid fodder production - was established (Burigin *et al.,* 1956, Shamsutdinov, 1975, Makhmudov, 1998). It developed into a science at the interfaces between ecology, phytocenology, botanic resources management, introduction, breeding, and agronomy. Its component parts are: grazing management, introduction, plant breeding, pasture phyto-reclamation, small-oasis fodder production on the basis of underground water use, etc. The achievement in phyto-reclamation includes creation of protected zones, technology of creation of autumn-winter pastures in semi-desert foothills, creation of multi-component pasture agro-phytocenoses of different life forms of plants, etc. (Anon, 1982; Nechaeva and Prikhodko, 1966).

**Technology of phyto-reclamation of arid grazing land**. Biological reclamation of arid grazing land is explained on a theoretic basis by floristic and coenotic incompleteness of natural phytocenoses. Availability of undeveloped ecological niches and underused water and mineral resources are an important ecological reserve for enrichment of species and population structure of natural phytocenoses and forming a supplemental phytomass. In other words, introduction of bushes, subshrubs and grasses capable of acclimatizing in different ecological niches; improving natural herbage by reseeding or seeding is a radical tool of arid grazing land phyto-reclamation. Proceeding from the peculiarities of geomorphologic and ecological conditions and degree of degradation, surface, radical and semi-radical methods of improvement of pasture in arid conditions have been developed (Nechaeva, 1974; Rabotnov, 1960).

**Surface improvement** -increasing the productivity per unit area without cultivation by seeding (reseeding) valuable forages that are absent or scarce in a natural community aims to achieve two objectives - increase the yield and improve the quality of green fodder from introduced plants.

**Semi-radical improvement** is based on resource saving principles. The main essence of it, unlike the radical one, lies in partial, narrow-strip (12–40 cm) cultivation on the area being improved, where at least 54–60% of natural herbage is left. Another equally important advantage of this technology is that all the methods (soil cultivation, preparing seed beds, sowing and seed covering) are made in one passage by combined machinery such as APP-2,8, AS-2, AS-4, and, thereby, the cost of improvement is sharply reduced.

**Radical improvement** of grazing in arid areas implies creation of pasture of a new type instead of the low-productive, degraded one by strip ploughing and sowing of valuable, high yielding, heat, drought and salt resistant forages. For arid areas, both the correct method of improvement and selection of phyto-reclaimers with regard to their bio-ecological and adaptive characteristics are very important. Reasoning from these considerations, in gypsum desert, on adyry it is necessary to use methods of radical improvement using gypsum-tolerant xerophytes; in the sand desert - surface and semi-radical improvement and of phyto-reclaimers - psammophytes are more effective. Another important condition of efficiency of phyto-reclamation of arid grazing is that recommended phyto-reclaimers (kinds, ecotypes) should be resistant to a complex of abiotic, exploitative, competitive stress in conditions of deserts. Correct selection of sites, cultivation of a strip, definition of terms and rates of seed sowing,

ways and technique of sowing, depth of seed covering, are considered to be the necessary elements of phyto-reclamation technology.

**Establishment of protection strips.** Plots for establishment of protective strips are selected proceeding from the soil-climate, pasture conditions of farms, farmers and biologic characteristics of ha*loxylon aphyllum*. It is advisable to establish them on sierozems and brown-brown soils of mainly clay sand texture at the level of the groundwater table not less than 15–30 meters. Soils with light and medium sulphate and chlorine-sulphate type of salinisation are also suitable. The strips are located transversely to the direction of prevailing winds. The width of the strips is 12–25 m depending on the type of land. The distance between the strips varies depending on forest plant conditions: in an *Artemisia*-ephemeral desert and adyry 250–300 m, in the Kyzlkum Desert: 100–150 m. Establishment of the protection strips is carried out by partial ploughing: cultivated narrow strips must be 1.4–2.8 m wide. The optimum rate of seeding, that ensures a stand density of 850–1 200 plants, satisfactory growth and development, is 3–5 kg/ha counting on 100% economical suitability of seeds. In the case of combined participation with *Salsola paletzkiana* and *Salsola richleri* the following rates of sowing should be used: 3-5 kg/ha for basic kind and 2-3 kg/ha for the supplementary one. The best sowing time is the autumn-winter. Seed is covered to 1-2 cm depending on soil texture. Seeds are covered by rolling or harrowing.

Nursery-raised seedlings must transplanted in early spring using forest planting machines. Standard seedlings should have an above-ground part at least 25 cm and the underground part over 35 cm.

**Grazing land agro-phytocenoses.** These agro-phytocenoses are created on the basis of materials of soil, geobotanic, hydrogeological and other research. In this, concrete peculiarities of the natural area of each farm, shepherd team, peasant farm, etc., should be taken into account. Taking into account the peculiarities of natural fodder conditions of the arid area of the republic, establishment of grazing agro-phytocenoses of summer, spring-summer, autumn-winter and all-the-year-around term of use is in practice now.

**Agro-phytocenoses for autumn-winter use** are established in conditions of submountain semi-desert. The disadvantage of adyry grazing with ephemeral vegetation, which are perfect spring-summer pastures, is that they have a short season. Grasses after drying-out (at the end of spring) break easily and are blown away so their yield and sustenance sharply decreases. By winter, if short grasses are covered with snow, they become inaccessible to sheep. That is why in the autumn-winter period there is a deficit of pasture.

**Introduction and selection of arid zone fodder plants.** One way to raise the level of productivity and sustainability of desert grazing agro-phytocenoses and improve fodder quality is, undoubtedly, introduction and selection of native fodder plants. Natural plant resources, which are a great wealth and important source for introducing into cultivation, are the initial material for selection. The flora of Central Asia has about 7 000 species of main plants. Of them about 300 species of fodder plants belonging to 29 genera have been studied to varying degrees (Khasanov, 1995; Shamsutdinov and Ibragimov, 1983). Among them 25–30 local species of shrubs, subshrub and grasses are identified as the most promising for introduction and selection. Consequently, the potential for introduction of fodder plants from Central Asia's natural flora is great and should be studied and developed in a planned way.

As a result of the introductory work of the Uzbek Scientific Institute of Astrakhan Sheep-Breeding over many years ecotypes of ha*loxylon aphyllum* "Nortuya", *Kochia prostrata* - "Karnabchulskiy", "Otavniy", "Pustinniy", "Sahro", *Salsola orientalis* - "Pervenets Karnaba", "Senokosniy", ha*lothamnus subaphyllus* - "Jaikhun", *Camphorosma lessingii* - "Sogdiana", *Astragalus agameticus* - "Ok tog" and *Poa bulbosa* - "Rokhat", etc., were selected. The basic method is mass selection. These species are drought and heat resistant. Their yield of fodder is 1.0-1.2 tonnes/ha of hay, which is 2.5-3 times higher than that of natural grazing.

**Seed production for the arid zone.** In conformity with the arid conditions of Uzbekistan there is a two-tier system of arid fodder plant seed-growing: the first part is scientific research institutions producing

the best specimens of seeds; the second part is seed-growing farms growing commodity seeds of 1, 2, 3 generations. The technology of growing of prospective phyto-reclaimers is based on the correct allocation of seed crops to the areas with annual precipitation totalling 200–350 mm, with comparatively well developed top-soil. For seed plantations, land of light and typical sierozems of sandy and loamy texture of soil with low salinisation are the most favourable.

# 7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

In the development of policy, information, and livestock-farming in Uzbekistan the leading role belongs to the adjusted management system: livestock-farming central boards, veterinary and scientific-production centre of the Ministry of Agriculture and Water Resources and their regional and district networks, institutions and companies of meat and milk production, poultry production, "Uzbekistan karakul", pedigree stock breeding associations of the republic, scientific-research institutions of livestock raising, Karakul (astrakhan) sheep-breeding and veterinary (UzSRILSF, UzSRIASBDE, UzSIV).

The scientific development of livestock raising - selection and genetic development of livestock, problems of forage reserves, development forecast of methods of animal treatment, implementation of advanced experience, scientific achievements - is carried out by research institutions and their experimental farms. Agricultural science of the republic is managed and coordinated by the Uzbek Agricultural Scientific Production Centre (UzASPC) with 19 scientific research institutes.

The Uzbek Scientific Research Institute of Astrakhan Sheep-Breeding and Desert Ecology (UzSRIASBDE) is the scientific headquarters for the development of desert livestock raising and arid fodder production. While the UzSRILSR is a leading scientific organization for general livestock raising and irrigated fodder production, the universities of the republic, Institute of Cotton Growing and Plant Growing deal to some extent with scientific developments in fodder production and pasture management. Now there are 14 scientific branches and four scientific departments at the UzSRIASBDE, where there are 80 scientists including 5 professors, many doctors and 28 candidates of science work. The institute has priority in developing an effective system of arid land radical improvement, selection, seed-growing of prospective fodder plants (phyto-reclaimers), and resource-saving zonal systems of improvement of natural fodder production.

Training of highly qualified specialists (zootechnicians, agronomists, veterinary surgeons) is carried out at establishments of agricultural higher education. The training of post-graduate students and persons working for doctor's degree is carried out at scientific research and educational institutions. The training of the support staff is done at agricultural and professional colleges. Systematic contacts with scientific institutions of foreign and CIS countries are being strengthened.

After gaining independence the fodder scientists of the republic began to take an active part in international congresses, conferences, seminars and symposiums. During the past 3-4 years joint scientific field research was carried out with ICARDA on the following areas:

- evaluation of pasture conditions, production of biomass, nutritive value of produced fodder;
- approbation of different technologies for restoration of grazing land;collection and reproduction of the most important local fodder species used for restoration of grazing lands;
- creation of nurseries of valuable forage plants and organization of growing their seeds;
- evaluation of conditions and shortcomings of winter feeding as well as testing management technologies to improve the feeding of small stock in winter.

For more information see http://www.worldbank.org/html/cgiar/newsletter/Oct96/6farming.html

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Since the drafting of this profile a major book on Uzbekistan's rangelands has been published (Gintzburger *et al*., 2003)

## 9. CONTACTS

**For information on pasture and fodder production and management.**

Ashirov Murodillo. - UzRILP. Kizil shalola, Tashkent
8702145, Uzbekistan/ tel.7-3712643307, fax.7-3712-394993.
Abdraimov Seifulla. KazRIKSB, Timiryazeva, 38/
Shimkent, 486011. Kazakhstan, fax 8-325-2231302.
Mustafa Bunejmat - ICARDA/ P.O. Box 5466.Aleppo Syria.
tel. 963-21-213433, fax 963-21-225105.
Dr.Adel El-Beltagy. Director General - ICARDA.P.O. 5466, Aleppo, Syria.
tel: (963-21) 213433. Fax: (963-21) 213490, 225105.
Dr. Shamsutdinov Zebri, the Russian Federation, 141740 Moscow Region,
Lobno, ARIF. Tel: 5777263. Fax:5770107.
Dr.Nurmatov Sherali - USPCA, Yusupova str. 1.Tashkent 700000
Uzbekistan. Tel: (83712) 414507. Fax: (83712) 394993.

**For information on Uzbekistan flora:**

Dr.Prof.Ashurmetov O.A. Academy of Sciences of Uzbekistan Republic
Institute of Botany
Fax: (371) 1627938
E-mail: post@botany.org.uz.

This profile was written in August 2001 and will be updated from time to time by:

Professor Mahmudov Mukhiddin Makhmudovich,
Leader, Centre of Plant and Forages for Arid Zones,
Uzbek Research Institute of Karakul Sheep Breeding and Ecology,
St. M. Ulugbek 47, Samarkand, Uzbekistan.
Telephone (3662) 333279
Fax: (3662) 333481
E-mail:mukimov@samarkand.uz

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