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Improvement of Degraded Pastures of Northwestern Caspian Areas

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***Abstract*—Today, the area of open sands in Kalmykia is 126.2 thousand hectares according to the data of deciphering satellite images. Desertification creates many socio-economic and demographic problems not only in the areas of desertification, but also on adjacent lands. The ecological ties of desert and semi-desert territories are very fragile, and therefore it is so important to expand the area of the forest fund, fix moving sands, create protective forest stands on degraded pastures. All this will make it possible to produce competitive agricultural products, based on natural fodder land, which means that it will solve food and environmental safety issues in a short time. The arrangement of ordinary protection from reeds prevents the seedlings from entering the sand after planting and promotes the accumulation and preservation of moisture in the root habitat for the period of the beginning of vegetation and rooting. All this ultimately led to an increase in the survival rate of the juzgun and its better development.**

Keywords: component introduction, degradation, arid zone, agricultural lands

I. INTRODUCTION

The statistic data analysis showed that the greatest increase in desert areas in the Russian Federation was due to the degradation of agricultural land in the arid zone in the last 30 years [1, 2]. The rates of desertification of the Black Lands and Kizlyar pastures in the Russian part of the Caspian Sea turned out to be unprecedented for Russia and in a whole Europe under territorial coverage and the severity of socio-economic consequences. Although an anthropogenic desert has already appeared on an area about 1 million hectares for the period 1976–1986 [3, 4].

II. MATERIALS AND METHODS (MODEL)

At present it needs revaluation of the degraded lands and determination of an area of lands exposed to desertification [5]. To make the given evaluation is very difficult, because it will require large expenditures [6, 7]. Therefore, the most promising method of finding out the state of the mentioned land is kartografic - aerospace monitoring [8, 9, 10]. The advantage of this method is that using ACF data, it is possible to assess the natural and economic potential of the territory 3-4 times faster at costs 12-15 times less than with traditional (ground) methods [11].

We connected computer images to geographic coordinates that enabled to preserve an image as a detached layer combined with a layer and a digitized topographical card. Determination of the level of degradation was performed on average statistical values of fototon image, which ever is the range set for each type of soil (sand) in the estimated areas.

Results of the research can be used to develop a conceptual-methodological framework, approaches, definition of strategy, tactics and system of measures to combat desertification, as well as the system of program activities at various levels: federal, regional and subregional ones.

III. RESULTS AND DISCUSSION

Our research was conducted on the territory of the Khulkhutinsky village of the Yashkul region of the Republic of Kalmykia [12]. In the center of the deserted lands there are watering wells. An analysis of the studies shows that in the immediate vicinity of the deflation site (Fig. 1) a very strong degree of slaughtering (pasture) digression is manifested. The area of trails on 1m2is more than 70%.

Fig. 1. Development of cattle trails in the immediate vicinity of the hearth

Fig. 2. Development of cattle trails at a distance of 50 m from the hearth zone

Fig. 3. Development of cattle trails at a distance of 100 m from the hearth zone

100 meters before the hearth zones N-moderate degree of disturbance. The composition of the dominant species is preserved, but individual structural and physiological characteristics of the communities change; there is a change in the species composition of communities towards increasing the phytocenotic role of more xerophytic species; species vitality worsens; morphological changes in plant organs occur; medium-disturbed communities are not floristically floristic (loss of fodder and other valuable species), with the participation of weed species, rarefied grass cover, satisfactory living condition of individuals with slight mechanical damage, satisfactory generativity, and a decrease in soil sodding by 10-25%; dynamics has the character of directed successions; self-healing ability is possible while limiting or mitigating loads.

50 meters to the hearth zones N-strong degree of disturbance. Changes are taking place in the species composition of dominates and edificators - rod-root, rhizome, vegetatively mobile species dominate; the species composition of communities is strongly changed and depleted - the number of young, synanthropic (ruderal, weed species) is increasing - more than 50%; the emergence of new communities; litter and rags are absent; community components are weakly generative; communities are characterized by sparse grass stand and reduced soil sodding by more than 50%; dynamics has the character of catastrophic successions; the ability to self-repair is possible with a complete cessation of stress.

Immediately near the hearth zone – a very strong degree of disturbance. Catastrophic changes in vegetation, up to the death of indigenous communities; communities are characterized by a completely changed floristic composition and structure, insignificant participation of native flora species, severely sparse or having a low projective cover (not more than 20%); dynamics is chaotic; are not capable of self-healing without special measures for phytomelioration.

Today, according to the data of deciphering satellite images, the area of open sands in Kalmykia is 126.2 thousand hectares. Desertification creates many socio-economic and demographic problems not only in the areas of desertification, but also on adjacent lands. The ecological ties of desert and semi-desert territories are very fragile, and therefore it is so important to expand the area of the forest fund, fix moving sands, create protective forest stands on degraded pastures. All this will make it possible to produce competitive agricultural products based on natural fodder land, which means that it will solve food and environmental safety issues in a short time.

The experience of fixing open sands shows that one of the main woody plants suitable for these purposes is leafless dzhuzgun (Calligonumaphyllum (Pall.) Guerke), which is planted on open sand dunes with a large amplitude of landscape. This is a highly branching shrub from the Buckwheat family, up to 2 metershigh with light, whitish-gray, or pinkish bark. It gives abundant shoots and root offspring, and when falling asleep with sand forms additional roots. Planting buckwheat performed even on large moving dunes, quickly leads to the consolidation of sand and the gradual hall angling rows. 3-4 years after planting, juzgun begins to bear fruit; the seeds begin to germinate in the depressions (especially after snowy winters), which better contributes to the consolidation of open sands.

In Kalmykia conditions after fixing sands and grassing between rows (Calligonumaphyllum (Pall.) Guerke) gradually dies away, leaving behind 10-15 year desert and semi-desert pastures, good quality with occasional clumps buckwheat.

The territory of the Khulkhutinsky village is a natural pasture, leased to various categories of agricultural producers.

For phyto-reclamation measures, 31 sites of degraded pastures (open sands, weakly fixed sands, “downed” pastures) with a total area of 5500 hectares were selected. Land plots are given for temporary use only for the period of phyto-reclamation work and after completion of work they are transferred to the owner under the land commissioning acts.

Land area is hummocky, with low, middle and high dunes, open waving sands with depressions which forms the dune chain of sands in height of 3 meters with the centers of the blowing of hollows and cusps that open hearths sands degrading potentially hazardous areas. The vegetation cover is very sparse and is represented by coronet wormwood, sparse rare bushes of sandy oats and annual clusters. Sands are characterized by light particle size distribution (less than 10% of physical clay) throughout the profile. The initial composition is sandy. There is no vegetation on open moving sands. Moving sand plumes form sand bars in the surrounding area (mainly western) rangelands cover new areas of pasture degradation, reducing their productivity to a minimum-0.7 0.0 c/ha of edible mass.

The technology for phyto-reclamation work was determined taking into account the characteristics of the plots, their cultural and technical condition, degradation, topography, traffic and is given in the schemes of the working draft.

According to the technological scheme No. 1, a mechanized landing (Calligonumaphyllum (Pall.) Guerke) is provided for a total area of 1223 ha according to the scheme (5.0 x 1.0) -2000 pieces/hectares manual landing of juzgun.

The technological scheme number 2 provides manual landing on the medium-and large sand dune height of the ridges, dunes, dune chains and more than 3-7 meters, with deep hollows blowing complicated terrain, danger of overturning units and tree-planting machines in the area of 332 hectares.

In manual planting layout (Calligonumaphyllum (Pall.) Guerke) (5,0 x 1,5) is 1333 units/hectares. The manual landing of the dzhuzgun is carried out under the protection of decomposition along the entire length of the landing of rolls of reeds. The arrangement of ordinary defenses from the reeds will serve to protect against blowing and skidding of sand after planting and during the period of the beginning of the growing season and their rooting. It will also contribute to the accumulation and preservation of moisture and ultimately increase survival rate (Fig. 4).

Fig. 4. The manual landing

Landing from the camp is carried out depending on climatic conditions in the fall (October, November) or early spring (February, March, until mid-April). Perhaps in winter thaw windows (December), it is necessary across the direction of erosion-hazardous winds (southeast direction), i.e. the main orientation of the north-south rows (or along the dune chains, across the main harmful rose of the winds). The recommended planting depth of not less than 40 cm. Low, middle and high sand dunes with considerable margin transported sand necessary to apply large-sized landing material and increase the planting depth of at least 70-80 cm or more.

Table 1, Fig. 5 presents data on the survival rate of seedlings in the territory of the Khulkhutinsky village of the Yashkul region of the Republic of Kalmykia. Our observations showed that the arrangement of ordinary defenses from reeds served as effective protection against blowing and sanding of seedlings both immediately after planting (safety 98.6 versus 78.2%) at the beginning of the growing season (May), and throughout the growing season.

TABLE I. SURVIVAL RATE (%) OF SEEDLINGS IN OPEN SANDS DEPENDING ON GROWING METHODS

Growing method	**Months**					**% deathofseedlings**	
	V	***VI***	***VII VIII***	***IX***	***X***	***Total***	***Perseason***
Manual	98.6	96.4	91.6 89.7	83.2	80.8	19.2	17.8
Mechanized	78.2	73.9	68.4 65.7	60.3	58.0	42.0	20.2

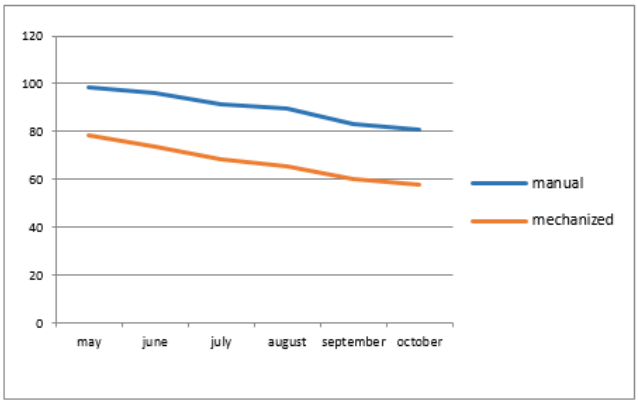

Fig. 5. Seedling survival

By the end of the first year of life, the survival rate of seedlings (Calligonumaphyllum (Pall.) Guerke) with manual planting was 80.8% versus 58% with a mechanized planting method. With the manual planting method (1333 seedlings per ha) during the growing season, 259 seedlings fell out of the stand (table 2, Fig. 6), while with the mechanized method (2000 seedlings per ha) - for the vegetation-837.

In a word, initially, with a different planting rate by the end of the growing season, the density of seedlings was almost the same and is 1074 for the manual method and 1163 for the mechanized one. Thus, within 1 year of life, the survival of the seedling did not depend on the planting method.

The formation of vegetation in a sandy desert depends entirely on the moisture reserves in the soil. Therefore, in order to understand the mechanisms of plant adaptation to environmental conditions, first of all, it is necessary to understand the issues of water availability in soil. The soil moisture in the surface layer (0-100 cm) both at the beginning and at the end of the growing season was higher on the option - manual planting of seedlings + reeds (table 3).

TABLE II. DENSITY OF STANDING (CALLIGONUMAPHYLLUM (PALL.) GUERKE) (PCS/HA) IN OPEN SANDS DEPENDING ON THE GROWING METHOD

Growin gmethod	**Months**						**Fell out per sea son**
	V	***VI***	***VII***	***VIII***	***IX***	***X***	Pcs /ha
Manual (1333 pcs/ha)	1314	1285	1221	1196	1109	1074	259
Mechani zed (2000 pcs/ha)	1564	1478	1368	1314	1206	1163	837

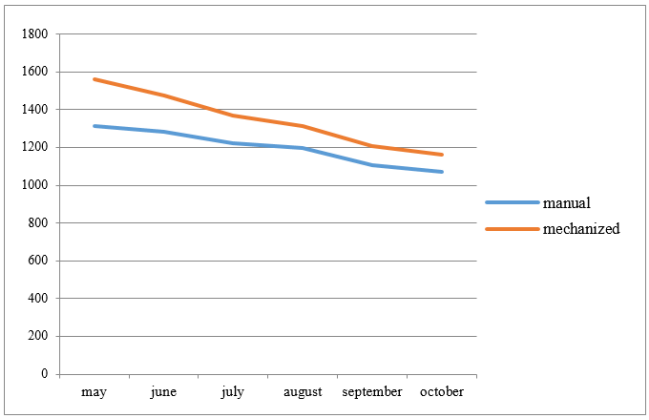

Fig. 6. Density of standing

TABLE III. THE ENVIRONMENT-FORMING ROLE OF REED ROLLS WHEN PLANTING SEEDLINGS (CALLIGONUMAPHYLLUM (PALL.) GUERKE) ON OPEN SANDS

Options	**Handgrowi ng+reeds**	**Mechanizedg rowing**
The amount of precipitation (%), detained in the surface layer (0-100 sm)		
The smallest moisture capacity (%) in the surface layer (0-100cm)	38	10
Soil moisture (%) in the surface layer (0-100cm) At the beginning of the growing season At the end of the growing season	16 6-8 3-4	12 3-4 1-2

First of all, theenvironment-forming role of reed rolls when planting seedlings (Calligonumaphyllum (Pall.) Guerke) on open sands is indicated by the fact that the use of this covering material increases 3.8 times the amount of precipitation in the surface layer. That is, reed rolls reduce the rate of sediment infiltration into deep horizons by filtering them through the sandy layer to the level of mineralized groundwater with the formation of local fresh lenses on the surface of the saline ones.

The higher moisture content in the rooting layer had a positive effect on the degree of coverage of the soil withseedlings planted according to the variant - manual planting + reeds (table 4, figure 7).

TABLE IV. THE DIAMETER OF THE ROOT SYSTEM (M) IN SEEDLINGS (CALLIGONUM APHYLLUM (PALL.) GUERKE) OF THE 1ST YEAR OF LIFE ON OPEN SANDS

Wayof growing	**Months**			
	V	***VI***	***IX***	***X***
Manual	0.3	1.2	2.1	2.4
Mechanized	0.3	1.0	1.6	1.8

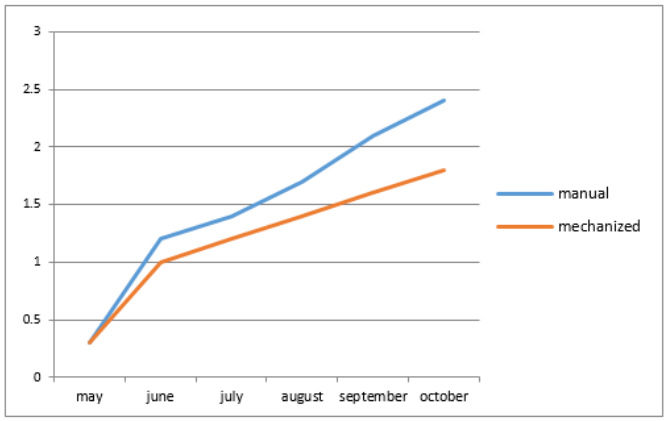

Fig. 7. The diameter of the root system

So by the end of the vegetation period in plants of 1 year of life, the diameter of the sand system cover by the root system was 2.4 meters versus 1.8 in the variant — mechanized planting.

The high moisture content of thesoil and the greater coverage by the roots of the sand thickness had a positive effect on the height of the plants (table 5, Fig.8).

TABLE V. HEIGHT (M) OF SEEDLINGS OF DZHUZGUN OF THE 1ST YEAR OF LIFE ON OPEN SANDS

Wayof growing	**Months**			
	V	***VI***	***IX***	***X***
Manual	0.5	0.8	1.3	1.4
Mechanized	0.5	0.7	1.1	1.2

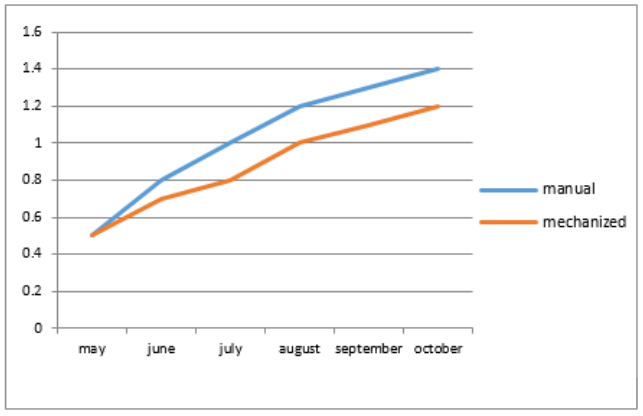

Fig. 8. Plant height

IV. CONCLUSION

The above preferences allowed plants (Calligonumaphyllum (Pall.) Guerke) to rise to a height of more than 1 meter by the end of the first year - with an

advantage in the growth of plants with a manual planting method (Fig. 9, 10).

Manual planting of seedlings using reeds as a covering material is objective in all respects (survival, preservation, growth and development of plants) superior to the second planting option - mechanized.

The arrangement of ordinary protection from reeds prevents the seedlings from entering the sand after planting, for the period of the beginning of vegetation and rooting and promotes the accumulation and preservation of moisture in the root habitat of the sand during the growing season. All this ultimately led to an increase in the survival rate of the juzgun and its better development.

Fig. 9. Fixing dunes for 2 years

Fig. 10. Fixingdunesfor 3 years

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