Study on the development of the desert pasture agrophytocenoses using a wide range of forage plants

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Abstract. The drained bottom of the Aral Sea covers an area of about 6 million hectares, of which 3.2 million hectares are located on the territory of the Republic of Uzbekistan. In addition to the fact that salt is spread from the drained bottom, dust and sand causing enormous damage to the environment, on the drained bottom there is a forest suitable area of 1.5 million hectares where it is possible to create desert shrub agrophytocenoses. The purpose of the work was to develop the most effective methods for creating desert agrophytocenoses on forest suitable types of bottom sediments of the dried bottom of the Aral Sea and the selection of desert forage plants to increase the productivity of the created pastures. Studies shown that when using focal, pasture protection and reclamation-fodder methods, as well as such fodder plants as teresken, boialich, keyreuk, it is possible to create pastures with a fodder capacity of up to 500 fodder units per hectare. This will increase the number of grazed animals by 20-30%. The field of application of the results arising from this work are forest suitable types of bottom sediments of the drained bottom of the Aral Sea. The drained bottom of the Aral Sea is a reserve of a forage base for animals in the near future, which will give a new impetus to the development of animal husbandry in the Aral Sea region, and at the same time, fodder plants, fixing the soil of the drained bottom of the Aral Sea, will significantly improve the ecological situation in the Region.

1 Introduction

Deserts and semi-deserts in the Republic of Uzbekistan occupy 65% of the territory, the main part of which is represented by treeless natural pastures and sand dunes. A low percentage of employment with forest plantations contributes to the development of wind erosion, which impedes the natural regeneration of pasture plants, causes low productivity of pastures and full or partial degradation of land [1-5].The problem, which today is in dire need of a solution, is especially important for Uzbekistan during the period of population growth (the population of Uzbekistan is about 34 million people). Uzbekistan has embarked on a course of providing itself with its own food products, including livestock products. To achieve these goals, an annual increase in the number of cattle and sheep is required. However, it is not so easy to do this due to the lack of animal feed. To create additional pastures on irrigated land is a difficult task, since they grow other crops of strategic importance to the state. And it becomes more and more difficult to water additional pastures every year, because there is a great shortage of water. In 2019-2020 all planted crops on the household plots of the local population died due to the scarcity of water for irrigation [6-8]. According to FAO and UNEP, 6,800,000 km2 of land on Earth was degraded due to overgrazing, 1,370,000 km2 due to the felling of trees for cooking and insulation of dwellings. It should be noted that, according to the sources mentioned, 5,500,000 km2 of the territory was degraded due to improper farming, as well as due to improper irrigation and watering [57].If until recently the development of animal husbandry took place through the development of still undeveloped pasture areas, now this reserve has been exhausted. However, in Uzbekistan there is one more reserve where it is possible to create pastures - these are forest suitable types of bottom sediments of the drained bottom of the Aral Sea. People have the opinion that the drained bottom is solid sands and salt marshes. This is not at all the case. Unsuitable types of bottom sediments occupy an area of about 35%, and the area on which desert pastures can be created is 1.5 million hectares [8]. In this region, with the correct use of scientific recommendations: Novitsky Z.B. - Recommendations on methods for creating pastures on the drained bottom of the Aral Sea (Tashkent, 2014), Recommendations for creating desert pasture agrophytocenoses on the drained bottom of the Aral Sea (Tashkent, 2017), Recommendations on the creation of pastures from fodder plants on weakly overgrown sandy sediments subject to deflationary processes on the drained bottom of the Aral Sea (Tashkent, 2020), it is possible to create pastures with a productivity of 400-500 fodder units per hectare [10-13]. It is assumed, that in the future this Region can become a supplier of feed for, which on May 18 at the

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75th UN General Assembly, the Aral Sea Region was declared a zone of environmental innovation and technology. The purpose of the study is to develop methods and select an assortment of desert forage plants for the creation of pasture agrophytocenoses on forest suitable types of bottom sediments of the drained bottom of the Aral Sea.

2 Methods

The studies were done on suitable types of bottom sediments of the drained bottom of the Aral Sea in the period from 2012 to 2020. The technology of creating desert pastures was studied, an assortment of forage plants was selected, and the productivity of the created agrophytocenoses was taken into account. The work was carried out within the framework of the State programs for research projects: KHI - 5 - 012 - 2016; KHA - 7 - 026 - 2015; KX - A - KX - 2018 - 110; I-BV-KH-2019-4.The objects of research were bottom sediments with chlorine less than 0.04% and according to the soil texture related to sandy loam and loamy soils [14]. The methods of creating desert shrub pastures were pasture protection, reclamation-fodder and focal forest plantations.The assortment of forage plants consisted of the following breeds:

gray teresken - Ceratoideslatens J.F. Gmel., chogon - Aelleniasubaphylla (C.A. Mey.) Aellen., keyreuk - Salsolaorientalis S.G. Gmel., Boyalich -SalsolaarbusculaPall., Izen - Kochiaprostrata (L.) Schrad., In addition, the main forest-forming species is black saxaul - Haloxylonaphyllum (Minkw.) Lljin. Soil processing was performed with a chisel aggregated on a T-150K tractor, followed by sowing seeds or planting annual saplings. The aforementioned desert fodder plants, which form the basis of the created pastures, were tested. All work was carried out by setting up experiments in the field in 10-12 replication [50-54].

3 Results and Discussion

Let us consider the results of the above long-term studies on the creation of pasture agrophytocenoses using a wide range of desert forage plants. The targeted scientific research to test the possibility of growing an expanded range of forage plants on the drained bottom of the Aral Sea in order to create a desert pasture agrophytocenosis had not been done before. Therefore, this work was carried out, for the first time and in the spring of 2015; a series of experiments was laid to create desert pasture agrophytocenoses, in which 2 or more species of fodder plants participated. The experiment was carried out by a statistical method by sowing the seeds of forage plants. Throughout the growing season, soil moisture was studied and biometric measurements of emerging plant shoots were carried out. It is known that the moisture content of the soil has a great influence on the growth and development of plants, especially in the first year. .The still poorly developed root system in plants was in the horizon up to 15 cm, so it is here that moisture plays a particularly important role. For sowing the seeds, the soil was treated with chisel, and the moisture was studied, both in the control also on the soil treated with chisel, for months [61-65].

Table 1. Soil moisture (%) on the variants of the experiment on the creation of pasture agrophytocenoses (2015)

Horizon depth, cm	**Months of research**				
	April	**May**	**June**	**July**	**September**
Option with soil treatment with chisel					
0 - 5	6.80	3.60	2.56	1.98	1.12
6 - 10	7.34	5.06	3.45	2.21	1.75
11 - 20	10.08	8.38	6.12	3.24	2.22
21 - 40	21.77	22.40	17.65	15.46	12.41
41 - 60	26.60	28.93	26.71	23.45	22.34
The drained bottom was not subjected to soil treatment (control)					
0 - 5	5.43	2.77	2.21	1.78	1.12
6 - 10	6.10	4.10	3.42	2.36	1.76
11 - 20	8.75	7.31	5.41	3.42	2.23
21 - 40	20.95	21.45	17.64	15.41	12.54
41 - 60	26.10	27.98	23.45	21.29	17.68

In May 2015, 70.9 mm of precipitation fell, which is almost an average annual rate, and this made it possible to have a moisture content of 3.60-8.38% in the 0-20 cm horizon (Table 1). In April, the soil moisture in the 0-5 cm horizon was 6.80%, and at the end of the growing season in September it was only 1.12%. 2015 was favorable for the germination of seeds and the emergence of friendly seedlings of forage plants in the agrophytocenosis. However, in June and July, there was intense heat, the air temperature reached 50^0 C, and on the surface of the earth it was more than 60^0 C, which led to a burn of the teresken leaves that have not yet matured and other types of forage plants. Despite the fact that the leaves were burned, the root system of plant seedlings was alive [9]. In September, as a result of the autumn counts of the number of plants remaining after the summer heat, we excavated the root systems of the chogon and teresken. The state of root systems in 22 model plants was studied. It was revealed that the roots from sowing seeds in depth, on average, spread by 15-17 cm and horizontally by 10-12 cm. Summer heat did not have a detrimental effect on the condition of the roots. They had been in a living state and, upon receiving additional moisture reserves due to winter-spring precipitation, began their biological development [58-60].

Table 2. Accounting for the number of seedlings of forage plants (pcs./m^2) in the created desert agrophytocenoses on the drained bottom of the Aral Sea in 2015

№ r/o	Plant species	Counting time of the number of germinated seedlings by months			
		13 May	6 June	30 July	15 September
		number of germination	number of germination	number of germination	number of germination
Chogon-teresken agrophytocenosis					
1	Chogon	21.1±0.73	23.2±0.82	23.7±0.70	18.4±0.48
2	Teresken	29.0±0.72	31.3±0.62	32.3±0.51	27.6±0.60
	Total:	50.1±0.73	54.5±0.70	56.0±0.60	45.0±1.08
Boyalych -Keyreuk agrophytocenosis					
1	Boyalych	2.6±0.37	3.9±0.34	2.3±0.27	1.0±0.17
2	Keyreuk	3.0±0.33	4.0±0.45	2.3±0.26	1.0±0.15
	Total:	5.6±0.35	7.9±0.40	4.6±0.27	2.0±0.32
Saxaul-Cherkez agrophytocenosis					
1	Saxaul	9.2±0.69	11.0±0.64	9.9±0.68	6.6±0.59
2	Cherkez	2.9±0.38	5.0±0.44	3.0±0.37	1.5±0.20
	Total:	12.1±0.53	16.0±0.54	12.7±0.52	8.1±0.79
Chogon-keyreuk-boalych-teresken agrophytocenosis					
1	Chogon	24.8±1.05	26.5±1.18	24.6±1.0	20.1±0.93
2	Keyreuk	1.8±0.29	3.5±0.34	1.9±0.18	0.7±0.13
3	Teresken	28.5±0.96	30.0±0.89	27.5±0.90	23.1±0.96
4	Boalych	1.4±0.25	2.6±0.42	1.5±0.25	0.7±0.15
	Total:	46.5±0.63	62.6±0.70	55.5±0.58	44.6±2.17

As our experimental studies showed that the most favorable conditions for the growth of forage plants on the sandy loam plain of the drained bottom of the Aral Sea are found in teresken and chogon, less favorable in boyalych and keireuk. In the chogon-teresken agrophytocenosis, there are 45 ± 1.08 plants per 1 m2, while in the boalyche-keireuk agrophytocenosis there are only 2 plants (Table 2). To create desert shrub pastures, it is advisable to create multi-species agrophytocenoses, such as chogon-keyreuk-boalyche-teresken agrophytocenoses in which there are 44.6 ± 2.17 plants per 1 m2, which will allow for 4-5 years of growth to obtain productive pastures with a capacity of up to 500 feed units with 1 ha [46, 47, 55.56]. Determination of the stock of forage mass in the air-dry state in the aforementioned variants of the experiment in September 2017 showed that the capacity of pastures in the chogon-teresken agrophytocenosis was 562 ± 12.4 kg / ha, in the boalyche-keireuk agrophytocenosis - 118 ± 4.7 c / ha. , saxaul-Cherkez agrophytocenosis - 285 ± 7.9 centners / ha and in chogon-keyreuk-boalychev-teresken agrophytocenoses, respectively 522 ± 12.7 centners / ha.As we can see from the experimental material, despite the fact that in the first year there was a strong heat, and the ground mass was damaged, the preserved root system allowed the plants to recover due to the accumulation of moisture in the winter-spring period and form pastures with a good supply of forage mass for 3 the first year of their growth. [48, 49, 56]. In the process of conducting scientific research on the drained bottom of the Aral Sea, different methods of creating pastures were tested, but among them were used focal methods, as well as the creation of pasture protective forest and reclamation-forage belts (project KKH-A-KKH-2018-110). Forest reclamation science, developing measures that determine the possibility of creating pastures on a drained bottom, attaches great importance to the creation of pasture protective forest belts from black haloxylon The role of these bands in improving the microclimate elements when creating pastures cannot be overestimated. Being a biophysical body and an active element of desert landscapes, forest plantations reduce the wind speed, improve its turbulent exchange, regulate the processes of moisture evaporation from soil and growing vegetation, prevent deflationary processes, and significantly optimize the wind regime of interband spaces [15-25]. The accumulation, conservation and wise use of moisture is an important challenge facing foresters. In the summer, when intense heat is felt on the open part of the drained bottom, the reduction of evaporation under the protection of the strips plays a decisive role in the life of plants. The experiment showed that under the protection of forest belts, the daily moisture saving is 11.3 mm. By months, under the protection of forest belts, daytime evaporation in April decreased by 31.3%, nighttime by 46.4%, in May by 25.3 and 30.6%, and in June-July by 26.0 and 48.7%, respectively. Forest belts not only hold the soil together on the drained bottom, but by reducing evaporation, create additional moisture reserves in the soil for the growth of forage plants, which is especially important for the drained bottom, where the annual precipitation rate does not exceed 90 mm per year [26-36]. As our research has shown, haloxylon forest strips not only contribute to better growth and development of forage plants, but also significantly increase its nutritional value. Our zoo-technical analysis showed that under the protection of forest belts in fodder plants there is 1.0-2.7% more protein and protein than in open pastures of the drained bottom, and at the same time the amount of water is 2.4-17.0% higher, while fiber is less by 0.32- 5.16% [41-45]. Consequently, under the protection of forest belts, food is more nutritious, and they are easier to eat by animals, because their moisture content is higher [43]. The placement of protective forest belts depends on the area of wind activity. The weaker the wind regime, the greater the distance between the stripes (90-120m). In areas of strong wind activity, the distance between the stripes is 30-50 m. The stripes are created in 3 rows. Seeds of such fodder plants as chogon, teresken, boyalich, keireuk, izen, etc. are sown in the spaces between strips. On the drained bottom of the Aral Sea, reclamation and forage strips are widespread, which can be located both in the spaces between the protective forest belts and in open spaces. Such strips are created mainly from forage plants and are placed in spaces between stripes with a distance of 20 m between them, i.e. 3-4 such strips are placed, and in the open areas of the drained bottom, reclamation and forage strips are placed 10 m from one another [37-39]. Fodder plants enter the fruiting stage within 2-3 years and under the influence of the wind the seeds are spread over the entire inter-strip space, thus creating enriched desert pastures. Studies have shown that in the 3rd year after the creation of reclamation-forage strips in the inter-stripe spaces as a result of self-seeding, there were numbered 6-8 pcs plants per 1 m^2. The technology for creating reclamation and forage strips is that the soil is processed in strips 1.5 m wide using a chisel or disc harrow. Seeds of shrubs and semi-shrubs are sown along the loosened strips. From the assortment of plants tested, the best results on the accumulation of phytomass were obtained in chogon, keireuk and teresken. The seeds of these breeds are sown in autumn, winter and spring after collecting and determining the purity of the seed heap and laboratory germination. Seeding is done with tine harrows followed by rolling. At the same time, a mixture of keireuk and teresken seeds can be sown, and it is better to sow chogon seeds in pure rows [40, 66, 67]. The drained bottom of the Aral Sea is represented by different types of bottom sediments from soils of light granulometric composition to heavy ones, and to varying degrees of salinity up to highly saline soils. We studied one of the promising methods of creating pastures - this is the focal method, the essence of which is that 7-10 sites (foci) measuring 2 x 2 meters are placed on 1 hectare of the drained bottom. On these sites, seeds of fodder plants are sown, which enter the fruiting stage for 2-3 years, and their seeds under the influence of the wind are spread throughout the territory, forming a continuous cover of fodder plants (pastures). Studies have shown that already in the 5th year, the entire territory where foci of forage plants were laid was covered with forage plants, which subsequently gave seeds, and their distribution proceeded exponentially. The stock of fodder in the air-dry state per 1 hectare of such pastures was 5060 kg, which amounted to 2176 fodder units (kg). Created forest and forage plantations play a very important role on the drained bottom of the Aral Sea, where vegetation grows in very small quantities. This is especially important at the present time, when a huge emission of carbon dioxide into the atmosphere, and, accordingly, a decrease in oxygen, lead to a warming of the Earth's climate. In 1997, Uzbekistan signed the Kyoto Protocol, which entered into force in 2005. It is impossible to fulfill the main provisions of the Kyoto Protocol without vegetation. Forests counteract the greenhouse effect by working for the entire Planet [50]. In this regard, forest plantations and pastures created from forage plants on a drained bottom are priceless. They are a biological factor that can return the population of the Aral Sea region to a healthy life, solve the problem of providing animals with food, and also minimize the occurrence of deflationary processes, which has a positive effect on air purity, reducing carbon dioxide and increasing oxygen [56]. The creation of desert shrub pastures on the drained bottom of the Aral Sea is of ecological, economic and social importance.

- *ecological*. Plants with their roots, including fodder ones, hold the soil together and thereby prevent their destruction, which leads to a decrease in the occurrence of deflationary processes. Accordingly, less salt and dust are carried away, which then settle on irrigated lands and reduce their fertility, while the yield of agricultural crops stabilizes; the air becomes cleaner, which people breathe, which will have a positive effect on the gene pool of the local population.
- *economic*. The suitable types of bottom sediments of the drained bottom are a reserve for creating a forage base for animal husbandry in the Region. Methods have already been developed for creating desert agrophytocenoses on a drained bottom using a wide range of forage plants. Correctly selected assortment of forage plants in the creation of desert agrophytocenoses will make it possible to increase the capacity of pastures to 500 forage units per hectare. The number of grazed animals can be increased by 20-30% in comparison with natural pastures and, accordingly, the population of the country can be provided with livestock products.
- *social*. Scientists of our institute see their task also in the fact that by creating multicomponent pastures, the local population will develop animal husbandry, because they will be provided with food. People will unite in groups and graze their animals on the pastures of the drained bottom of the Aral Sea, which are already being created by forestry enterprises according to our recommendations. If these groups of people (communities), who will graze 40-50 cows, are provided with mini-factories for processing dairy products, and which once a week the machine will pick up for sale through the distribution network, and next week bring money for the delivered dairy products, then the local population will come to grips with animal husbandry. People will feel that their work is appreciated and for the money they earn they will be able to provide their families with everything they need, then the whole family will start breeding own domestic animals. The results of work on the creation of pasture agrophytocenoses will make it possible to organize a movement for the development of animal husbandry on the drained bottom of the Aral Sea. At first it will be Initiative, which will then turn into Movement. Thus, we will be able to solve social issues of the local population through the creation of pasture agrophytocenoses on the drained bottom of the Aral Sea.

4 Conclusions

On the basis of the research results, it can be argued that on forest suitable types of bottom sediments of the drained bottom of the Aral Sea, it is possible to create desert pasture agrophytocenoses using a wide range of forage plants. To achieve this goal, it is advisable to use the focal method of creating pastures, as well as methods of pasture protection and reclamation-fodder afforestation, which will increase the fodder productivity of the territory, and increase the number of grazed animals by 20-30%.

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