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Mixed agroforestry systems for saline landscape restoration in Karakalpakstan, Central Asia

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Introduction

Degraded deforested landscapes and lack of water are the main problems of Karakalpakstan. This poses a serious threat to the development of the region, since the income of the majority of the population depends on the productivity of agricultural and pasture lands and the recreational value of landscapes. Enormous efforts are expended to combat salinization and soil degradation; the main methods used remain technical and physical-chemical measures. Agroforestry can be seen as a promising technology for landscape reconstruction, restoration of saline degraded lands and agricultural development.

The purpose of the study is to develop an appropriate technology for landscape restoration using agroforestry methods on degraded and saline lands and its approbation in the conditions of Karakalpakstan.
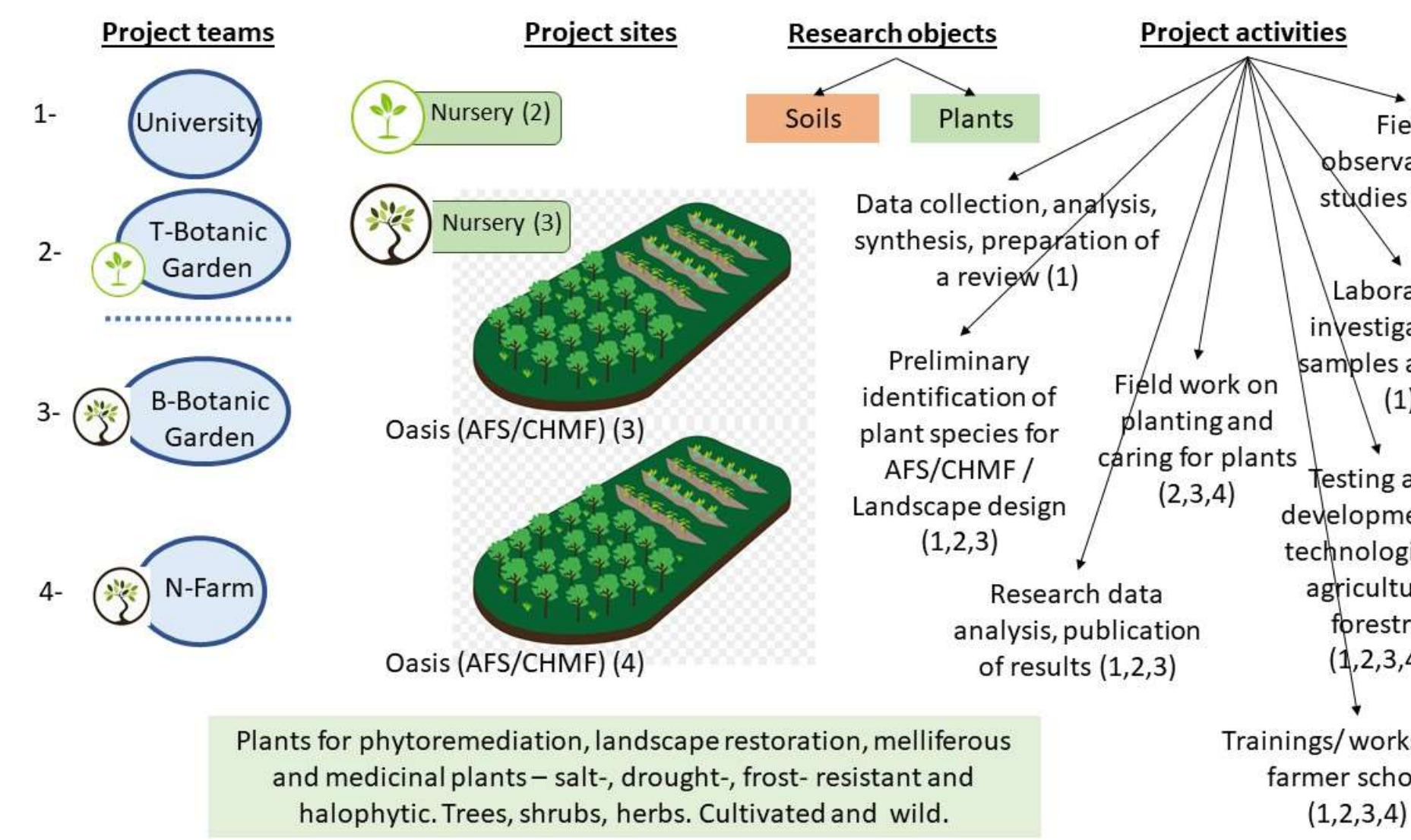

Figure 1: Layout of the project

Methodology

The project is based on methods and approaches of agroforestry. The first stage is a geobotanical survey of the project sites. The soil, water sources and natural flora were studied. The next stage – scientifically based selection of the assortment of plants for the creation of sustainable plant communities in agroforestry systems, taking into account a number of factors: (1) the need to include all forms of life (trees, shrubs, semi-shrubs and grasses) in the systems, (2) the presence of plants with different tiers in the community, (3) the resistance of plants to soil and climatic features of the environment in Karakalpakstan (high and low temperatures, water scarcity and salinity), (4) consideration of allelopathic interactions, (5) availability of economically valuable properties, in particular, honey, phytoremediation, medicinal, feed or technical value.

Results and Discussion

Two experimental plots (model gardens) have been established in Karakalpakstan: (1) in the delta of the Amudarya river and (2) in the Nukus region on the border with the Kyzylkum desert; the area is about 6 ha.

Figure 2: Project sites

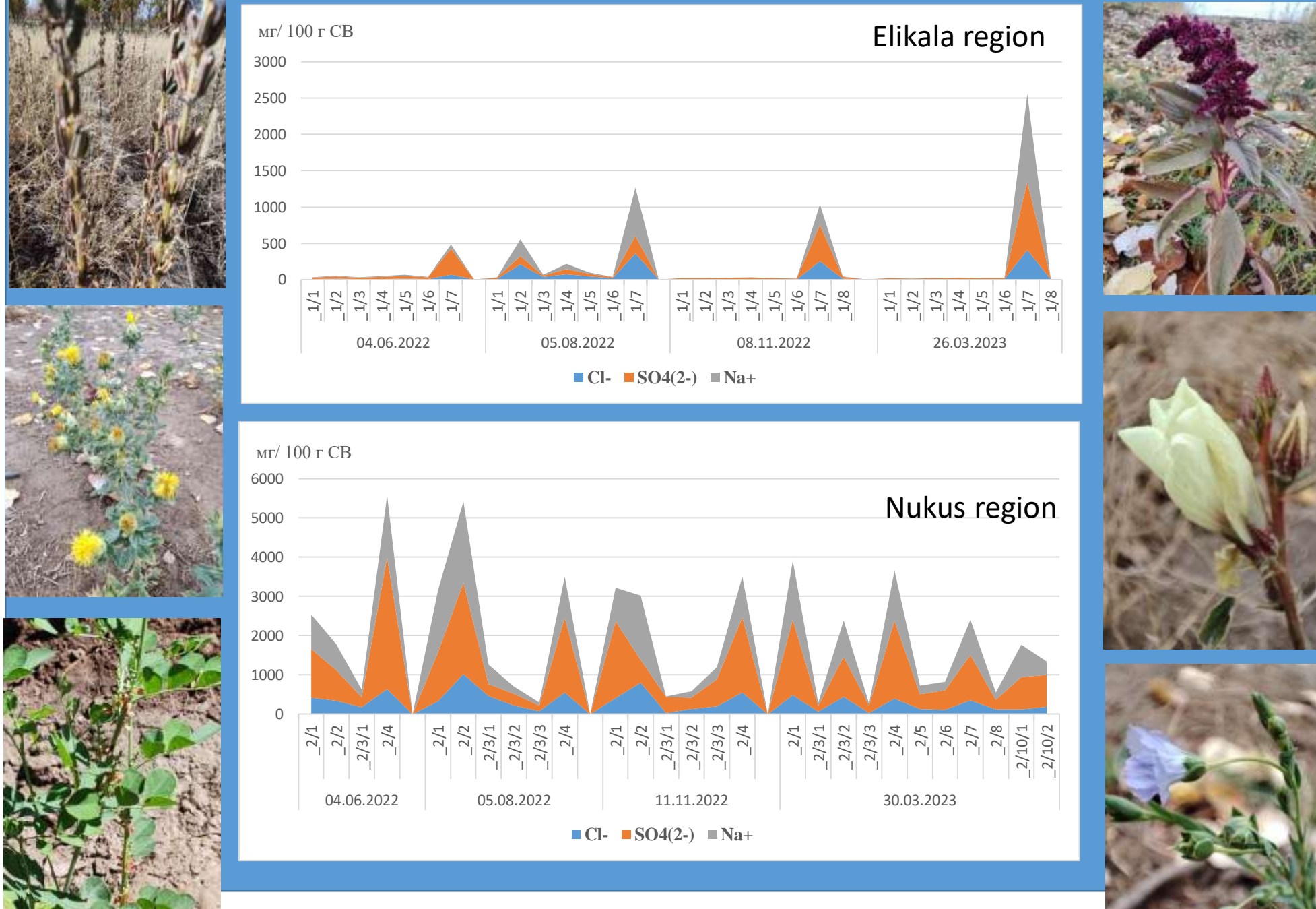**Figure 3:** Electrical conductivity of the soil at the project sites

Figure 4: The content of chlorides, sulfates and mobile sodium in the soil of experimental plots

Figure 5: Accumulation of chlorides (A) and sulfates (B) in vegetative parts of plants, August-November, 2022

Conclusions

The soils of the project sites are predominantly sulfate-chloride salinization and have very low microbial activity. Within the framework of the project, it is planned to analyze almost 30 plant species recommended for agroforestry for salt accumulation, to study the mechanisms of their survival in these stressful conditions and allelopathic interactions to create sustainable plant communities (agroforestry systems)

References

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Acknowledgements

	Ammonifying		Bacilli		Oligonitrophils		Amylolytic		Oligotrophic	
	M	±M	M	±M	M	±M	M	±M	M	±M
1.1	7,95	0,2385	0,434	0,013	27,4	0,822	8,07	0,2421	7,87	0,236
1.2	21,9	0,438	2,4	0,048	22,3	0,446	19	0,38	6,73	0,134
1.3	7,84	0,392	1,4	0,07	5,2	0,26	5,4	0,27	4,07	0,203
1.4	7,65	0,2295	1,12	0,033	4,73	0,1419	7,27	0,2181	3,86	0,115
1.5	1,3	0,039	0,913	0,027	9,8	0,294	3	0,09	4,2	0,126
1.6	0,14	0,0028	0,314	0,006	0,04	0,0008	0,015	0,0003	0	0
1.7	7,2	0,144	0,89	0,017	17,7	0,354	14	0,28	22,0	0,44
2.1	3,3	0,099	0,58	0,017	0	0	3,6	0,108	0	0
2.2	0,12	0,0024	0,676	0,013	0,11	0,0022	1,2	0,024	0,46	0,0092
2.3	2,2	0,11	0	0	0,3	0,015	1,93	0,0965	0,33	0,0165
2,3,2	3,3	0,099	0,277	0,008	0,02	0,0006	0	0	0	0
2,3,3	0,84	0,0168	0	0	0,033	0,0007	0	0	0	0
2.4	0,55	0,022	0	0	0	0	0	0	0	0

Table 1 - The number of microorganisms of various ecological and trophic groups in the soils of the project sites (million CFU per 1 g of soil)

Managing salt-affected soils for sustainable future