

**MEASURES TO COMBAT DEFLATION BASED ON THE CLIMATIC CONDITIONS  
OF BEKOBOD DISTRICT AND THEIR CURRENT IMPORTANCE**

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**Abstract.** Wind erosion is a major factor contributing to the decline of agricultural land productivity, disruption of ecological balance, and acceleration of desertification processes in arid and semi-arid regions. This study evaluates the effectiveness of key mitigation measures, including the establishment of windbreak shelterbelts, adoption of minimum and zero tillage practices, implementation of crop rotation systems, conservation of crop residues through mulching, optimization of irrigation regimes, and reclamation of degraded lands. Agro-technical, forest-meliorative, engineering, and organizational measures were analyzed using an integrated and systematic approach. The results demonstrate that the combined application of these measures significantly reduces wind erosion risks and enhances sustainable land use. The findings provide a scientific basis for developing effective land management strategies under conditions of increasing climatic aridity.

**Keywords:** wind erosion, land degradation, shelterbelts, conservation agriculture, mulching, crop rotation, land reclamation.

**Introduction.** Globally, nearly 28% of the land area affected by land degradation suffers from soil erosion caused by wind action, resulting in the destruction of the fertile topsoil layer. In Central Asia, the alarming increase in air temperature—nearly doubling in recent decades—has intensified soil erosion processes, negatively affecting the livelihoods of approximately 30 million people, while recurring dust and sand storms have become a common phenomenon. These trends pose serious environmental and socio-economic challenges.

In agricultural lands, wind-induced soil erosion primarily occurs through the removal of the finest and most biologically active soil particles, which are richest in organic matter and nutrients. Repeated exposure of land to wind erosion leads to continuous degradation of agricultural soils, making it increasingly difficult to maintain favorable soil conditions in the long term. Therefore, the rational and efficient use of agricultural land resources, along with the protection of the fertile soil layer from wind impact, is of critical importance. In this context, preserving existing shelterbelts, expanding windbreak systems based on regional conditions, and considering prevailing wind direction and velocity in land-use planning are key measures in combating wind erosion.

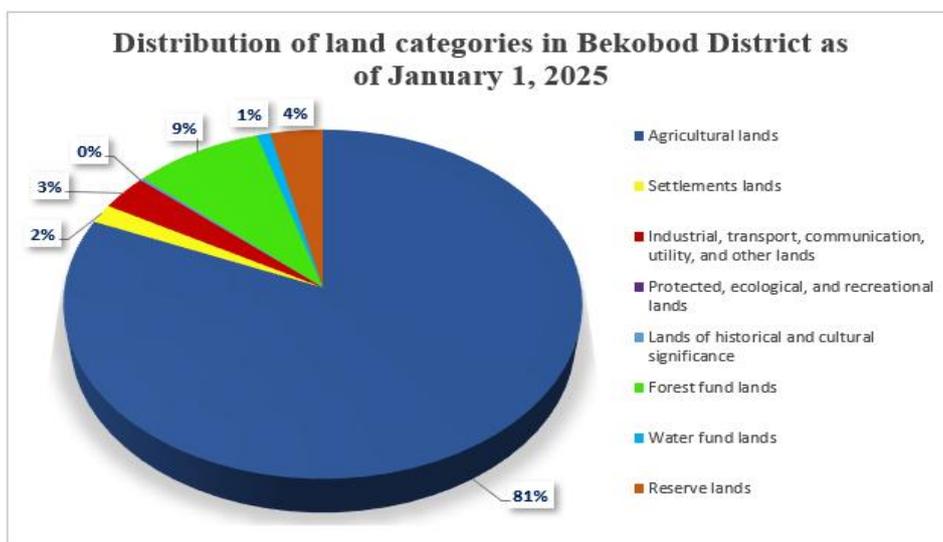
Strategic priorities in this area are reflected in the Decree of the President of the Republic of Uzbekistan dated September 11, 2023, No. PF-158, “On the Uzbekistan–2030 Strategy”. Task No. 68 of Annex 1, Section 3, titled “Protection of lands from erosion and melioration facilities from sand movement”, outlines major strategic objectives aimed at mitigating land degradation. Additionally, the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated June 5, 2018, No. 422, “On measures for the establishment and reconstruction of shelterbelt plantations to protect irrigated lands from wind erosion and water management facilities from sand encroachment”, along with other regulatory documents, emphasizes the reduction of deflation and the preservation of agricultural land productivity.

**Materials and Methods.** The object of the study is the agricultural land of Bekobod District, Tashkent Region, Republic of Uzbekistan. The research employed a combination of statistical analysis, comparative assessment, and geostatistical methods to evaluate land conditions, erosion processes, and the effectiveness of mitigation measures.

**Results and Discussion.** As of January 1, 2025, the total land area of the study region is 74,969 hectares, of which 61,065 hectares (81.4%) are classified as agricultural land. Bekobod District borders Bo‘ka District of Tashkent Region to the north, Syrdarya Region to the west, and the Republic of Tajikistan to the east and south. The territory is partly characterized by the Dalvarzin Desert, while the Syrdarya River flows through the district, exerting a significant influence on land resources, irrigation systems, and agricultural potential ( Figure 1).

Figure 1. **Distribution of land categories in Bekobod District as of January 1, 2025.**

The climate of the region is sharply continental, with hot and dry summers and cold winters. High average summer temperatures combined with low precipitation levels accelerate wind



erosion processes. Considering the district’s cracked soils, semi-arid climate, dominant south-to-north wind direction, reliance on irrigation canals for water supply, and predominantly flat terrain, a set of optimal measures was developed to mitigate wind erosion.

### Recommended Measures

1. Establishment of Protective Shelterbelts (Windbreaks).

Purpose: Reduction of wind speed and prevention of soil displacement.

Recommendations: Plant shelterbelts along southern boundaries and roads. Three- to five-row plantations in triangular or layered arrangements are recommended. Suitable fast-growing, drought-resistant, and flexible species include *Populus* spp., *Robinia pseudoacacia*, *Elaeagnus angustifolia*, as well as walnut and almond for long-term ecological and economic benefits. Additional shelterbelt layers may be established at intervals of 300–500 m.

2. Contour Farming and Strip Crop Rotation.

Purpose: Limitation of soil movement and reduction of wind impact.

Recommendations: Crops should be planted perpendicular to prevailing wind direction (east–west orientation). Rotational systems incorporating cover crops such as alfalfa, clover, and mung bean are advised, along with early spring fast-growing crops.

3. Organic Soil Protection and Mulching.

Purpose: Conservation of soil moisture and mitigation of surface wind effects.

Recommendations: Crop residues should remain on the field after harvest. Straw, reeds, compost, or other organic materials may be used as mulch. Drip irrigation is recommended to further maintain soil moisture in irrigated areas.

4. Reclamation of Pastures and Abandoned Lands.

Purpose: Restoration of vegetation cover on degraded lands.

Recommendations: Plant native protective species such as *Ferula*, *Calligonum*, and *Haloxylon*. Regulate grazing pressure through rotational grazing systems. Sandy areas should be stabilized using physical barriers combined with vegetation (e.g., mulberry and acacia).

5. Protection of Water Management Infrastructure.

Purpose: Prevention of wind erosion around canals, ditches, and roads.

Recommendations: Establish tree and shrub plantations along irrigation and drainage channels. Create double-sided protective strips using species such as poplar and oleaster. Ground cover or grass should be planted near water outlets to reduce dust emissions.

6. Awareness, Training, and Monitoring

Purpose: Strengthening farmers' understanding of erosion risks and mitigation practices.

Recommendations: Conduct training seminars and demonstration activities for local farmers. Ensure systematic monitoring by local authorities and water management institutions. Promote farm management systems based on agroecological recommendations.

Wind erosion is a significant ecological issue worldwide affecting agricultural productivity and sustainability. This phenomenon includes detachment, transport, and deposition of soil particles by natural forces such as water and wind. The consequences of wind erosion are extensive, leading to the loss of fertile soil layers, reduction in agricultural yields, siltation of water bodies, and overall land degradation. Preventing soil erosion is particularly important in districts heavily dependent on agriculture, where soil quality directly impacts food security and economic stability.

In recent years, environmental problems have emerged in Bekobod District and its surrounding areas, particularly issues related to soil erosion intensified by agricultural activities and climate change. The historically significant agricultural sector of the district has become increasingly vulnerable to climate variability. Changes in temperature and precipitation patterns affect crop yields and soil fertility, creating challenges for local farmers who depend on stable agricultural production [6].

Moreover, soil erosion has become a pressing issue due to agricultural intensification and deforestation, which is further exacerbated by adverse weather conditions. Efforts aimed at mitigating soil degradation and conserving agricultural land are of critical importance for ensuring food security and economic stability in the district. Although Bekobod has retained its industrial significance and continues to develop economically, the district faces serious environmental challenges related to agriculture, the degradation of fertile soil layers through erosion, and the impacts of climate change. The effective resolution of these problems is essential for ensuring the long-term sustainability and resilience of the district's economy and population livelihoods.

Taking the above into consideration, ten-year data on existing perennial plantations in Bekobod District were analyzed. The results indicate that the area of perennial plantations increased from 1,406 ha in 2015 to 1,742 ha by 2025. As shown by the findings, over the ten-year period, plantation areas expanded by approximately 337 hectares (Table 1). Nevertheless, in certain parts of the district, strong winds occurring during the spring and autumn seasons cause significant damage to the fertile layer of agricultural soils. This demonstrates the need not only to expand plantation areas but also to implement precise and effective land-use planning projects [5].

When wind intensity increases, dust storms are generated. To reduce the negative impact of winds in Bekobod, agricultural fields are designed with widths of 100–120 m, with 5–10 m buffer zones allocated for the establishment of protective shelterbelt trees (Figure 2).

Table 1.

**Analysis of Agricultural Perennial Plantations in Bekobod District (2016–2025)**  
(hectares)

Land Massifs	2016	2020	2025	Difference (+;-)
G'alaba	103,8	110	43	- 60,8
Dalvarzin	124,2	145	63	- 61
Dehqonobod	47,1	53	35	- 12
Farxod	12,5	13	7	- 5,5
Xos	33,1	56	52	+ 19
O'zbekiston	151,3	163	99	- 52
A.Navoiy	66	61	42	- 24
Avangard	56,5	66	65	+ 9
Bekobod	133	201	152	+ 19
Bobur	39,3	109	26	- 13
Do'stlik	66,2	115	51	- 15
M.Ulug'bek	156,4	216	157	+ 1
Mavlonov	70,9	83	58	- 13
Navbahor	246,9	314	314	+ 68
Oybek	65,9	77	60	- 5,9
Turon	5,4	5	10	+ 5
Yangi xayot-Sholikor	29,5	28	12	- 17
Other auxiliary farms	0,4	0,4	496	+ 495
<b>Total perennial plantations:</b>	1406	1815	1 742	+ 337

\* Total land area of the district: **74,969 ha**

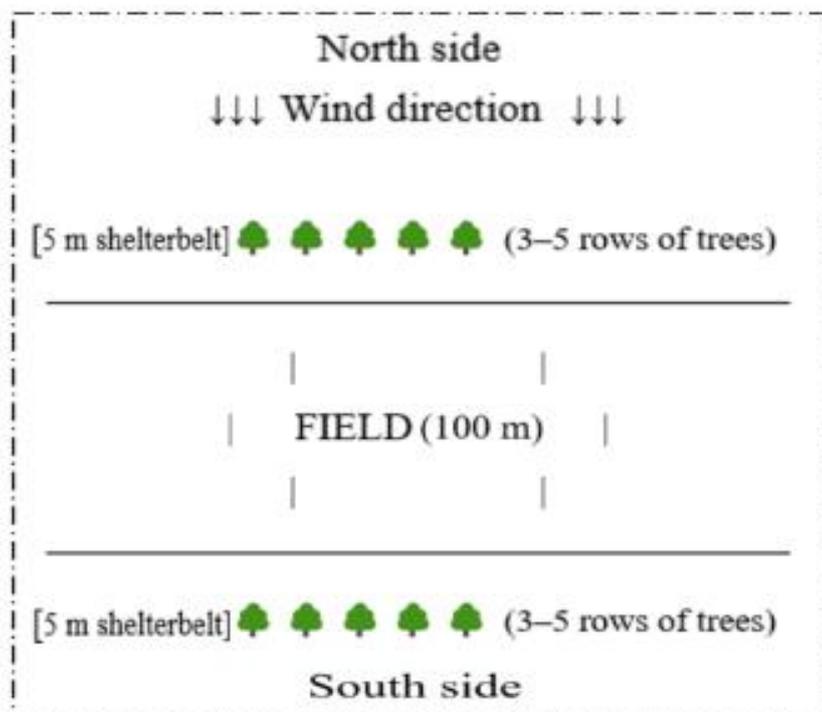


Figure 2. Scheme for planting shelterbelt trees with 5 m spacing in 100-meter-wide fields, proposed by the author.

The use of shelterbelt trees to protect agricultural crop lands from wind, stabilize soil, and increase productivity is widely practiced in the district. The proposed recommendations and the presented scheme have been shown to positively influence the effectiveness of ongoing practical measures.

**Conclusion, proposals, and recommendations.** Based on the climatic and soil conditions of Bekobod District, measures such as windbreaks, contour farming, and mulching are effective and economically feasible. Additionally, engineering and organizational measures should be implemented in coordination with biological interventions.

In the first row of the shelterbelt, trees such as poplar, elm, and maple are planted, while the last row consists of mulberry or fruit trees. Until the trees mature, it is necessary to carry out agrotechnical measures against wind erosion between them.

Currently, in areas such as Mirzacho‘l, Qarshi deserts, and newly developed land plots in Central Fergana, shelterbelts have been established considering prevailing wind directions, and this measure serves as a continuous and ongoing protection strategy.

The shelterbelt protects crops and cultural seedlings from dust storms and wind erosion until the shelterbelt trees reach maturity.

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