



## Features of projects for the establishment of protected areas for the protection of agricultural lands in the Khavos district of the Syrdarya region

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This article analyzes the causes, effects, and countermeasures of arable land degradation, which is currently becoming a global environmental problem, the stages of developing projects for the organization of green spaces and land development projects, and several important factors in the use of land resources.

**Keywords:**

agriculture, degradation, cropland, erosion, forestry, parks, trees, irrigated.

**Introduction:** Khovos district is located in the Syrdarya region of the Republic of Uzbekistan. Geographically, it borders Boyovut district to the northeast, Bekobod district of Tashkent region to the southeast, the Republic of Tajikistan to the south, Zomin district of Jizzakh region to the west, and Sardoba and Mirzaobod districts to the northwest. The total area of the district is 621 km<sup>2</sup>. The climate of the district is sharply continental, characterized by hot and dry summers and cold winters. The average annual air temperature is approximately 15°C. In January, the average temperature is -2°C, with absolute minimum temperatures reaching -30°C. In July, the average temperature is 30°C, while maximum temperatures may rise to 46°C. The annual precipitation averages 315 mm, ranging from 200–250 mm in the northwestern part to 400–450 mm in the southern areas. One of the most significant climatic features of the region is the Khovos (Bekobod) wind, recognized as one of the strongest winds in Central Asia. Strong winds are observed on

average 48–52 days per year, typically beginning in November and lasting until March. During winter, wind speeds reach 25–30 m/s, while in summer they range between 10–15 m/s. Wind events may persist for 1–3 days and occasionally up to five consecutive days. The vegetation period in the district lasts approximately 224 days.

Agricultural lands in the district are irrigated through the Southern Mirzachul Canal named after Sarkisov, which originates from the Syrdarya River. The average population density is 49,4 persons per km<sup>2</sup> (2004 data).

The first field ecstasy forests in the irrigated lands of Central Asia were established in the 1930s. In the lands of Mirzachul and Central Fergana, systematic planting of ecstasy trees began in 1957. By 1990, field ecstasy forests in the Republic of Uzbekistan covered an area of more than 40 thousand hectares.

Field forest stands are divided into main and auxiliary types. The main field forest stands are located perpendicular to the direction of the

prevailing wind, and the auxiliary ones are located perpendicular to the main zone. The reclamation effect of forest stands depends on their shape and structure (construction). By their construction, field forest stands are divided into 3 main types;

windproof (dense) structure forest stands (complex multi-tiered forest stands with the same density on the bottom and top, almost impervious to the wind);

lattice forest stands (2- and 3-tiered forest stands evenly spaced along the entire vertical profile; wind flow can pass through the forest stands);

partially wind-permeable forests (in the upper part there are dense branches, and in the lower part there are gaps between the tree trunks, the width is 2,5-3,5 m).

The parameters of field forests are determined depending on the wind movement indicators of a particular area. For example, Uzbekistan is divided into 3 forest reclamation regions;

areas with strong wind movement (wind frequency up to 60 days per year, speed more than 15 m/s; maximum speed 30 m/s and higher);

areas with moderate wind movement (wind frequency 10-15 days per year; maximum speed 25 m/s);

areas with weak wind (wind speed more than 15 m/s, 3-7 times per year).

In the first group, a windbreak covering 25-35% of the entire profile is effective, in the second group - 40-50%, and in the third group - partially windbreaks.

In arable lands, these indicators are: 45-55%, 50-60%, 70-75%, respectively. Fields are well protected from strong winds by forest hedges. In irrigated areas with strong winds, it is advisable to have 3-4 rows of trees in the main hedges, 3 in the average wind zone, and 2 in areas with weak winds. Auxiliary hedges consist of 2 rows (in arable lands, 5-6, 4-5, 4 rows, depending on the zone). In irrigated areas in strong wind zones, the distance between the main fences is 250-350 m, in the average zone it is 300-400 m, and in weak wind zones it is 400-500 m; the distance between auxiliary fences is 800-1000 m.

In irrigated areas, field-lined forests are established from fast-growing and economically useful tree species (oak, sycamore, bolle poplar, black poplar, white acacia, blackthorn, maple, sycamore, mulberry, etc.), and on saline soils, it is recommended to plant salt-tolerant trees (alder, sycamore, white acacia, Bolle poplar, mulberry, aylant - stinking tree, felt, etc.).

**Research object and methods:** The object of the research work is the arable land and adjacent land plots of land users (all types of rights) in the Khavos district of the Sirdarya region.

Tree cultivation and maintenance are carried out using specialized silvicultural and agrotechnical methods developed with consideration of local soil and climatic conditions. Field shelterbelts contribute significantly to increasing crop productivity. Fields protected by shelterbelts demonstrate yields that are 8-10 centners per hectare higher than those of unprotected fields.

Shelterbelts are typically established on deeply plowed soils during autumn or early spring. Their maintenance includes agrotechnical measures such as soil loosening, weed control, and protection against pests and diseases, as well as silvicultural practices including pruning of dried or diseased branches and removal of root suckers.

Natural forest regeneration occurs without direct human intervention. Forests regenerated naturally tend to be more resistant to pests and diseases, have longer lifespans, and provide higher long-term economic efficiency due to lower labor and financial inputs. However, in many regions of the Republic, natural regeneration processes remain extremely limited.

One of the primary constraints to natural regeneration is uncontrolled livestock grazing. For example, in mountainous areas, natural regeneration of juniper species is barely observable. While certain shrubs and semi-shrubs such as mountain cherry, hawthorn, rosehip, and cotoneaster are expanding in area, valuable tree species such as walnut, pistachio, maple, and others are declining. Therefore, artificial reforestation through seed sowing or seedling planting remains the principal method

of forest restoration. In sandy regions of the country, 80–90% of artificial forests are established through direct seeding. In mountainous and irrigated areas, afforestation is mainly carried out by planting seedlings.

Seedling-based plantations typically exhibit faster initial growth compared to seedlings emerging from direct seeding. However, forests established through direct seeding often develop stronger root systems and demonstrate greater biological resilience.

The establishment of artificial forests does not necessarily require specialized nurseries when direct seeding methods are used, and sowing is generally less labor-intensive than planting seedlings. Nevertheless, seed-based afforestation is highly dependent on climatic conditions. Artificial forest plantations involve activities aimed at restoring forests. The term “afforestation” refers to establishing forests in areas that were previously covered by forests (such as fields, lands unused in agriculture, sandy areas, and cliffs), in empty spaces between existing forests, on lands cleared of trees, in areas where planted seedlings have failed to grow, and in pastures, either by planting seedlings or sowing seeds.

The primary objective of afforestation is to create various shelterbelts, plantations, and green barriers in mountainous, desert, and irrigated regions, as well as along roads, fields, shorelines, cities, villages, and workers’ settlements. In desert pastures, green belts also help prevent soil erosion and increase land productivity. Soil preparation is frequently a critical prerequisite in establishing artificial forests, as it plays a significant role in ensuring seedling growth, survival, and development during the first year.

The main purpose of soil preparation is to enhance its physical properties, moisture and temperature regimes, and mineral nutrition, while simultaneously removing weeds. When these activities are carried out at a high agro-technical standard, they provide optimal conditions for creating resilient and highly productive forest plantations. Research has demonstrated that soil preparation can

influence the growth of planted seedlings for up to 10–15 years. Shelterbelt plantations are established on slopes with inclinations of 4–6 degrees or more. Trees are arranged in rectangular plots, with the long side of the rectangle accommodating the main rows and the short side accommodating supplementary (assistant) rows. The main rows are generally oriented perpendicular to prevailing strong winds, while the supplementary rows are arranged crosswise to the main rows.

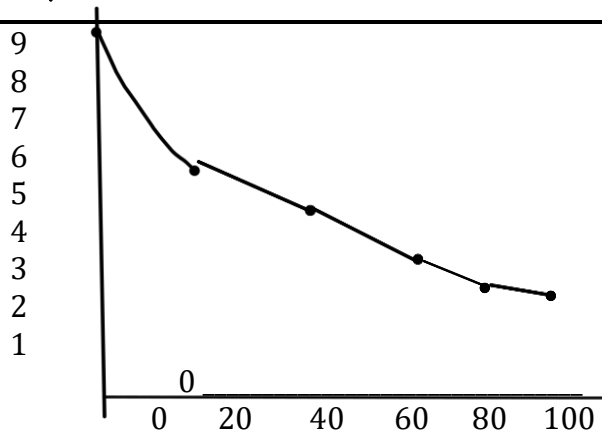
In designing shelterbelt plantations on irrigated and arable lands, the biological characteristics, environmental conditions, and intended purposes of each species are carefully considered. The main focus in plantation design and planting is the selection of tree species composition and structure. The structure of shelterbelts depends on site-specific wind conditions and varies according to tree species and cultivation practices. In irrigated areas, shelterbelts are generally established using fast-growing, long-lived, and resilient tree species. Common trees include oak, white poplar, ulmus intermedia, white acacia, green ash, ash, and Crimean birch. Shrubs commonly used include red svidina, amorpha, bird cherry, scoparia, Japanese quince, currant, and caragana.

The structural design of shelterbelts significantly influences wind flow. Wind approaching the plantation from a single direction enters the plantation and alters its course. Part of the wind passes through the gaps in the plantation, while another portion flows over the top. The proportion of wind passing through gaps versus over the top depends on the density of the plantation. For instance, in dense windproof shelterbelts, most of the wind impacts the trees and flows over them, with only a small portion passing through the gaps. The sparser the branches and trunks, the more wind passes through; conversely, denser plantations allow less wind to pass overhead. This effect is illustrated in Graph 1.

Improving methods for developing projects for the establishment of protected areas.

Region: Syrdarya region

Relationship between tree density and wind speed.

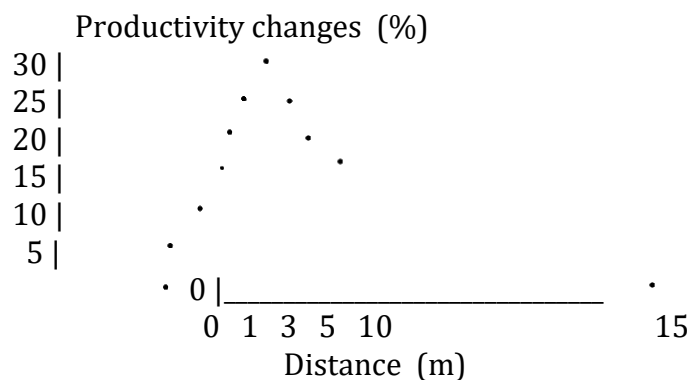


**Graph 1.** Effect of canopy density on wind speed.

Tree density (%)	Description	Wind speed decrease (%)	Explanation
0 %	There is no forest	0 %	The wind moves freely
20 %	Very rare	10-20 %	Creates a partial barrier
40 %	Rare	20-35 %	The protective effect is felt
60 %	Medium density	35-50 %	Effective protection
80 %	Dense	50-70 %	Strong wind drop
100 %	Very dense (like a wall)	40-60 %	Turbulence increases at the rear

Regardless of the structure of shelterbelt plantations, when wind approaches a plantation, it is forced to rise and pass over it. As the wind flows over the trees, it splits into two parts: one part is directed downward, while the other continues to rise (Graph 2). After passing through the plantation, a wind vortex forms in the protected area. In such sheltered zones, the reduction in wind speed increases air turbulence. This effect is more pronounced during hot summer days, while in winter, it can blow away snow, leaving the topsoil exposed and unprotected.

In windproof shelterbelts, within the protected zone, the wind flow is distributed into the lower layers at a height of 5-7 meters above the ground. In rectangular shelterbelts, because the wind passes through the gaps between branches and trunks, the wind moves more slowly, and the protective effect extends up to a height of 15-18 meters. In highly permeable shelterbelts, wind passes through with less resistance, resulting in a protective zone that extends significantly farther than that of rectangular plantations.



**Graph 2.** The impact of trees on crop productivity

**Graphic explanation:**

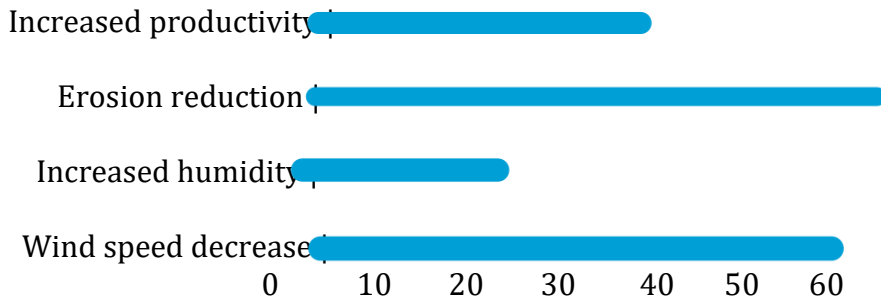
**0–1 m** - reduced productivity (shade and root competition)

**3–5 m** - maximum positive impact (highest yield)

**5–10m** - positive impact is maintained

**15 m away from** - almost no side effects

## Ecological efficiency of tree plantations %



**Graph 3.** Ecological Efficiency Indicators of Shelterbelt Plantations

**Effect of shelterbelt plantations on ground surface temperature.** Shelterbelt plantations reduce wind speed and air turbulence, which in turn decreases heat exchange at the soil surface. In windproof shelterbelt structures, air temperature in the protected zone during the daytime can be 1–3°C higher than the surrounding area, and in some cases even more. In rectangular shelterbelts, the temperature increase ranges from 0,4 to 1,2°C, while in highly permeable shelterbelts, changes in air temperature are negligible.

The elevated air temperature within the protected areas has a positive effect, especially during the early growth stages of cereal crops. Adequate heat is essential for the proper development of these crops.

The beneficial effects of higher air temperatures are particularly important for heat-loving crops such as maize, cotton, and vegetables. The more thermal energy available, the better these crops grow and develop.

Effects of shelterbelt plantations on plant growth and microclimate, in certain weather conditions during the plant growth period, the elevated air temperature within windproof shelterbelt plantations can have negative effects. In years with high precipitation, excessive temperature increases in the protected zones, combined with reduced wind flow, can promote the development of fungal

diseases in the intermediate areas of the shelterbelt.

However, the negative effects of rectangular and highly permeable shelterbelt structures are minimal. The temperature between two shelterbelts has a positive impact on fruit trees. For example, during early spring, cold air can adversely affect the flowering stage of fruit trees. If the temperature drops 4–5°C below the critical level, fruit blossoms may freeze, resulting in the loss of that year's harvest.

Shelterbelt plantations also influence nighttime air temperature, reducing soil surface cooling. This occurs because reduced wind and the absence of vortices prevent mixing between cold near-surface air and warmer upper air. Evaporation processes in the gaps between shelterbelts further protect the soil from excessive cooling. As a result, the soil does not freeze, young seedlings are not damaged by frost, and plant growth proceeds effectively.

Air temperature within shelterbelt gaps is also affected by field conditions, such as stubble left after wheat harvest, growing cereal crops, and forage plants. In protected areas, air temperature is higher during early summer mornings, gradually decreasing by noon. Occasionally, the temperature within shelterbelt zones can be 2–3°C lower than surrounding areas.

In regions with strong winds, the air temperature under rectangular shelterbelt protection is 0,2–2,4°C higher than unprotected areas in April and May, and 0,3–3,5°C lower in June and July. Warmer temperatures during spring create favorable conditions for the germination of grains.

It is known that air temperatures above 30°C in pastures negatively affect the physiological processes of cereal crops. During the milk stage, if the temperature rises to 35–40°C, grains can be damaged or destroyed. In rectangular and highly permeable shelterbelt structures, temperatures are lower compared to open fields, providing a positive effect on cereal crops. The reduction of wind speed by 50–70% within shelterbelt gaps slows down evaporation, which in turn helps preserve soil moisture and moderate high temperatures. This contributes to creating a more favorable microclimate for crop growth during hot periods. Effects of shelterbelt plantations on solar radiation and air humidity. Shelterbelt plantations help moderate incoming solar radiation. As a result, they create favorable conditions for plant growth, improve metabolic processes, and contribute to better grain filling in cereal crops.

**The effect of groves of trees on air humidity.** The influence of shelterbelt plantations on air humidity depends on wind speed, variations in turbulent airflow, and fluctuations in near-surface air temperature.

Scientific observations conducted by the Uzbek Research Institute of Forestry at the G'allaorol and Qashqadaryo stations between 1961 and 1969 revealed that the relative humidity within rectangular and highly permeable shelterbelt plantations was 3–6% higher compared to open fields. Specifically, in rectangular shelterbelt protected zones: During 07:00–09:00, the average relative humidity from May to September was 53%, compared to 49,4% in unprotected areas. During 12:00–14:00, relative humidity was 40,5% in the protected zone, compared to 36,6% in control

plots. During 17:00–19:00, relative humidity was 38,2% in the protected area versus 33,6% in the control. Thus, relative humidity in rectangular shelterbelts was 13,3% higher in the morning and 15,6% higher in the evening compared to daytime values.

In highly permeable shelterbelts, scientific observations in cotton fields showed that relative humidity at 07:00–09:00 from April to the end of August averaged 55,4% in protected areas versus 49,2% in unprotected areas. At 12:00–14:00, humidity was 32,4% in protected fields and 29,2% in control plots, while at 17:00–19:00 it was 30,4% in protected zones versus 29,2% in unprotected areas.

For cotton fields protected by rectangular shelterbelts, relative humidity at a height of 1,5 meters above ground in the morning (07:00–09:00) was 53,4% in protected plots versus 52,8% in unprotected plots. At 12:00–14:00, it was 36,0% in protected areas and 34,6% in controls; at 17:00–19:00, it was 34,5% in protected zones compared to 29,0% in controls.

In six-year-old rectangular shelterbelts protecting cotton fields, relative humidity in the morning at the height of the cotton plants was 6–14% higher than in unprotected areas, while during midday and evening hours it was 4–6% higher.

Effects of Shelterbelt Plantations on Agricultural Productivity and Recommendations. After the establishment of shelterbelt plantations, their positive influence on microclimate generally increases after 3–4 years in irrigated lands and 4–5 years in rainfed lands. In highly permeable shelterbelts, morning relative humidity reaches 9–19%, while in unprotected areas it is 10–12% at ground level. In areas protected 150–200 meters from the shelterbelt, relative humidity reaches 20–22%. Maximum relative humidity of 24–28% is observed at a distance of 80–120 meters from the shelterbelt in protected crop fields (Table 1).

1-table

**Based on agrotechnical experiments in the areas where ichthyosaurs were established, the following were identified:**

Indicator	Unprotected Area	Protected Area	Increase (%)
Cotton Yield (c/ha) (s/ga)	20-25	30-35	+20-25%
Cereal Yield (c/ha)	40-45	55-60	+25-30%
Vegetable and Melon Crops	Lower	Significantly higher	+20-30%

**Considering local natural conditions, the following effective shelterbelt schemes are recommended:**

Type of Shelterbelt	Species Used	Number of Rows	Benefits
Belted Shelterbelt	3-5	Trees + shrubs	Most effective; stable wind barriers
Transverse Shelterbelt	2-3	Mainly poplar, elm	Cuts wind; reduces erosion risk
Roadside Shelterbelt	1-2	Willow, ulberry, artemisia	Protects from dust; aesthetic improvement

Planting one shelterbelt every 100–150 meters can reduce wind speed by 40–50%.

Conclusions from Graph Analysis shows that shelterbelt plantations in Sirdaryo region improve the microclimate of crop fields, reduce soil erosion, and increase crop yields.

**Research findings and discussion.** Effective technologies have been developed to restore soils in arable and saline lands. Combining chemical, biological, agro-technical, and mechanical methods reduces soil salinity and improves fertility.

New irrigation systems (micro-irrigation, drip systems, and surface coverage irrigation) adapted to soil conditions can enhance water use efficiency, reduce soil salinity, and increase crop productivity.

Practical recommendations to improve the economic efficiency of land reclamation projects include optimizing costs for land restoration and improving irrigation and fertilization systems.

Special technologies have been developed for establishing shelterbelts to protect agricultural lands. Research-based selection of effective plant species, creation of

suitable conditions for their growth, and soil improvement techniques are recommended

**Conclusion, proposals and recommendations:** In summary, field shelterbelts effectively preserve the fertile layer of arable lands, prevent soil erosion, and maintain long-term productivity. As a result, large areas of agricultural lands remain suitable for farming.

Key recommendations include:

Plant trees, grasses, and shrubs that protect the area from wind and water flow and prevent soil acidification.

Implement crop rotation, alternating different crops in fields.

Apply modern systems for re-cultivating fallow fields.

Avoid excessive tillage of dry soils and regulate livestock grazing in pastures

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