

Vegetative Methods to Prevent Wind Erosion in Central Anatolia Region

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Abstract Wind erosion is the phenomenon of transportation of worn-away soils and their accumulation in any other place by the action of wind. Wind erosion affecting factors are human affect and natural factors and those natural factors are climate, soil and vegetation. Widespread wind erosion areas in Turkey are the arid and semi-arid areas. Those areas are located in South-East- Anatolia and Central-Anatolia region in Turkey. Wind erosion formation of the total area is of 465,913 ha, approximately 70% of these (322,474 ha) is located within the borders of Konya Closed Basin. The main factors of effective wind erosion creation in Central Anatolia; annual less and disorderly being rainfall amount, high wind blowing, early and over-grazing, using some plants as fuel, inappropriate land use, unsuitable machinery and equipment. Wind erosion area of Konya-Karapınar the reclamation work in the field as the continuation of each other was conducted in two stages. First physical measure (reed-screen curtains), the second is cultural measures (planting and reforestation). Cultural measures are used as herbs (*Agropyron cristatum*, *Onobrychis sativa*, etc.) and trees are (*Elaeagnus* sp., *Fraxinus* sp. *Robinia pseudeaccucia*, etc.), which dry and hot-resistant plants were selected plantation. There are two different kinds helpful of vegetation in the erosion area. One is biologically and other is mechanical. The biological benefits increase soil organic matter and soil structure formation to serve. Mechanical benefits are breaking wind speed against to prevent erosion. In this study, Konya Closed Basin was examined in terms of meteorological, soil and vegetation, in the direction of desertification prevention. The work done by the success of the new measures has been put forward to be taken. Obtained developing alternatives have been successfully applied to the rest of the desert climate, in or other the regions.

Keywords: Desertification, Xerophyt plants, Wind erosion, Konya, Soil, Sand.

1. Introduction

Wind erosion generally occur at flat topography of arid and semi-arid climatic zones and in areas close to the level, in light and medium soil structure, soil when dry and plant absent coverage [1]. It has also damaged the place moved up where eroded soil. For this reason, it should be trying to stop at the where point starts. Wind erosion problem often occurred places in Turkey are located widespread areas of arid and semi-arid regions. Large parts of this area are included in the mid-Anatolian region (98%) and especially in the Konya province (69%) (Table I).

Wind erosion areas, according wind erosion severity of the Konya province and Turkey and the distribution is shown in Table II. Karapınar land (103.000 ha, 22.1%) is the most important place for wind erosion problem in Konya districts even Konya province in Turkey [3].

The formation of wind erosion influential factors in the region;

- An ancient lake bed and surface area of the lake dried out, the base of the dunes and the land is suitable for convection.
- It is hot climate and dry terms (total rainfall 260-280 mm per year, mean. annual temperature 11-12 Co), wind and rainfall are irregular.
- It is created an excessive number of animals; pasture early, excessive and unplanned grazing.
- Unsuitable cultivation and usage of the wrong tool machines [3,5,6].

Climate and soil characteristics of The greatest wind erosion occurring Karapınar and around places are as follows. The area consist of alluvial, colluvial, sieorezem and regosol soils which have a texture of light sandy loam on upper layers and of heavy clay on lower layers. They are rich in lime and potash and poor in organic material and phosphorous. Climate of the region can be defined as semi-arid continental. The summers are dry and have warm day-temperatures, followed by cold

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nights. The winters are usually cold with an verge of twenty day a year in which the soils are covered with snow. Greatest amount of snow falls in January and February. Average annual precipitation in the area is about 270 to 280 mm, about 40% falls in winter. During the growing season rainfall normally amount to only 90 to 120 mm and is not enough for crops that are not irrigated. Average temperature is 11 Co .The nights are cold in winter. In time the temperature is falls below -20 Co or lower. In summer the temperature is often between 30 and 35 Co and is occasionally above 35 Co. The dominant winds are commonly from south-western corner, mainly from south, south-west and rise to dust storms that are disagreeable and destructive. Stormy days are common and wind attains speeds of 20 to 25 m/sec or more. The average relative humidity between about 40 % in summer to 80 % in winter [4].

Table 1. Cities in Turkey affected by wind erosion areas [2]

Cities	wind erosion areas (ha)	%
Konya	322.474	69.22
Niğde	122.741	26.34
Kayseri	12.894	2.77
Kars	2.910	0.62
İçel	2.552	0.55
Sakarya	2.342	0.50
Total	465.913	100.00

Table 2. Distribution of wind erosion according to the severity i Turkey and Konya Province [1,3]

Erosion Intensity	Wind Erosion Areas in Turkey (ha)	Wind Erosion in Konya (ha)	Shares in Konya Province (%)
Low	165.664	124.521	36.61
Medium	231.041	138.794	43.04
Severe	64.385	56.678	17.58
Very Severe	4.823	2.481	0.77
Total	465.913	322.474	100.00

2. Natural Flora of Wind Erosion Places in Located Central Anatolia

Central Anatolia flora formed as the majority of the xerophytic plants (xerophytes). For this reason, this place of Central Asia as a part was characterised by some scientists as step and some others semi-arid deserts. Altitude above sea level of Central Anatolian plateau varies between 800-1100 m. is Most wind erosion occurring places of Karapınar is formed from neolithic lake beds land and covered in volcanic ash soils with fine particles [7,8]. The some plants are found natural flora of this place and around; *Artemisia santonicum*, *Salvia cryptantha*, *Astragalus microcephalus*, *Plomis* sp., *Trigonella monantha*, *Atriplex convulvulata*, *Alyssum strigosum*, *Moltkia coerulea*, *Centaurea picris*, *Briza humilis*, *Poa bulbosa*, *Bromus tectorum*, *Noaea mucronata ssp.mucronata*, *Bromus tomentellus*, *Achillea willhelmsii*, *Anthemis fumariiflora*, *Ceratocephalus falcatus*, *Cousinia birandiana* etc. and especially the sandy, wind erosion, which is where *Artemisia scoparia*, *Papaver argemone*, *Bromus madritensis*, *Anchusa hybrida*, *Marrubium parviflorum*, *Astragalus strigillosus*,

Agropyron cristatum, *Trigonella auronitica*, *Consolida orientale* etc. were found. In these places, there are few amounts of *Centaurea pulchella*, *Phleum exaratum*, *Thymus sipyleus*, *Scabiosa ucranica*, *Stipa lagascae*, *Alhagi pseudoalhagi*, *Centaurea urvillei*, *Agropyron orientale*, *Onobrychis armena*, *Kochia prostrata*, *Ziziphora tenuior*, *Astragalus ovalis*, *Phleum exaratum*, *Bromus squarrosus*, *Alyssum micranthum*, *Allium stamineum*, *Muscari longipes* etc. [7].

The majority of volcanic ash and the former lake bed of sand in the soil pose a severe wind erosion started at step excessive grazing pasture, burned, dismantled and converted to agricultural land in the field machine[7,9]., some halophytic dune plant associations formed with adaptation to the natural sand dunes and dune environment. Different plants in coverage plant union development contain parallel to dune phase development [10]. Some of the most important dominant plant species in these places is the *Artemisia scoparia*, *Astragalus microcephalus*, *Astragalus christianus* and *Salvia cryptantha*. This species grow going through the soil of perennial and deep roots, and flight bag in the form of a sand dune which are in keeping features. Places around this plant contains high sand ratio in the soil, lime rate and pH [7]. 25-30 among specified quality grass species 1945-50 years was found in Karapınar pasture grass type, but only 4-5 in 1963. This grass species was not wanted the grass species by animals [11]. Still wrong use of pasture continued today.

3. Works around Wind Erosion Region

Vegetation was destroyed with different factors in arid and semi-arid areas of sand dune formation and going harmful movement (such as Karapınar-Konya sand dunes). A different plant occurs rarely constantly changing on the dunes as other than shrub or tree. Because, plants can not be developed at surface of the dry dunes in the dry season [10]. Wind curtain statement was used to protect to buildings, gardens, fields and other facilities from wind damage for the purpose of the mechanical and plants were used all kinds of obstacles. The young vegetation disappeared without forming vegetation without creating any blocking effect of wind moving through the sand dunes planted. Therefore, vegetation grown the direction perpendicular to the wind one side by cutting the material to keep the speed, on the other hand prevents further removal of material [5].

Studies conducted in two stages realized against wind erosion in Konya Karapınar.

1. Physical measures (the reed screen construction)
2. Cultural measures (A-Planting, B-Afforestation) [6]

3.1. Physical Measures

Reduce to advanced erosion and planned performing wind-breaking the prevailing winds in the direction perpendicular to wind prevent devastating effects (wood and bamboo curtains(reed), shrubs fences, rocks, etc.). These measures are extremely effective against wind erosion and to stop sand dune in order the move and keep in the place [1]. Appropriate and economic measures for the region should be selected in physical measures. Most suitable curtain rod for Karapınar is selected [2,6].

Used materials in the establishment were made up cane, wooden stakes, wire, nails and lath (see Figure 1). Obtained

canes are used after two months dried. Reed curtains must be perpendicular to the dominant wind direction to according sand dunes topographic conditions of the land and of prevailing winds. Curtain height is between 1.25-2.00 m, in order of the between the two screens in land slope, should be interval according to wind speed of 8-10 times the screen height. Reed screen to be fixed with wooden stakes every 2 m from the land (Fig. 1) [1,2,6].

Reed curtains benefits: 1 - Helps preventing wind erosion. 2 - Reduces moisture loss in the soil. 3 - Shade protects crops burning from the sun. 4 - Prevents snow drift during the snow precipitation [2].

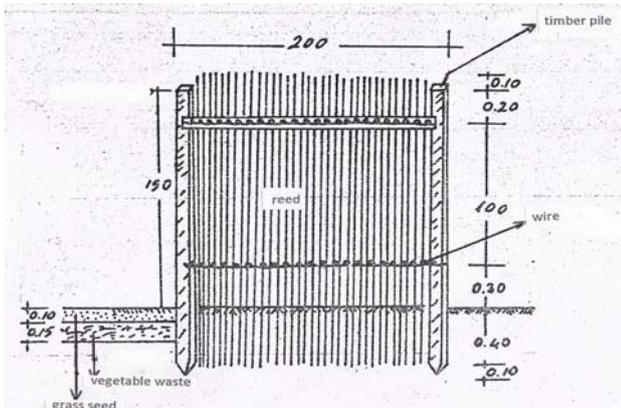


Fig. 1 Structure and shape of reedy application in Karapınar [2,6]

3.2. Cultural Measures

It is difficult to provide a protective vegetative cover for wind erosion occurs in arid and semi-arid regions to combat erosion [5,12]. The grass covers and continues to create in the forest is possible perform the stabilized dunes [5]. Wind erosion destruction will be the inversely proportional to surface vegetation amount [2].

The main control methods for this purpose are reducing mobility of sand dunes with plants (phytobonification) and fixing sand with fast growing xerophytes (psammophyllus) plants [8].

A-Planting: Between the bamboo curtains in Karapınar has been grass planted after bamboo curtain made. Goal in here is to stop the movement soil and sand off the surface thoroughly. Dry and heat-resistant plants (*Marrubium parviflorum*, *Astragalus microcephalus*, *Alhagi camalorum*, *Artemisia* sp.

etc.) widely used the pasture weed seeds collected from grass area together other plants. In this region, first time *Secale* sp., *Agropyron cristatum*, *Agropyron elongatum* was used [6] in addition, *Koeleria cristata*, *Festuca ovina*, *Agropyron intermedium*, *Onobrychis sativa*, as well as *Poterium sanguisorba* were also tested today.

B-Afforestation: Finally forestation has been worked in Karapınar after grassing to stop sand movements completely and as long-lasting measures [6]. Plants should be preferred suitable for dry and wind-resistant deep-rooted fast-growing, branching from the bottom of certain size and long-lasting ones which wood pitch for the establishment of the selected trees and shrubs of the region's climate and soil characteristics (Fig. 2) [2,4-6]. Used plantations in the selection of seedlings are a good indicator selected in the areas close to plantations grown as a natural plant community. It is necessary to prefer local experience instead of brought plant from outside as the selection of species. Combination each other the species recommended more than one type of plant. Planting one plant species alone is more vulnerable to pests and diseases. Plant species competition with each other in groups can be planted pure or mixed. At combination occurring places, substitute stock of seedlings or saplings production location must be created for plants negative affected from biotic and a biotic damaged. After seedlings planting and loss prevention should be taken care measures of this place and performed some maintenance [5]. The ground soil must be protected well-organized at wind breaking -range of trees generation and must be perpendicular to wind direction [5,13]. Trees planting time or after at strong dryness location can be applied mulch process [13].



Fig. 2. Wind-breaking trees bands and stripped cultivation method applied way in the agriculture land [6]

Annual high tall plants (*Sorghum* sp., *Helianthus annuus* etc.) can be planted at two sides of the seedlings to protect the young tree seedlings strips [5].

Tree species grown in the Karapınar erosion area are as follows; *Elaeagnus* sp., *Fraxinus* sp., *Robinia pseudeacacia*, *Ulmus* sp., *Acer* sp., *Amygdalus* sp., Prunus mahalep, Black pine, cedar trees, such as were planted pure and mixed [6]. Pear, apricot and fruit trees were planted at some places after enhancement of the irrigation wells. The wind speed breaking and soil protection by vegetation and other benefits are important. Some of them such facilities; 1-It will prevent wind drift of the soil move. 2- It will reduce water loss in soil and plants. 3- It will prevent plant mechanically from the negative effects of wind. 4- It prevents snow transport at snowing places. 5-It gives aesthetic value at treeless area. 6- It has many benefits and prevents losses with increasing snow. Similar studies with Turkey have been made in the world in different ecological zones and accordance with these methods. For example, Takyr area in Turkmenistan were planted with *Haloxylon aphyllum*, *Salsola richteri* and *Tamarix* sp. for pasture plant for the wind-breaking [14].

However, there are sandy areas xerophyte plants in Turkmenistan. Some of these grass-type ones are *Carex pachystylis*, *Carex physodes*, *Eremopyrum* sp., *Bromus* sp., *Poa bulbosa*, *Artemisia* sp. etc., and those who are commonly in the form of shrubs are *Calligonum* sp., *Salsola richteri*, *Haloxylon persicum*, *Haloxylon aphyllum* ve *Ephedra* sp. [14].

4. Conclusion

Generally, the work force of taking measures against wind erosion is covered to prevent wind erosion and transportation. An important thing is in this study that it is difficult to put obtained results of these studies in the diligently success to protect and sustainability in the areas. It is necessary to apply range management rules at pasture areas, planning ecological production structure at agricultural fields and gardens and must be given priority to training works, too.

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