The Greening Desert Of Karapinar: An Example from Turkey

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Abstract: In Turkey, there is an area of 465.913 hectares which is subject to wind erosion. 103.000 hectares of this area is in the Karapınar district of Konya province. The Karapınar district of Konya faced the risk of emigration in the 1960s because of reasons such as that the region was an old lake bed and the climate of the region was extremely hot, soil properties etc. The soils lost their yield capacity, the dunes rose, clouds of dust and sand storms made life difficult for the people living in the area as the result of erosion in that period. Because of these problems, the first studies started in 1962. An area of 160.000 decares was taken under control. As the result of approximately 47 years of improvement practice, which constitutes the topic of this paper, today, activities aimed at research and production are also being maintained in Karapınar.

Key Words: Desert, dune, improvement practice, sand storms, wind erosion.

Introduction

Agriculture is practiced on the 28 million hectares of the 78 million hectares total area of Turkey. The lack of the development of a sustainable agricultural policy and the human effect have caused a decrease in organic matter, resulted in the loss of soil aggregation and the dispersion of soil structure, and also, together with bad climatic effects, caused the occurrence of wind erosion in cultivated areas.

Wind erosion in Turkey is commonly seen within the borders of Konya, Niğde, Kayseri province, which is located in the southern part of Central Anatolia, and Kars province in the east, both of which are areas under the effect of an arid and semiarid climate (Anonymous 2007).

Karapınar county of Konya is located in the most arid region of Turkey with the lowest precipitation; consequently, it is most affected by aridity and desertification. For this reason, the first disaster related to the problems of aridity, climatic change and desertification experienced in our country occurred in this region.

In Turkey, wind erosion is observed as a problem varying from light to severe on an inland dune area of 465.913 hectares. Approximately 70% (322.474 hectares) of this area is located within the borders of Konya province (Anonymous 1975), and 103.000 hectares of this area are located in the Karapınar district of Konya. This area constitutes the 22.1% of the area of wind erosion throughout the country (Yıldırım 1999).

Reasons for the Occurrence of Wind Erosion in Karapınar

In the 1960s, the people living in the Karapınar district of Konya were at risk of emigrating from the region as the result of the wind erosion that occurred in that period. There is an inland dune in the South-Southwest of the district which covers an area of 4000 hectares.

The soils lost their yield capacity and sand dunes occurred as the result of erosion; it was observed that clouds of dust rose and cars on the Konya-Adana Highway were dragged and the paint of the cars was totally or partially damaged. Children could not go to school because of sand storms, machines did not work, and the incidence of ear-nose-throat diseases increased among the people. Winds that cause erosion in this region blow from the South-Southwest, and it was determined that the wind speed reached 110 km/h in the month of March in 1962(Anonymous 2007).

We can list the primary factors that cause wind erosion to be effective in the region as follows:

This region was an old lake bed, therefore, the lake dried and the dunes that were on the base of the lake rose to the surface, the climate of the region is extremely hot and arid, animal husbandry was highly common and excessive grazing was practiced in the pastures, some plants (*Astragalus micracophalus*,*Salvia cryptantha, Verbascum mucronatum*) which the animals did not like but supported the soil were pulled out by the people and used as fuel, pastures were destroyed, the use of disk ploughs which overturned and broke the soil increased erosion in the region where fallow-cereal rotation system was implemented, and the district is located in an active wind zone.

Characteristics of the Wind Erosion Area of Karapınar

Karapınar is located on Konya-Adana Highway and is 95 km from Konya. The population of Karapınar is 31.913 according to the 2007 census. The altitude of the district is 995 m above sea level and its area is 3030 km^2.

***Geological Characteristics*:** In Central Anatolia, there are several sand beds located near Karapınar. The dune systems were altered during the late Pleistocene and Holocene period. The main dune system located in the south of Karapınar was formed as the result of the coastal winds that were caused by the withdrawal of the old lake. The climate changes that occurred during the Holocene period caused the sand to move inland, afterwards, sand movements started as the result of human activity (such as extreme pasturage, becoming poor of soil) (Demiryürek et al. 2007).

***Climate Characteristics*:** The climate of the region is semiarid; summers are arid and hot, and winters are cold and snowy. The large part of the snowfall occurs in January and February. The annual average precipitation is 275 mm, and 40% of the precipitation falls in the months of winter. The average precipitation from July to September is 15 mm. Long term climate values of the study area are given in Table 1. The annual precipitation for 2008 is 232.1 mm (Anonymous 2009).

Climate data	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mean Temp. ^oC	-1.8	-0.8	4.2	11.1	14.8	18.7	22.4	22.1	17.2	11.0	5.9	0.4
Max Temp.^oC	19.6	20.5	25.5	31.4	36.0	36.8	41.2	38.4	36.2	33.2	25.3	18.4
Min. Temp. ^oC	-21.4	-26.8	-22.8	-8.0	-2.3	3.1	5.0	4.5	-3.3	-6.4	-15.0	-21.2
Precipitation (mm)	29,9	27,6	28,5	39,6	38,9	25,5	4,6	2,7	7,5	22,6	27,5	39,5
Moisture (%)	78	75	69	62	62	53	48	47	51	63	75	79
Mean wind speed (m/sec)	2.97	3.21	3.36	3.31	2.66	2.92	3.29	3.09	2.46	2.34	2.61	2.86
Wind Max direction and speed (m/sec)	SSW 27.3	SW 29.0	SSW 28.8	SSW 32.7	NNW 23.1	ENE 23.0	NNW 20.2	NNE 28.0	S 32.0	NW 19.8	SSW 21.8	SSW 27.7

Table 1. Long term climate values of the study area (between 1983-2006 years) (Anonymous 2009**)**

In the erosion area of Karapınar, the most important factor that affects erosion is the wind, and the dominant direction of the wind is north-east and south-west. Mean wind speed is between 2.34 - 3.36 m/sec. Stormy days are common and the wind speed reaches 20-32 m/sec on those days (Table 1).

Soil Characteristics **:**Although the soil belongs to the group of alluvial soils which is formed over old lake deposits, colluvial, sierozem and regosol soil groups are also seen in Karapınar, where wind erosion studies are conducted. The soil color of the plow layer is light gray and light brown and the lower parts are pale yellow and white. The soil texture is generally light (loamy sand) in the top soil, and heavy (clay) in lower layers. Soils are rich in lime and potassium and poor in organic matter and phosphorus. Some characteristics of the study area soils are given in Table 2.

Depth (cm)	**Sand (%)**	**Silt (%)**	**Clay (%)**	**Texture Class**	**Field capacity (mm)**	**Volume weight (g/cm^3)**	**pH (1/2.5)**	**EC(mmhos/cm) (1/2.5) 25°C**	**$CaCO_3$ (%)**	**Organic matter (%)**
0-15	68.1	15.1	16.6	SL	23.3	1.10	8.1	0.62	44.7	1.9
15-30	57.2	22.7	20.1	SCL	32.9	1.09	8.1	0.45	48.6	1.6
30-60	31.0	28.0	43.0	C	79.6	1.01	8.2	0.45	53.5	1.5
60-90	16.0	24.4	59.6	C	88.6	1.06	8.3	0.85	54.6	1.3
90-120	12.5	42.3	45.2	SiC	85.7	1.18	8.0	1.10	53.3	1.2

Table 2. Some characteristics of the study area soils (Anonymous 2009)

Studies Conducted to Improve Problematic Areas

The first step taken against erosion in the district was establishing an association with the name "Association for Saving Karapınar from Erosion" in 1959. Afterwards, studies were started by Mülga Topraksu (the Directorate General of Agriculture) in 1962. First, a team was formed of technical personnel and an area of 160.000 decares was taken under control by being enclosed with wire fence.Then, 30.000 decares of this area was assigned to the Armed Forces to be used for military purposes. The remaining 130.000 decares area was divided into four sections based on the problems observed. Soil improvement practices started on this area considering the degree of the problem. Mülga Konya Topraksu VI. Region Management (The Directorate General of Agriculture) maintained its studies continuously for 10 years and when the improvement studies were completed, the area was assigned to Konya Institute of Soil and Water Research Directorate in 1973 to be used for protection control, research and production studies.Today, 43.000 decares of this land is given back to farmers and studies are continued in the 87.000 decares under the control of the government (Yıldırım 1999). The studies conducted on these areas are as follows:

Sand Dunes (Dune Barkhan) Area(40.000 decares): This area is located to the south west of the district 7 km from Karapınar. The size of the area is 40.000 decares. The severest erosion effects were observed in the area in the 1960s. Sand dunes with heights of 41 m, widths of 50 m and lengths of 240 m, which are shaped like the moon and completely look like a desert, have been formed in the area. These dunes are inclined at a rate of 5-17% to the direction of the wind and 20-48% to the other directions. The dunes in this area have the characteristics of moving with the lightest wind. The dunes that move with the effect of the strong winds started to threaten the district by digging up the Ketir Hill, which is covered with 15 hectares of basalt rocks. The improvement study conducted on this area was carried out in two subsequent stages.

a.Physical measures

Construction of Bamboo Screens: First, bamboo screens were constructed on the sand dunes in order to decrease the speed of the wind and prevent the movement of the sand. These bamboo screens were woven with two lines of wires running perpendicular to the blowing direction of the wind leaving parts of 40 cm uncovered at the top and bottom tips. During the fixing process, the screens were supported with wooden posts at every two meters in order to prevent the collapse of the screens with the effect of the wind.

b.Cultural measures

Grassing: After the bamboo screens were constructed and the speed of the wind and the movement of the sand completely stopped, the process of grassing the spaces between the screens started. Weed seeds collected from the pastures around the region were used in grassing the area and also rye (*Secale sp*.) and wheat grass (*Agropyron elongatum*), which are known to be resistant to aridity and hot conditions, were extensively used as crop plants.

Afforestation: After the area between the bamboo screens was grassed, afforestation studies started as a long lasting precaution in order to completely prevent soil movements. Saplings obtained from the nursery gardens established in the area and from other regions were planted and grown between these screens. The types of trees selected for afforestation were oleaster(*Eleagnus sp.*L), acacia(*Robinia pseudeaccacia*), ashen(*Fraxinus sp.*L), elm(*Ulmus sp.*L) and maple(*Acer sp*.L) since they are trees which are resistant to aridity peculiar to the area.

The Active Dune(Barkhan) Area(25.000 decares): There were some plants peculiar to the region which were not eaten by animals and were resistant to aridity on this area, which was known to be a high quality pasture a long time ago. Dunes have accumulated around these plants and formed hills with heights of 0.3-1.2 m and widths of 0.2-2.00 m. The inclination of these hills is 30-60% to the direction of arrival of the wind, and 5-19% to the direction of the wind. These plants are *Salvia cryptantha, Astragalus micracophalus*, *Alhagi camalorum* and *Artemisia sp.* .Such areas were enclosed with wire fences during the implementation of the improvement practices. Following the enclosing process, the existing plants were reproduced through self-pollination and other plants were reproduced through grafting. As the result of the studies, today, the soil is completely covered with vegetation and natural flora has been reestablished.

Flat Soils Sensitive to Erosion(26.000 decares): This area is composed of agricultural lands on which no vegetation exists, and which was formerly used for dry farming and abandoned because of erosion. 14.000 decares of this area are privately owned lands where erosion prevention practices have been successfully performed and the owners have resettled. Agricultural activities are still being carried out on this area under the control of the government. Today, agriculture is performed through band seeding along paths of 40-60 m width vertical to the prevailing wind direction on the 10.000 decares of the remaining land and fallow-cereal rotation system is implemented, as is done under the conditions of Central Anatolia.Approximately 2.000 decares of land has been irrigated and vineyards and orchards peculiar to the region have been planted on the land. This part of the area is used as a demonstration site for fruit production, and there are also nursery gardens and pasture seed production facilities in the area.

Ketir Hill (10.000 decares): Before the implementation of improvement practices, this area was covered with basalt boulders and there were not any trees on the hill. After the erosion studies were conducted and sand movements were stopped, plants such as blackthorn, wild almond and blackberry started to grow on the area. Furthermore, almond seeds (700.000 pieces) were planted on the foot of the hill during the practices. Currently, pine and cedar trees are being planted on the hill.

Current Land Use Planning

The following improvement practices are implemented on the remaining 87.000 decares of land, which is under the government control:

The areas where the problem has reemerged are afforested, practices are performed for the trial of new irrigation techniques, the activity areas of newly drilled wells are widened, and new orchards and sapling production practices are established.

The current status of land use is as follows (Table 3):

Status of Land Usage	Area(decares)
Woodland area	40.000
Basaltic area	10.000
Vineyard, garden, orchards and sampling generation areas	2.000
Nature grass pasture	25.000
Band seeding(dry cultivation)	5.000
Watery cultivation	5.000
Total	87.000

Table 3. The current status of land use(Anonymous 2009)

The plants that were determined in the study conducted on the approximately 30.000 decares of pasture area which is under protection in Karapınar Station of Soil and Water Resources Research Institute are as follows: *Festuca ovina* (29.8%), *Centaurea virgata* (17.6%), *Euphorbia kotschyana* (10,1%), *Alhagi pseudalhagi* (5,9%), *Astragalus microcephalus* (5,0%), *Scabiosa argentea* (4,6%), *Scorzonera cana* (3,4%), *Centaurea urvillei* (3,4%) and several other plants at smaller rates (TAGEM 2007). With these plants, the pasture area has acquired the characteristics of a typical arid climate pasture.

Conclusion

As the result of the studies conducted to prevent the Karapınar District from being moved to another location, the problem has been solved at a cost less than almost a quarter of the moving cost. The project is highly important in terms of presenting the new agricultural techniques to the farmers living in the region and increasing the agricultural value of the land by means of new irrigation wells and canals.

Previously, the project area often caused traffic jams and accidents over an 8 km part of the Karapınar Highway when strong winds blew. All of these problems have been solved as the result of the erosion prevention practices.

A farmer training camp was organized within the project studies and the workers of the farms were trained on irrigated and dry farming. Groundwater surveys that were conducted at the start of the project studies were found to be favorable and the wells drilled based on these surveys were used for sapling production and irrigated farming. Today, the number of wells is over 5000. Beet-wheat crop rotation system has started under irrigated conditions. Animal feed products such as clover and trefoil, vegetables, fruit, even strawberry is produced in the area. A forestland of 4000 hectares covered with trees has been a good shelter for wild animals (such as fox,rabbit, grouse and nightingale) .

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