Araştırma Makalesi

www.ziraat.selcuk.edu.tr/ojs
Selçuk Üniversitesi
Selçuk Tarım ve Gıda Bilimleri Dergisi
26 (1): (2012) 60-69
ISSN:1309-0550

İç Anadolu'da Rüzgâr Erozyonundan Etkilenen Tarım ve Mera Topraklarının Verimlilik Durumları

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(Geliş Tarihi: 14.03.2011, Kabul Tarihi: 05.01.2012)

Özet

Bu araştırma, 'Çölleşmenin Azaltılması ve Arazi İyileştirilmesi-DESIRE' isimli ve 037046 Kontrat No'lu AB 6. Çerçeve Programı projesi kapsamında erozyon ve çölleşmeden etkilenen Karapınar İlçesindeki (Konya) tarım ve mera topraklarının verimlilik durumlarını ve jeolojik geçmişini belirlemek amacıyla yapılmıştır. Bu amaçla Temmuz 2007'de Karapınar merkeze bağlı Apak, Yeniceoba, İnoba ve Samuk Yaylalarının tarım ve mera arazilerini temsilen GPS koordinatları belirlenen 74 noktada (44 tarla + 30 mera) toprak derinlikleri ölçülüp, arazi özellikleri belirlenmiş ve 0-30 cm derinliği temsilen toprak örnekleri alınmıştır. Araştırma sonuçlarına göre, genellikle kuvvetli alkalin pH, tuzsuz, aşırı kireçli, düşük organik maddeli, kumlu-killi-tın tekstür ve erozyon ile çölleşme etkilerini yaygınca gösteren bu topraklarda P az, K ve Ca fazla, Mg ve Cu yeterli, Fe, Zn ve Mn ise yetersiz bulunmuştur. Tarım topraklarının pH, kireç ve demir kapsamları mera topraklarınınkine göre daha düşük iken, diğer parametre sonuçları daha yüksek çıkmıştır. Düz ve alçak alanların çoğu eski bir gölün çamurlu materyali veya son zamanlardaki erozyonla taşınan kumlu materyal ile kaplıdır.

Anahtar Kelimeler: *Karapınar, tarım, toprak verimliliği, besin elementleri, kuraklık*

Fertility Status of Agricultural and Pasture Soil Affected by Wind Erosion in Central Anatolia

Abstract

This investigation was carried out to determine the fertility status and geological past of agricultural and pasture soil of the Karapınar District, which has been affected, by severe wind erosion and desertification. The scope of this project was envisaged by DESIRE (an EU-supported program). In this study, 74 soil samples were taken in a layer of 0-30 cm from the agricultural and pasturelands and analyzed in July 2007. According to the results, the soil has a generally high alkaline pH and is very low in salinity, low in organic matter, excessive in lime and sandy-clay-loam in texture. In the soil showing a high level of erosion and desertification symptoms, in the average values of macro and micronutrients, P was low, K and Ca were high, Mg and Cu were sufficient, whereas, Fe, Zn and Mn were insufficient. While the pH, lime and Fe contents of the agricultural soil were lower than that of pasture soil, the other results were higher than that of the pasture soil. Most of the flat and low areas are covered with the muddy material of an ancient lake or the sandy material of a recent sand deflation origin.

Key words: *Karapınar, agriculture, soil fertility, nutrients, aridity*

Introduction

The agricultural and pasturelands of Turkey have been decreasing and degrading each year by various factors while the population of Turkey has been continuously increasing. Therefore, it is necessary to increase the crop yields per unit area to feed the human population by using the existing land, which has become limited by degradation. Attaining this aim depends on the soil fertility. Increasing and maintaining sustainable fertility in the soil is needed for a good soil management system.

Therefore, the general characteristics and plant nutrient contents of the soil should be determined by means of soil analysis and should be decided on for the most suitable management system and fertilizer types and for the amount, which needed to be applied.

In Karapınar where wind erosion is common, there are 150 000 ha of arable land of which 148 928.5 ha is used for growing field crops, 249 ha is used as orchards (fruit and vineyard), 1 121 ha is used for vegetable production. According to the data from 2008, the amount of crops obtained and the area intended for crops are as follows: 78 300 tones of wheat from a 22 500 ha field area, 45 650 tones of barley from a 32 500 ha field area, 71 250 tones of corn from a 7 500 ha field area, 1 630 tones of legumes from a 1 300 ha field area, 147 100 tones of fodder crops from a 5 120 ha field area, 1 708 tones of oily seeds from a 690 ha field area, 9360 tones of root crops from a 266 ha field area, and 465 035 tones of industrial crops from a 9 400 ha field area (Anonymous, 2008a).

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The amount and quality of yield obtained from the field crops are closely related to the plant nutrient contents of the soil. There have not been any detailed studies carried out for the soil and land characterization in the area, but this study, i.e., the collection of the required amount of soil samples from the arable, pasture and natural lands protected from erosion, with the exception of some of the soil samples for analysis taken individually by some farmers from their own fields in Karapınar District. However, many studies have been carried out especially in the regions of agronomical value in Turkey. For instance, the fertility status of the Harran Plain soil in Şanlıurfa (Güzel et al., 1991; Saraçoğlu and Taş, 2008), the tomato soil in the South Marmara Region (Kovancı and Yağmur, 1992), the soil of The Research and Practice Farm of Uludağ University (Çil Özgüven and Katkat, 1997), the soil of pistachio areas in the Şanlıurfa vicinity (Kızılgöz et al., 1999), the vineyard the soil around Şanlıurfa (Kızılkaya et al., 1999), the soil of the Çanakkale-Lapseki agricultural areas (Demirer et al., 2003), the soil of agricultural and pasturelands in the Çelikli Basin in Tokat Province (Oğuz et al., 2008), the pepper greenhouse soil in the Antalya Region (Özkan et al., 2008), the soil of kiwi orchards around Yalova (Uysal and Soyergin, 2008), the soil of kiwi orchards in Samsun and Ordu Provinces (Özdemir et al., 2008), the soil of apple orchards in Karaman Province (Oktay and Zengin, 2005), the soil of various orchards in Mersin (Pınar et al., 2008), the soil of rose gardens in Isparta and the surrounding area (Küçükyumuk and Erdal, 2008), the soil of The Salt Lake Special Environment Protection Area (Özcan et al., 2008) and the soil of potato fields in the Misli Plain and Çukurova Region (Torun et al., 2008) were all investigated.

The aim of this study is to determine the general properties and fertility status of agricultural and pasture soil in the Karapınar District, which have been affected intensively by erosion and desertification.

Material and Method

The Karapınar District is located in the East of the Konya Province. The continental area of Karapınar is 293 916.6 ha; 150 000 ha of that area is arable land, 130 444 ha are pastures, 11 459.9 ha is unoccupied land and 2 013 ha is forestland. Generally in the South, West and North of the district, there are waste agricultural areas, while the other parts of the district are pasturelands and mountainous. Beside crop production, livestock production also has an important role in the area and sheep and goat are fed freely on the pasturelands and cows are fed with weeds (Anonymous, 2008a).

Most of the flat areas are characterized by the accumulated mud material on the bottom of a large lake in the early Holosen. Stony alluvial grounds also exist more sparsely in this old lake bed (Figure 1). Widespread and high (locally 2-3 m) sand dunes are located in the South of the district in the vicinity of Samuk Plateau. These dunes have been inactive since the 1960s following state-supported erosion mitigation, strip cereal farming and modern irrigated cropping. Basalts and limestone, which range in the North-South direction in the East and West of the district are cropped out respectively. The Soil of the region substantially inherited the properties of the basement on which they were developed. While the texture of the soil which developed on the old lake material are generally loam and clay loam; those of the soil which developed on the sandy areas and lime stones are calcareous and sandy loam.

The climate of the Karapınar District is typical continental. Summers are hot and dry, while winters are cold and snowy. The annual mean temperature is 11.5 ^{o}C, the humidity rate is 63% and the total precipitation is about 250 mm (Anonymous, 1978; Anonymous, 2008b).

The research material consists of 74 soil samples, which were taken from a 0-30 cm depth from the wheat, barley, sugar beet, clover, corn, sunflower grown lands and sheep grazed pasturelands of Apak, Yeniceoba, İnoba and Samuk Plateaus (Figure 1) which belong to Central Karapınar.

The soil samples were taken randomly from the fields and pastures according to the principles reported by Jackson (1962). In the soil samples, the pH was determined by using a pH-meter, the EC was measured by means of an EC-meter, the lime was measured by a calcimeter, the organic matter was determined by the Smith-Weldon method, the texture was determined by the Bouyoucous method, the available P was determined by the Olsen method, the exchangeable K, Ca, Mg and Na measured after extracting with a 1 N NH_4OAc solution (pH 7) by means of ICP-AES (Bayraklı, 1987; Soltanpour and Workman, 1981), the extractable Fe, Zn, Mn and Cu in 0.05 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA extract (pH 7.3) by means of ICP-AES (Lindsay and Norvell, 1978; Soltanpour and Workman, 1981).

Results

Some of the properties of the research soil were given in Table 1. The soil pH of the investigated soil ranged between 7.5 and 8.4 with a mean of 8.1. Therefore, the soil studied was belonging to a strong alkaline soil group. The electrical conductivity values determined were between 42 and 850 µS cm^{-1}, as a mean value, it was calculated as 149 µS cm^{-1}. According to these values, the soil was found to be within the no saline class. The organic matter contents were found between 0.33% and 2.27% with a mean of 1.19%. According to these results, the examined soil was very poor inorganic matter. The 41.9% of the soil samples were very poor in organic matter (0-1%), 52.7% of those are poor (1-2%) and 5.4% of those contain organic matter at a medium level. The lime content of the soil samples differed between 22.5% and 64.0% with the mean of 47.8%. According to the mean value for lime, the examined soil was marl. The 1.3% of the soil was very calcareous (15-25%), 98.7% of this was excessively calcareous (> 25%). Most of the soil samples were found to have a light texture, that of 22.9% were sandy clay loam, 20.3% were sandy, 20.3% were loamy sand, 6.8% were sandy loam, 6.8% were loamy, 17.6% were clay, 4.0% were clay loam and 1.3% were sandy clay.

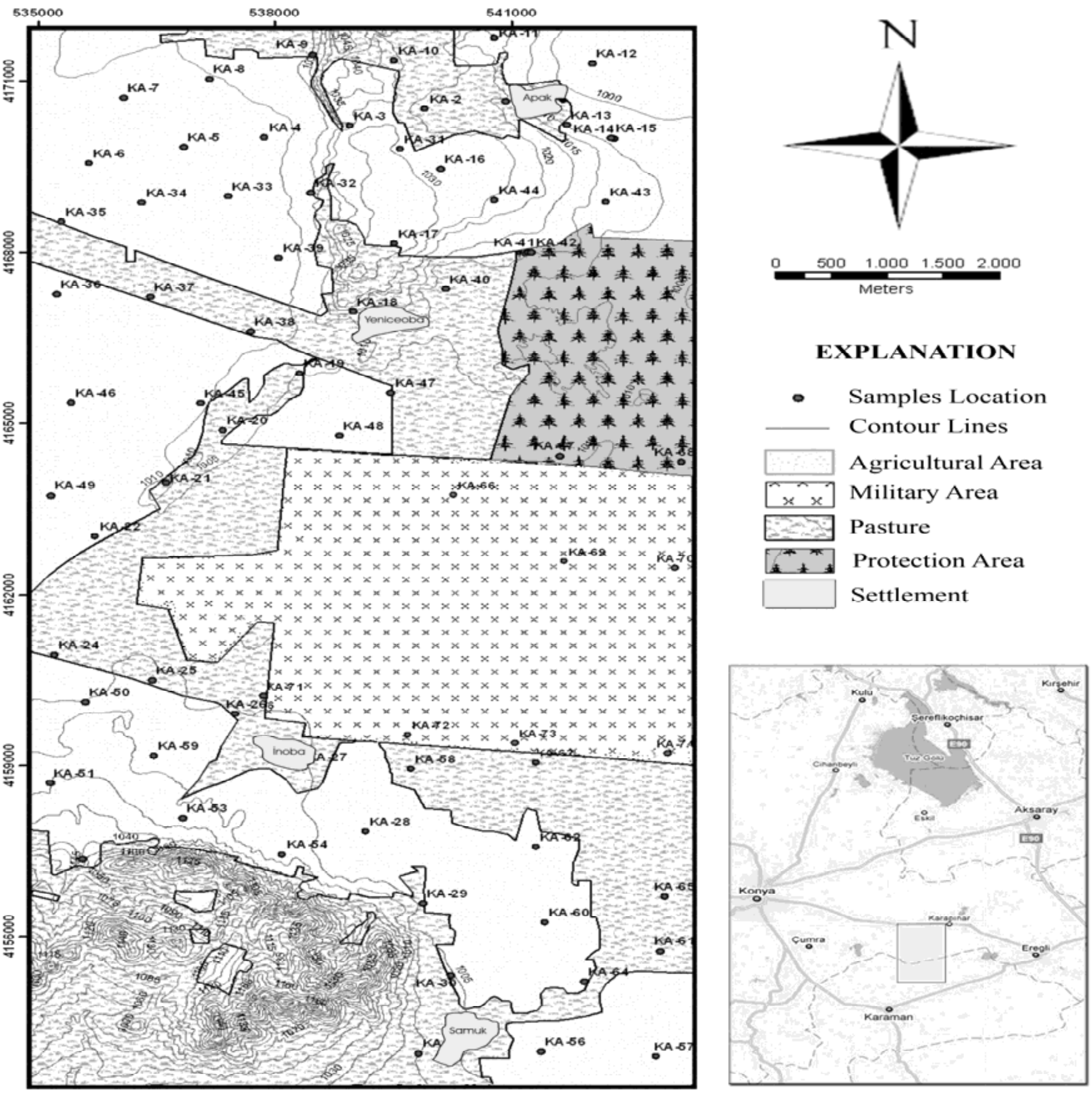

Figure 1. Sampling points related to plateaus from which soil samples were taken

On the other hand, available P contents differed between 1.31 and 21.12 mg kg^{-1} with a mean of 4.65 mg kg^{-1}. Taking into consideration the P contents of the soil samples, according to FAO's (1980) standards values (< 2.5 mg kg^{-1}: very low; 2.5-8 mg kg^{-1}: low; 8-25 mg kg^{-1}: sufficient; 25-80 mg kg^{-1}: high, > 80: very high) only 5.4% of the soil samples contained a sufficient amount of P; 94.6% of those contains low and very low P.

The available K contents of the soil specimens were obtained between 87 and 681 mg kg^{-1} with a mean of 346 mg kg^{-1}. With respect to the available K content according to standard values which FAO (1980) has reported (> 50.7 mg kg^{-1}: very low; 50.7-109.2 mg kg^{-1}: low; 109.2-288.6 mg kg^{-1}: sufficient, 288.6-998.4 mg kg^{-1}: high; > 998.4 mg kg^{-1}: very high) the soil contains K at a high level. 1.3% of the soil samples contain a low level, 44.6% of those contain a sufficient level and 54.1% of those contain a high level of K.

Table 1. Selected physical and chemical properties of the soil from croplands and pastures of Karapınar District

Sample No	Coordinate X	Coordinate Y	Land use	pH	EC µS cm^{-1}	Or.Mat. %	Lime %	Texture class	P mg kg^{-1}	K mg kg^{-1}	Ca mg kg^{-1}
KA-1	540880	4170654	Pasture	8.06	127	1.21	59.7	SL*	1.96	330	5994
KA-2	539873	4170513	Pasture	8.05	118	1.34	41.4	C	3.92	598	7727
KA-3	538924	4170216	Wheat	7.90	120	0.84	59.2	SCL	6.22	181	7018
KA-4	537853	4170017	Sugarbeet	7.85	255	1.93	43.5	C	5.85	323	6825
KA-5	536833	4169839	Corn	7.92	173	1.59	46.1	C	2.06	545	6216
KA-6	535645	4169554	Wheat	7.53	194	1.92	56.6	C	6.13	294	7312
KA-7	536072	4170707	Sugarbeet	8.00	160	2.23	56.5	C	4.37	681	5746
KA-8	537151	4171040	Wheat	7.94	147	2.17	44.2	C	5.67	421	7285
KA-9	538457	4171473	Pasture	7.93	118	1.35	47.3	L	4.37	464	6865
KA-10	539486	4171367	Pasture	8.07	67	1.23	45.3	SCL	3.17	413	7225
KA-11	540752	4171769	Wheat	8.05	119	0.79	57.4	SL	5.61	286	5766
KA-12	541969	4171313	Bean	7.73	149	1.32	50.7	SC	6.68	294	6603
KA-13	541653	4170226	Clover	8.06	155	1.80	52.9	SL	10.11	615	5677
KA-14	542260	4169994	Protec.ar.	8.05	114	0.33	62.5	LS	2.61	223	5044
KA-15	542213	4170004	Wheat	7.82	124	0.77	48.9	C	8.54	197	5054
KA-16	540062	4169459	Wheat	7.88	108	1.21	47.6	CL	4.09	167	6716
KA-17	539482	4168149	Pasture	8.05	92	0.75	49.4	CL	2.43	172	6736
KA-18	538960	4166960	Pasture	8.28	126	1.32	49.7	L	5.57	374	6306
KA-19	538296	4165872	Wheat	7.93	130	1.25	50.0	L	3.54	385	7083
KA-20	537326	4164871	Wheat	8.28	165	1.47	57.7	L	5.67	471	6633
KA-21	536603	4163950	Pasture	8.00	129	2.27	42.3	L	5.02	306	7290
KA-22	535721	4163019	Wheat	8.08	225	1.46	28.8	C	4.37	464	6783
KA-23	534819	4162152	Clover	8.05	167	1.71	36.5	C	5.11	487	7206
KA-24	535211	4160936	Wheat	7.79	117	1.30	45.5	SCL	5.20	146	6334
KA-25	536436	4160483	Fallow	8.15	110	1.39	57.7	SCL	6.87	471	6931
KA-26	537476	4159892	Pasture	7.92	110	1.67	44.7	C	3.26	651	7783
KA-27	538331	4158966	Pasture	8.18	42	1.05	53.1	SCL	1.31	220	6756
KA-28	539125	4157840	Wheat	8.15	230	0.52	61.3	LS	5.39	115	4490
KA-29	539839	4156571	Wheat	8.00	102	0.66	57.2	S	5.94	230	3853
KA-30	540203	4155305	Wheat	8.25	104	0.53	61.9	LS	5.30	174	4344

Sample No	Coordinate X	Coordinate Y	Land use	Mg mg kg^{-1}	Na mg kg^{-1}	Fe mg kg^{-1}	Zn mg kg^{-1}	Cu mg kg^{-1}	Mn mg kg^{-1}	Soil type
KA-1	540880	4170654	Pasture	250	4.3	1.86	0.25	0.39	2.70	Calcaric Regosol
KA-2	539873	4170513	Pasture	403	12.4	1.34	0.17	1.13	4.03	Calcaric Regosol
KA-3	538924	4170216	Wheat	380	20.2	1.94	0.20	0.83	5.21	Calcaric Regosol
KA-4	537853	4170017	Sugarbeet	829	53.2	0.73	0.13	0.42	0.93	Calcaric Regosol
KA-5	536833	4169839	Corn	830	31.0	0.66	0.10	0.59	1.29	Calcaric Regosol
KA-6	535645	4169554	Wheat	780	35.6	1.62	0.12	0.67	2.80	Calcaric Regosol
KA-7	536072	4170707	Sugarbeet	985	37.0	0.62	0.74	0.40	0.82	Calcaric Regosol
KA-8	537151	4171040	Wheat	723	45.4	1.89	0.27	0.80	3.95	Calcaric Regosol
KA-9	538457	4171473	Pasture	252	16.1	3.62	0.28	0.90	5.11	Calcaric Regosol
KA-10	539486	4171367	Pasture	312	8.1	1.45	0.28	0.80	2.92	Calcaric Regosol
KA-11	540752	4171769	Wheat	314	16.7	1.26	0.26	0.41	2.50	Calcaric Regosol
KA-12	541969	4171313	Bean	524	34.3	0.57	0.18	0.33	0.99	Calcaric Regosol
KA-13	541653	4170226	Clover	332	13.3	1.19	0.15	0.40	2.61	Calcaric Regosol
KA-14	542260	4169994	Protec.ar.	158	1.6	2.45	0.25	0.56	3.52	Calcaric Regosol
KA-15	542213	4170004	Wheat	278	11.1	1.82	0.15	0.42	2.50	Calcaric Regosol
KA-16	540062	4169459	Wheat	338	24.3	2.35	0.25	0.97	3.69	Calcaric Regosol
KA-17	539482	4168149	Pasture	298	13.2	1.77	0.11	1.08	2.51	Calcaric Regosol
KA-18	538960	4166960	Pasture	258	4.4	2.03	0.16	0.73	2.46	Calcaric Regosol
KA-19	538296	4165872	Wheat	258	20.8	2.01	0.16	0.88	2.61	Calcaric Regosol
KA-20	537326	4164871	Wheat	502	61.1	1.63	0.83	0.88	3.00	Luvic Calsisol
KA-21	536603	4163950	Pasture	242	3.9	3.29	0.26	0.80	3.82	Luvic Calsisol
KA-22	535721	4163019	Wheat	930	48.0	0.68	0.52	0.49	1.33	Luvic Calsisol
KA-23	534819	4162152	Clover	927	83.1	0.98	0.41	0.62	3.14	Luvic Calsisol
KA-24	535211	4160936	Wheat	267	33.3	3.46	0.33	0.62	2.75	Luvic Calsisol
KA-25	536436	4160483	Fallow	155	1.3	2.92	0.22	0.54	3.66	Calcaric Regosol
KA-26	537476	4159892	Pasture	276	6.0	1.39	0.13	0.94	4.27	Calcaric Fluvisol
KA-27	538331	4158966	Pasture	401	4.1	1.40	0.10	0.42	2.12	Calcaric Regosol
KA-28	539125	4157840	Wheat	318	53.8	1.34	2.61	0.39	2.27	Calcaric Regosol
KA-29	539839	4156571	Wheat	131	3.5	1.53	0.11	0.22	1.94	Calcaric Regosol
KA-30	540203	4155305	Wheat	93	2.3	1.95	0.23	0.21	2.94	Lithic Leptosol

Table 1. (Continue)

Sample No	Coordinate X	Coordinate Y	Land use	pH	EC µS cm^{-1}	Or.Mat. %	Lime %	Texture class	P mg kg^{-1}	K mg kg^{-1}	Ca mg kg^{-1}
KA-31	539559	4169807	Wheat	7.78	151	1.09	43.0	SCL	4.18	146	6477
KA-32	538436	4169039	Sugarbeet	7.69	177	1.28	33.5	SCL	4.92	467	7702
KA-33	537386	4168980	Wheat	7.97	156	1.89	48.3	SCL	3.26	630	7070
KA-34	536304	4168869	Sugarbeet	7.80	169	1.97	44.7	C	4.84	463	6840
KA-35	535297	4168530	Wheat	7.87	138	1.49	35.3	C	3.07	440	7782
KA-36	535227	4167269	Bean	7.46	233	1.56	45.6	C	4.92	549	6614
KA-37	536404	4167213	Clover	7.95	179	1.57	40.2	SCL	1.50	592	5117
KA-38	537674	4166609	Sugarbeet	7.76	138	1.1	28.9	CL	4.92	486	6918
KA-39	538026	4167898	Wheat	7.85	243	1.35	22.5	SCL	4.37	386	6805
KA-40	540123	4167356	Pasture	8.07	94	0.56	53.2	LS	4.00	157	4710
KA-41	541163	4167999	Pasture	8.10	127	0.85	53.2	LS	3.35	195	4844
KA-42	541210	4168000	Protec.ar.	8.17	110	0.84	49.3	LS	4.09	256	5640
KA-43	542150	4168873	Sugarbeet	7.97	182	0.91	39.3	LS	4.09	279	7087
KA-44	540747	4168917	Wheat	8.20	130	1.10	47.5	LS	2.61	87	5417
KA-45	537038	4165344	Clover	8.08	189	1.99	39.4	SCL	6.59	580	6656
KA-46	535415	4165357	Sugarbeet	8.07	580	2.23	40.9	SCL	21.12	670	5973
KA-47	539438	4165530	Pasture	8.10	116	1.32	43.5	LS	3.35	598	8908
KA-48	538788	4164779	Wheat	8.07	167	1.59	38.8	SCL	3.72	444	6697
KA-49	535157	4163729	Wheat	8.06	200	1.64	35.2	SCL	3.54	602	8198
KA-50	535586	4160100	Potato	7.96	201	1.27	43.2	SCL	6.03	579	8073
KA-51	535141	4158673	Fallow	8.06	106	0.65	45.9	SL	4.46	397	6469
KA-52	535556	4157354	Barley	8.11	114	0.83	39.5	SL	4.00	162	7829
KA-53	536813	4158066	Fallow	8.07	161	1.49	40.8	LS	5.20	342	7111
KA-54	538074	4157433	Sugarbeet	7.95	242	1.52	36.7	SCL	5.76	463	7823
KA-55	539796	4153937	Pasture	8.16	119	1.22	53.2	S	2.06	304	5758
KA-56	541332	4153969	Pasture	8.17	119	0.76	46.8	LS	2.24	238	5938
KA-57	542776	4153879	Barley	8.29	102	0.84	59.5	S	2.98	262	6381
KA-58	539692	4158926	Pasture	8.27	109	0.53	59.2	S	1.50	270	6020
KA-59	536461	4159158	Chickpea	7.87	175	1.45	40.2	LS	9.00	271	6964
KA-60	541378	4156241	Wheat	8.21	120	0.70	56.7	LS	4.74	179	5781
KA-61	542835	4155734	Pasture	8.26	109	0.99	43.7	S	1.87	270	5761
KA-62	541270	4157560	Wheat	8.14	122	0.89	49.8	SCL	5.11	182	6748

Sample No	Coordinate X	Coordinate Y	Land use	Mg mg kg^{-1}	Na mg kg^{-1}	Fe mg kg^{-1}	Zn mg kg^{-1}	Cu mg kg^{-1}	Mn mg kg^{-1}	Soil type
KA-31	539559	4169807	Wheat	319	24.5	1.48	0.13	0.66	2.25	Calcaric Regosol
KA-32	538436	4169039	Sugarbeet	707	15.1	1.80	0.66	0.78	2.33	Calcaric Regosol
KA-33	537386	4168980	Wheat	992	27.2	1.62	0.19	0.98	4.22	Calcaric Regosol
KA-34	536304	4168869	Sugarbeet	840	41.4	1.16	0.40	0.59	2.73	Calcaric Regosol
KA-35	535297	4168530	Wheat	961	36.0	1.72	0.46	1.05	2.95	Luvic Calsisol
KA-36	535227	4167269	Bean	967	56.9	1.32	1.48	0.48	1.25	Luvic Calsisol
KA-37	536404	4167213	Clover	946	47.8	0.84	0.07	0.69	1.66	Luvic Calsisol
KA-38	537674	4166609	Sugarbeet	849	35.2	2.13	0.17	0.71	1.42	Luvic Calsisol
KA-39	538026	4167898	Wheat	1271	58.1	2.27	0.86	1.00	0.91	Calcaric Regosol
KA-40	540123	4167356	Pasture	151	2.8	2.35	0.33	0.59	1.99	Calcaric Regosol
KA-41	541163	4167999	Pasture	140	3.8	2.01	0.17	0.26	2.95	Calcaric Regosol
KA-42	541210	4168000	Protec.ar.	184	4.6	2.99	0.15	0.44	2.38	Calcaric Regosol
KA-43	542150	4168873	Sugarbeet	415	26.6	1.32	0.31	0.41	1.20	Calcaric Regosol
KA-44	540747	4168917	Wheat	359	26.3	2.55	0.34	0.50	2.82	Calcaric Regosol
KA-45	537038	4165344	Clover	633	46.7	3.23	0.46	0.71	4.69	Luvic Calsisol
KA-46	535415	4165357	Sugarbeet	1301	440.3	1.38	0.45	0.90	3.53	Luvic Calsisol
KA-47	539438	4165530	Pasture	394	12.2	2.31	0.10	1.03	1.90	Calcaric Regosol
KA-48	538788	4164779	Wheat	700	37.7	1.82	0.79	0.67	2.45	Calcaric Regosol
KA-49	535157	4163729	Wheat	1206	121.3	2.21	0.32	0.99	5.37	Luvic Calsisol
KA-50	535586	4160100	Potato	246	2.0	1.75	0.68	0.60	3.94	Calcaric Regosol
KA-51	535141	4158673	Fallow	186	2.2	1.56	0.13	0.34	2.80	Calcaric Regosol
KA-52	535556	4157354	Barley	190	4.0	2.10	0.11	0.48	2.46	Calcaric Regosol
KA-53	536813	4158066	Fallow	730	45.0	0.95	0.81	0.56	5.57	Calcaric Regosol
KA-54	538074	4157433	Sugarbeet	597	105.5	1.59	0.41	0.59	3.64	Calcaric Regosol
KA-55	539796	4153937	Pasture	160	1.8	2.55	0.25	0.35	2.95	Lithic Leptosol
KA-56	541332	4153969	Pasture	354	50.6	3.58	0.18	0.40	2.19	Calcaric Regosol
KA-57	542776	4153879	Barley	203	2.3	2.46	0.09	0.35	2.10	Calcaric Fluvisol
KA-58	539692	4158926	Pasture	198	2.1	2.51	0.15	0.33	1.53	Calcaric Fluvisol
KA-59	536461	4159158	Chickpea	187	17.8	1.86	0.23	0.34	3.14	Calcaric Regosol
KA-60	541378	4156241	Wheat	286	4.7	2.13	1.41	0.44	1.96	Calcaric Fluvisol
KA-61	542835	4155734	Pasture	208	11.7	2.45	0.06	0.33	1.50	Calcaric Fluvisol
KA-62	541270	4157560	Wheat	412	9.8	3.18	1.15	0.61	1.19	Calcaric Fluvisol

Table 1. (Continue)

Sample No	Coordinate X	Coordinate Y	Land use	pH	EC µS cm^{-1}	Or.Mat. %	Lime %	Texture class	P mg kg^{-1}	K mg kg^{-1}	Ca mg kg^{-1}
KA-63	541266	4159044	Pasture	8.15	100	0.83	57.8	S	2.52	171	5178
KA-64	541870	4155197	Pasture	8.27	113	0.55	41.3	LS	2.52	304	7205
KA-65	542886	4156696	Pasture	8.12	95	0.77	55.3	S	2.61	201	5834
KA-66	540270	4163743	Milit.zone	8.18	105	0.58	52.2	S	2.98	178	4595
KA-67	541561	4164421	Milit.zone	8.32	130	0.52	64.0	S	3.91	244	4987
KA-68	543098	4164317	Milit.zone	8.29	93	0.36	49.3	S	3.44	137	3808
KA-69	541671	4162585	Milit.zone	8.39	104	0.70	50.2	S	2.43	223	5085
KA-70	543068	4162469	Milit.zone	8.35	99	0.35	57.8	S	1.87	172	5127
KA-71	537833	4160210	Milit.zone	8.19	124	1.78	40.8	LS	4	587	7335
KA-72	539688	4159535	Milit.zone	8.32	114	0.91	56.2	S	3.07	251	5484
KA-73	541045	4159391	Milit.zone	8.22	113	0.73	51.2	S	4.92	185	5877
KA-74	542977	4159209	Milit.zone	8.36	121	0.71	54.6	S	2.61	237	5300
Min.	-	-	-	7.50	42	0.33	22.5	-	1.31	87	3808
Max.	-	-	-	8.40	580	2.27	64.0	-	21.1	681	8908
Mean	-	-	-	8.10	149	1.19	47.8	-	4.6	346	6345

Sample No	Coordinate X	Coordinate Y	Land use	Mg mg kg^{-1}	Na mg kg^{-1}	Fe mg kg^{-1}	Zn mg kg^{-1}	Cu mg kg^{-1}	Mn mg kg^{-1}	Soil type
KA-63	541266	4159044	Pasture	197	1.2	1.95	0.05	0.17	2.00	Calcaric Fluvisol
KA-64	541870	4155197	Pasture	433	2.6	3.28	0.08	0.79	1.86	Calcaric Fluvisol
KA-65	542886	4156696	Pasture	154	1.5	3.02	0.09	0.37	2.13	Calcaric Fluvisol
KA-66	540270	4163743	Milit.zone	171	17.9	3.01	0.14	0.14	1.66	Calcaric Fluvisol
KA-67	541561	4164421	Milit.zone	220	4.0	2.74	0.15	0.27	1.37	Calcaric Fluvisol
KA-68	543098	4164317	Milit.zone	145	7.4	3.30	0.09	0.12	1.36	Calcaric Fluvisol
KA-69	541671	4162585	Milit.zone	179	8.3	2.53	0.08	0.14	1.11	Calcaric Fluvisol
KA-70	543068	4162469	Milit.zone	247	81.5	2.34	0.04	0.20	5.45	Calcaric Fluvisol
KA-71	537833	4160210	Milit.zone	412	12.7	3.33	0.18	1.29	1.99	Calcaric Fluvisol
KA-72	539688	4159535	Milit.zone	197	4.5	3.49	0.15	0.26	1.22	Calcaric Fluvisol
KA-73	541045	4159391	Milit.zone	214	6.5	2.66	0.07	0.27	1.34	Calcaric Fluvisol
KA-74	542977	4159209	Milit.zone	173	3.9	2.28	0.08	0.31	1.99	Calcaric Fluvisol
Min.	-	-	-	93	13.0	0.57	0.05	0.12	0.82	-
Max.	-	-	-	1301	440.3	3.62	2.61	1.29	5.57	-
Mean	-	-	-	450	35.4	2.04	0.36	0.58	2.62	-

**: C: clay, SL: sandy loam, L: loam, SCL; sandy clayey loam, CL: clayey loam, LS: loamy sand, S: sand, SC: sandy clay, Milit. zone: Protec. ar.: Protection area, Military zone.*

The available Ca contents of the soil samples were found to be between 3 808 and 8 908 mg kg^{-1} with a mean of 6 345 mg kg^{-1}. The soil was found to contain a high level of Ca with respect to the mean value of Ca according to standard values (< 238 mg kg^{-1}: very low; 238-1 150 mg kg^{-1}: low, 1 150-3 500 mg kg^{-1}: adequate, 3 500-10 000 mg kg^{-1}: high; > 10 000: very high) reported by FAO (1980).

The available Mg content was determined to range 93-1301 mg kg^{-1} with a mean value of 450 mg kg^{-1}. Considering the mean Mg content, according to FAO's (1980) reported standard values (> 50.4 mg kg^{-1}: very low; 50.4-159.6 mg kg^{-1}: low; 159.6-480 mg kg^{-1}: sufficient; 480-1 500 mg kg^{-1}: high, > 1 500 mg kg^{-1}: very high), the Mg levels of all of the soil samples were sufficient. 10.8% of the samples contain a low level, 58.1% contains a sufficient level and 31.1% contains a high level of Mg.

The exchangeable Na contents of the soil samples were determined to range between 1.3-440.3 mg kg^{-1} with a mean value of 35.4 mg kg^{-1}. These results indicate that because of a high level of Ca in the studied soil, the levels lead to no alkalinity problems. The mean values of the extractable Fe, Zn, Mn and Cu of the soil were respectively 2.04, 0.36, 2.62 and 0.58 mg kg^{-1}. The critical threshold values for DTPA-extractable Fe, Zn, Mn and Cu were 2.5 (Lindsay and Norvell, 1978), 0.7, 14 (FAO, 1980) and 0.2 mg kg^{-1} (Follet, 1969).

In this study, 44 of the total 74 examined soil samples were taken from agricultural lands and 30 of those were taken from the pasturelands. The minimum, maximum and mean values of the investigated parameters of the agricultural areas (Table 2) and pastureland soil were presented in Table 3. As seen in these Tables, while the pH values, lime and Fe contents of the agricultural land soil were lower than those of the pastureland soil, the values related to the other parameters of the agricultural land soil were higher than those of the pastureland soil. The PH values (mean: 7.96) in the agricultural land soil were lower than that of the pasturelands (mean: 8.17).

On the other hand, while the EC value of the agricultural land soil was 176 µS cm^{-1} as the mean, it was lower (107 µS cm^{-1}) in the pasture soil. In addition, a higher organic matter content (mean: 1.35%) was determined in the agricultural land soil than that of the pastureland soil (mean: 0.97%). While the mean lime content of the agricultural land soil was 45.6%, that of the pastureland soil was 51.0% as a mean value. The texture of the agricultural land soil was within the heavier textural class (usually clay and sandy clay loam) and that of the pastureland soil was determined as sandy and loamy sandy. Regarding the P, K, Ca and Mg, except Fe, the soil of the agricultural lands was richer than those of the pasturelands.

The correlation coefficients among the soil properties analysis are presented in Table 4. The pH values of the calcareous soil were high. In fact, this can be understood from the statistically positive correlation (0.360**) between the pH and lime content. Besides, a negative relationship (-0.476**) between the pH and organic matter content was determined. The EC value also increased with the increasing organic matter content because the mineral matter (salts) was coming out due to the decomposition of the organic matter. Accordingly, as seen in Table 4, significant positive relationships were found between the EC and organic matter (0.506**) and available P (0.736**), K (0.435**), Mg (0.661**), Na (0.843**) and Zn (0.335**). Additionally a great amount of nutrients was released with the mineralization of the organic matter. Likewise, positive relationships were determined between the organic matter and the P (0.388**), K (0.732**), Ca (0.549**), Mg (0.666**), Na (0.360**), Mn (0.357**) and Cu (0.513**) contents. On the other hand, the availability of K, Mg and micronutrient elements was generally low in the soil with high lime content. Just as the one between the K (-0.444**), Mg (-0.598**), Na (-0.252*) and Cu (-0.487**) and lime content.

Table 2. Some of the chemical analysis results of the cropland soil in the studied area (44 soil samples in total)

	pH	**EC $\mu S\ cm^{-1}$**	**Or. Mat. %**	**Lime %**	**P $mg\ kg^{-1}$**	**K $mg\ kg^{-1}$**	**Ca $mg\ kg^{-1}$**
Min.	7.46	102	0.52	22.5	1.50	87	3853
Max.	8.29	580	2.23	61.9	21.12	681	8198
Mean	7.96	176	1.35	45.6	5.66	378	6532
	Mg $mg\ kg^{-1}$	**Na $Mg\ kg^{-1}$**	**Fe $mg\ kg^{-1}$**	**Zn $mg\ kg^{-1}$**	**Cu $mg\ kg^{-1}$**	**Mn $mg\ kg^{-1}$**	
Min.	93	1.3	0.57	0.07	0.21	0.82	
Max.	1301	440.3	3.46	2.61	1.05	5.57	
Mean	582	50.1	1.73	0.49	0.60	2.69	

Table 3. Some of the chemical analysis results of the pasture soil in the studied area (30 soil samples in total)

	pH	**EC $\mu S\ cm^{-1}$**	**Or. Mat. %**	**Lime %**	**P $mg\ kg^{-1}$**	**K $mg\ kg^{-1}$**	**Ca $mg\ kg^{-1}$**
Min.	7.92	42	0.33	40.8	1.31	137	3808
Max.	8.39	130	2.27	64.0	5.57	651	8908
Mean	8.17	107	0.97	51.0	3.08	303	6048
	Mg $mg\ kg^{-1}$	**Na $Mg\ kg^{-1}$**	**Fe $mg\ kg^{-1}$**	**Zn $mg\ kg^{-1}$**	**Cu $mg\ kg^{-1}$**	**Mn $mg\ kg^{-1}$**	
Min.	140	1.2	1.34	0.04	0.12	1.11	
Max.	433	81.5	3.62	0.33	1.29	5.45	
Mean	247	12.4	2.51	0.15	0.53	2.54	

Table 4. Correlation coefficients (r) among the selected soil properties of the studied area

	pH	**EC**	**O. M.**	**Lime**	**P**	**K**	**Ca**	**Mg**	**Na**	**Fe**	**Zn**	**Mn**
EC	-0.272*											
O. M.	-0.476**	0.506**										
Lime	0.360**	-0.368**	-0.457**									
P	-0.248*	0.736**	0.388**	-0.124								
K	-0.258*	0.435**	0.732**	-0.442**	0.271							
Ca	-0.400**	0.155	0.549**	-0.579**	0.057	0.527**						
Mg	-0.446**	0.661**	0.666**	-0.598**	0.285*	0.617**	0.397**					
Na	-0.063	0.843**	0.360**	-0.252*	0.667**	0.325**	0.067	0.567**				
Fe	0.374**	-0.346**	-0.347**	0.142	-0.206	-0.352**	-0.150	-0.467**	-0.213			
Zn	-0.126	0.335**	0.072	-0.031	0.168	0.046	-0.000	0.263*	0.149	-0.174		
Mn	-0.100	0.070	0.357**	-0.117	0.226	0.306**	0.422**	0.054	0.108	0.151	0.025	
Cu	-0.333**	0.210	0.513**	-0.487**	0.119	0.533**	0.694**	0.450**	0.196	-0.035	0.062	0.556**

***: (P< 0.01), *: (P< 0.05)*

Discussion and Conclusion

The values of the pH, lime and Ca of the soil samples were very high (Table 1) and these cause some problems in taking up nutrients of plants like K, Mg, Fe, Zn, Mn and B, which is an antagonistic relationship with Ca. The results of some researchers (Kızılkaya et al., 1999; Oktay and Zengin, 2005; Oğuz et al., 2008; Özkan et al., 2008; Özbahçe and Zengin, 2011) were similar to these findings.

The microelements such as Fe, Zn and Mn in the samples, except Cu, were deficient (Table 1). Therefore, the organic and inorganic fertilizers containing micronutrients, preferably foliar fertilizers should be applied frequently. Some researchers (Güneş et al., 1999; Alpaslan et al., 2001; Kacar and Katkat, 2007) made similar suggestions in the condition of microelements deficiency in soils because of high pH and lime.

The values of the pH in the agricultural land soil were lower than that of the pasturelands (Tables 2 and 3). This situation might have resulted from the sulphurous and acidic fertilizers use for years on the agricultural lands. Similarly, organic and inorganic fertilizers seem to be responsible for the increase in the EC values (mean: 176 $\mu S\ cm^{-1}$) in the agricultural land soil (Table 3). While no fertilizer has been applied to the pastureland soil, the EC value of this soil was found to be as low as 107 $\mu S\ cm^{-1}$, although both kinds of land soil originated from nearly the same parent material. With respect to the mean values, fertilizing seems to increase the EC value at a rate of 64%, even though irrigation was implemented in the area. Nevertheless, as explained above, the EC values were not high enough to create salinity in the soil which causes yield and quality losses in crops. Agricultural activities like organic fertilizer applications, the incorporation of weeds to the soil and irrigation might affect the result of the higher organic matter values in the cropland soil. Excessive and early grazing on pasturelands decreased the sources of the organic matter in the soil. The lime content of the agricultural land soil was lower than that of the pastureland soil. Here, irrigations and acidifying materials which have been applied for nearly half a century may result in the leaching of lime to a deeper layer in agricultural lands. The P, K, Ca, Mg, except Fe contents of the agricultural lands were higher than those of the pasturelands. As a result of the factors like organic and inorganic fertilization, mineralization of organic materials and incorporating to the soil, micro and macronutrient elements may be added to the agricultural land soil. However, a lower level of Fe in the soil of the agricultural lands may result from with a lack of Fe containing fertilizers and an uptake of Fe by cultural crops. In addition, the similar values for the Cu and Mn contents of the soil of agricultural and pasturelands may indicate a lack of fertilizers containing these elements in the agricultural land soil. As explained above, because the Cu contents of the agricultural land soil were highly above the critical levels, there seems to be no need for using the fertilizers containing Cu. However, the Mn content was found to be at a very low level (FAO, 1980; Özbahçe and Zengin, 2011). Therefore, applying fertilizers containing Mn, like Fe and Zn, will increase the yield and quality of the cultural crops. The addition of fertilizers containing Mn have been suggested as needed, particularly for common bean growing under these conditions (Özbahçe and Zengin, 2011).

Statistically the positive correlation between the pH and lime content and the negative relationship between the pH and organic matter content were determined (Table 4). Similar relationships were also reported by Özkan et al. (2008). This may arise from H^+ ions, which are released by organic and inorganic acids, which originate from organic matter decomposition processes (McCauley, 2003). Accordingly, significant positive relationships were determined between the EC and organic matter and available P, K, Mg, Na and Zn. Similarly, significant positive relationships were determined between P, K and Mg with EC also by Özkan et al. (2008).

In conclusion, it has been determined that the Karapınar District soil is alkaline in pH, free of problems in salinity, low in organic matter content, excessive in lime content and generally light in texture. Besides, the effects of desertification were displayed in the entire sampling area, however much more intensively in the pasturelands. According to the static water level measurements of the wells carried out by the State Water Affairs (DSİ), decreases in the ground water level were recorded in the last 10 years. Because of the drought (the total amount of annual precipitation is 270 mm between the years 1971 and 2000; Anonymous, 2008b) in the pasturelands, natural vegetation cover is about to be extinct. Only several thorny plants and harmel (*Syrian rue*) which livestock have no palate for have grown sparsely. The soil is shallow and full of stones. Detailed studies should be continued on many more soil samples. Fertilization in agricultural lands should be implemented after considering the soil analysis results. As P is sufficient in 64% of the soil, addition of P with fertilization in the soil leads to an increase in expenses, besides it causes to cadmium pollution in environment and accumulation of it in foods and feeding stuffs and that threatens health. This may also result in an impediment of microelements uptake by plants, such as Fe and Zn. Irrigation should be carried out after sunset to prevent evaporation and pressurized irrigation techniques should be preferred. From the point of view of organic matter gain, stubble should not be burned and legumes should be included in crop rotation. The pastures should be protected, ameliorated and grazed with control. Drought resistant and protective trees such as almond, elaeagnus, acacia and *Caragana* bushes should be planted perpendicular to the wind direction on the borders of the fields and pastures against to wind erosion. These drought and high lime resistant living walls, like a green belt, are beneficial in many aspects, i.e., in controlling of harmful insects in wheat, honey production, increasing soil organic matter contents, enhancing atmospheric humidity and in mitigation of wind erosion. Strip farming system is useful in drought climates where they grow cereals, which is to protect the soil from erosion for high and quality yield. So wheat growing seasons during 2009-2010 and 2010-2011 strip farming system of wheat will be realized in the scope of this Project in Apak Plateau.

Acknowledgement

This study was carried out within the Project with contract number 037046 and titled "Desertification Mitigation and Remediation of Land" (DESIRE) funded by

EU 6. Frame Program. The authors are grateful to the Mayor of Karapınar Mehmet MUGAYİTOĞLU and the representative of TEMA-Karapınar Musa CEYHAN for providing local facilities during this study.

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