Case Study

Investigating the Suitability of Drainage Channels Water for Irrigation in Bafra Plain

Bafra Ovasındaki Drenaj Kanallarındaki Suyun Sulamaya Uygunluğunun İncelenmesi

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Abstract

In this study, drainage effluent water quality parameters of Muamlı and Bedeş drainage canals, to which there are not any intrusion from other places, were monitored all year-long. Water samples were taken from 9 different locations of Muamlı and Bedeş canals in July and September. Soil samples were taken from paddy fields irrigated with the effluents of these drainage canals after harvest. Water and soil samples were analyzed for different quality parameters. Present findings revealed that water samples did not have any problems with regard to residual sodium carbonate (RSC), sodium, sulphate and chlorine and can be used safely. For salinity of water samples taken from Muamlı drainage canal varied between 2.79-2.97 dS/m and the salinity values of Bedeş drainage canal varied between 1.01-4.95 dS/m. It was concluded that drainage canal effluents created serious salinity problems and ultimately resulted in significant yield losses. To reduce the effect of salinity problem caused by irrigation with drainage waters, it was recommended to apply extra water to leach salts below the rootzone.

Keywords: *Drainage channels, Bafra Plain, paddy, salinity*

Öz

Bu çalışmada, Bafra ovasında herhangi bir şekilde dışarıdan drenaj kanallarına su karışımı söz konusu olmayan Muamlı ve Bedeş drenaj kanallarındaki suların kimyasal değerlerinin yıl içerisindeki değişimleri incelenmiştir. Muamlı ve Bedeş kanallarının 9 farklı noktasından Temmuz ve Eylül aylarında su örnekleri alınmıştır. Bu kanallarla sulama yapılan çeltik alanlarından da hasat sonunda toprak örnekleri alınmıştır. Alınan su ve toprak örnekleri farklı kalite parametreleri kullanılarak analiz edilmiştir. Analiz sonuçlarına göre suların kalıcı sodyum karbonat (RSC), sodyum, sülfat ve klor açısından herhangi bir sorun teşkil etmemekle birlikte, yüksek tuz içeriklerinin bitki gelişimine zarar verecek seviyede olduğu belirlenmiştir. Muamlı drenaj kanalındaki suyun tuzluluk değerleri 2.79-2.97 dS/m arasında, Bedeş drenaj kanalındaki suyun ise tuzluluk değerlerinin 1.01-4.95 dS/m aralığında olduğu belirlenmiştir. Sonuç olarak bu suların tuzluluk açısından sorun teşkil ettiği ve bu kanallarla sulanan çeltik alanlarında önemli verim kaybı oluşturduğu ve topraktaki tuz içeriğini de daha fazla artırabileceği tespit edilmiştir. Drenaj sularının neden olduğu tuzluluk probleminin etkisini azaltmak için, kök bölgesi altında bulunan tuzların ekstra sulama uygulayarak yıkanması tavsiye edil-miştir.

Anahtar kelimeler: *Drenaj kanalları, Bafra Ovası, çeltik, tuzluluk*

Introduction

Water is one of the main input providing higher yields in agricultural practices. In order to efficient agronomic practices, it should be used at optimum quantities. In this context, irrigation facilities should be properly operated, general irrigation programs should definitely be created and water management should be well-performed for better control of water in agricultural practices. In addition to this, in areas where irrigation water is scarce, reusing of drainage effluents is an important part of water management.

Agricultural drainage is an indispensable component of irrigated agriculture, which is an engineering practice to reduce water table levels beneath the harmful levels for plant growth and development and to prevent salt accumulation within root zone. In humid regions, drainage practices provide a proper soil-water-air balance within the root zone. Such practices in arid and semi-arid regions with intensive irrigation practices prevent accumulation of salt within the root zone, provide salt balance and prevent agricultural lands from aridity (Çiftçi et al., 1995).

Regardless of the climate zone, irrigation and drainage practices are the primary factors providing continuity in agricultural practices. Drainage effluents is normally of lower quality compared with the original irrigation water. Chemical composition of drainage effluents is influenced by several factors such as drainage system, agricultural practices, soil structure, soil infiltration rates, initial soil salinity, irrigation methods and climate conditions. These factors also affect irrigation water quality and designate potentiality of reuse of drainage effluents in irrigation practices (Erözel & Çakmak, 1993). State Hydraulic Works (DSI) identified improper irrigation practices as the primary reason of drainage and salinity problems over agricultural lands of Harran plain. Smoot topography of the project site, outlet problems, heavy soil textures and lack of land leveling practices aggravated already existing problems (Özer & Demirel, 2003).

Leaching is one of a significant practice used in soil reclamation. The amount of leaching water to be used for a full reclamation is primarily depend on concentration and type of salt in soil and groundwater, quality of leaching water, soil permeability, drainage system efficiency and depth of soil profile to be leached (Singh & Dahiya, 1979).

Bahçeci et al. (2007) carried out a study to investigate the potential environmental impacts of drainage effluents and salt leaching through sub-surface drainage system in Konya plain and indicated that current sub-surface drainage system was able to provide sustainability of agricultural practices. Cemek et al. (2006) in a study carried out in Bafra plain reported excessive water use because of recent paddy culture in the plain and indicated that such excessive uses may result in salinity problems over the agricultural lands. In this study, drainage effluent water quality parameters were monitored year-long and the effects of drainage canals on salt leaching from plain soils were assessed.

Material and Method

Geographical Location and Climate Characteristics

The research site is located in Middle Black Sea region between 41° 10’-41° 45’ North latitudes and 35° 30’ - 36° 15’ East longitudes. Mild climate conditions of Black Sea Region are dominant in the research site. Meteorological data were supplied from Bafra Meteorological Station. Long-term annual average precipitation of the research site is 722.5 mm. July is the driest and December is the wettest month. July is the hottest and January the coldest month of the year (Table 1).

Table 1
Long-Term (1993-2013) Averages for Climate Parameters and 2013 Precipitations of the Research Site

Months	*Temperature °C*	*Relative Humidity %*	*Precipitation mm*	*2013 Precipitation mm*
January	5.7	70.0	91.2	62.8
February	6.9	71.0	48.9	14.0
March	7.8	77.0	54.9	82.8
April	11.2	77.0	55.6	43.0
May	15.6	78.0	38.1	28.8
June	20.2	72.0	33.4	43.6
July	22.7	70.0	26.3	48.0
August	22.3	73.0	52.5	66.8
September	19.0	77.0	71.8	37.2
October	15.1	77.0	79.6	8.4
November	12.0	70.0	79.9	21.8
December	8.4	69.0	100.4	38.0
Annual	13.9	73.0	722.5	435.2

Soil Characteristics

Soils of the research site are composed of young alluvial deposits, brought by Kızılırmak. Research Site which is located close to Alaçam border of Bafra along Samsun-Sinop motorway and covers the drainage canals of Muamlı and Bedeş (Figure 1).

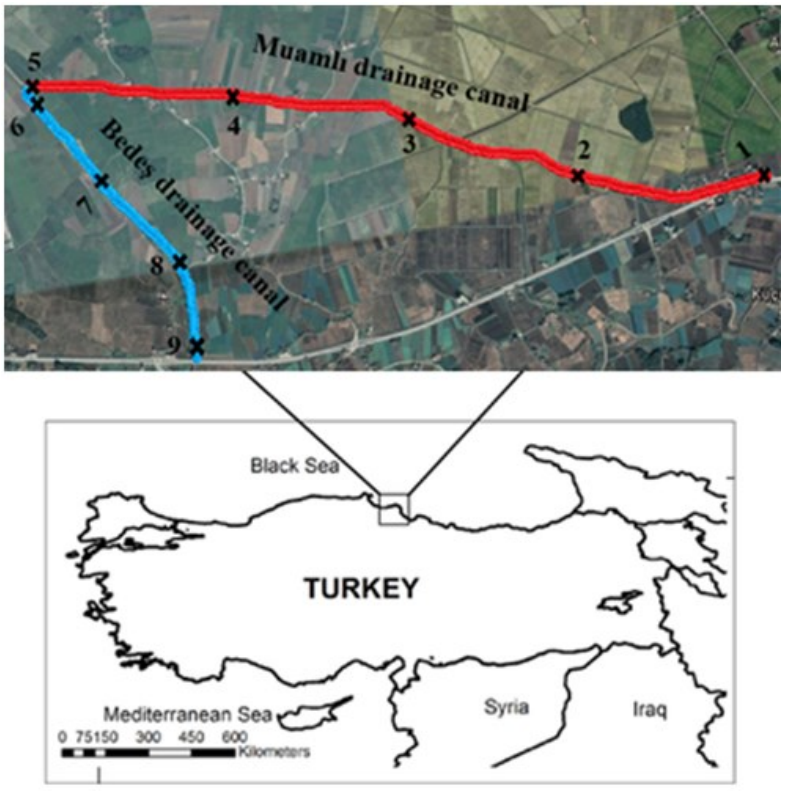

Figure 1. General view of Muamlı and Bedeş drainage canals.

Water and Soil Sampling from Drainage Canals

Physical, chemical and bacteriological characteristics of irrigation water should not include any risks on soil quality and plant development (Ayers & Westcot, 1985; Fipps, 1994). Therefore, irrigation water (surface or groundwater) quality should definitely be analyzed before irrigation. Irrigation water quality generally assessed with physico-chemical quality parameters such as total salt concentration, sodium absorption ratio, chlorine content, toxic ions, water temperature and pH. Analyses are performed in accordance with national and international standards (EPA, 1994; Anonymous, 2004). In this study, irrigation water samples were analyzed in accordance with the principles specified in Tüzüner (1990).

Water samples were taken twice in July and September from the locations with 1 km distance from each other as shown in Figure 1. Soil samples were taken from 9 different locations in paddy fields irrigated with pumping from specified drainage canals after the harvest. Water and soil samples were taken by qualified technical staff. Specifications provided in Ayyıldız (1990) were used in water samplings. Water samples were taken into 2-liter glass bottles with a rubber plugs and samples were numbered from 1 to 9 based on sampling locations over the canals. Water samples were analyzed in accordance with Standard Methals 3000 method. Samples were subjected to EC, pH, Na, Ca, K, Mg, CO_3, HCO_3 and Cl analyses. Water samples were also subjected to hardness, nitrate, nitrite, sodium adsorption ratio (SAR), sulphate, phosphate, and ammonium and pesticide analyses. Results were expressed as ppm. The equation developed by US Salinity Lab. was used to calculate SAR values (Kanber et al., 1999). In this equation, Na, Ca and Mg, K, carbonate, bicarbonate, chloride and sulphate values were expressed both in ppm and me/l. With these values, total anion and cation values were calculated. Soil samples were extracted and resultant extract was subjected to Na, Ca and Mg, K, carbonate, bicarbonate, chloride, and sulphate analyses and then total anions and cations were calculated. Electrical conductivity, pH, SAR, hardness analyses were also performed in laboratory.

Results and Discussion

In this study, chemical characteristics of effluent waters of Muamlı and Bedeş drainage canals of Bafra plain, to which there is no intrusion of water from anywhere around, and soil of paddy fields which were irrigated with these effluent waters were investigated.

Chemical Characteristics of Irrigation Waters of Muamlı and Bedeş Drainage Canals

To assess the irrigation water quality of Muamlı and Bedeş drainage canals, EC, SAR, RSC and other ions (Ca, Mg, K, Na, and Cl) and heavy metals were analyzed. Descriptive statistics for the samples taken from Muamlı drainage canal are provided in Table 2 and 3. Sodium, carbonate, SAR and pH values increased and the other parameters decreased in September. Coefficient of variation (CV) was used to assess the changes in irrigation water quality parameters. Wilding (1985) classified CV values as follows: low variability, ≤ 15%; moderate variability, 16–35%; and high variability, ≥36%. According to this assessment, in Muamlı drainage canal, the greatest variability was observed in potassium in July and in sulphate and carbonate in September. Descriptive statistics for the

samples taken from Bedeş drainage canal are provided in Table 4 and 5. Only the carbonate values increased and the other parameters decreased in September. The greatest variability was observed in sulphate, carbonate, sodium and SAR in July and in sulphate, sodium, chloride and SAR in September.

Table 2

Descriptive Statistics for Water Quality Parameters of Muamlı Drainage Canal in July

Parameter	*Unit*	*Min*	*Max*	*Mean*	*SE*	*SD*	*Kurt*	*Skew*	*CV(%)*
Sodium(Na)	meq/l	209.68	222.53	214.66	2.39	5.34	-0.35	0.72	2.49
Potassium(K)	meq/l	6.30	18.50	11.90	2.49	5.56	-2.59	0.06	46.72
Calcium (Ca)	meq/l	118.53	130.47	124.42	2.15	4.81	-1.54	0.13	3.87
Magnesium(Mg)	meq/l	73.67	85.04	80.34	2.26	5.05	-2.35	-0.66	6.29
Carbonate(CO_3)	meq/l	5.39	9.70	7.33	0.86	1.93	-2.32	0.06	26.33
Bicarbonate(HCO_3)	meq/l	278.22	309.95	293.11	5.49	12.28	-0.64	0.35	4.19
Chloride(Cl)	meq/l	454.0.7	518.94	481.46	10.85	24.26	1.26	0.88	5.04
Sulphate (SO_4)	meq/l	139.27	241.22	189.50	20.92	46.79	-2.85	0.26	24.69
EC	dS/m	1.79	1.90	1.83	0.02	0.05	0.51	0.90	2.73
pH	---	7.44	7.59	7.52	0.03	0.06	-0.48	-0.52	0.80
Sodium percentage	%	40.07	42.88	41.78	0.47	1.05	2.49	-1.30	2.51
SAR	---	3.64	3.81	3.73	0.03	0.07	-0.39	-0.27	1.88
Water Hardness	°dH	33.54	37.53	35.90	0.74	1.66	-1.23	-0.76	4.62

Note. *Min* = minimum, *Max* = maximum, *SE* = standard error of mean, *SD* = standard deviation, *Kurt* = kurtosis, *Skew* = skewness, *CV* = coefficient of variation

Table 3

Descriptive Statistics for Water Quality Parameters of Muamlı Drainage Canal in September

Parameter	*Unit*	*Min*	*Max*	*Mean*	*SE*	*SD*	*Kurt*	*Skew*	*CV(%)*
Sodium(Na)	meq/l	126.34	284.66	229.09	28.76	64.31	1.44	-1.19	28.07
Potassium(K)	meq/l	6.10	8.10	6.84	0.39	0.87	-1.29	0.89	12.72
Calcium (Ca)	meq/l	78.30	110.64	96.43	7.11	15.90	-3.20	-0.55	16.49
Magnesium(Mg)	meq/l	46.57	73.73	55.93	4.64	10.38	3.64	1.76	18.56
Carbonate(CO_3)	meq/l	7.54	60.34	40.08	8.90	19.90	2.37	-1.32	49.65
Bicarbonate(HCO_3)	meq/l	250.15	369.74	293.35	20.68	46.23	2.36	1.47	15.76
Chloride(Cl)	meq/l	234.24	486.51	339.47	45.39	101.50	-0.45	0.59	29.90
Sulphate (SO_4)	meq/l	60.24	311.77	181.54	41.64	93.12	0.45	0.24	51.29
EC	dS/m	1.28	1.90	1.69	0.12	0.28	-0.77	-1.01	16.57
pH	---	8.11	8.35	8.23	0.04	0.09	1.85	-0.23	1.09
Sodium percentage	%	34.96	55.82	50.16	3.96	8.87	3.26	-1.84	17.68
SAR	---	2.45	5.62	4.61	0.58	1.30	2.37	-1.54	28.20
Water Hardness	°dH	21.69	28.18	26.38	1.19	2.67	4.32	-2.05	10.12

Note. *Min* = minimum, *Max* = maximum, *SE* = standard error of mean, *SD* = standard deviation, *Kurt* = kurtosis, *Skew* = skewness, *CV* = coefficient of variation.

Table 4

Descriptive Statistics for Water Quality Parameters of Bedeş Drainage Canal in July

Parameter	*Unit*	*Min*	*Max*	*Mean*	*SE*	*SD*	*Kurt*	*Skew*	*CV(%)*
Sodium(Na)	meq/l	53.75	484.19	366.29	104.30	208.59	3.96	-1.99	56.95
Potassium(K)	meq/l	5.10	11.90	10.08	1.66	3.32	3.97	-1.99	32.94
Calcium (Ca)	meq/l	90.82	176.52	135.16	17.55	35.10	1.41	-0.25	25.97
Magnesium(Mg)	meq/l	39.55	117.10	83.24	16.12	32.23	1.82	-0.88	38.72
Carbonate(CO_3)	meq/l	0.00	10.77	6.47	2.45	4.90	-0.74	-0.90	75.73
Bicarbonate(HCO_3)	meq/l	297.74	339.23	319.71	9.85	19.70	-4.10	-0.18	6.16
Chloride(Cl)	meq/l	216.23	900.94	723.46	169.18	338.36	3.97	-1.99	46.77
Sulphate (SO_4)	meq/l	-48.89	338.71	197.57	91.45	182.90	-0.28	-1.05	92.57
EC	dS/m	0.65	3.17	2.53	0.63	1.29	4.00	-2.00	50.99
pH	---	7.55	7.74	7.65	0.04	0.09	-2.99	0.00	1.18
Sodium percentage	%	23.00	58.66	48.29	8.46	16.92	3.86	-1.96	35.04
SAR	---	1.20	7.67	5.88	1.56	3.13	3.92	-1.98	53.23
Water Hardness	°dH	21.80	45.69	38.07	5.63	11.26	2.38	-1.60	29.58

Note. *Min* = minimum, *Max* = maximum, *SE* = standard error of mean, *SD* = standard deviation, *Kurt* = kurtosis, *Skew* = skewness, *CV* = coefficient of variation.

Table 5

Descriptive Statistics for Water Quality Parameters of Bedeş Drainage Canal In September

Parameter	*Unit*	*Min*	*Max*	*Mean*	*SE*	*SD*	*Kurt*	*Skew*	*CV(%)*
Sodium(Na)	meq/l	52.67	466.17	170.92	99.14	198.29	3.69	1.92	116.01
Potassium(K)	meq/l	5.40	7.90	6.55	0.53	1.07	-0.30	0.48	16.34
Calcium (Ca)	meq/l	45.96	104.68	84.26	13.27	26.55	2.43	-1.58	31.51
Magnesium(Mg)	meq/l	18.89	52.52	29.82	7.88	15.76	2.26	1.58	52.85
Carbonate(CO_3)	meq/l	21.55	35.55	29.09	2.95	5.90	0.25	-0.49	20.28
Bicarbonate(HCO_3)	meq/l	215.99	286.76	251.99	16.05	32.09	-3.09	-0.07	12.73
Chloride(Cl)	meq/l	57.66	544.17	209.22	113.73	227.45	3.13	1.77	108.71
Sulphate (SO_4)	meq/l	27.87	419.91	156.00	89.93	179.87	3.10	1.75	115.30
EC	dS/m	0.75	2.49	1.22	0.43	0.85	3.98	1.99	69.67
pH	---	8.22	8.31	8.26	0.02	0.04	1.59	0.40	0.48
Sodium percentage	%	25.51	69.61	42.73	10.47	20.93	-1.75	0.76	48.98
SAR	---	1.27	9.73	3.86	2.00	4.00	3.11	1.77	103.63
Water Hardness	°dH	12.99	24.31	18.66	2.31	4.63	1.40	-0.02	24.81

Note. *Min* = minimum, *Max* = maximum, *SE* = standard error of mean, *SD* = standard deviation, *Kurt* = kurtosis, *Skew* = skewness, *CV* = coefficient of variation.

There were not significant differences in EC values of Muamlı drainage canal in July and September. EC values of Muamlı drainage canal varied between 1.79-1.90 dS/m in July and between 1.28-1.90 dS/m in September. There were significant differences in EC values of Bedeş drainage canal in July and September. EC values of Bedeş drainage canal varied between 0.75-2.49 dS/m in July and between 0.65-3.17 dS/m in September. Sensitivity of all plants to salinity may differ and, less yield loss occurs in some plants at much greater salinity than others (Abrol et al., 1988). For example, if Muamlı drainage canal is used for irrigation purposes in paddy fields, there will nearly a full yield. If Bedeş drainage canal is used, it will cause 15-20% losses in yields. Instead of paddy, if wheat is grown by using

these drainage canals, there will not almost a yield loss. With regard to SAR values, waters of both drainage canals were classified as "low sodium waters" and hazardous Na accumulation was not identified. Since RSC values of both drainage canals were lower than zero, it was thought that such levels would not have significant effects on plant growth and development. Sodium levels of irrigation waters should not exceed 50-60 ppm. Only the water sample taken from 6th sampling location of Bedeş canal in September had sodium level over 60 ppm. Except for this sample, the other waters did not exert any problems with regard to sodium. The pH values of drainage canals were between 7.50-8.30 and did not pose a significant effect on plants.

Wilcox's graphic (USSL diagram, 1954) was used in classifying Maumlı and Bedeş drainage channels water for irrigation (Figure 2 and 3). With regard to irrigation water quality class, the water samples taken from the 1st, 2nd, and 3rd locations in July and September were classified as "C3S1" (high saline and low sodium waters). The waters taken from 4th and 5th locations in July were placed in "C3S1" and "C3S2" (high saline and medium sodium waters) class in September. The samples taken from the 6th location in July was classified as "C4S2" (very high saline and medium sodium waters), while in September the water was placed in "C4S3" class indicating very high salinity and high sodicity risk. The waters taken from 7th and 8thlocations in July were classified as "C4S2" and as "C3S1" class in September. The water samples taken from the 9thlocation were classified as "C2S1" (medium saline – low sodium waters) in July and as "C3S1" class in September. In this case, high saline waters should not be used as irrigation water and water should be supplied from the other canals. In this way, possible yield losses could be prevented.

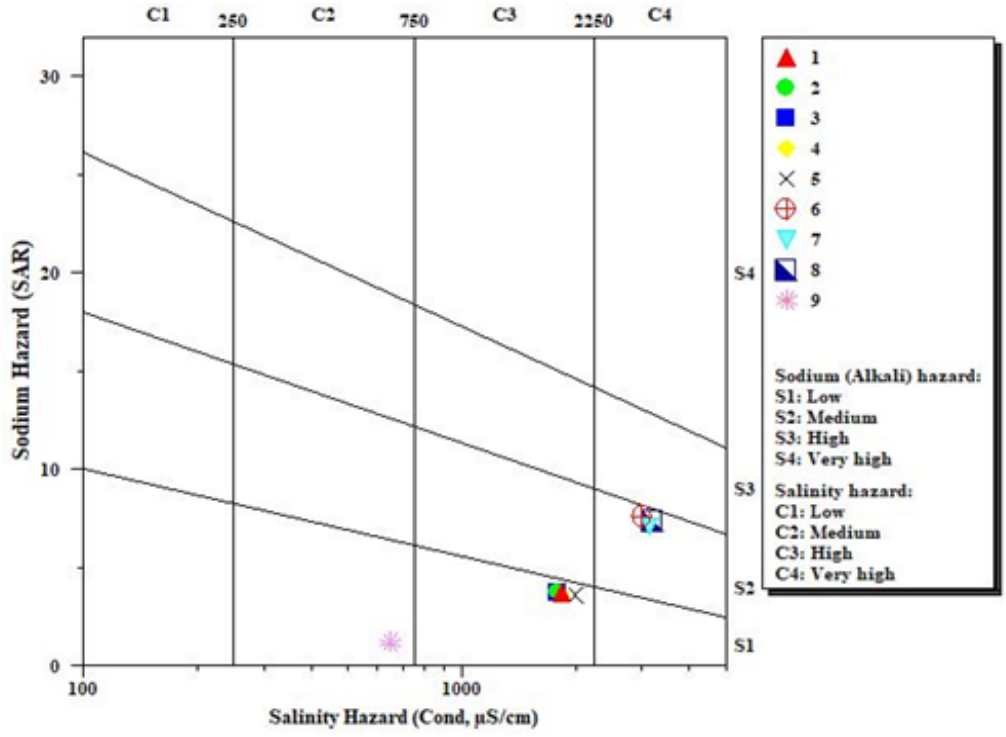

Figure 2. Classification of irrigation water quality in different locations of Muamlı and Bedeş canals in July.

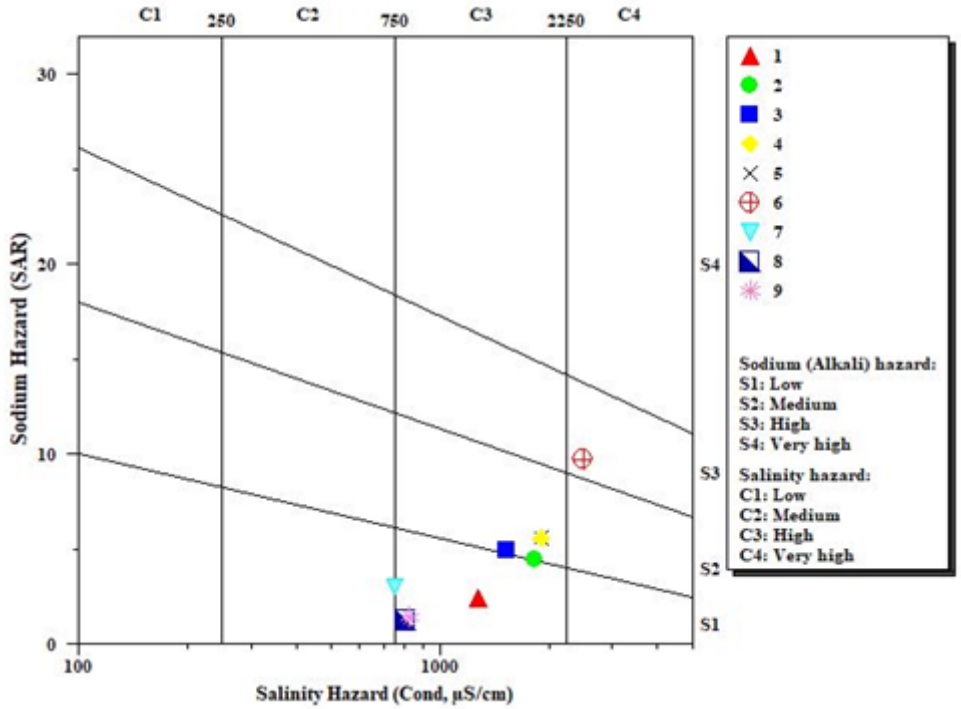

Figure 3. Classification of irrigation water quality in different locations of Muamlı and Bedeş canals in September.

The variations in the before and after irrigation season (July to September) on both canals in EC, pH, Na%, SAR and hardness values based on sampling locations are presented in Figure 4. In the 1st sampling location, all parameters, except for pH, increased. In the 2nd sampling location, maximum 20% decrease was observed in all parameters, except for hardness. In the 3rd sampling location, EC and hardness increased by 30-40% and the other parameters decreased. In the 4th sampling location, increase was observed only in hardness and decreases were observed in all the other parameters. In the 5th sampling location, about 30% increase was observed in hardness and a slight increase was observed in EC values and large decreases were observed in the other parameters. In the 6th sampling location, a distinctive increase was observed in hardness and EC values and sharp decreases were observed in the other parameters. Especially in the 7th and 8th sampling locations, a sharp increase was observed in all parameters, except for pH with slight decreases. In the 9th sampling location, about 10% increase was observed in hardness and decreases were observed in all the other parameters. All of these changes on Muamlı (sample 1-5) and Bedeş (sample 6-9) canals were probably due to seasonal rainfall and cultural applications such as, fertilization.

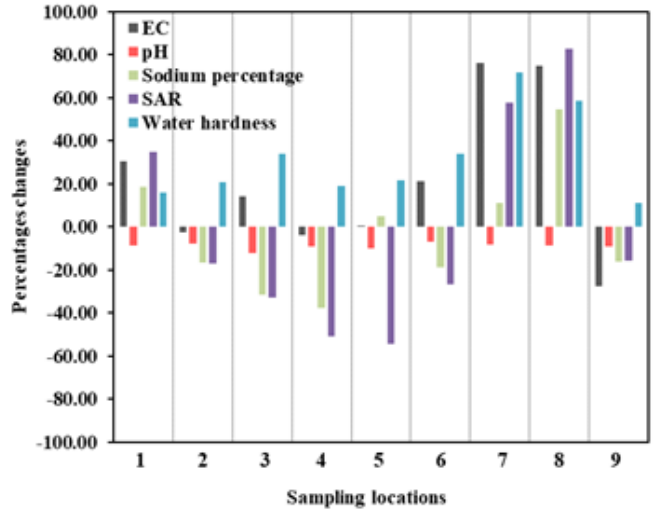

Figure 4. Percentage changes in the various water quality parameters.

Assessment of Soil Samples

Variations in soil salinity values of the samples taken from the lands irrigated with pumping from drainage canals are presented in Figure 5.

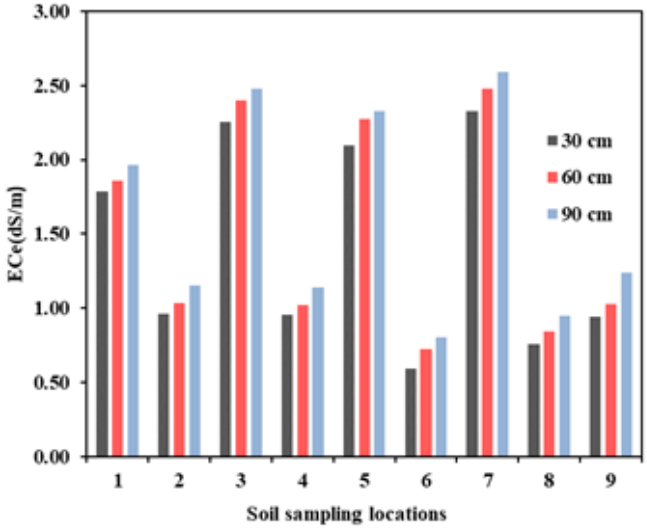

Figure 5. Variations in soil salinity.

According to USSL (1954), a saline soil has an EC_e of the saturated paste extract of more than 4 dS/m. Soils did not have an important problem with regard to salinity. However, especially in 3rd, 5th and 7th sampling locations, soil salinity levels at 30, 60 and 90 cm soil profile reached to 2.50 dS/m. Such a value indicated slightly salinity levels for these samples. In the other location, salinity at all depths was around 1.00-2.00 dS/m.

A soil SAR value below 2.00 is most desirable. A soil SAR level above 13.00 is considered very high, and the soil is classified as sodic (McKenzie & Woods, 2010). Soil SAR values at 30, 60 and 90 cm soil profile varied between 0.20-3.00 (Figure 6).

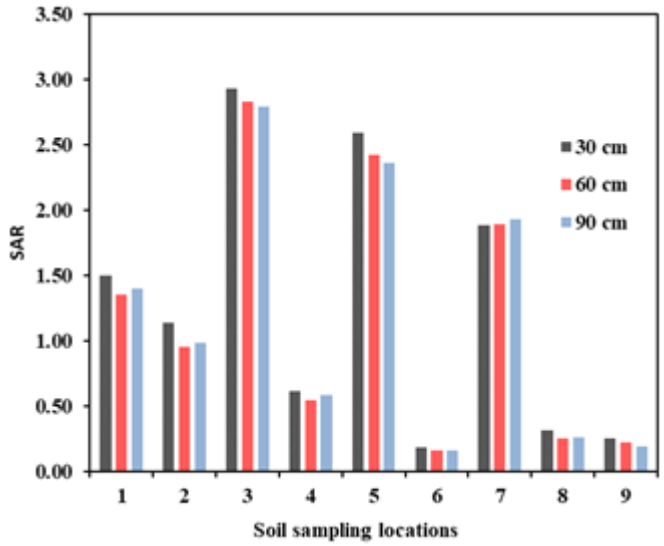

Figure 6. Variations in soil SAR values.

The SAR value at 3rd sampling location was higher than the SAR values of other locations. The SAR value of the 7th and 8th sampling locations varied between 2.00-2.50. The SAR value of the 1st and 2nd locations varied between 1.00-1.50 and the SAR values of the other sampling locations at 30, 60 and 90 cm soil profile varied between 0.20-0.60.

The pH value of the saturated soil paste is generally less than 8.2 and more often near neutrality (Abrol et al., 1980). Soil pH values at 30, 60 and 90 cm soil profile of 9 sampling locations varied between 7.15-7.42 (Figure 7). Soil pH values were within the desired values.

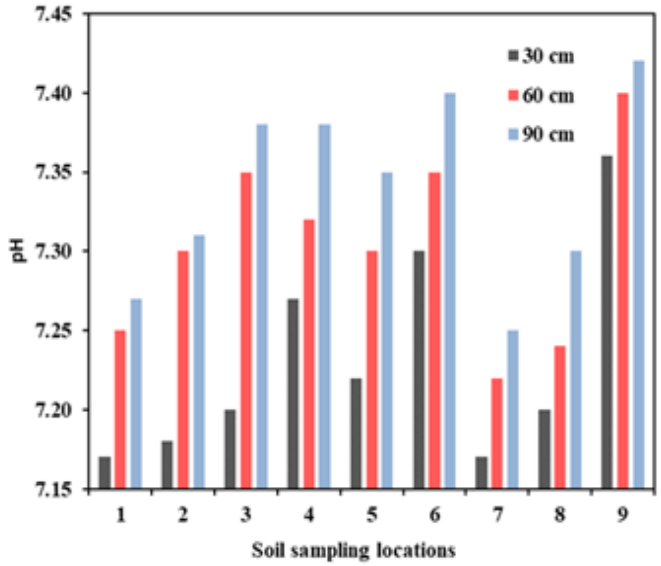

Figure 7. Variations in soil pH values.

Conclusion

The water samples taken from Muamlı and Bedeş drainage canals varied between 2.79-2.97 dS/m and 1.01-4.95 dS/m, respectively. It was concluded that drainage canal effluents created serious salinity problems and ultimately resulted in significant yield losses.

The water samples taken from 6^{th}, 7^{th} and 8^{th} locations in July were found to be unsuitable for irrigation with regard to chlorine contents. On the other hand, in September, these water samples were suitable for use in irrigation because of precipitations. In this case, these waters should not be used in July and water should be supplied from other canals. There were not any problems with regard to chlorine contents in other sampling locations.

Drainage effluents did not pose any problems for irrigation with regard to sodium and sulphate contents. Drainage effluents did not have any problems also with regard to residual sodium carbonate (RSC) and can be used safely. Soil salinity values determined for 9 sampling locations at 30, 60 and 90 cm soil profile revealed that soil salinity was a serious problem for present irrigated lands. The greatest reason of soil salinity was identified as the high salt contents of drainage effluents since these effluents were used in irrigations.

Since paddy was cultivated over irrigated lands of plain, excessive water was used in irrigation and thus high salt content of drainage effluents resulted in 15-25% losses in yields. Precipitations were not sufficient to leach excess salt in soil profile. Low-saline waters should be used for leaching purposes. If there is a chance, farmers are recommended not to use drainage effluents in irrigation. They should search for other quality water resources for irrigation rather than using highly saline drainage effluents.

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Extended Turkish Abstract
(Genişletilmiş Türkçe Özet)

Bafra Ovasındaki Drenaj Kanallarındaki Suyun Sulamaya Uygunluğunun İncelenmesi

Su, tarımsal üretim artışında en etkili bileşenlerden birisidir. Bu girdinin verimli olabilmesi ihtiyaç oranında kullanılmasıyla mümkündür. Bu nedenle suyun kontrolünün sağlanması için sulama tesislerinin iyi işletilmesi, genel sulama planlarının mutlaka yapılması ve planlı su dağıtımının diğer bir anlatımla su yönetiminin çok iyi uygulaması gerekmektedir. Tarımsal drenaj, taban suyunu bitki gelişimini engellemeyecek düzeye düşürmek ve kök bölgesinde tuz birikimini önlemek için yapılan mühendislik çalışmalarıdır. Sulu tarım uygulamalarında tarımsal drenaj, sulamanın ayrılmaz bir parçası olarak kabul edilmektedir.

Sulama ve drenaj hangi iklim kuşağında olursa olsun üretimde sürekliliği sağlayan ve diğer faktörlerin değerlendirilmesine imkân tanıyan temel uygulamalardır. Drenaj suyunun kimyasal bileşimi, drenaj sistemi, tarımsal faaliyetler, toprağın yapısı, toprağın infiltrasyon hızı, başlangıçtaki toprak tuzluluğu, sulama yöntemleri ve iklim gibi çok sayıda faktöre bağlı olarak değişmektedir. Aynı zamanda sulama suyu kalitesini kontrol eden bu faktörler yardımıyla drenaj suyunun sulamada kullanım olanağı belirlenebilir.

Bu çalışma ile Bafra Ovasında drenaj kanallarındaki suların kalite özelliklerinin yıl içerisindeki değişimlerinin incelemesi, drenaj kanallarının ovadaki tuzluluğun yıkanması üzerine olan etkilerinin belirlenmesi ve değerlendirilmesi amaçlanmıştır.

Çalışma alanı, Samsun Sinop Yolu üzeri Bafra'nın Alaçam sınırına yakın bir kısmında yer alan Muamlı ve Bedeş drenaj kanalları ve civarında gerçekleştirilmiştir. Çalışma alanı olarak belirlenen bu alandan Temmuz ve Eylül aylarında iki sefer olmak üzere ortalama birer km aralıklarla su örnekleri alınmıştır. Toprak örnekleri ise belirtilen drenaj kanallarından pompajla sulanan 9 farklı noktadan alınmıştır. Çalışma alanına ait suların özelliklerinin belirlenmesi amacıyla örnekler üzerinde Elektriksel iletkenlik (EC), pH, Na, Ca, K, Mg, CO_3, HCO_3 ve Cl analizleri yapılmıştır. Toprak örnekleri ise laboratuvar koşullarında gerekli işlemler uygulanıp, toprak suyu süzülerek Na, Ca ve Mg, K, CO_3, HCO_3, SO_4 ve Cl gibi değerler hesaplanarak toplam anyonlar ve katyonlar bulunmuştur. EC, pH, SAR, Sertlik (Alman) gibi değerlerde laboratuvar koşullarında analiz edilmiştir. Toprak örnekleri ise bu drenaj sularının pompajla araziye verildiği ve çeltik yetiştiriciliği yapılan alanlardan, hasat sonrası alınabilmiştir.

Muamlı ve Bedeş drenaj kanallarının sulama suyu olarak kullanımı açısından değerlendirmede EC, SAR, RSC ve diğer iyonların (Ca, Mg, K, Na, Cl vb.) etkileri ile birlikte ağır metallerde incelenmiştir. Muamlı drenaj kanalında temmuz ayında en fazla değişim gösteren parametre potasyum, eylül ayında ise sülfat ve karbonat olmuştur. Bedeş drenaj kanalında ise temmuz ayında en fazla değişim gösteren parametreler sülfat, karbonat, sodyum ve SAR, eylül ayında ise sülfat, sodyum, klor ve SAR olarak tespit edilmiştir.

Temmuz ve eylül aylarındaki Muamlı drenaj kanalları sularının EC değerleri incelendiğinde dönemler arası çok büyük farklılıkların olmadığı görülmektedir. Muamlı drenaj kanalı suyu EC değeri temmuz ayı için 1.79-1.90 dS/m arasında değişmekte iken, eylül ayı için 1.28-1.90 dS/m arasında değişmiştir. Bedeş kanalından alınan su örneklerinde ise dönemler arasında farklılıklar oluştuğu belirlenmiştir. Drenaj kanalı EC değeri temmuz ayı için 0.75-2.49 dS/m, eylül ayı içinse 0.65-3.17 dS/m olarak belirlenmiştir.

SAR değeri açısından her iki drenaj kanalından alınan su örneklerinin az sodyumlu sular sınıfına girdiği ve toprakta zararlı miktarda sodyum birikmeyeceği tespit edilmiştir.

RSC değeri her iki drenaj kanalında da sıfırın altında olduğundan dolayı, arazide bitki yetiştirmeye önemli bir etkisinin olmadığı görülmüştür.

Sodyum değerinin sulama sularında 50-60 ppm değerini geçmemesi istenmektedir. Alınan örneklerden sadece Bedeş kanalında eylül ayında 6. noktada 60 ppm değerini geçtiği görülmüştür. Bunun dışında drenaj suları sodyum açısından bir sorun teşkil etmemektedir.

9 noktada ve 30-60-90 cm derinliklerden alınan toprak numunelerinde tuzluluğun önemli bir sorun olduğu belirlenmiştir. Bunun en önemli sebebi ise pompajla alınarak araziye verilen drenaj kanallarındaki araziyi sulamak için kullanılan sulardaki tuz miktarlarının yüksek olmasından dolayıdır.

Arazilerde çeltik yetiştiriciliği yapıldığından dolayı sulama suyundaki tuz miktarının toprağa olan etkisinden dolayı çeltikteki verim kayıplarının %15-30 arasında olduğu belirlenmiştir. Bu durumda yağmurların toprak yıkama işleminde etkisinin yeterli olmadığı saptanmıştır. Drenaj suları ile yapılan sulamadan kaynaklanan tuzluluk sorununu topraklarda uzaklaştırmak için arazideki drenaj sisteminin varlığını göz önünde bulundurarak, toprağa tuzluluk açısından sorun teşkil etmeyen sulama suları ile tarla kapasitesi üzerinde su verilip toprak yıkaması yapılmalıdır. Eğer drenaj kanalındaki suları kullanmayarak sulama yapma imkânı varsa drenaj sularının kullanımından vazgeçilerek tuzluluk açısından sorun teşkil etmeyen sulama suları ile topraklar sulanmalıdır.