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AN APPRAISAL OF SURFACE IRRIGATION WATERS IN PESHAWAR DISTRICT (NORTH WEST FRONTIER PROVINCE).

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Studies on the quality of surface water for the irrigation purposes were carried out at the Agricultural Research Institute Tarnab, Peshawar. A total of 13 surface waters from different canals of Peshawar District were collected for chemical analysis. Out of these 13 surface irrigation waters, 9 fell in the $C_2 S_1$ and 4 in the $C_1 S_2$ classes. The SAR and RSC of these waters ranged from 0.36 to 1.41 and zero to 0.50 me/l, respectively. The total suspended matter of these samples ranged from zero to 0.12 per cent. All these surface waters were categorised as excellent sources for irrigation purposes.

INTRODUCTION

The economy of N.W.F.P. is agriculture - oriented but successful agriculture is dependent on the availability of irrigation water. Although N.W.F.P. has a million and a half acres of land under irrigation, there are several thousand acres which still remain virgin because of lack of water (1974). The exigency of the situation demands that all the available sources of water must be cautiously used so as to boost production and ward off the deleterious effects of the misuse of the irrigation water. The determination of the quality of irrigation waters is a pre-requisite for using them efficiently.

The quality of water is determined by its constituents. Irrigation waters containing excessive salts are generally considered unfit for irrigation purposes. Waters which have a preponderance of sodium over calcium and magnisium disperse the soil particles and subsequently the soil structure is destroyed. These deflocculated soils are thus unfit for the cultivation of crops. Likewise, concentrations of carbonates, bicarbonates, chlorides and sulphates in irrigation waters beyond optimum levels are phyto-toxic.

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The object of these studies was to determine the composition of surface irrigation waters of Peshawar District and to classify them, according to the U.S.D.A. system (1955). This classification will not only be useful to the growers but also serve as a source of guidance for the future planning of agricultural production.

MATERIALS AND METHODS

Collection of water samples

Thirteen samples of water were collected from different canals of Peshawar district on 25.5.1972. The sample bottles filled were securely stoppered, labelled and brought to laboratory immediately for chemical analyses. Three drops of toluene were added to each samples for inactivating the micro-organisms.

Total suspended matter was determined gravimetrically as outlined by Sawyer (1960). Electrical conductivity and pH of the water samples were determined by Evershed's conductivity meter and cambridge pH meter with glass electrode, respectively. The concentrations of carbonates, bicarbonates, chlorides, sulphates, calcium, magnesium and sodium were determined according to U.S.D.A. Handbook No. 60 (1955). Sodium adsorption ratio of the water samples was calculated from the following equation :

$$SAR = \frac{\overset{+}{Na}}{\sqrt{\frac{\overset{++}{Ca} + \overset{++}{Mg}}{2}}}$$

wherein concentration are expressed in me/l.

Residual sodium carbonate value of the water samples was calculated as follows:

$$RSC = (\overset{=}{Co_3} + \overset{-}{MCo_3}) - (\overset{++}{Ca} + \overset{++}{Mg})$$

wherein the concentrations are expressed in me/l.

RESULTS AND DISCUSSION

The diagram (Fig. 1) is based on the electrical conductivity in micromhos/cm and on the sodium adsorption ratio. The irrigation waters have been divided into four broad classes. Waters with the electrical conductivity ranging from zero to 250 micrombos/cm at 25°C are classed as C_1, 250 to

750 micromhos/cm at 25°C as C_2, 750 to 2250 micrmhos/cm at 25°C as C_3, and above 2250 micromhos/cm at 25°C as C_4. Similarly, waters having SAR from zero to 10 are classed as S_1, from 10 to 18 as S_2, from 18 to 26 as S_3 and above 26 as S_4. The description regardings classification of the irrigation waters on the above criteria is given in the U.S.D.A. Handbook No. 60 (1955).

The chemical composition of the canal irrigation waters is shown in Table 1. Samples collected from the Khweshki lift irrigation scheme, Warsak left bank, lower Swat, Island, Mian Gujar, Hazar Khwani and Kurvi canals fell in C_1 S_1 class. Waters falling in this class can be used safely for the irrigation purpose. It may be necessary to leach soils of low permeability occasionally, if salt-sensitive plants are to be grown. There is little danger of developing harmful levels of exchangeable sodium from the use of waters of this class (1955) and (Wilcox 1959).

The samples of water collected from Bara drain and Warsak gravity, Joe-zardad and Joe Sheikh canals were classed as C_1 S_2. Waters in this class can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most instances without special practices for salinity control or with a little danger of the development of harmful level of exchangeable sodium. However, sodium sensitive crops such as stone fruit trees and avocados may accumulate injurious concentrations of sodium (1955 and 1959).

The more important anions found in irrigation waters are carbonates, bicarbonates, sulphates, chlorides, nitrates. Sulphates and nitrate are essential plant nutrients and are desirable in reasonable concentrations. Chloride in higher concentrations i.e. above 5 me/l is undesirable, as it is toxic to some plants. Here all water samples contain desirable amounts of chloride.

Carbonate waters are strongly alkaline, but bicarbonate waters are only mildly so. The total quantity and relative proportions of the two determine, to a great extent, the total alkalinity and pH of water. In waters containing high concentrations of these ions, there is a tendency for calcium and possibly magnesium to precipitate as carbonate when the water is concentrated by transpiration and evaporation. With the removal of calcium and magnesium from the soil solution, the relative proportion of sodium is increased with the attendant increase in alkali hazard. The RSC is a measure of hazard involved in the use of high bicarbonate waters. Since the values of RSC of these

TABLE 1. *Chemical composition of some representative canal waters used for irrigation in Peshawar district.*

S. No.	Canal/Drain	ECx 10^6 at 25°C	Total soluble salts (ppm)	Total suspended matter (%)	pH	Soluble cations (me/l)		Soluble anions (me/l)				SAR	RSC (me/l)	Class
						Ca+Ma	Na	CO_3	HCO_3	Cl	SO_4			
1.	Warsak left bank canal	250	160	0.00	7.9	1.52	0.88	0.00	1.60	0.25	0.70	1.01	0.08	Cl-SI
2.	Warsak lift canal	250	160	0.02	8.1	1.76	0.39	0.00	1.70	0.30	0.67	0.42	0	Cl-SI
3.	Hazar Khawani canal	225	144	0.12	8.3	1.68	0.37	0.00	1.20	0.12	1.00	0.40	0	Cl-SI
4.	Joe Sheikh canal	120	77	0.00	8.2	1.12	0.30	0.00	0.80	0.20	0.52	0.40	0	Cl-SI
5.	Kurvi canal	110	70	0.00	7.5	1.04	0.32	0.00	0.54	0.20	0.64	0.44	0	Cl-SI
6.	Joe Zardad canal	115	74	0.00	7.5	1.11	0.32	0.00	0.70	0.20	0.54	0.44	0	Cl-SI
7.	Mian Gujar canal	250	160	0.10	8.0	2.37	0.54	0.00	1.80	0.80	0.95	0.49	0	Cl-SI
8.	Lower Swat canal	250	160	0.10	8.1	2.32	0.39	0.00	1.60	0.30	0.87	0.36	0	Cl-SI
9.	Island canal	250	160	0.08	8.3	1.94	0.54	0.00	1.20	0.40	0.80	0.56	0	Cl-SI
10.	Warsak gravity flow canal	275	176	0.12	8.2	1.96	0.44	0.00	1.60	0.24	1.03	1.41	0	C_2-SI
11.	Bara drain	500	320	0.00	8.1	4.46	0.74	0.40	2.80	0.60	1.42	0.50	0	C_2-SI
12.	Ichri branch	300	192	0.08	8.0	2.28	0.44	0.00	2.20	0.28	0.63	0.41	0	C_2-SI
13.	Khweshki irrigation lift canal	625	400	0.02	8.1	4.50	1.18	0.00	5.00	0.52	0.88	0.97	0.50	C_2-SI

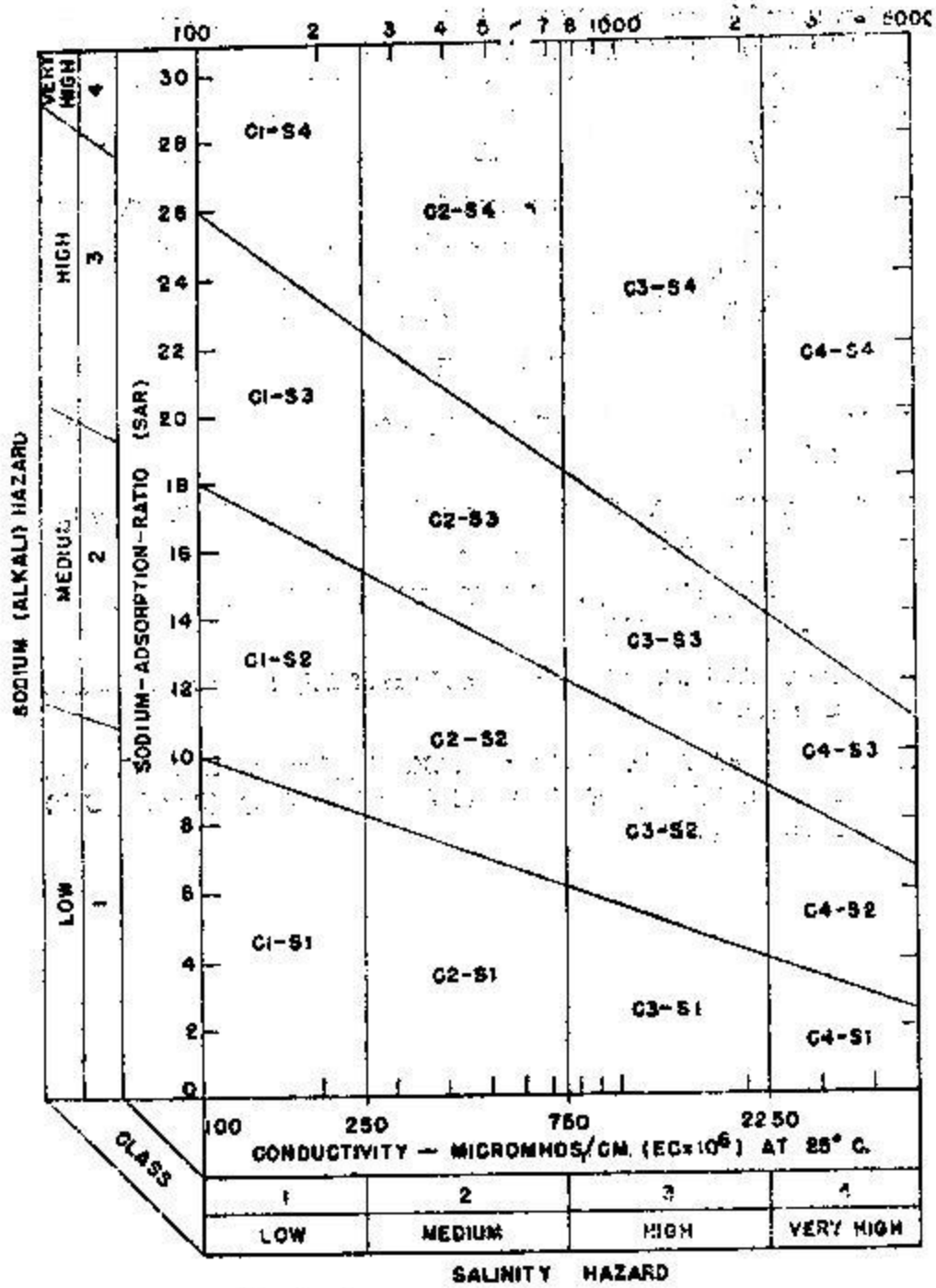

Fig. 1. —Diagram for the classification of irrigation waters

waters ranged from zero to 0.50 me/l, these waters are safe for irrigation. The laboratory and field studies have resulted in the conclusion that waters with more than 2.5 me/l RSC are not suitable for irrigation purposes. Waters containing 1.25 to 2.5 me/l RSC are marginal, and those containing less than 1.25 me/l RSC are probably safe (1955) and (Wilcax, 1959).

The SAR of these waters ranged from 0.36 to 1.41 and the total suspended matter ranged from zero to 0.12 per cent. On the basis of these observations also, all these surface waters are of good quality and no restriction should be applied to their use for irrigation purposes.

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