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Assessment of Quality of Groundwater of Tehsil Garhi Khairo, District Jacobabad, Pakistan

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Abstract: This study was carried out to provide guidelines to farmers and researchers regarding quality of ground water in Tehsil Garhi Khairo. A total 7 tube wells/canals were surveyed throughout tehsil and water samples were taken. Tube wellsand canal water analytical results revealed that pH ranged in between 7.00-7.30, EC 0.50-1.58 dS/m. Soluble sodium (Na^+) ranged between 2.70-6.75 dS/m, soluble Calcium (Ca^{2+}), 0.41-2.89 meq/L. Soluble Magnesium (Mg^{2+}) 0.33-2.1 meq/L, soluble potassium (K^+) ranged between 0.18-2.16, Chloride (Cl-) 2-6.81 dS/m, Sulphate (SO_4^{2-}) 0.2-0.6 meq/L. Overall results conclude that ground water of tehsil Garhi Khairo District Jacobabad can be used for irrigation.

Key words: Ground water, Garhi Khairo, Jacobabad, Sindh, irrigation, guidelines

INTRODUCTION

Pakistan is basically an agricultural country whose agriculture mostly depends on irrigation (Qureshi *et al*., 2003). Out of its total area of 79.61 Mha irrigated agriculture is spread over 16 Mha. The country lies in the arid or semi-arid part of the world between 24°N and 37°N latitude and between 61°E and 77°45 E longitude. Most of the irrigated area of Pakistan receives average rainfall of 200 mm which is not enough to grow a single crop. Fresh water resources which are very scarce form only 3% of the total water reserves. Fresh water quality and availability remain one of the most critical environmental and sustainability issues of 21st century (Khan and Sharma, 2007). The availability of sufficient amounts of water is fundamental to all biological processes for maintenance of biodiversity and ecosystems and for primary and secondary production functions. Role of water is directly linked with the quality of life and the precursor for the essential functions in a developing economy (Mohtadullah *et al*., 1993). Ground water is a valued fresh water resource and constitutes about two-third of fresh water resources of world and serves as the most important source for irrigation of agriculture in the world (Arslan *et al*., 2007). The ground water reservoir of the world is about 5.0×1041 L. This volume is more than 2,000 times that the volume of water in the entire world's rivers. Ground water has more mineral composition than surface water. More than half of the world's groundwater supplies are saline and the proportion is increasing as demand for water supply increases (Fetouani *et al*., 2008). For successful crop production on sustainable basis without damaging soils, the quality of groundwater is the main concern (Ghafoor *et al*., 1991). Tehsil Garhi Khairo of District Jacobabad is located on the border between Sindh and Baluchistan provinces at lat. 28°16'37.32"N, long. 68°27'05.04"E. It is said to be the hottest area in Pakistan. Like other parts of the Sindh Province this Tehsil Garhikhairo of Sindh is also deficient in rainfall which is generally insufficient and its distribution is also unsatisfactory. Due to the shortage of canal water supply, artificial irrigation is the major source to irrigate field crops in the area. Crops such as rice, wheat, pulses and vegetables like onions, tomato and fruit trees like jujube are mainly growing throughout the tehsil. This study was planned to provide guidelines to farmers and researchers for better crop production by applying good quality water. The objectives of current research is to assess the quality of groundwater in the tehsil Garhi Khairo, District, Jacobabad for its suitability to irrigation and to suggest suitable crops for growing under prevailing conditions.

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MATERIALS AND METHODS

Sampling of ground water: Public and private tube wells and canals located at tehsil Garhi Khairo were surveyed. Tube well selection was made at random in all dehs of the tehsil. These water samples were taken in bottles and sent to Department of Chemistry, Federal Urdu University and Department of Soil Sciences, Sindh agriculture University, Pakistan.

Methods used for laboratory analysis: To check the quality of irrigation water, following methods were applied in the laboratory pH of water was determined by pH m. Electrical Conductivity (EC) was determined with conductometer (Jenco Model, 3010). Potassium (K^+) and sodium (Na^+) were determined by flame photometer. Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) were determined by titrating with EDTA. Chloride (Cl^-) and Sulphate (SO_4^{2-}) are determined by Mohr's Method (Korkmaz, 2001).

RESULTS AND DISCUSSION

Water is a most precious resource which the nature has given to the mankind and other living beings. Its excessive and wrong use creates numerous problems. The quality of groundwater plays a vital role in assessing the availability of safe water for miscellaneous uses such as drinking, industrial and irrigation use. The detailed analytical results of tube wells/canals water samples collected from tube wells and canal waters of Tehsil Garhi Khairo, District Jacobabads were subjected to quantitative determination of anions and cations (pH, EC, Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^- and SO_4^{2-}).

pH: It is often useful to characterize an environment such as body of water by meaning of its pH. Different rocks, e.g., sandstone, limestone and basalt (a common rock, formed from a rapid cooling of basaltic lava) all have different composition. The longer the groundwater is in contact with minerals, the greater the extent of reaction with those minerals and higher will be the concentration of these minerals in water (Nasr and Zahran, 2014; Kumar *et al*., 2007). The results regarding tube well and canal water pH of study area showed that pH ranged between 7.0-7.3. The maximum pH was noted from the tube well water at village Seerwah, Gul Mir Khan Jamali, Hyder Shah Bukhari, however, the minimum pH (7.00) was noted in Saifullah and Begari Canal water. According to classification given by Ayers and Westcot (1985) 28 and 72% of samples came under desirable and permissible level, respectively.

Electrical Conductivity (EC): Electrical conductivity is an important parameter for the measurement of concentration of salts in irrigation water (Pal *et al*., 2015; Mandare *et al*., 2008). The analytical results for EC of tube well and canal water showed that it ranged from 0.50-1.58 dS/m. The maximum accumulation of soluble salts was recorded in the tube well water running at Seerwah village whereas the minimum EC was noted in Saifullah canal. The categorization of samples on the basis of EC showed that 25, 55.14 and 20% of samples were found useable, marginal and hazardous, respectively.

Sodium (Na^+): All ground water contains some sodium because most soil contains directly added in ground water from industrial and domestic wastes and contributes salinity (Grasso *et al*., 1993; Naeem *et al*., 2007). The concentrations of Na^+ (meq/L) in tube well and canal water of Tehsil Garhi Khairo ranged between 2.70-6.75 dS/m. The maximum Na^+ was noted in the tube well water at village Gul Mir Khan Jamali, the minimum Na^+ was noted in well water of village Hyder Shah Bukhari. According to the classification of Na^+ in water by Food and Agriculture Organization, all water samples were found in useable limit.

Potassium (K^+): Potassium is common in many rocks. Many of these rocks are relatively soluble and potassium concentration in drinking water increase with time. Artificial source of potassium in ground water is fertilizers. Most of fertilizers applied in agriculture are enriched with potassium (Sayyed and Bhosle, 2011; Rodvang *et al*., 2004). Results regarding soluble K^+ (meq/L) in tube well and canal water of study area ranged between 1.31-2.16 meq/L. The highest soluble K^+ was noted in the Beghari Canal water whereas the lowest soluble K^+ was noted from well water of village Gul Mir Khan Jamali. The categorization showed that 100% samples were found useable limit, respectively.

Calcium (Ca^{2+}): Calcium may dissolve readily in ground water from carbonate rocks and lime stones or be leached from soil (Arabi *et al*., 2013). Soluble Ca^{2+} contents of tube well water and canal water of Tehsil Garhi Khairo ranged between 0.41-2.89 meq/L. The maximum soluble Ca^{2+} was found in the tube well water running at village Gul Mir Khan Jamali whereas the minimum soluble Ca^{2+} (0.32 meq/L) was noted in Beghari canal. The categorization of samples on the basis of soluble Ca^{2+} revealed that all samples were found useable.

Magnesium (Mg^{2+}): The most common source of magnesium is erosion of rocks and magnesite. Magnesium

Table 1: Summary of chemical paramters of ground water of Tehsil Garhi Khairo

Location of tube well	pH	EC	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}
Khamiso Khan Brohi	7.1	1.00	4.89	1.76	2.20	1.10	4.78	0.20
Khadimabad	7.2	1.10	3.48	1.70	2.40	0.96	5.00	0.59
Seerwah	7.3	1.58	5.61	1.80	2.78	1.90	6.21	0.60
Gul Mir Khan Jamali	7.3	0.68	6.75	1.31	2.89	2.10	6.81	0.50
Hyder Shah Bukhari	7.3	0.96	2.70	1.78	0.60	0.33	2.00	0.20
Saifullah Canal	7.0	0.50	2.80	2.10	0.32	0.38	2.90	0.20
Beghari Canal	7.0	0.54	3.00	2.16	0.41	0.39	2.00	0.20

generally occurs lesser in concentration than calcium because of dissolution of magnesium rich minerals is slow process and calcium is more abundant in Earth's crust (Rapant *et al*., 2017; Sial *et al*., 2003). Soluble Mg^{2+} (meq/L) in tube well and canal water of study area ranged between 0.33-2.1 meq/L. The maximum soluble Mg^{2+} was recorded from the tube well water of village Gul Mir Khan Jamali whereas the minimum soluble Mg^{2+} noted from well water of village Hyder Shah Bukhari. On the basis of Mg^{2+} water samples were classified for irrigation which showed that 85 and 15% of the samples were within the useable and hazardous limits, respectively.

Chloride (Cl^-): Plants take up chloride as Cl^- ion from soil solution. It plays some important roles in plants, including in photosynthesis, osmotic adjustment and suppression of plant disease (White and Broadley, 2001). Results regarding Cl^- (meq/L) concentrations in tube well and canal water of Tehsil Gharhi Khairo ranged between 2-6.81 meq/L. The maximum were recorded in tube well water collected from village Gul Mir Khan Jamali while the minimum Cl^- (1.98 meq/L) were observed in tube well water of village Begari Canal and Hyder Shah Bukhari. The categorization of irrigation water on the basis of Cl^- revealed that 82 and 18% of samples were found useable and above safe limits, respectively.

Sulphate (SO_4^{2-}): In plants, sulfur is essential for nitrogen-fixing nodules on legumes and necessary in the formation of chlorophyll (Buchner *et al*., 2004). The results for SO_4^{2-} (meq/L) concentration (Table 1) determined in tube well and canal water of Tehsil Gharhi Khairo indicated that it ranged from 0.2-0.6 meq/L. The maximum SO_4^{2-} concentrations was recorded in tube well water of village Seerwah whereas the minimum SO_4^{2-} concentration (1.17 meq/L) was noted in 4 other spots. The categorization of irrigation water on the basis of SO_4^{2-} revealed that 91 and 9% of samples were found useable and above safe limits, respectively.

CONCLUSION

Public and private tube wells/canals of Tehsil Garhi Khairo will be surveyed. Tube well selection will be made at random in all Dehs of the Tehsil. These samples will be analyzed for EC, pH, cations (Ca^{2+}, Mg^{2+} and Na^+, K^+) and anions (SO_4^{2-} and Cl^-). Overall results conclude that groundwater of taluka Garhi Khairo District Jacobabad can be used for irrigation purpose.

REFERENCES

Arabi, A.S., I.I. Funtua, B.B.M. Dewu, M.L. Garba and S. Okoh *et al*., 2013. Assessment of Calcium and Magnesium concentrations in groundwater as supplements for sleep related ailments. J. Appl. Environ. Biol. Sci., 3: 29-35.

Arslan, H., M. Guler, B. Cemek and Y. Demir, 2007. Assessment of groundwater quality in Bafra plain for irrigation. J. Tekirdag Agric. Faculty, Vol. 4,

Ayers, R.S. and D.W. Westcot, 1985. Water Quality for Agriculture. Food and Agriculture Organization of United Nations, Rome, Italy.

Buchner, P., H. Takahashi and M.J. Hawkesford, 2004. Plant sulphate transporters: Co-ordination of uptake, intracellular and long-distance transport. J. Exp. Bot., 55: 1765-1773.

Fetouani, S., M. Sbaa, M. Vanclooster and B. Bendra, 2008. Assessing ground water quality in the irrigated plain of Triffa (North-East Morocco). Agric. Water Manage., 95: 133-142.

Ghafoor, A., M. Qadir and R.H. Qureshi, 1991. Using brackish water on normal and salt-affected soils in Pakistan: A review. Pak. J. Agric. Sci., 28: 273-288.

Grasso, D., K. Strevett and H. Pesari, 1993. Impact of sodium and potassium on environmental systems. J. Environ. Syst., 22: 297-323.

Khan, M.A. and M. Sharma, 2007. Assessment of ground water quality in Churu District, Rajasthan. Ann. Arid Zone, 46: 145-149.

Korkmaz, D., 2001. Precipitation titration: Determination of Chloride by the Mohr Method. Methods, 2: 1-6.

Kumar, D.R., M.S. Badrinath, T. Chikkaramappa and B.R. Jagadeesh, 2007. An assessment of ground water quality in eastern dry zone (Kolar District) of Karnataka. Environ. Ecol., 25: 80-82.

Mandare, A.B., S.K. Ambast, N.K. Tyagi and J. Singh, 2008. On-farm water management in saline groundwater area under scarce canal water supply condition in the Northwest India. Agric. Water Manage., 95: 516-526.

Mohtadullah, K., C.A.U. Rehman and C.M. Munir, 1993. Water for the 21st Century. Environment and Urban Affairs Division, Government of Islamabad, Pakistan.

Naeem, M., K. Khan, S. Rehman and J. Iqbal, 2007. Environmental assessment of ground water quality of Lahore Area, Punjab, Pakistan. J. Applied Sci., 7: 41-46.

Nasr, M. and H.F. Zahran, 2014. Using of pH as a tool to predict salinity of groundwater for irrigation purpose using artificial neural network. Egypt. J. Aquat. Res., 40: 111-115.

Pal, M., N.R. Samal, P.K. Roy and M.B. Roy, 2015. Electrical conductivity of lake water as environmental monitoring-a case study of Rudrasagar Lake. IOSR J. Environ. Sci. Toxicol. Food Technol., 9: 66-71.

Qureshi, A.S., T. Shah and M. Akhtar, 2003. The Groundwater Economy of Pakistan. International Water Management Institute, Lahore, Punjab, Pakistan, ISBN:9789290905301.

Rapant, S., V. Cveckova, K. Fajcikova, D. Sedlakova and B. Stehlikova, 2017. Impact of Calcium and Magnesium in groundwater and drinking water on the health of inhabitants of the Slovak republic. Intl. J. Environ. Res. Publ. Health, 14: 1-21.

Rodvang, S.J., D.M. Mikalson and M.C. Ryan, 2004. Changes in ground water quality in an irrigated area of southern Alberta. J. Environ. Qual., 33: 476-487.

Sayyed, J.A. and A.B. Bhosle, 2011. Analysis of Chloride, Sodium and Potassium in groundwater samples of Nanded City in Mahabharata, India. Eur. J. Exp. Biol., 1: 74-82.

Sial, N.B., I. Rajper, H.R. Mangio and J.K. Suther, 2003. Assessing irrigation quality of well water in Thar Dessert. Pak. J. Agric., Agril. Eng., Vet. SC., 19: 8-10.

White, P.J. and M.R. Broadley, 2001. Chloride in soils and its uptake and movement within the plant: A Review. Ann. Bot., 88: 967-988.