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Groundwater Quality Assessment for Chittoor District of Andhra Pradesh for Irrigation Purpose and Management Options

P Venkata Subbaiah[1]*, MVS Naidu[1], Y Radha Krishna[1], MJ Kaledhonkar[2] and BL Meena[2]

[1]AICRP on Management of Salt affected Soils and Use of Saline Water in Agriculture ANGRAU, Bapatla-522 101, Andhra Pradesh, India
[2]ICAR-Central Soil Salinity Research Institute, Karnal-132001, Haryana, India
**Corresponding author E-mail: venkat.076@gmail.com*

Abstract

A survey was undertaken during the year 2019 to assess the quality of groundwater for irrigation in Chittoor district of Andhra Pradesh. A total of 358 samples were collected and GPS locations of sampling points were recorded. The water samples were analyzed for various chemical properties *viz.*, pH, EC, Ca^{+2}, Mg^{+2}, Na^{+} and K^{+}; CO_3^{-2}, HCO_3^{-}, Cl^{-} and SO_4^{-2}. The pH, EC, SAR and RSC in groundwater ranged from 5.5-8.8, 0.2-13.5 (dS m^{-1}), 0.26-20.4 (mmol $l^{-1})^{1/2}$, and 9.4-37.6 (me L^{-1}), respectively. The concentration of cations *viz.*, Ca^{+2}, Mg^{+2}, Na^{+} and K^{+} varied from 0.8-26.4, 0-15.6, 0.25-91.31 and 0.001-2.64 me L^{-1} with mean values of 5.13, 3.64, 6.58 and 0.11 me L^{-1}, respectively. Concentration of anions viz., CO_3^{-2}, HCO_3^{-}, Cl^{-} and SO_4^{-2} varied from 0-5.6, 0.2-14.6, 0.8-85.2 and 0-45 me L^{-1} with average values of 0.84, 6.46, 5.84 and 2.03 me L^{-1}, respectively. The relative abundance of ions for most of the water samples were $Na^{+} > Ca^{+2} > Mg^{+2} > K^{+}$ for cations and $HCO_3^{-} > Cl^{-} > SO_4^{-2} > CO_3^{-}$ for anions. In total the irrigation water samples were 65.64, 25.69, 0.27, 6.7, 1.11 and 0.55 per cent of good, marginally saline, high SAR saline, marginally alkaline, alkali and highly alkali, respectively. Spatial variability maps of EC, SAR, RSC of ground water used for irrigation in the district and groundwater quality map were also generated. Yields of major crops grown with poor- quality groundwater (saline/ alkali) were assessed. Yield losses (7.7 to 53.3%) under seven different crops due to poor-quality irrigation were estimated by comparing those yields with good-quality ground water areas. Soil and crop management practices were suggested to overcome the crop yield losses in poor-quality soil and water environment in the district.

Key words: Ground water quality, RSC, SAR, Spatial variability, Yield losses, Management options

Introduction

Water has become a scarce commodity due to its over exploitation as well as its pollution due to different reasons. Globally, one fifth of the water used is obtained from the ground water resources. For many important agricultural areas ground water is the ultimate source of fresh water as surface water sources have been depleted .The countries with largest extent of areas equipped for irrigation with ground water in absolute terms are India (39 m ha), China (19 m ha) and USA (17 m ha) (Siebert *et al.*, 2010). The use of ground water for irrigation is significant and provides farmers with a reliable source of water that can be used in a flexible manner. Total ground water withdrawals are essential to be in the range of 6000-1100 km^3 $year^{-1}$ or between $1/5^{th}$ and $1/3^{rd}$ of the global fresh water withdrawals (Shah *et al.*, 2017).

Generally, the rates of ground water recharge in semiarid and arid regions are low such that in the absence of alternative resources of water, ground water withdrawals can exceed aquifer recharge and can result in depletion. Quality of irrigation water is an important consideration in any appraisal of salinity or alkali conditions in irrigated areas and it depends on primarily on the total amount of salt present and proportion of sodium to other cations and certain other parameters (Singh *et al.*, 2019). The assessment of ground water quality gains importance in recent times due to contamination of ground water by geo-hydrological pollution, weathering of minerals, urbanization and point source pollution and also because of over exploitation due to increase in urbanization, industrialization and interference of agricultural activities (Ackah *et al.*,