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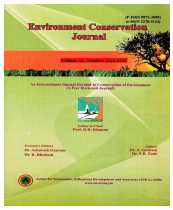

Characterization of irrigation water quality of groundnut belt of erstwhile Mahbubnagar district of Telangana

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ABSTRACT

An investigation was performed to characterize the irrigation water quality of the groundnut belt in the erstwhile Mahabubnagar district, Telangana for which 35 irrigation water samples from both canal and groundwater sources from the study area were collected through a preliminary survey in the selected farmer's fields. The samples which were analyzed for pH, EC, RSC, SAR Mg/Ca ratio and Kelly's ratio in the laboratory interpreted that the pH was slightly alkaline (pH: 7.58) with medium salinity (0.64 dS/m) and high Mg/Ca (1.15) ratio though the RSC (5.05) and SAR (2.68) fall in the safe ranges and were classified under C2S1 and C3S1 irrigation water classes. Considering the pH range in the irrigation water, proper management of the soil through incorporation of organic manures at regular intervals is suggested in all the regions of the groundnut belt (highly and marginally potential zones) having pH above 7.50 to prevent mounting up of soil pH when irrigated continuously over a period of time.

Introduction

In arid and semi-arid parts of India, groundwater is the primary source of irrigation for household, agricultural, and industrial needs. India has 2.2 percent of the world's territory, 4% of its water resources, and 16% of the world's people (Ramesh and Elango 2011; Bhutiani and Ahamad, 2019). So, development of irrigation in India has been driven by the paramount imperative of feeding a rapidly increasing population. Water quality is a major concern for humanity because it is directly linked to human welfare, particularly for drinking and agriculture (Tyagi *et al.,* 2020; Ruhela *et al.,* 2021; Bhutiani *et al.,* 2021).

The irrigation water quality can be defined based on the concentration and kind of salts and solids dissolved in it (Etteieb *et al.,* 2017). Irrigation water quality testing is necessary to ensure a safe supply of water to the crop. In recent years, there has been a growing concern over irrigation's long-term prospects and the ramifications of continuing existing water management techniques on the system's long-term viability (Chintapalli *et al.,* 2000). The information regarding irrigation water quality has critical importance in understanding the changes in the quality of the product, and the modifications that are required in the water management (Ramakrishnaiah *et al.,* 2009). The quality of irrigation water is an essential element in the assessment of salinity or alkali conditions in irrigated regions, and it is largely determined by the overall quantity of salt present, the proportion of sodium (Na) to other cations, and a number of other factors (Tiwari, 2011). The efficiency of the product and the potential for emergence of hazardous conditions of the soil should be considered during the evaluation of water quality

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for irrigation for obtaining better yields in the crop production (Bhardwaj *et al.,* 2020). Thus, evaluation of water quality is mandatory in planning, design and operation of irrigation systems (Mirabbasi *et al.,* 2008). So, the present exploration was taken up aiming for irrigation water quality characterization during rabi 2019-20 in the erstwhile Mahabubnagar district of Telangana.

Material and Methods

Study area

Mahabubnagar district of Telangana lies between 15°55' to 17°20' latitudes and 77°15' to 79°15' Northern and Eastern longitudes where the climate is generally hot. The mean monthly maximum temperature ranges between 30.5˚C in August and 38.8˚C during April-May. The average monthly minimum temperature ranged from 16.3˚C during and to 26.4˚C during May. The mean annual rainfall is 604 mm which is mostly received during South-West monsoon. The annual rainfall was hardly 64.0 per cent of the state average (940 mm). The year-to-year variation in the actual rainfall showed that there were more dry spells during the cropping season (District census handbook-Mahabubnagar, 2011). The principal soil is the chalka dubba in about 70.0 per cent of the study area and has low water holding capacity (Statistical year book-Mahabubnagar, 2017). Krishna and Tungabhadra are the two principal rivers that flowed through the district. The total ayacut area under different irrigation projects is 5.37 lakh ha. The major irrigation projects occupy an area of 3.70 lakh ha. The medium irrigation projects occupy an area of 0.20 lakh ha, and an area of 1.30 lakh ha is under minor irrigation projects. There are about 1,87,216 minor irrigation sources in the district which include shallow tube wells, dug wells, deep tube wells, surface flow and lift irrigation projects (Statistical year book-Mahabubnagar, 2017). The average irrigation intensity of the state is 1.42 (average from 2011-12 to 2015-16). Net area irrigated under different sources of irrigation in the district was 2.50 lakh ha (2010-12), out of which the area irrigated by the groundwater resources was 2.10 lakh ha, which constitutes 83.2 per cent of the net area irrigated. Area irrigated by surface water was 0.30 lakh ha, which accounts for 13.7 per cent of the total irrigated area and remaining by other sources (Madhusudhana, 2013).

Water sample collection and analysis

The groundnut crop being an important *rabi* season crop of the erstwhile Mahabubnagar district is a crop colony of groundnut. The marginally potential zones of the crop colony have high crop spread but has low productivity. So, assessment of irrigation water could reveal the reason for low crop productivity in the study area. Thirty-five (35) irrigation water samples in total were collected from both borewell (24 samples) and canal (11 samples) (Table 1 & Figure 1) sources from the study area at the time of crop harvest i.e., from 28th November, 2019 to 6th February, 2020. The samples were analysed for pH, EC (Electrical Conductivity), carbonates, bicarbonates, calcium, magnesium and sodium following the standard procedures in the laboratory Jackson, 1967; Barnes (1964); Wood (1976); Hem (1970); Diehl (1950) from which sodium absorption ratio (SAR) residual sodium carbonate (RSC), magnesium/calcium ratio and Kelly's ratio were computed and categorized them into suitable classes (Table 2). A detailed methodology followed for the assessment of quality of irrigation water samples was presented in Figure 2.

Results and Discussion

The irrigation water quality determines its suitability for the crop and its yield. So, a careful analysis was carried out for the assessment of pH, EC, RSC, SAR, Mg-Ca ratio and Kelly's ratio in the samples of the groundnut belt in the erstwhile Mahabubnagar district, Telangana and the results were detailed here under (Table 3).

pH of Irrigation water:

The study area with regards to irrigation water pH was categorized in to three classes viz., acidic (< 6.50), neutral (6.50-7.50) and alkaline (> 7.50). The pH of the water samples in the research site stretched from 6.91 to 8.10 with the mean of 7.58. The pH of borewell samples stretched from 6.91 and 7.90 with a mean of 7.56. Similarly, pH of canal water samples stretched from 7.10 and 8.10 by mean value of 7.59. The overall assessment of both the sources showed that the irrigation water in the groundnut zone falls into alkaline range. Ranjit *et al*. (2017) at Kalwakurthy mandal of Mahabubnagar also reported pH of water samples ranging from 7.78 to 8.90 with a mean value of 8.12.

Table 1: Location and coordinates of the selected groundnut crop fields.

SN	Village	Mandal	Division	Latitude	Longitude
1	Shekupally	Itikyal	Gadwal	16.11833	77.92636
2	Kothakota	Kothakota	Wanaparthy	16.36164	77.93672
3	Putanpally	Gadwal	Gadwal	16.16716	77.84795
4	Dattaipally	Wanaparthy	Wanaparthy	16.31787	78.07460
5	Maldakal	Maldakal	Gadwal	16.10839	77.68590
6	Basavapuram	Gattu	Gadwal	16.15046	77.58418
7	Mylagadda	K.T.Doddi	Gadwal	16.23944	77.60169
8	Nallahelli	Dharoor	Gadwal	16.28208	77.61575
9	Pathapalem	Dharoor	Gadwal	16.28136	77.61658
10	Mylaram	Kodair	Nagarkurnool	16.17734	78.31488
11	Buddharam	Gopalpet	Wanaparthy	16.41820	78.14000
12	Velgonda	Chinnambavi	Wanaparthy	16.10885	78.09300
13	Nallavelly	Nagarkurnool	Nagarkurnool	16.48328	78.24618
14	Ankiraopally	Kollapur	Nagarkurnool	16.10828	78.31293
15	Kottapally	Amrabad	Nagarkurnool	16.35644	78.81134
16	Pentlavelly	Pentlavelly	Nagarkurnool	16.07197	78.23838
17	Veljal	Talakondapally	Shadnagar	16.65389	78.19442
18	Gopaldinne	Veepanagandla	Wanaparthy	16.12852	78.06158
19	Uppununtala	Uppununtala	Nagarkurnool	16.52633	78.66717
20	Lingala	Lingala	Nagarkurnool	16.23610	78.08784
21	Gattunellikuduru	Telkapally	Nagarkurnool	16.40301	78.44006
22	Chennaram	Balmoor	Nagarkurnool	16.38845	78.55522
23	Kakunooru	Keshampet	Shadnagar	16.91817	78.32250
24	Kalvakolu	Peddakottapally	Nagarkurnool	16.17726	78.31484
25	Waddeman	Bijinapally	Nagarkurnool	16.48315	78.22762
26	Gummakonda	Timmajipet	Nagarkurnool	16.65451	78.19461
27	Lingotam	Achampet	Nagarkurnool	16.41383	78.62158
28	Chinna Aadirala	Jadcherla	Mahabubnagar	16.83731	78.31447
29	Chinnamylaram	Kodangal	Kodangal	17.09258	77.70106
30	Dudhyal	Kodangal	Kodangal	17.04719	77.71156
31	Pedda Aadirala	Jadcherla	Mahabubnagar	16.09869	78.29169
32	Papagal	Tadoor	Nagarkurnool	16.65180	78.30635
33	Rudrasamudram	Makhtal	Narayanpet	16.49499	77.92636
34	Rudrasamudram	Makhtal	Narayanpet	16.46476	77.93672
35	Mahabubnagar	Mahabubnagar	Mahabubnagar	16.72500	77.84795

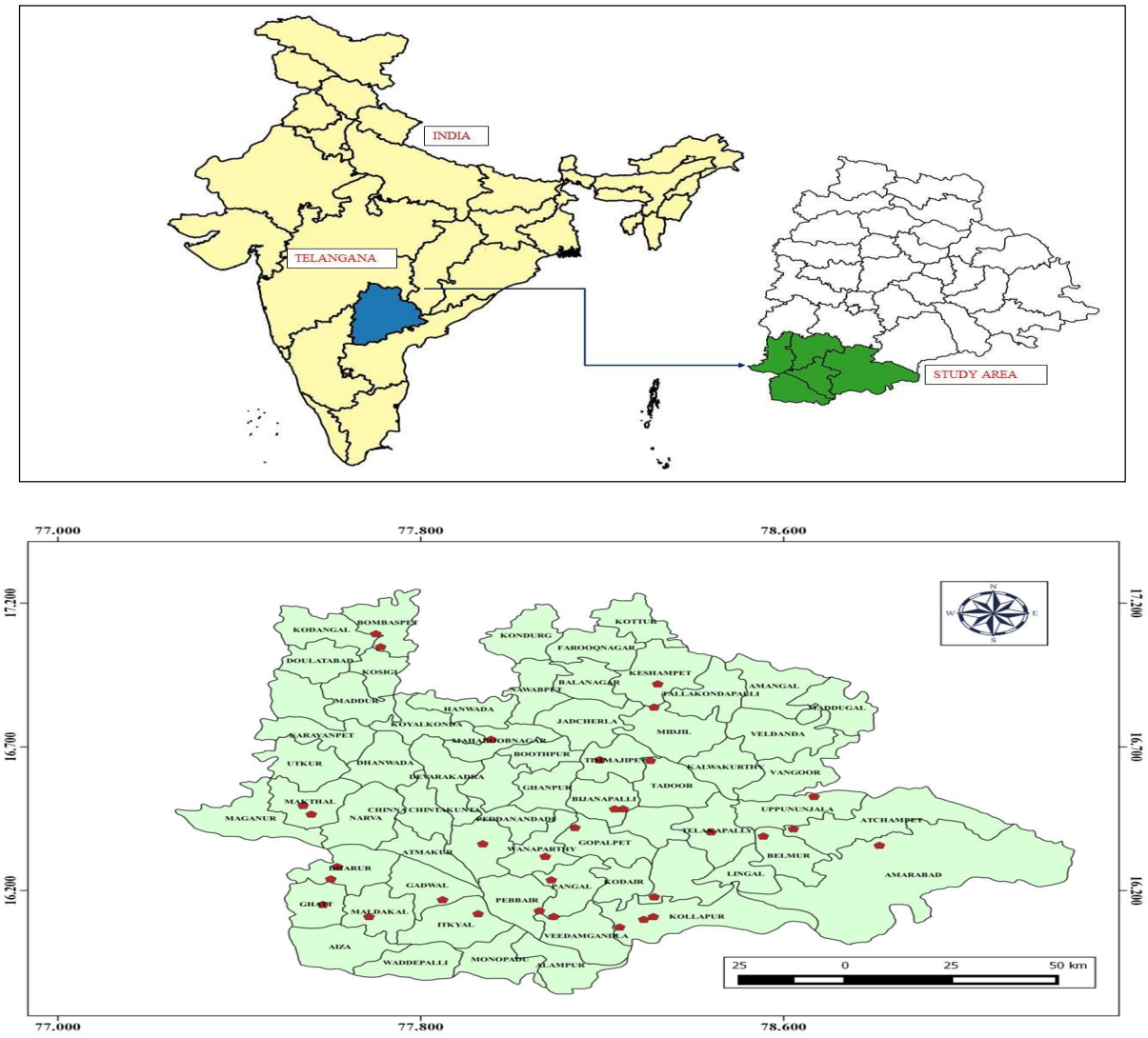

Figure 1: The study area map representing the coordinates of the groundnut fields

Table 2: Classes assigned for irrigation water parameters to assess the water quality in the study area (US Salinity Lab, 1954)

SN	Water quality parameter	No of classes assigned	Details of classes
1.	pH (1:2.5)	03	▪ < 6.00: Acidic ▪ 6.00-7.50: Neutral ▪ > 7.50: Alkaline
2.	EC (dS/m) (US Salinity Lab, 1954)	04	▪ C1: < 0.25-Low saline ▪ C2: 0.25-0.75-Medium saline ▪ C3: 0.75-2.25-Highly saline ▪ C4: > 2.25-Very highly saline
3.	SAR	04	▪ S1: 0-10.0- Low ▪ S2: 10.0-18.0-Medium ▪ S3:18.0-26.0-High ▪ S4:> 26.0-Very high
4.	RSC (me l^{-1})	03	▪ < 1.25: Safe ▪ 1.25 -2.5 0: Moderate ▪ > 2.5 0: Unsafe
5.	Mg/ Ca ratio	02	▪ < 1.00: Safe ▪ > 1.00: Unsafe
6.	Kelly's Ratio	02	▪ < 1.0: Suitable ▪ > 1.0: Unsuitable

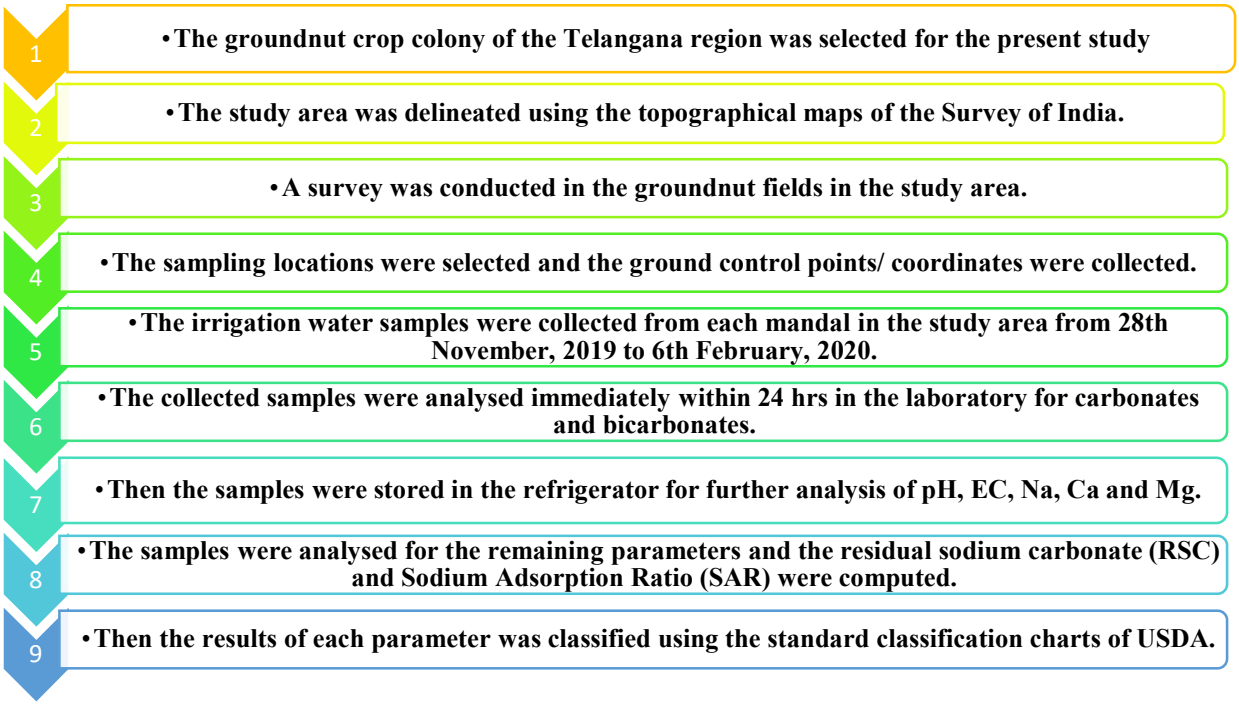

Figure 2: Detailed methodology for sampling and analysis of irrigation water samples

Assessment of groundwater quality in selected villages of Mahabubnagar by Srinivasulu *et al*. (2015) also showed that pH ranged from 7.09 to 8.19 which are slightly basic. The higher pH of the most of groundwater samples may be due to considerable Na^{+}, Ca^{2+}, Mg^{2+}, CO_3^{2-} and HCO_3^{-}. The samples from Nagarkurnool and Wanaparthy divisions of the research site in the groundnut belt showed that pH of irrigation water was mostly alkaline with exception of Timmajipet, Tadoor and parts of Bijinapally, Nagarkurnool, Telkapally, Balmoor, Uppununtala, Achampet, Kollapur, Veepangandla, Pebbair, Ghanpur mandals having neutral pH. Contrastingly, the irrigation water of entire Narayanpet and Gadwal divisions was characterized as alkaline with few exceptions in parts of Itikyal, Gadwal and Monopad mandals of Gadwal division with neutral irrigation samples. Considering the pH range, proper management of the soil through incorporation of organic manures at regular intervals is suggested in all the regions of the groundnut belt (highly and marginally potential zones) having pH above 7.50 to prevent mounting up of soil pH when irrigated continuously over a period of time.

Electrical Conductivity of irrigation water:

The irrigation water samples for electrical conductivity were classified into four classes viz., low saline (very good water: < 0.25 dS/m), medium saline (good water: 0.25-0.75 dS/m), highly saline (doubtful water: 0.75-2.25 dS/m) and very highly saline (not useful water: > 2.25 dS/m). The Electrical conductivity (EC) in the irrigation water samples (borewells and canals) in the study area ranged from 0.14 to 1.47 dS/m with a mean value of 0.64 dS/m. These values can be supported from EC values obtained at Kalwakurthy mandal which extend from 0.40 to 1.20 dS/m with a mean value of 0.71 dS/m in the irrigation water (Ranjit *et al.,* 2017). The irrigation water from borewells had reported EC ranging from 0.14 to 0.98 dS/m with a mean of 0.47 dS/m. On the other hand, the EC of the water samples of canal irrigated regions ranged from 0.15 to 1.47 dS/m with an average value of 0.72 dS/m. The EC of the water samples (both borewells and canals) indicated that the irrigation water though was doubtful (highly saline) for crop growth in some regions it was mostly good for irrigating the crop. Disintegrated regions of (doubtful) highly saline water were seen in Kodangal, Kosgi, Bomraspet, Doultabad and parts

Table 3: Results of laboratory analysis of the irrigation water samples collected from the farmer's fields in the study area.

SN	District	pH (1:2.5)	Rating	EC (dS/m)	Rating	SAR	Rating	Irrigation water class	Mg/Ca ratio	Rating	RSC	Rating	Kelly's ratio	Rating
1	**Gadwal**	6.91	Neutral	0.14	Low (C1)	1.80	Low Na (S1)	C1S1	0.79	Low	-6.70	Safe	0.32	Suitable
2	**Wanaparthy**	8.10	Slightly alkaline	0.79	Highly saline (C3)	1.99	Low Na (S1)	C3S1	1.07	Low	-6.40	Safe	0.34	Suitable
3	**Gadwal**	7.40	Neutral	0.17	Low (C1)	1.83	Low Na (S1)	C1S1	0.84	Low	-7.20	Safe	0.32	Suitable
4	**Wanaparthy**	7.70	Slightly alkaline	0.49	Medium saline (C2)	1.47	Low Na (S1)	C2S1	2.93	Medium	-7.90	Safe	0.23	Suitable
5	**Gadwal**	7.90	Slightly alkaline	0.57	Medium saline (C2)	1.30	Low Na (S1)	C2S1	2.80	Medium	-9.00	Safe	0.20	Suitable
6	**Gadwal**	8.05	Slightly alkaline	1.01	Highly saline (C3)	3.43	Low Na (S1)	C3S1	0.84	Low	-7.20	Safe	0.57	Suitable
7	**Gadwal**	7.90	Slightly alkaline	0.64	Medium saline (C2)	1.90	Low Na (S1)	C2S1	0.51	Low	-4.30	Safe	0.40	Suitable
8	**Gadwal**	8.10	Slightly alkaline	0.53	Medium saline (C2)	1.82	Low Na (S1)	C2S1	0.93	Low	-3.10	Safe	0.36	Suitable
9	**Gadwal**	8.01	Slightly alkaline	0.24	Low (C1)	1.33	Low Na (S1)	C1S1	1.95	Medium	-9.00	Safe	0.19	Suitable
10	**Nagarkurnool**	7.60	Slightly alkaline	1.43	Low (C1)	10.3	Medium Na (S2)	C1S2	1.80	Medium	-3.20	Safe	2.00	Unsuitable
11	**Wanaparthy**	7.90	Slightly alkaline	0.36	Medium saline (C2)	1.70	Low Na (S1)	C2S1	1.71	Medium	-10.5	Safe	0.24	Suitable
12	**Wanaparthy**	7.72	Slightly alkaline	0.67	Medium saline (C2)	3.26	Low Na (S1)	C2S1	1.30	Low	-6.00	Safe	0.59	Suitable
13	**Nagarkurnool**	7.30	Neutral	0.32	Medium saline (C2)	3.34	Low Na (S1)	C2S1	1.95	Medium	-4.60	Safe	0.64	Suitable
14	**Nagarkurnool**	7.80	Slightly alkaline	0.38	Medium saline (C2)	2.44	Low Na (S1)	C2S1	0.68	Low	-1.70	Safe	0.60	Suitable
15	**Nagarkurnool**	7.60	Slightly alkaline	0.15	Low (C1)	2.00	Low Na (S1)	C1S1	1.86	Medium	-7.10	Safe	0.30	Suitable
16	**Nagarkurnool**	7.16	Neutral	1.19	Highly saline (C3)	2.33	Low Na (S1)	C3S1	1.25	Low	-5.70	Safe	0.25	Suitable
17	**RangaReddy**	7.15	Neutral	0.62	Medium saline (C2)	1.33	Low Na (S1)	C2S1	0.60	Low	-3.95	Safe	0.29	Suitable
18	**Wanaparthy**	8.05	Slightly alkaline	0.96	Highly saline (C3)	3.39	Low Na (S1)	C3S1	0.10	Low	-6.95	Safe	0.22	Suitable
19	**Nagarkurnool**	7.20	Neutral	0.81	Highly saline (C3)	1.96	Low Na (S1)	C3S1	0.90	Low	-4.10	Safe	0.36	Suitable
20	**Nagarkurnool**	7.56	Slightly	0.44	Highly	2.07	Low Na	C3S1	0.60	Low	-5.55	Safe	0.08	Suitable

			alkaline		saline (C3)		(S1)							
21	**Nagarkurnool**	7.44	Neutral	0.45	Medium saline (C2)	1.92	Low Na (S1)	C2S1	1.07	Low	-4.50	Safe	0.04	Suitable
22	**Nagarkurnool**	7.20	Neutral	0.25	Low (C1)	2.92	Low Na (S1)	C1S1	0.04	Low	-3.75	Safe	0.23	Suitable
23	**RangaReddy**	7.20	Neutral	0.85	Highly saline (C3)	2.18	Low Na (S1)	C3S1	0.60	Low	-3.95	Safe	0.47	Suitable
24	**Nagarkurnool**	7.72	Slightly alkaline	1.47	Highly saline (C3)	2.89	Low Na (S1)	C3S1	0.27	Low	-1.80	Safe	0.61	Suitable
25	**Nagarkurnool**	7.54	Slightly alkaline	0.98	Highly saline (C3)	4.47	Low Na (S1)	C3S1	0.19	Low	1.00	Safe	1.18	Unsuitable
26	**Nagarkurnool**	7.52	Slightly alkaline	1.26	Highly saline (C3)	4.24	Low Na (S1)	C3S1	2.40	Medium	-5.65	Safe	0.33	Suitable
27	**Nagarkurnool**	7.79	Slightly alkaline	0.67	Medium saline (C2)	1.42	Low Na (S1)	C2S1	2.43	Medium	-7.10	Safe	0.26	Suitable
28	**Mahabubnagar**	7.10	Neutral	0.31	Medium saline (C2)	1.06	Low Na (S1)	C2S1	0.35	Low	-0.80	Safe	0.81	Suitable
29	**Vikarabad**	7.50	Neutral	0.84	Medium saline (C2)	6.57	Low Na (S1)	C2S1	0.74	Low	-2.15	Safe	0.60	Suitable
30	**Vikarabad**	7.60	Slightly alkaline	0.88	Medium saline (C2)	5.47	Low Na (S1)	C2S1	0.84	Low	-5.85	Safe	0.36	Suitable
31	**Mahabubnagar**	7.40	Neutral	0.53	Medium saline (C2)	1.16	Low Na (S1)	C2S1	1.33	Low	-2.90	Safe	0.48	Suitable
32	**Nagarkurnool**	7.26	Neutral	0.92	Medium saline (C2)	3.79	Low Na (S1)	C2S1	1.41	Low	-4.70	Safe	1.57	Unsuitable
33	**Narayanpet**	7.16	Neutral	1.19	Highly saline (C3)	1.92	Low Na (S1)	C3S1	1.08	Low	-5.34	Safe	0.66	Suitable
34	**Narayanpet**	7.15	Neutral	0.62	Medium saline (C2)	1.34	Low Na (S1)	C2S1	1.09	Low	-4.61	Safe	1.29	Unsuitable
35	**Mahabubnagar**	7.59	Slightly alkaline	0.32	Medium saline (C2)	1.42	Low Na (S1)	C2S1	1.18	Low	-4.36	Safe	1.39	Unsuitable

of Bhootpur, Timmajipet, Jadcherla, Tadoor, Midjil, Bijinapally, Ghanpur, Keshampet, Kothur, Kondurg, Farooqnagar, Uppununtala, Vangoor, Amrabad, Kothakota, Pebbair, Ghattu, Alampur, Monopadu, Veepanagandla, Pangal, Kodair, Peddakothapalli and Kollapur mandals. In these regions, while irrigating the crop precautions to be taken to manage the soil by adding organic matter once in two years to prevent build-up of soil EC due to long term irrigation with waters of high EC (0.75-2.25 dS/m). An overview of study area shows that the overall study (Nagarkurnool and Wanaparthy Narayanpet and Gadwal divisions) of groundnut cultivation receive medium saline water for irrigating the crop.

Sodium Absorption Ratio (SAR)

Corresponding to RSC contents, the SAR values were low for the irrigation water ranging from 1.06 to 10.3 with a mean value of 2.68 showing that the irrigation water was safe and sound for irrigating the crop. The sodium absorption ratio of the canal waters ranged from 1.30 to 4.48 with a mean of 2.47, while the SAR of borewell waters extended from 1.06 to 10.3 with an average value of 2.78. However, Ranjit *et al*. (2017) reported SAR values extending from 0.30 to 1.40 with a mean of 0.60 at Kalwakurthy mandal. The sodium absorption ratio was mapped with two rates viz., very low (-1.00 to -5.00) and low (-5.00 to -10.0). Entire district was portrayed as having very low SAR with few areas of low SAR in parts of Kodair, Kollapur, Kodangal, Kosgi, Bomraspet and Doulatbad mandals. A very low SAR in irrigation water was observed in the entire study area (Nagarkurnool, Wanaparthy, Narayanpet and Gadwal divisions) of groundnut except in parts of Kodair, Kollapur and Kosgi mandals with low SAR values. Ayers and Westcot (1976) reported that irrigation water having SAR of 0-10, i.e., low Na^+ water poses almost no risk of exchangeable Na^+. Since calcium is the predominantaly adsorbed cation in both seasons, soil tend to have a granular structure, which is easily worked and readily permeable (Laloo *et al.,* 2020).

Irrigation water class (EC x SAR):

In accordance with the US Salinity Lab Classification System of irrigation water class, out of 35 water samples analysed, 18 samples fell into C2S1 category, 11 into C3S1, 5 into C1S1 and 1 sample into C3S2. Similar analysis was performed in Turkey by Yilmaz and Avci (2021), where the irrigation water samples were classified into C2S1 and C3S1

Residual Sodium Carbonate (RSC) content:

The RSC content of irrigation water from both canals and borewells in the entire study area was very low ranging from -10.5 to 1.00 me l^{-1} with mean of -5.05 showing that irrigation water was safe for attaining good groundnut yields. Sundaraiah *et al*. (2014) at Kalwakurthy mandal of Mahabubnagar district indicated similar RSC values of irrigation samples varied from -6.91 to 0.19 me l^{-1}. More precisely, the RSC content ranged from -10.5 to 1.00 me l^{-1} in canal waters and -0.80 to -9.10 me l^{-1} in borewell waters with a mean of 5.05 me l^{-1} in both the cases. No large variations in either highly (Nagarkurnool and Wanaparthy divisions) and marginally (Narayanpet and Gadwal divisions) potential regions with respect to residual sodium carbonate was observed. Similar results were observed with Ranjitha *et al.* (2018) where the irrigation water was safe w.r.t SAR and RSC.

Magnesium-Calcium ratio:

The assessment of Mg/Ca ratio for irrigation water was carried out with two classes viz., safe (< 1.00) and not safe (> 1.00) for mapping. As per the classification given by U. S. Salinity Laboratory, Mg/Ca ratio < 1.50 is considered safe, 1.50 - 3.00 is moderately safe and >3.00 is unsafe (United States Salinity Laboratory, 1954). Though the irrigation water was safe in terms of sodium, the Mg/Ca ratio was higher in the study area ranging from 0.04 to 2.93 with an average of 1.15 which is not considered safe for irrigating the crops. Generally, Calcium and Magnesium maintains an equilibrium in water. But when Magnesium content increases, it promotes the increase in sodium concentration in water (Vasu *et al.,* 2015; Ayers and Wescot, 1985). Considering different sources, the Mg/Ca ratio in canal water extending from 0.04 to 2.80 with a mean of 1.06, whereas in borewell waters, it stretched from 0.10 to 2.43 with an average value of 1.20. Most of the groundnut growing regions were classified as having Mg/Ca ratio in safe limits with few unsafe areas in Bomraspet, Kodangal, Doultabad, Kosigi, Kothur, Keshampet and parts of Maddur, Kondurg, Farooqnagar, Balnagar, Talakondapally, Amangal, Midjil, Bijinapally, Uppununtala, Balmoor, Lingal, Kollapur, Pebbair,

Itikyal, Gadwal, Veepangandla, Monopadu, Alampur, Ghattu and Dharur mandals. Of the above mandals, unsafe regions were distributed in few clusters of Nagarkurnool, Wanaparthy, Narayanpet and Gadwal divisions) of groundnut belt.

Kelly's ratio (KR):

Sodium measured against calcium and magnesium was considered by Kelly (1940). The formula used in the estimation of Kelley's ratio is expressed as $KR = (Na^{+} / Ca^{2++} Mg^{2+})$. If KI value is >1, then the water is unfit for irrigation. In the present study the values of KR ranged from 0.04 and 2.00 with a mean value of 0.54 which explains the suitability of water for irrigating the crop. Maximum KR value was found in Kodair mandal of Nagarkurnool district and minimum value was found in Telkapally mandal of Nagarkurnool district. All samples showed favourable KR values except in Kodair, Bijinapally and Tadoor mandals Nagarkurnool district, Makhtal mandal of Narayanpet and Mahabubnagar mandal.

Conclusion

Irrigation water quality assessment helps to sort out the reasons for reduced crop productivity in the marginally potential zones and this helps in providing better quality of resources to the crop. The overall quality of the irrigation water samples of both canal and groundwater was good for providing irrigation to the crop. However, the salt concentration and high magnesium-calcium ratio can be reduced with good crop management practices like application of organic manures to the crop and conjunctive use of irrigation water.

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Conflict of interest

The authors declare that they have no conflict of interest.

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