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# Contribution of nutrient through irrigation water in salt affected soils of Purna valley in Vidarbha region of Maharashtra

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**Abstract**

The experiment was conducted during 2014-2015 at Dr. PDKV, Akola to evaluate the nutrient content and contribution of nutrients through irrigation water and to assess the effect of irrigation on soil properties in Purna Valley of Vidarbha in Akola district of Maharashtra. The water samples from ten bore wells were collected in the month of October 2014. Simultaneously soil samples were taken before and after irrigation in chickpea.

The quality of bore well water samples were found to be in $S_1C_3$ class. Amongst the cations the presence of Na > Ca> Mg >K, among the anions $HCO_3$ > Cl >$SO_4$. The SAR and Mg: Ca ratio falls in acceptable range whereas the Adj SAR was higher. As per the Kelley's ratio, seven samples are unsuitable and three samples are suitable for irrigation, on the basis of permeability index water was suitable for irrigation. The residual sodium bicarbonate in all samples was above permissible limit whereas magnesium adsorption ratio of the seven bore wells are in acceptable range.

The results showed that the irrigation water contributes the nutrient in soil to the considerable extent i.e. nitrate N (1.1 to 1.31 $kgha^{-1}$), K (3.7 to 6.43 $kgha^{-1}$), Zn (0.07 to 0.15 $mgkg^{-1}$), Cu (0.12 to 1.11 $mgkg^{-1}$), Fe (0.26 to 0.64 $mgkg^{-1}$) and Mn (0.044 to 0.056 $mgkg^{-1}$) respectively in Chickpea. The irrigation water decreased hydraulic conductivity and increased bulk density.

**Keywords:** Bore well, water sources, nutrient contribution through irrigation

## Introduction

The nutrients from the ground water sources can act as additional enrichment sources, especially at the time of critical plant growth stages. The nutrients present in the groundwater can be due to various factors, i.e. due to the parent material; soluble minerals leaving nutrients into water aquifer, runoff, and top fertile soil can add all the nutrients and added fertilizer. Plants require macro nutrients, secondary nutrients and micro nutrients for their growth. All these nutrients can be supplied in small amounts by ground water sources such as farm ponds, community tanks, open wells and bore wells (Hodges, 2001) [4].

The amounts of macro, secondary and micronutrients added through various water sources used for irrigation during the critical stages of plant growth supplements the nutrients. However, higher concentrations of these nutrients present in groundwater, especially sodium can lead to plant toxicity (Shahinasi and Kashuta, 2008) [4].

## Materials and Methods

### Sampling of irrigation water

The ten bore well water samples were collected in the month of October 2014, from the Devri and Raundala village in Purna valley. Simultaneously, soil samples were taken before irrigation and after irrigation of chickpea in the month of January 2015. The samples were collected in closed air tight polyethylene bottles and transported to laboratory for analysis. The water samples were analyzed for various quality parameters and nutrient content as well as soil samples for available nutrient content. The micro and macro nutrient analysis of (Fe); Copper (Cu); Zinc (Zn); Manganese (Mn) were carried out by Inductively Coupled Plasma (ICP); and Sodium (Na); Potassium (K); Nitrate-N ($NO_3^-N$) in the water was obtained by reducing it using Devadra alloy followed by distillation.

### Computation of nutrient additions

The nutrient concentrations in the water sources were converted from mg $L^{-1}$ to kg $ha^{-1}$ with regards to surface irrigation considering, 100,000 L of water per hectare is required for 1 cm depth of irrigation (Rao *et al*., 2009) [8]. For surface irrigation of various crops, the concentrations of macro and micro nutrients (mg $L^{-1}$) in various groundwater sources are given in Table 1 and the computed nutrient additions through irrigation water in (kg $ha^{-1}$) are given in tables 2 to 8.

**Table 1:** Nutrient content in irrigation water (mg $L^{-1}$)

| Location area | $NO_3^-$ N | P | K | Zn | Cu | Fe | Mn |
|---|---|---|---|---|---|---|---|
| $W_1$ | 1.77 | 0.79 | 1.85 | 0.12 | 0.028 | 0.4 | 0.046 |
| $W_2$ | 2.11 | 0.76 | 1.92 | 0.15 | 0.038 | 0.36 | 0.054 |
| $W_3$ | 2.7 | 0.75 | 1.89 | 0.08 | 0.022 | 0.44 | 0.056 |
| $W_4$ | 1.65 | 0.76 | 3.17 | 0.08 | 0.024 | 0.44 | 0.048 |
| $W_5$ | 1.9 | 0.73 | 1.93 | 0.08 | 0.028 | 0.38 | 0.05 |
| $W_6$ | 2.01 | 0.74 | 1.93 | 0.12 | 0.011 | 0.5 | 0.044 |
| $W_7$ | 1.65 | 0.67 | 2.14 | 0.13 | 0.058 | 0.42 | 0.046 |
| $W_8$ | 2.05 | 0.66 | 3.19 | 0.15 | 0.038 | 0.28 | 0.054 |
| $W_9$ | 2.52 | 0.77 | 1.95 | 0.07 | 0.032 | 0.64 | 0.044 |
| $W_{10}$ | 1.9 | 0.79 | 3.22 | 0.14 | 0.026 | 0.36 | 0.048 |

The nitrate nitrogen content in bore well water was in the range of 1.65 to 2.52 $mgL^{-1}$, which was within safe limit of 5 $mgL^{-1}$. Phosphorus content was in the range of 0.66 to 0.79 $mgL^{-1}$ which exceeds the recommended value of 0.1 to 0.4 $mgL^{-1}$. The potassium content was in between 1.85 to 3.22 $mgL^{-1}$ which was in normal limit. Zinc content was in the range of 0.07 to 0.15 $mgL^{-1}$ indicates that four samples are in acceptable range and remaining six had maximum concentration. Copper content was in the range of 0.022 to 0.11 $mgL^{-1}$ which was in acceptable range < 0.2 $mgL^{-1}$. Iron content was ranged from 0.28 to 0.64 $mgL^{-1}$ which was in acceptable range of 2.4 to 4.00 $mgL^{-1}$, whereas manganese content in irrigation water was in the range of 0.044 to 0.056 $mgL^{-1}$ which was within acceptable range <0.2 as per criteria given by Dancun *et al.* (2000) [3].

**Table 2:** Amount of nitrogen added to chickpea through irrigation water (kg $ha^{-1}$)

| Particular | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 236.2 | 203.4 | 214.1 | 281.2 | 341.2 | 188.1 | 212.2 | 200.23 | 223.25 | 212.14 | 231.21 |
| After irrigation | 249.2 | 216.8 | 225.8 | 295.1 | 352.7 | 200.7 | 227.4 | 213.4 | 235.1 | 225.8 | 244.22 |
| Increment | 13.03 | 13.48 | 11.78 | 13.96 | 11.49 | 12.54 | 15.17 | 13.01 | 11.91 | 13.66 | 13.00 |
| Contribution through Water | 3.54 | 4.22 | 5.4 | 3.3 | 3.8 | 4.02 | 3.3 | 4.1 | 5.04 | 3.8 | 4.05 |
| Contribution through Other sources | 9.49 | 9.26 | 6.38 | 10.66 | 7.69 | 8.52 | 11.87 | 8.91 | 6.87 | 9.86 | 8.95 |
| Test result | t value - 36.43 Significance at 5% and 1% level. | | | | | | | | | | |

The data presented in Table 2 reveals that the nitrogen content in soil increased after irrigation and the difference was significant at 5% and 1% level of significance (t value 36.43). The highest contribution of nitrate nitrogen through irrigation was recorded in treatment $S_3$ (5.4 kg $ha^{-1}$) whereas the lowest content in chickpea was found in treatment $S_4$ and $S_7$ (3.3 kg $ha^{-1}$). Whereas, the rest of the nitrogen was added through sources like fertilizer and nitrogen fixation. The contribution of nutrients through bore well ground water had high concentration of $NO_3^-$N (3 kg $ha^{-1}$) comparison with farm pond (Srinivasarao *et al.* 2009) [8].

**Table 3:** Amount of phosphorus added to chickpea through irrigation water (kg $ha^{-1}$)

| Particulars | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 23.74 | 27.42 | 25.23 | 26.65 | 25.98 | 22.4 | 26.08 | 22.17 | 24.12 | 23.09 | 24.68 |
| After irrigation | 28.76 | 29.18 | 29.10 | 31.52 | 28.61 | 29.60 | 30.08 | 27.11 | 30.10 | 28.15 | 29.24 |
| Increment | 5.22 | 1.76 | 3.87 | 4.87 | 2.63 | 7.2 | 4 | 4.94 | 5.98 | 5.06 | 4.55 |
| Contribution through Water | 1.31 | 1.26 | 1.25 | 1.26 | 1.21 | 1.23 | 1.11 | 1.1 | 1.28 | 1.3 | 1.23 |
| Contribution through Other sources | 3.91 | 0.5 | 2.62 | 3.34 | 1.42 | 5.97 | 2.89 | 3.84 | 4.7 | 3.76 | 3.29 |
| Test result | t value – 9.15 Significance at 5% and 1% level. | | | | | | | | | | |

The data regarding the availability of phosphorus in chickpea grown soil as a result of irrigation is presented in Table 3. The availability of phosphorus content in Devri and Raundala village increased over initial value after irrigation. The difference was statistically significant at 5% and 1% level of significance with t value 9.15. The highest contribution of phosphorus through irrigation water in chickpea crop was recorded in treatment $S_1$ (1.31 kg $ha^{-1}$) where as the lowest was observed in treatment $S_8$ (1.1 kg $ha^{-1}$) and rest of the phosphorus was contributed through other sources. The contribution of phosphorus through irrigation water was negligible i.e. around 1 kg.

Addiscott and Thomas (2000) [1] studied and observed the transport of phosphorus to groundwater and potential phosphorus contributions to surface / ground waters via base flow are generally assumed to be negligible because of the high potential for mobile phosphorus to be retained in the upper soil horizons by adsorption or metal complex formation (commonly with iron, aluminum or manganese in acidic soils).

Further, they reported the phosphorus concentrations in all of the groundwater sources of the entire studied watershed were found to be negligible. This could be accounted for phosphorus getting adsorbed to the clay particles and getting associated with the positively charged cations Nayak and Nandagiri (2009) [7].

**Table 4:** Amount of potassium added to chickpea through irrigation water (kg ha$^{-1}$)

| Particular | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 357.0 | 325.2 | 364.0 | 352.1 | 406.0 | 414.4 | 395.2 | 393.4 | 366.9 | 334.9 | 370.92 |
| After irrigation | 361.9 | 330.1 | 374.1 | 359.2 | 412.1 | 423.2 | 405.1 | 403.1 | 374.2 | 347.0 | 379.13 |
| Increment | 4.93 | 4.87 | 10.09 | 7.11 | 6.12 | 8.82 | 9.91 | 9.71 | 7.34 | 13.15 | 8.20 |
| Contribution through Water | 3.7 | 3.83 | 3.78 | 6.33 | 3.85 | 3.85 | 4.28 | 6.38 | 3.9 | 6.43 | 4.6 |
| Contribution through Others sources | 1.23 | 1.04 | 6.31 | 0.78 | 2.27 | 4.97 | 5.63 | 3.33 | 3.44 | 6.72 | 3.57 |
| Test result | t value - 9.90 Significance at 5% and 1% level | | | | | | | | | | |

The data presented in Table 4 shows that the potassium content in soil increased over initial value after irrigation in chickpea grown soil, which was statistically significant between before and after irrigation at 5% and 1% level of significance. The highest contribution of potassium through irrigation water was recorded in treatment $S_{10}$ (6.43 kg ha$^{-1}$) whereas the lowest potassium content was observed in treatment $S_1$ (3.7 kg ha$^{-1}$) and remaining potassium was contributed through other sources.

Ashraf *et al.* (2006) studied the highest supplementation of potassium through groundwater irrigation were found to be in the order of (5.20 and 3.60 kg ha$^{-1}$ in the studied water source.

**Table 5:** Amount of zinc added to chickpea through irrigation water (mg kg$^{-1}$)

| Particulars | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 0.31 | 0.36 | 0.38 | 0.28 | 0.3 | 0.26 | 0.48 | 0.36 | 0.24 | 0.36 | 0.34 |
| After irrigation | 0.46 | 0.58 | 0.55 | 0.34 | 0.56 | 0.41 | 0.56 | 0.54 | 0.5 | 0.51 | 0.46 |
| Increment | 0.08 | 0.06 | 0.04 | 0.06 | 0.26 | 0.08 | 0.14 | 0.26 | 0.08 | 1.06 | 0.21 |
| Contribution through Water | 0.12 | 0.15 | 0.08 | 0.08 | 0.08 | 0.12 | 0.13 | 0.15 | 0.07 | 0.14 | 0.10 |
| Contribution through other sources | 0.03 | 0.07 | 0.09 | 0.1 | 0.18 | 0.03 | 0.07 | 0.03 | 0.19 | 0.01 | 0.08 |
| Test result | t value - 4.44 Significance at 5% and 1% level | | | | | | | | | | |

The data presented in Table 5 showed that, the availability of zinc increased after irrigation in all the treatments which shows statistical significance between before and after irrigation at 5% and 1% level. The highest zinc contribution through irrigation water to chickpea was recorded in treatment $S_2$ and $S_8$ (0.15 mgkg$^{-1}$) whereas the lowest zinc was observed in treatment $S_9$ (0.07 mgkg$^{-1}$) and rest of the zinc might be contributed through other sources.

Hundal *et al.* (2009) [5] studied the average amount of zinc supplement through tube well irrigation with variation from 64 g in piedmont plain to 361 g ha$^{-1}$ in alluvial plain with sand dune to wheat crop.

**Table 6:** Amount of copper added to chickpea through irrigation water (mg kg$^{-1}$)

| Particulars | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 2.3 | 2.48 | 1.93 | 2.26 | 1.23 | 1.73 | 2.33 | 1.5 | 2.38 | 1.8 | 1.99 |
| After irrigation | 2.75 | 2.65 | 2.58 | 2.38 | 1.54 | 2.12 | 2.94 | 2.61 | 2.65 | 2.03 | 2.42 |
| Increment | 0.45 | 0.17 | 0.65 | 0.12 | 0.31 | 0.39 | 0.61 | 1.11 | 0.27 | 0.23 | 0.43 |
| Contribution through Water | 0.028 | 0.038 | 0.022 | 0.024 | 0.028 | 0.11 | 0.058 | 0.036 | 0.032 | 0.026 | 0.040 |
| Contribution through Other sources | 0.422 | 0.132 | 0.628 | 0.096 | 0.282 | 0.28 | 0.552 | 1.074 | 0.238 | 0.204 | 0.38 |
| Test result | t value – 4.60 Significance at 5% and 1% level | | | | | | | | | | |

The data in with respect to copper content in soil is presented in Table 6 which shows that the copper content in soil increased over initial value, which was statistically significant at 5% and 1% level (t value 4.60), there is significant difference between two mean values i.e. before and after irrigation. The highest contribution of copper through irrigation water to chickpea was recorded in treatment $S_6$ (0.11 mg kg$^{-1}$) whereas the lowest was observed in treatment $S_3$ (0.022 mg kg$^{-1}$) and rest of copper content was contributed through other sources.

Srinivasarao *et al.* (2009) [8] also reported the 120 g ha$^{-1}$ contribution of copper through irrigation water in ICRISAT watershed Patancheru, Hyderabad.

**Table 7:** Amount of iron added to chickpea through irrigation water (mgkg$^{-1}$)

| Particulars | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 5.99 | 5.01 | 6.6 | 6.81 | 5.15 | 5.16 | 5.25 | 4.71 | 4.99 | 5.9 | 5.55 |
| After irrigation | 7.52 | 5.63 | 8.72 | 8.2 | 6.75 | 6.71 | 6.13 | 8.68 | 6.17 | 6.35 | 7.08 |
| Increment | 1.53 | 0.62 | 2.12 | 1.39 | 1.6 | 1.55 | 0.88 | 3.97 | 1.18 | 0.45 | 1.52 |
| Contribution through Water | 0.4 | 0.36 | 0.44 | 0.44 | 0.38 | 0.50 | 0.42 | 0.26 | 0.64 | 0.36 | 0.42 |
| Contribution through Other sources | 1.13 | 0.26 | 1.68 | 0.95 | 1.22 | 1.05 | 0.46 | 3.71 | 0.54 | 0.09 | 1.10 |
| Test result | t value – 4.87 Significance at 5% and 1% level. | | | | | | | | | | |

The data in relation to available iron content in soil is reported in Table 7 which reveals that the iron content in soil increased after irrigation in all the treatments. The highest iron contribution through irrigation water to chickpea was recorded in treatment $S_9$ (0.64 mg kg$^{-1}$). Which shows statistically significant difference between before and after irrigation of mean values (t value 4.87) at 5% and 1% level, whereas, the less iron was observed in treatment $S_8$ (0.26 mg kg$^{-1}$) and rest of the iron was contributed through other sources.

Islam and Shamsad (2009) [6] studied the Iron (Fe) content of irrigation water samples of the study area was from 0.00 to 0.112 $meL^{-1}$ with an average value of 0.013 $meL^{-1}$. No Fe was detected in some samples. Highest iron concentration was recorded in Kuthibari village under Dhunot upazilla from a shallow tube well (STW).

**Table 8:** Amount of mangnese added to chickpea through irrigation water (mg $kg^{-1}$)

| Particulars | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before irrigation | 4.19 | 5.23 | 6.12 | 4.00 | 4.05 | 7.42 | 5.89 | 7.07 | 7.23 | 2.19 | 5.33 |
| After irrigation | 6.15 | 7.63 | 8.15 | 7.82 | 6.12 | 9.91 | 8.84 | 10.12 | 8.26 | 2.51 | 7.55 |
| Increment | 1.96 | 2.4 | 2.03 | 3.82 | 2.07 | 2.49 | 2.95 | 3.05 | 1.03 | 0.32 | 2.21 |
| Contribution through Water | 0.046 | 0.054 | 0.056 | 0.048 | 0.05 | 0.044 | 0.046 | 0.054 | 0.044 | 0.048 | 0.054 |
| Contribution through Other sources | 1.914 | 2.346 | 1.974 | 3.772 | 2.02 | 2.446 | 9.904 | 2.996 | 0.986 | 0.272 | 2.85 |
| Test Result | t value – 6.97 Significance at 5% and 1% level. | | | | | | | | | | |

The available manganese content in soil is presented in Table 8 which indicates that the available manganese in soil increased after irrigation. Statistically it was significant at 5% and 1% level.

The highest addition of manganese through irrigation water to chickpea was noticed in treatment $S_3$ (0.056 mg $kg^{-1}$) whereas the lowest manganese addition was observed in treatment $S_9$ (0.044 mg $kg^{-1}$) also that the contribution of nutrients through tube well irrigation water to wheat crop recorded that supplement of manganese through irrigation water ranged from 2 g in Siwalik hill to 161 g $ha^{-1}$ in active /recent flood plain (Hundal *et al.* 2009) [5].

## Conclusion

Hence, the contribution of the nutrients through irrigation should be considered while application of fertilizers and the quality of irrigation water should be considered for its safe use in Purna Valley of Vidarbha region.

## References

1. Addiscott TM, Thomas D. Tillage, mineralization and leaching phosphate. Soil Tillage Research. 2000;53:255-273.
2. Ashraf M, Saeed MM, Asghar MN. Evaporation pan: A tool for irrigating scheduling. Journal of Drainage and Water Management. 2006;6:45-51.
3. Duncun RR, Carrow RN, Huck M. Understanding water quality and Guidelines to Management USGA Green section Record. 2000;September-October:14-24.
4. Hodges. Soil fertility basics. Soil Science extension, North Carolina State University, NC certified crop advisor training. USA. 2001.
5. Hundal H, Dharwindersing S, Kuldipsing, Rajkumar. Contribution of nutrients through tube well irrigation water to wheat and rice in different landform zone of Punjab. JISSS. 2009;57(1):97-99.
6. Islam MS, Shamsad SZKM. Assessment of Irrigation Water Quality of Bogra District in Bangladesh. Bangladesh J Agril Res. 2009;34(4):597-608.
7. Nayak S, Nandagiri L. Characterization of small-scale groundwater irrigation schemes in a humid coastal region of southern India. Journal of Tropical Agriculture. 2009;47:37-42.
8. Rao GGSN Desai, Ch. Srinivasarao. Impact, Adaptation and Vulnerability of rainfed agriculture to climate change: Research at CRIDA. Indian Journal of Dryland Agricultural Research and Development. 2009;24:10-20.
9. Shahinasi E, Kashuta V. Irrigation water quality and its effects upon soil. BALWOIS 2008, Ohrid, Republic of Macedonia. 2008;27-31 May.
10. Shrinivasanrao CH, Wani SP, Sabrawad KL, Jakkula VS, Kundu S, Pathak P, Rajesh C, Pardhasardhi G. Contribution of nutrients through critical irrigation from divers water sources in selected watershed of semi arid tropical India. JISSS. 2012;27(1):58-69.