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Temporal Irrigation Water Quality Monitoring and Analysis in Semiarid Tropics: Implication on Crop Production

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Abstract: Irrigation water quality analysis and monitoring is tricky task in semiarid tropics (SAT characterized) experiencing water scarcity. Conjunctive use of water in SAT have emphasizes on surface and ground water quality analysis for increase in agricultural production. Surface water quality analysis is carried out for reservoir water, canal flow, return flow and streams fora Devarabelakere, Village in Harihara Taluk in Davangere District of Karnataka State, India. Itis located 12 Km towards west from Davanagere and 9 Km from Harihara. Devarabelakere pickup is constructed at downstreamof the Bhadra Reservoir at a distance of 136.00 Km. The total catchment area of this sub-project is 2106.90sq. Km. of which 1338.90 sq.Km SAT. Average Water quality index in the pre and post monsoon season for surface water was found between in the range of 51 to 75 and falls in the poor water quality status and suitable for irrigation and industrial purpose. Ground water sampling is also carried out at Deverabelekere command area and water quality index in pre and post monsoon seasons was found between the range 26 to 50 and falls in good water quality status and used for drinking, irrigation and industrial purpose. Although WQI shows many of the water samples were suitable or fit for irrigation, calculated other indices such Kelly's Ratio (KR), Permeability Index (PI), Magnesium Absorption Ratio (MAR) with higher values covering all factors makes the water unsuitable which influences the irrigation water quality. In the study area the crops grown like Sugar cane in area of 28 ha, Plantation crop in area of 34 ha and Semi dry plant grow in 1152 ha and efficiency was found 37.03 % in post monsoon season for canal water and 44.38 % in pre monsoon due to temporal variations in season implicating the yield which is addressed by this paper.

Keywords: *Irrigation water quality, Return Flow, Salinity, Water quality Index.*

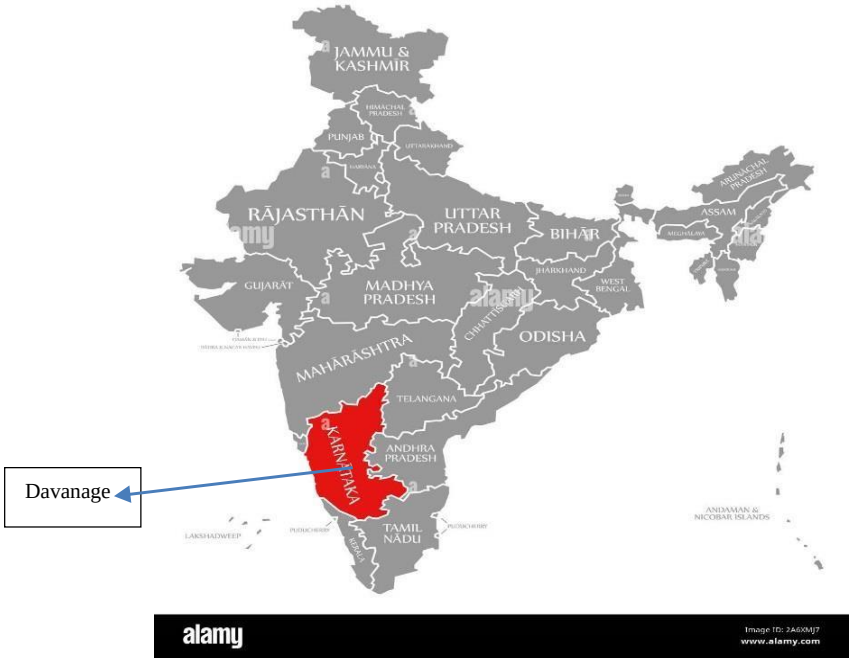
1. Introduction

The most part of the world is overcoming with an important problem regarding the increasing population day by day and these are the areas where the minimum amount of extra land is available for the agricultural purposes. Arid and Semi-arid regions are mainly differentiated byits climate or weather, with no or insufficient rainfall to carry out activity which are related to cultivation. In semiarid and arid regions, for cultivating crops, irrigation along the use of groundwater and surface water is inevitable. Renewable water utilized in an efficient and productive way and is important for the sustainable agricultural production and rural region regeneration in semi-arid and arid zones. The economic, climatic, environmental factors in thissemi-arid regions necessitate systematic and rational resource management as a means of averting water crises potential. With these types' areas, increased food production must be obtained from more amount of intensive farming with maximum yields. Because of this, there is an important need to maximize the Productivity of such lands besides rising in the groundwater tables and increased in the salinityin the groundwater mainly affects the agricultural production.

Study Area

Devarabelakere is one of the village present in Harihara Taluk which is situated in Davangere District, State of Karnataka, India. And is located 12 Km, in the direction of west from the headquarters of Davanagere districts and 9 Km away from Harihara(taluk). The pickup be constructed across Haridra River, which is tributary to Tungabhadra River, in Krishna Basin and Shagalehalla where both joins within command areas near Malebennur division canal of Davangere division canal, near Devarabelakere village,Harihara Taluk, Davangere District in Latitude be 14024'0" N, Longitude be 75050'0" E. A pickup is present at a distance of 100.00 Km from Malebennur and 12 Km from Davangere.

Fig. 1: Image showing the area of study



Site Selection

Devarabelakere pickup is constructed at downstream of the Bhadra Reservoir at distance of 136 Km. Totalcatchment region of this sub-project is 2106.90sq. Km. in which 1338.90 sq. Km. beintercepted catchment, the independent catchment be 768.00sq. Km. The Inflow in to the Devarabelakere pickup was not recorded. The catchment area is good and in addition seepage/surplus water from command region of the Malebennur branch canal, Harihar branch canal of Davangere branch canal of Bhadra Right Bank Canal is adequate to meet the needs of the Devarabelakere pickup command. The gross storage capacity ofthe pickup is 2.62Mm3. The average precipitation in command region is 680.65mm.

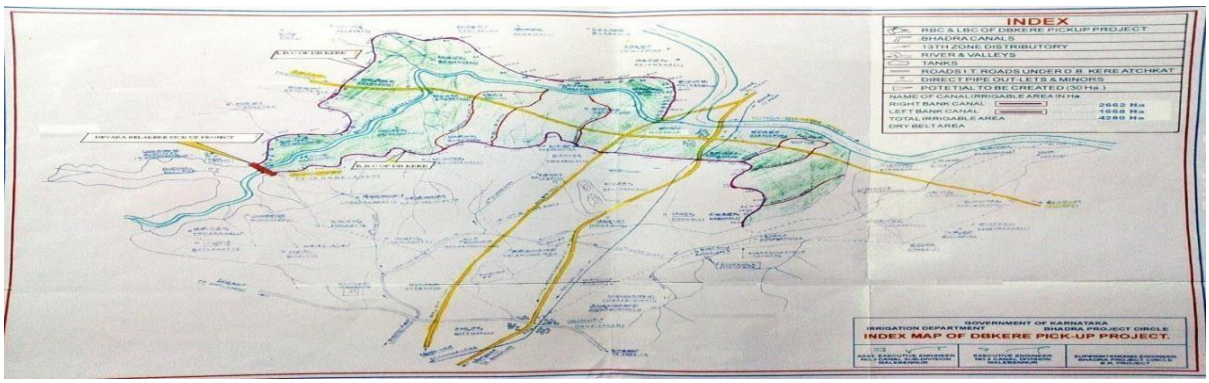


Fig. 2: Index Map of Devarabelakere PickupLocation of Sampling

Sampling has to be done by collecting the Devarabelakere reservoir water sample at different depths in seasons of Pre and Post- Monsoon. The collected samples were preserved in bottles of polythene. These samples were examined to determine irrigation water quality parameters topredict fitness of this water for reason of irrigation practice. Next the water samples from the bore well were taken in and around Devarabelakere reservoir for examination of water and privilege of groundwater for irrigation use. Simultaneously water sample from the canal as wellas the sample from the irrigation return flow were collected to find out the crop waterrequirement.

2. Results

2.1 Reservoir Water Quality

The water sample from the respective reservoir i.e., Devarabelakere Pickup Dam has been collected forthe present study at different depths of 0m, 2m and 5m in the vicinity of right bank canal in Post-Monsoon (i.e. November 2018) and Pre- Monsoon (i.e., March 2019).Irrigation water quality has been determined for the same samples along with various water quality indices for irrigation cause. Here in this results, acidity found high in seasons of pre monsoon, the alkalinity and turbidity was remarkably high throughout season of pre monsoon.
Results of reservoir water status which was accomplished in Pre monsoon and Post Monsoon mentioned in table 1 below;

Table 1: Represent the Reservoir Water Quality results

Reservoir Water Quality							
Parameter	**Post Monsoon**			**Pre Monsoon**			**Permissible Limits**
	0m	**2m**	**5m**	**0m**	**2m**	**5m**	
Acidity (mg/l)	60	44	40	0	0	0	0
Alkalinity (mg/l)	142	140	132	202	198	196	200 – 600
Total Hardness (mg/l)	106	100	102	136	138	142	300 – 600
Calcium (mg/l)	17.6	18.4	18.4	18.4	20	18.4	200
Magnissium (mg/l)	14.88	12.96	13.44	21.6	21.12	23.04	100
Chlorides (mg/l)	34	34	50	98	86	90	1000
pH	7.93	8.04	8.03	9.02	8.87	8.87	6.5-8.5
EC(ds/ m)	0.296	0.301	0.304	0.38	0.401	0.401	0-3
TDS (ppm)	157.6	156.7	157.7	560	590	590	2000
Turbidity (NTU)	6.63	6.11	6.74	16.7	18.9	17.5	5 to 10
Sulphate (mg/l)	38	26	29	62	70	58	400
Carbonates (me/l)	0	0	0	1.6	0	1.2	0.06-0.12

Bicarbonates (me/l)	3	3	3	2.6	4.8	2.2	0.7-11.3
Sodium (me/l)	5.19	4.97	5.04	1.33	1.21	0.95	200
SAR (√millimole/l)	5.06	4.99	5.01	1.146	1.035	0.8	<10
RSC (me/l)	0.9	1.02	0.98	1.51	2.07	0.59	<1.5

2.2 Canal Water Quality

The Canal and reservoir water samples collected in Pre and along with Post monsoon season and irrigation water quality has been determined for the same. During post monsoon season itwas found that acidity level was higher than the acceptable limit and all further water quality was within the permissible limit. Table 2 mentioned below will give the brief result of canaland reservoir water quality.

Table 2: Illustration of the result for Canal Water Quality

Canal Water Quality					
Parameter	**Post Monsoon**		**Pre Monsoon**		**Permissible Limits**
	Reservoir	**Canal**	**Reservoir**	**Canal**	
Acidity (mg/l)	42	60	0	0	0
Alkalinity (mg/l)	208	198	186	196	200 – 600
Total Hardness(mg/l)	126	134	136	138	300 – 600
Calcium (mg/l)	24	23.2	15.2	18.4	200
Magnesium (mg/l)	15.84	18.24	23.52	22.08	100
Chlorides (mg/l)	44	42	82	78	1000
pH	7.29	7.43	8.45	8.34	6.5-8.5
E C (ds/m)	0.566	0.552	0.387	0.387	0-3
TDS (ppm)	257.2	252.5	570	570	2000
Turbidity (NTU)	5.32	5.91	5.4	5.48	5 to 10
Sulphate (mg/l)	32	30	58	58	400
Carbonates (me/l)	0	0	2	1.2	0.06-0.12
Bicarbonates (me/l)	3	3	1.8	2.4	0.7-11.3
Sodium (me/l)	5.45	5.28	1.03	1.07	200
SAR (√millimo le/l)	4.87	4.57	0.889	0.919	<10
RSC (me/l)	0.5	0.34	1.106	0.864	<1.5

2.3 US Salinity Diagram

The US Salinity diagram mainly applied to rate the water for practice of irrigation. In which Electrical Conductivity is considered as index of salinity hazard and SAR as index of Sodium Hazard. The systematic values drawn on top of US Salinity diagram indicates that classof water samples. Postmonsoon sampling for surface water about 71.42% in C2-S1class and 28.57% are C3-S1 class (Fig.1a),for groundwater 100% of samples in C3-S1 class (Fig. 1b) and pre-monsoon surface water found 100% in C2-S1 class(Fig.1a) also groundwater establish 20% in C2-S1 class with 80% of samples in C3-S1 class(Fig. 1b). Since all sampled water are fall under the moderately good water quality category. Hence this type of the water can be used for the irrigation purposes.

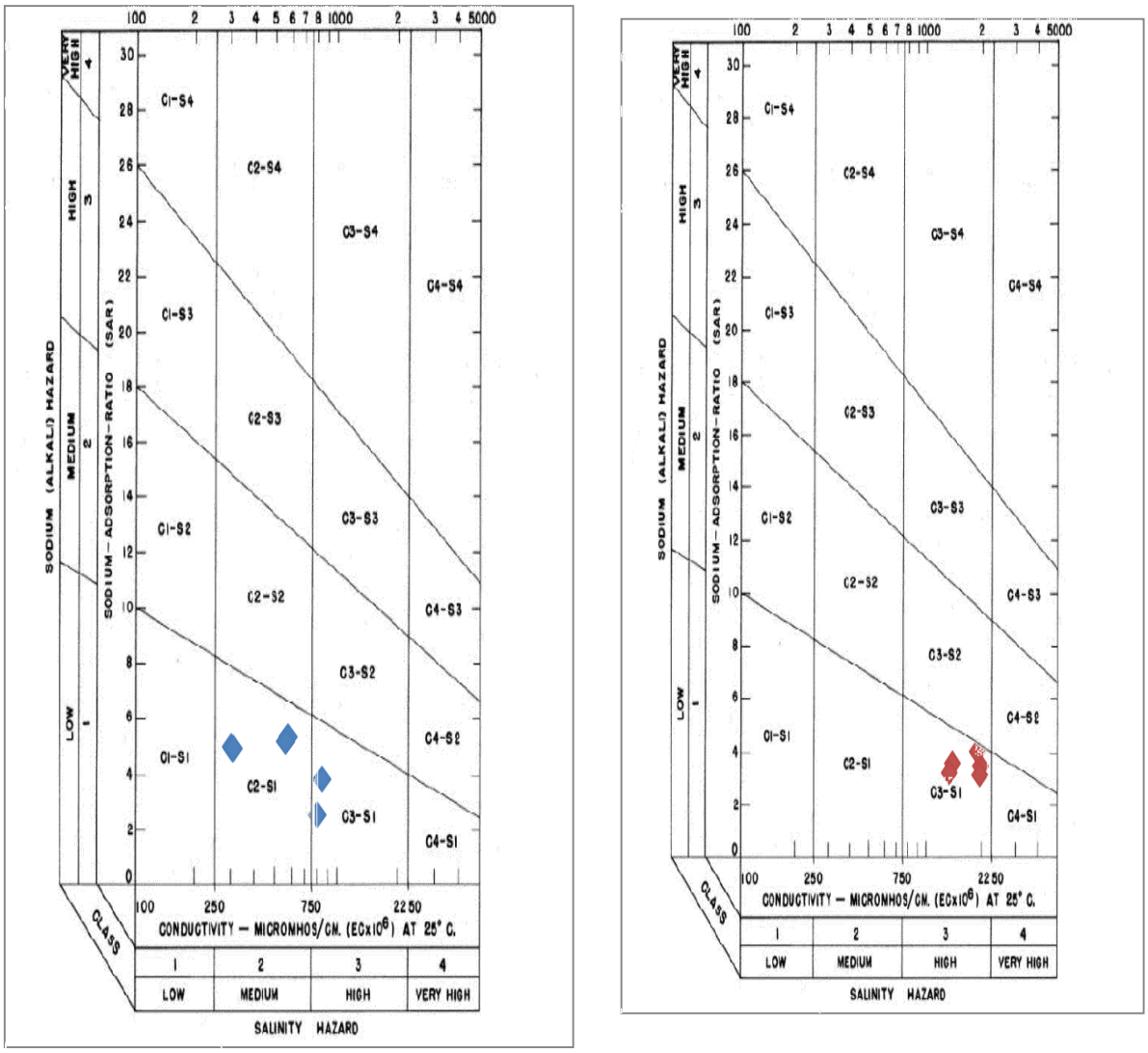


Fig. 1: US Salinity Diagram of Post monsoon samples for (a) Surface water (b) Groundwater

3. Conclusions

Irrigation Efficiency (Water Quantity Analysis)

It is calculated for the 3 different crops which are cultivated using the Deverabelekere canal water namely Sugarcane, Plantation Crops like areacanut and Semi- dry crops. And irrigation efficiency for post monsoon season found about 37.03% and for pre-monsoon season 44.38% mainly for canal irrigation. The values are low because of non- violence farming is carried outmore in that region. Several adjustments can be made to the volume of water diverted to the field, increase the Irrigation Efficiency or uniformity. However, efficiencies 100% not usually enviable or realistic. This analysis lead to achieve water conservation and protecting environmental quality in irrigated agriculture.

Water Quality Analysis

Surface water, groundwater and return flow samples collected from the various areas of Deverabelekere reservoir. Water samples from all the sources were assessed for different physico-chemical parameter. Water quality parameters were analyzed with irrigation water quality standards and water was found fit for irrigation purpose except the return flow water.

Seasonal Study

According to the temporal study of the reservoir water, pH, and turbidity values are more withPre-monsoon season related with Post monsoon season. It mainly due to scarce supply of waterto reservoir and it makes the dam to

close. It leads to the condition as reservoir static.

Groundwater Quality

Water samples from the 5 different bore wells near the Deverabelekere reservoir were collectedand analyzed. The result indicates that total dissolve solids (T D S) in bore well water shows more value in pre-monsoon season in comparison to post monsoon season due to decreased in groundwater table. And all other parameters were within the irrigation water quality standards.

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