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Evaluation of Mine Water Quality for Irrigation by Using Iwqi in Walajah Tank, Tamil Nadu State

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Abstract : The objective of present study is to assess the suitability of mine water quality for irrigation purposes flowing in walajah tankcuddalore district, TamilNadu through a single parameter called an Irrigation Water Quality Index(IWQI). There are several ways to assess the quality of water as deemed fit for drinking and irrigation use. Irrigation Water Quality Index (IWQI) is an effective tool for rating water quality interms of spatial and temporal changes. Water samples were collected from 8 supply channels of walajah tank at Head, Middle and Tail reaches. Collected samples were tested to determine various physico-chemical parameters such as pH, Total Dissolved Solids, Total Hardness, Bicarbonate, Nitrate, Sodium, Calcium, Magnesium, Chloride, Electrical Conductivity (EC), Sodium Absorption Ratio(SAR), Flouride Suitability of water for irrigation is interpreted interms of IWQI.

Key words : Sodium Absorption Ratio (SAR) physicochemical parameters, Irrigation Water Quality Index (IWQI), Head, , Supply Middle, Tail reaches channels.

Introduction

Water is an essential natural resources for sustaining life and environment. Its availability with good quality and adequate quantity is very important for human life and other purposes. However, with the rapid increase in the population ,urbanization and industrialization of the country and the need to meet the increasing demands of irrigation, human consumption, the available water resources in many parts of the country are getting depleted and the water quality has deteriorated[1]. In general, the quality of water is equally important as the quantity. Therefore, water quality is considered as an important factor to judge environment changes which are strong associated with social and economic development [2]. Several methods are available to analyze the water quality data that changes depending on informational goals, the type of samples, and the size of the sampling area. WQI is calculated according to the suitability of surface water for human consumption [3]. Water quality index (WQI), a well known method for assessing water quality offers a simple, stable and reproducible unit of measurement and communicates information of water quality to the makers and concerned

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citizens [4]. Water quality index (WQI) is a very useful and efficient method for assessing the suitability of water quality. The WQI approach has many variations concerning the selected parameters and aggregation methods. WQI is a mathematical equation used to transform large number of water quality data into a single number [5]. The water quality indices was first proposed by Horton 1965, later, numerous of indices have been developed all over the world. Different aggregation methods are available for calculation of water quality index. [6]discussed various types of aggregation methods and presented some examples of their application. [7]studied the water quality of river Cauvery in Tiruchirappalli district using WQI and revealed that the water of river Cauvery polluted moderately in the upstream of the city and unfit for human consumption towards the downstream. It needs sufficient treatment and management. coal mine water affected the quality of soil and insisted that the Suitable amelioration need to be done in order to improve the availability of micronutrients namely, zinc, copper and manganese [8] revealed that the disposal of acid sulphate mine water poses a universal problem and found Irrigation with lime treated acid mine water does not only seem feasible but also advantageous for the protection of water resources from mineral pollution.[9] aimed to determine the major, trace, and rare earth elements content in effluent discharge from the coal mine and its effect on groundwater and surface water bodies used for drinking and other uses and concluded that the values for physical and chemical parameters in the ground and surface water sources are within the W.H.O maximum permissible limit for drinking and livestock uses.

The fly-ash components and resulting alkalinity are largely dependent upon the composition and property of the parent coal and the conditions ofcombustion and final handling. The concentration of various elements also varies according to particle size [10]. It is reported that in perumal tank command area fertility status of soils in both canal irrigated and groundwater irrigated areas available nitrogen were found to be low. A similar range of values for available nitrogen was reported earlier by [11]. [12]. Metal mining in India is going to increase in coming future to meet it's economic requirement and thus mine water problem will remain as such and hence suggested the following recommendations such as zero discharge concept, specific methodology to reduce the concentrations of individual metal led by CPCB, reduction of high concentration of Acid rock drainage by effective technology. [13] discussed that the Rapid urbanization and industrialization has led to pollution of surface and ground water and suggested the criteria for suitability of water for irrigation purpose for TDS, EC, sodium salts[sodium adsorption ratio] and bicarbonate concentration [residual sodium carbonate].Water Quality Index provides a single number that expresses overall water quality at a certain location and time based on several water quality parameters The indices are among the most effective ways to communicate the information on water quality trends to the public or to the policy makers and water quality management. Environmental problems associated with mining have been felt severely because of the region's fragile ecosystems and rich biological and cultural diversity. Large scale denudation of forest cover, scarcity of water, pollution of air, water and soil and degradation of agricultural lands are some of the conspicuous environmental implications of coal mining [14].[15]studied about the lead mining and reported that the high values of potential salinity in the area can be ascribed to high sulfate content derived from the lead mining. [16]evaluated spatial and seasonal changes in the water quality from the Suquía River in Córdoba City (Argentina) and reported, the city sewage discharge affectedwater quality. [17]assessed the ground water quality using IWQI and concluded that 90.1 percent of the samples are in moderate restriction and 8.9 percent of the samples are in high restriction.

Study Area

The WalajahTank is one of the biggest and oldest Tanks in the Cuddalore district situated in 11^{o} 51′00″ latitude and 79^{o} 56′00″ longitude at an altitude of 1.5m above MSL .Mines drainage from Neyveli Lignite Corporation Limited reaches Walajah tank through the stream Upper Paravanar. For Minning one tone of lignite, about thirteen tones of water has to be pumped out. Mine-I and Mine-II produce over 6.5 million tones of lignite per annum respectively. The huge quantity of water from Neyveli mines along with coal wash water and trade effluent is led into the Upper Paravanar stream which ultimately reaches to walajah tank.

The tank collects runoff from its catchment during the rainy season, receives inflow from Neyveli mines throughout the year and receives surplus water from the Vellar Rajan canal. The total command area of 4577.21 hectares of walajahtank distributed in 22 villages is served by 11 channels.3

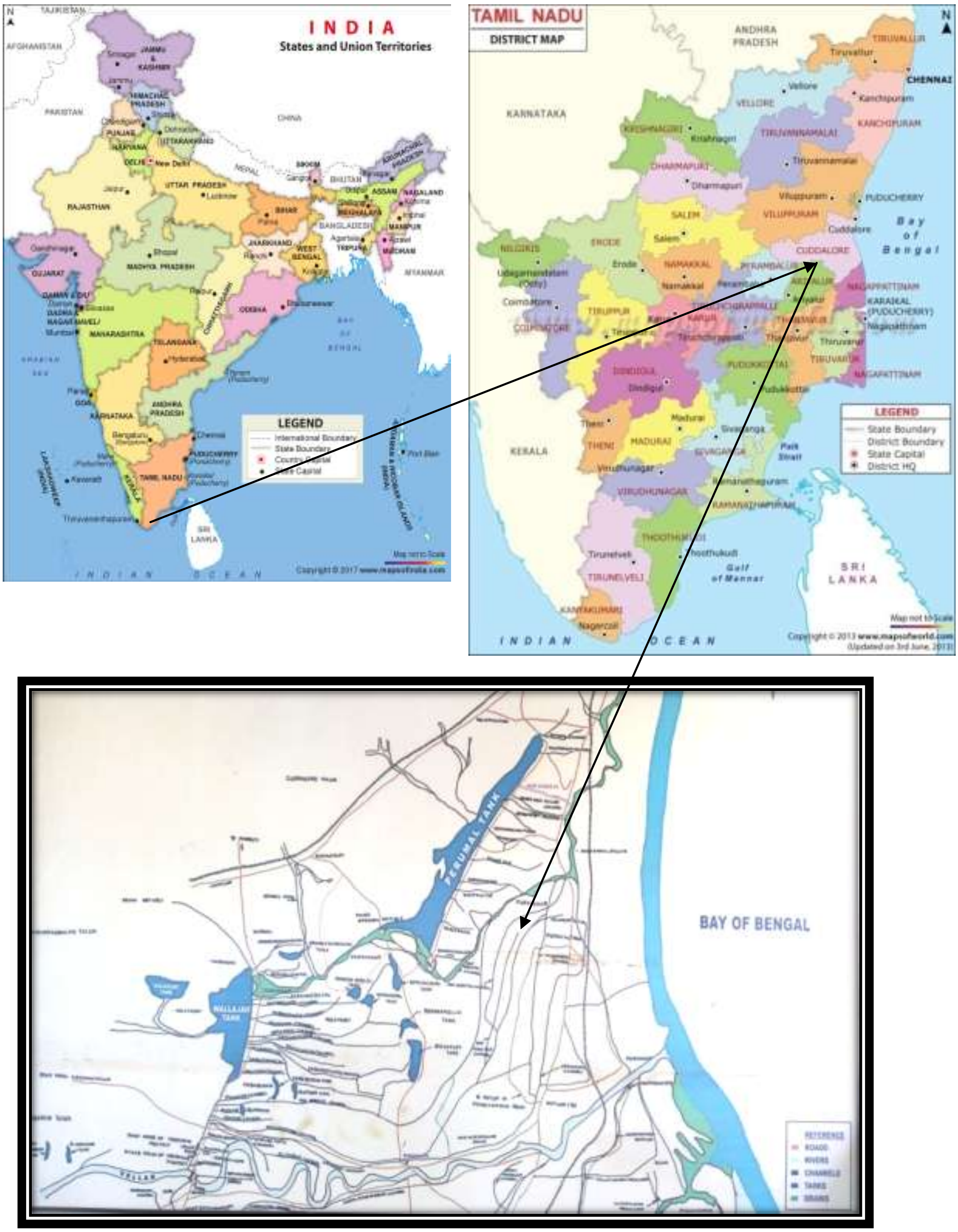

Fig 1 Map showing study area

Climate

The climate of the area is monsoon type with an average annual rainfall of 1284mm mostly during the North-East monsoon period of October-December.

The relative humidity is less during the hot month and more during the cold month. It ranges from 58 percent in may to 81 percent in December. Wind speeds are mild ranging from 5 km / h in the month of March, 12 km / h in month of June. Average number of hours of bright sunshine per day is about 8 and the average rainfall of wallajah tank command area is 1346.66 mm. These data pertain to the Indian Metrological Department Observatory located at Annamalai University Annamalai Nagar, which is the nearest weather station to study area.

Cropping Pattern

Paddy is the principle crop grown in commanded area of wallajah tank as the Ryots of the command of wallajah tank systems are blessed with continuous availability of water in from of mine drainage from Neyveli, they raised two crop in the tank irrigated commands, the first crop (Kuruvai) of paddy is usually grown in June/July to September/ October while the second (Navarai) in the command of wallajah tank is also a medium variety of baddy grown during December/ January to March/ April whereas black gram and green gram are the other crops cultivated as follows:

1. Paddy – Paddy
2. Paddy – Paddy – Black gram

Salient Features of Wallajah Tank

Maintained by : PWD (public works department)

1. Name of district : Cuddalore
2. Name of tank :Wallajah
3. Name of block : Sethiathope
4. Name of

a) Village : Pinnalur
b) Panchayath union : Pinnalur

5. Latitude : $11^0 51' 00''$ N
6. Longitude : $79^0 56' 00''$ E
7. Formation period : 1851

(163 Years old)

8. Total length of bund : 4.91 Km
9. Top of bund level : 16.13M
10. Maximum water level : 12.80 M
11. Full tank level : 11.43 M
12. Deepest sluice level : 8.38 M
13. Water spread area : 1644 acres
14. Capacity : 2057 M cm
15. Ayacut or command area: 11.392 acres
16. Catchment area : 191.66sqKm
17. Maximum flood discharge :14230 Cusecs
18. Area of the lake : 1662 Acres
19. Water spread area before de-silting : 275 Acres
20. Water spread area after de-silting 345 acres
21. No of sluices : 11
22. Length of distribution channels: 58.60 km 23. Weir length: 105.20 m and 37.8 m
24. The total surplusing capacity of the two surplus weirs are : 13525 cusecs
25. Volume of silt: 21 lakh cubic(7.41 crore cubic ft)
26. Capacity increasesd: 210 crore liters
27. Area of agricultural land to be Benefited : 11,392 acres
28. Vellarrajancannal system : 12,222 to under direct irrigation
29. Wallajah tank : 4,612 to under indirect irrigation

This study consists to conduct steps under various topics as follows

(i) Sampling
(ii) Testing various parameters
(iii) Estimation of IWQI using various water quality parameters.

Sampling

Surface water samples were collected from 8 irrigation supply channels in head, middle and tail, situated in wallajah tank irrigation supply channels in Pre, Monsoon and Post . These samples were collected in clean polythene bottle of one liter capacity. Bottles were thoroughly rinsed two to three times with water to be sampled at the time of sampling.

Testing Various Parameters

The physical parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS) phosphate (PO_4^{3-}), fluoride (F^-), carbonate (CO^{3-}), chloride (CL^-), nitrite (NO^{2-}), Nitrate (NO^{3-}) were measured in the field using water analysis kit. All other characteristics such as. Sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), total hardness (TH), sulphate (SO_4^{2-}), and bicarbonate (HCO_3^-) were estimated using standard procedures. Wat of water samples were predicted using standard procedure laid down by APHA at environmental laboratory at Annamalaiuniversity immediately after bringing the water samples. Water quality of the study area was assessed for suitability to irrigation in terms of critical pollutants such as pH, Electrical Conductivity, Percent Sodium, Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC).

Sodium Adsorption Ratio (SAR) is calculated from the following formula:

$$SAR = Na^+ / \sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}$$

Where,

SAR = sodium adsorption ratio (millimole/litre)
Na = sodium ion concentration, meq/l
Ca = calcium ion concentration, meq/l Mg = magnesium ion concentration, meq/l

Calculation of IWQI

IWQI is calculated by using the following Equation
IWQI = $\Sigma^{n}_{i=1}$QiWi
Where,
Qi= Quality rating of n_{th} water quality parameter.
Wi = Unit weight of n_{th} water quality parameter.

Quality rating (Qi)

The quality rating (Qi) is calculated using the expression given in Equation

$Q_i = Q_{imax} - [(X_{ij} - X_{inf}) \times Q_{iamp})/ X_{amp}$
Where,
Q_{imax} = is the maximum value of Qi for the category.
X_{ij} = is the observed value of each parameter.
X_{inf} = is the corresponding value to the lower limit of the class to which the parameter.
Q_{iamp}= is class amplitude.
X_{amp}= is class amplitude to which the parameter belongs where the upper most border was take as a maximal value obtained in the physico-chemical and chemical examination of water samples to determine this value for the final category of individual parameters.

Unit weight

The unit weight (W_i) is calculated using the expression given in Equation

$Wi = W_i / \Sigma^n_{i=1} W_i$

Where,

W_i = is the relative weight.

W_i = is the weight of each parameter.

n = is the number of parameters

Results and Discussions

(Head Reach)

Premonsoon

The water quality samples has been analysed and IWQI vide Fig No 2 of eight channels of wallajah tank in Head ,Middle and Tail reaches has also been estimated vide table no 6. In all eight channels IWQI of Head reach of Ampalpuram and Kothavacheri channel falls in second class which comes under low restriction. Remaining six channels falls in third class which comes under moderate restriction. Hence water in the head reach can be used for less sensitive plant to salts.

Monsoon

Except Alampadi channel IWQI of head reach of remaining seven channels falls in low and moderate restrictions. IWQI of Alampadi channel falls under severe restriction. Hence water in this channel can be used with the recommendations of soil and plant given in Table no 7.

Post Monsoon

IWQI of all channels are above hundred except Thalakulam channel vide Table no 8. It is inferred that the Irrigation water quality parameters are more than the permissible limits and hence water in these channels in the head reach can be used with more restrictions (or) it may become unsuitable for irrigation purpose.

IWQI (Head Reach)

As for as head reach is considered in all three seasons namely Pre monsoon, Monsoon and Post monsoon, as per IWQI of Head reach in eight channels the water quality is poor in post monsoon seasons compared to pre monsoon and Monsoon seasons. Hence it is recommended that water has to be treated and supplied for irrigation in the post Monsoon season.

Middle Reach

Pre Monsoon

The IWQI vide Fig No 3 of eight channels of Middle reach of Ampalpuram, Thittai and Kothavacheri channel falls in second class which comes under low restriction vide table no 6. Remaining five channels falls in third class which comes under moderate restriction vide table no 6. Hence water in the middle reach can be used for less sensitive plant to salts.

Monsoon

The computed IWQI of middle reach of Ampalpuram, Thittai, Krishnapuram and Kothavacheri falls in second class which comes under lower restriction vide table no 2. Remaining four channels falls in moderate restrictions vide table no 7. Hence water in this channel can be used with the recommendations of soil and plant given in Table no 2.

Post monsoon

The IWQI of all channels of middle reaches this season are above hundred. It is inferred that the Irrigation water quality parameters are more than the permissible limits and hence water in these channels in the middle reach can be used with more restrictions vide table no 2 (or) it may becomes unsuitable for irrigation purpose.

IWQI(middle reach)

As for as middle reach is considered in all three seasons namely Premonsoon, Monsoon and Post monsoon, as per IWQI of Middle reach in eight channels the water quality is poor in post monsoon seasons compared to premonsoon and Monsoon seasons. Hence it is recommended that water has to be treated and supplied for irrigation in the post Monsoon season.

Tail Reach

Pre monsoon

The values for IWQIvide Fig No 3 falls in the range of low and moderate restriction vide table no2 except Alampadi. Alampadi tail reach falls under High restriction vide table no2. Hence water in this channel can be used with the recommendations of soil and plant given in Table no 2

Monsoon Season

Except Ampalpuram channel IWQI of tail reach of remaining seven channels falls in low restrictions vide table no 2. IWQI of Ampalpuram channel falls under moderate restriction vide table no 2. Hence water in this channel can be used with the recommendations of soil and plant given in Table no 2

Post Monsoon

The values IWQI of all channels of tail reaches are above hundred except Thalaikulam . IWQI of Thalaikulam falls under low restriction vide table no 2. Hence water in the tail reach can be used for less sensitive plant to salts vide table no 2.

IWQI(Tail Reach)

In Tail reaches of channels in all three seasons IWQI falls in low and moderate restriction vide table No2. This is due to deposition of coal dust in head and middle reaches than in Tail reaches.

Table 1 Command area of each supply channel of wallajah tank

Sl no	Name of the tank/cannal	Bund length in Km	Area in acres
1	Omaiyan	1.62	143
2	Ambalpuram	3.23	790
3	Alampadi	6.44	622
4	Thittai	8.90	1200
5	Thalaikulam	4.83	838
6	Jayamkondam	10.34	1395
7	Krishnapuram	4.70	3014
8	Kothavachery	8.25	2774
9	Maruvai	1.61	216
10	Karaimedu	1.61	187
11	Kolakudi	4.84	163
		Total	**11392**

Table 2 water use restrictions, recommendations for soils and plants

IWQI	Water use Restrictions	Recommendations	
		Soil	**Plant**
0≤40	No restriction	May be used for the majority of soils with low probability of causing salinity and sodicity problems, being recommended leaching within irrigation practices, except for in soils with extremely low permeability	No toxicity risk for most plants
40≤55	Low restriction	Recommended for use in irrigated soils with light texture or moderate permeability, being recommended salt leaching. Soil sodicity in heavy texture soils may occur, being recommended to avoid its use in soils with high clay levels 2:1	Avoid salt sensitive plants
55≤70	Moderate restriction	May be used in soils with moderate to high permeability values, being suggested moderate leaching of salts.	Plants with moderate Tolerance to salts may be grown
70≤85	High restriction	May be used in soils with high permeability without compact layers. High frequency irrigation schedule should be adopted for water with EC above 2.000 dS m-1 and SAR above 7.0	Should be used for irrigation of plants with moderate to high tolerance to salts with special salinity control practices, except water with low Na, Cl and HCO3 values
85≤100	Severe restriction	Should be avoided its use for irrigation under normal conditions. In special cases, may be used occasionally. Water with low salt levels and high SAR require gypsum application. In high saline content water soils must have high permeability, and excess water should be applied to avoid salt accumulation.	Only plants with high salt tolerance, except for waters with extremely low values of Na, Cl and HCO3.
Above 100	Unfit for irrigation		

Table 3 Common Irrigation Water Quality Parameters (1985)

Water Parameters	Units	Range in Irrigation water
pH	-	6.5-8.5
EC	**μs/cm**	1000
TDS	**mg/l**	0-2000
SAR	**meq/l**	0-15
HCO_3	**meq/l**	0-10
Cl	**meq/l**	0-30
Na	**meq/l**	0-40
Ca	**meq/l**	0-20
Mg	**meq/l**	0-5
NO_3	**mg/l**	0-10
PO_4	**mg/l**	0-2
F	**mg/l**	1.5

Table 4 Parameter limiting values for quality measurement (Qi) calculation

Qi	EC(µs/cm)	SAR (mmol/L) ^1/2	Na+ mmol/L	Cl-	HCO3-
85-100	200≤EC<750	2 ≤SAR< 3	2 ≤ Na < 3	1 ≤ Cl< 4	1≤ HCO3<1.5
60-85	750≤EC<1500	3 ≤SAR< 6	3 ≤ Na < 6	4 ≤ Cl< 7	1.5≤ HCO3<4.5
35-60	1500≤EC<3000	6 ≤SAR< 12	6 ≤ Na < 9	7 ≤ Cl< 10	4.5≤ HCO3<8.5
0-35	EC<200 or EC≥3000	SAR<2 or SAR≥12	Na < 2 or Na ≥ 9	Cl< 1 or Cl≥ 10	HCO3<1 or HCO3≥ 8.5

Table 5 Weights for the IWQI parameters

Parameters	Units	FAO Standards	% Compliance	Weight	Relative Weight
pH	-	6.5-8.5	0	5	0.0909
EC	µs/cm	1000	0	5	0.0909
TDS	mg/l	0-2000	0	5	0.0909
SAR	me/l	0-15	0	5	0.0909
HCO_3	me/l	0-10	25	4	0.0727
Cl	me/l	0-30	0	5	0.0909
Na	me/l	0-40	0	5	0.0909
Ca	me/l	0-20	0	5	0.0909
Mg	me/l	0-5	0	5	0.0909
NO_3	mg/l	0-10	100	1	0.0181
PO_4	mg/l	0-2	0	5	0.0909
F	mg/l	1.5	0	5	0.0909
			Total	55	

Table 6 Calculation of Iwqi of Walajah Tank Supply Channel Pre- Monsoon Season

S. No	Study Area	W_i*Q_i of Ph	W_i*Q_i of EC μs/cm	W_i*Q_i of TDS mg/l	W_i*Q_i of SAR meq/l	W_i*Q_i of HCO_3 Meq/l	W_i*Q_i of Cl meq/l	W_i*Q_i of Na meq/l	W_i*Q_i of Ca meq/l	W_i*Q_i of Mg meq/l	W_i*Q_i of NO_3 mg/l	W_i*Q_i of PO_4 mg/l	W_i*Q_i of F mg/l	∑WQI	
1.	**Ampalpuram**	**Head reach**	7.4856	3.1815	3.3269	2.8602	5.089	0.9508	0.9726	0.8999	2.3634	13.575	2.2725	6.0593	49.0367
		Middle reach	7.6173	2.775	3.1635	2.7256	2.75	1.0545	0.9018	0.8325	2.4235	13.875	9.25	6.1660	53.5347
		Tail Reach	8.235	3.2	3.72	2.94	3.0	0.266	0.975	0.915	2.6	15	10	10	60.851
2.	**Alampadi**	**Head reach**	8.0201	1.9089	3.4360	2.6361	7.27	1.2116	0.8771	0.7817	2.3270	13.575	4.545	6.0593	52.6475
		Middle reach	8.7051	2.312	3.108	2.664	4.95	1.1433	0.8944	0.8232	2.627	13.875	9.25	6.1660	56.518
		Tail Reach	8.823	2.4	3.48	2.046	6.6	0.2472	0.965	0.87	2.84	15	5	6.66	76.5312
3.	**Thittai**	**Head reach**	8.0201	2.272	3.2724	2.0843	6.543	1.2962	0.9499	0.7408	2.3815	13.575	9.09	6.0593	56.2845
		Middle reach	8.1612	2.682	3.6075	1.4485	3.85	1.2330	0.6475	0.7122	2.405	13.875	9.25	6.1660	54.0379
		Tail Reach	8.823	2.8	4.08	2.82	3.6	0.2852	1.32	0.9	2.64	15	10	6.66	58.9282
4.	**Thalaikulam**	**Head reach**	7.4856	2.727	3.1633	2.3870	9.451	1.2116	1.158	0.9135	2.4361	13.575	9.09	6.0593	59.6574
		Middle reach	8.1612	3.237	2.775	2.2	6.05	1.2330	0.9129	0.9203	2.4975	13.875	9.25	6.1660	57.2779
		Tail Reach	8.235	3.6	3.84	2.173	7.2	0.2852	1.045	0.975	2.6	15	10	6.66	61.613
5.	**Krishnapuram**	**Head reach**	7.4856	2.908	3.1633	1.9752	7.27	1.0362	0.9499	0.8317	2.6361	13.575	4.545	9.09	55.466
		Middle reach	7.6173	2.59	3.6075	2.0220	6.6	1.0545	0.9916	0.9018	2.7195	13.875	9.25	6.1660	57.3952
		Tail Reach	8.235	3	4.08	2.193	6.6	0.2852	1.07	0.945	2.96	15	1	6.66	52.0282
6.	**Jayankondam**	**Head reach**	7.4856	3.454	2.9997	1.9570	14.54	0.9535	0.9062	0.7408	2.5815	13.575	4.545	6.0593	59.7973
		Middle reach	7.6173	3.607	3.108	2.0905	9.9	0.8787	0.9222	0.6798	2.405	18.5	4.625	6.1660	60.4995
		Tail Reach	8.823	3.5	3.24	2.08	6.0	0.2666	0.95	0.79	2.76	20	5	6.6	60.0696
7.	**Kollakudi**	**Head reach**	8.235	2.817	3.3178	1.9025	7.27	1.7543	0.8790	0.7181	2.6361	13.575	4.545	9.09	56.7398
		Middle reach	8.1612	2.59	3.552	1.9175	8.25	1.2330	0.8926	0.7261	2.775	13.875	4.625	9.25	57.8504
		Tail Reach	8.235	3	3.24	1.56	7.2	0.2092	0.727	0.8	2.96	15	10	10	62.9312
8.	**Kothavacheri**	**Head reach**	8.0201	2.727	3.9268	1.8116	5.816	1.3844	0.8590	0.8181	2.5270	13.575	2.2725	6.0593	49.7968
		Middle reach	7.6173	2.59	3.4965	1.8315	4.95	1.3190	0.8695	0.8463	2.5345	13.875	4.625	6.1660	50.7206
		Tail Reach	8.235	2.9	3.96	1.98	4.2	0.3426	0.94	0.915	2.72	15	2.5	6.66	50.3526

Table 7 Calculation of Iwqi of Walajah Tank Supply Channel Monsoon Season

S.No	Study Area		W_i*Q_i of Ph	W_i*Q_i of EC μs/cm	W_i*Q_i of TDS mg/l	W_i*Q_i of SAR meq/l	W_i*Q_i of HCO_3 meq/l	W_i*Q_i of Cl meq/l	W_i*Q_i of Na meq/l	W_i*Q_i of Ca meq/l	W_i*Q_i of Mg meq/l	W_i*Q_i of NO_3 mg/l	W_i*Q_i of PO_4 mg/l	W_i*Q_i of F mg/l	∑WQI
1.	Ampalpuram	Head reach	7.5927	2.4543	3.3087	2.4118	6.543	1.1240	1.2748	0.9317	3.4905	13.635	2.2725	6.0593	51.0983
		Middle reach	7.7968	2.8299	3.2638	2.5028	5.565	1.3457	1.3253	0.9480	3.5468	8.487	9.433	6.2880	53.3321
		Tail Reach	7.6175	4.625	3.478	2.479	14.98	1.3628	1.3042	0.9388	3.4965	8.3295	4.625	9.25	62.4863
2.	Alampadi	Head reach	8.0205	3.636	3.3360	2.3209	39.985	1.7300	1.2771	1.008	3.763	8.181	9.09	6.0593	88.4068
		Middle reach	9.1000	3.3015	3.1304	2.4651	7.42	1.4369	1.3272	1.004	3.7543	8.487	9.433	6.2880	57.1204
		Tail Reach	8.5970	2.8675	3.2005	2.4851	4.995	1.2765	1.3088	0.9435	3.515	8.3295	9.25	6.1660	52.9344
3.	Thittai	Head reach	7.4857	4.0905	2.6815	2.3693	5.816	1.5573	1.2726	0.9635	3.5814	8.181	4.545	9.09	51.6338
		Middle reach	8.3232	3.6788	3.6034	2.4776	3.71	1.4369	1.3206	0.9857	3.6788	3.772	9.433	6.2880	48.658
		Tail Reach	7.6175	2.8675	4.1255	2.4975	3.885	1.3196	1.2880	0.9065	3.367	3.702	4.625	6.1660	42.3671
4.	Thalaikulam	Head reach	7.5927	3.5451	3.5814	2.4057	7.27	1.7300	1.2680	0.9271	3.4542	13.635	9.09	9.09	63.5892
		Middle reach	7.7968	3.4902	3.5185	2.4085	5.565	1.7041	1.2970	1.0046	3.7354	8.487	9.433	9.43	57.9551
		Tail Reach	7.6175	2.8675	3.4687	2.3186	4.44	1.7173	1.2071	0.9203	3.4225	8.3295	2.3125	9.25	47.8715
5.	Krishnapuram	Head reach	7.4857	3.636	3.5451	2.3634	12.359	1.8603	1.2135	0.8817	3.2724	8.181	13.635	6.0593	64.4831
		Middle reach	7.7968	3.8675	3.8203	2.4399	4.452	1.6161	1.2593	0.9150	3.4524	3.772	9.433	6.2880	49.1123
		Tail Reach	7.6175	3.515	3.6907	2.3988	8.325	1.7173	1.2371	0.9018	3.367	3.702	9.25	6.1660	51.8882
6.	Jayankondam	Head reach	8.5552	3.636	3.9087	2.5148	7.27	1.5573	1.2816	0.8680	3.2360	13.635	2.2725	6.0593	54.7941
		Middle reach	7.7968	3.5845	3.6788	2.4462	2.968	1.4369	1.3088	9.9518	3.6977	8.487	4.7165	6.2880	56.361
		Tail Reach	7.7264	3.4225	3.7462	2.4660	2.775	1.628	1.2903	0.9296	3.478	8.3295	4.625	6.1660	46.5825
7.	Kollakudi	Head reach	7.4857	4.0905	3.7269	2.1466	14.54	1.9452	1.2748	0.8908	3.3269	8.181	9.09	6.0593	63.0774
		Middle reach	8.3232	3.7732	3.3958	2.4399	6.307	1.9746	1.311	0.9999	3.7166	8.487	9.433	6.2880	56.4492
		Tail Reach	7.6175	3.6075	3.552	2.4173	4.995	1.8098	1.2903	0.9666	3.6075	8.3295	9.25	6.1660	53.609
8.	Kothavacheri	Head reach	7.4857	3.636	3.7950	2.4179	7.27	1.5573	1.2657	0.9135	3.4178	8.181	9.09	6.0593	55.0892
		Middle reach	7.7968	3.5845	3.5373	2.5217	4..452	1.4369	1.3111	0.9338	3.4902	8.487	4.7165	6.2880	48.5558
		Tail Reach	7.6175	3.4225	3.6907	2.4235	6.105	1.4953	1.2834	0.9481	3.552	8.3295	4.625	6.1660	49.6585

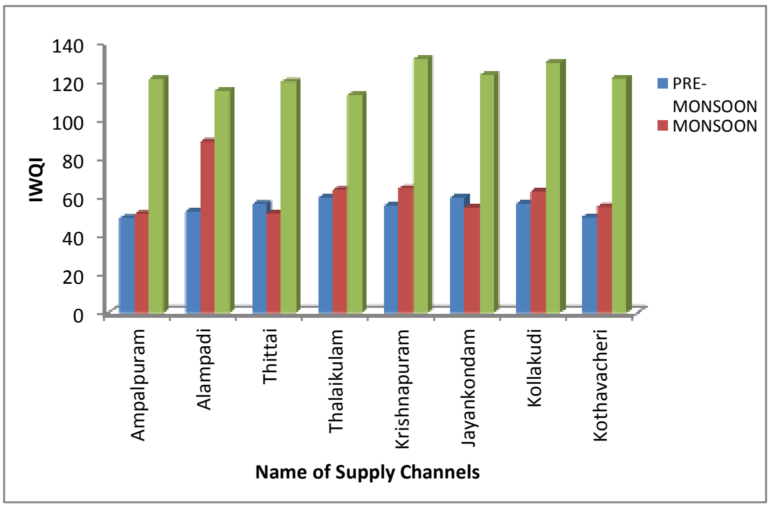

Fig 2 IWQI of supply channels at head reach in Pre, Monsoon and post Monsoon seasons.

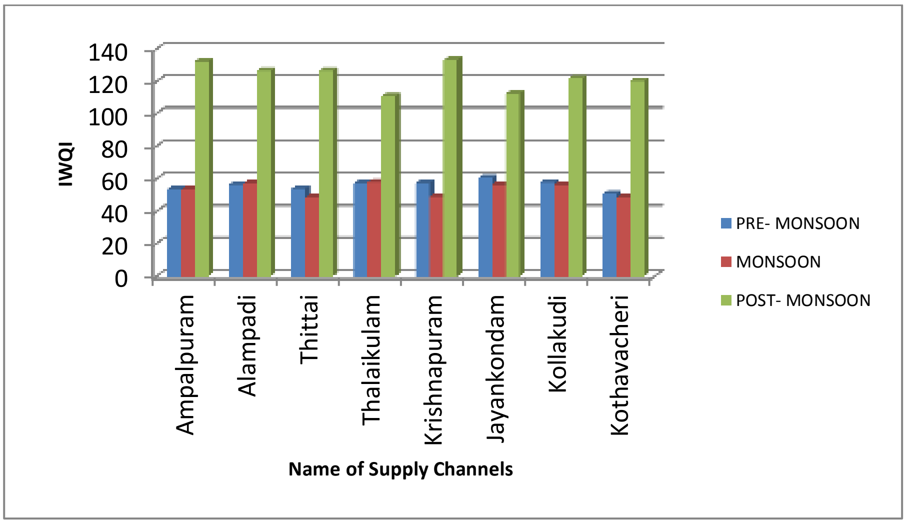

Fig 3 IWQI of supply channels at Middle reach for Pre, Monsoon and Post Monsoon seasons.

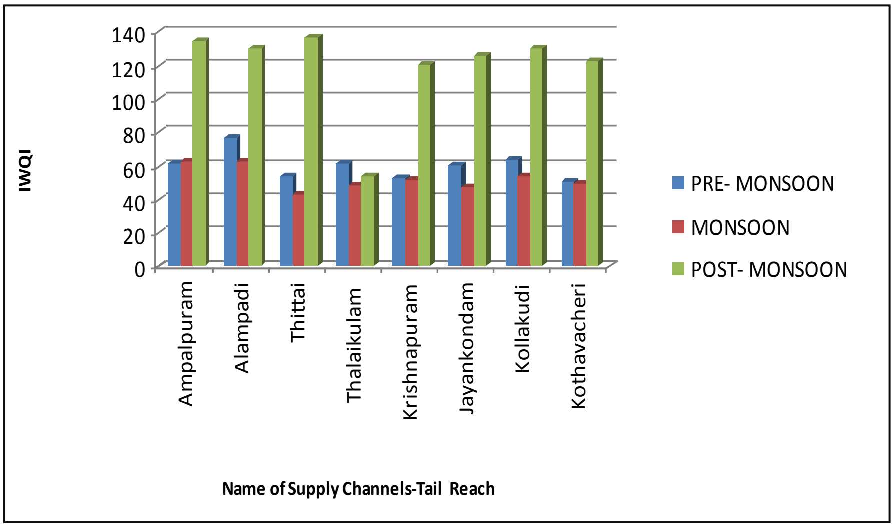

Fig 4 IWQI of various supply channels of wallajah tank tail reach forpre post and monsoon Seasons.

Conclusions

As per IWQI of eight channels the water quality is poor in head, middle, tail post monsoon season compared to pre monsoon and Monsoon seasons. IWQI of head, middle, tail reach in post monsoon falls under unfit for irrigation purpose, where as the remaining falls under low and moderate restriction vide table No 2. From this, it is concluded that the surface water in the area is suitable for irrigation purpose in pre and monsoon seasons. Hence it is recommended that water has to be treated and supplied for irrigation in the post Monsoon season. This poor water quality in post monsoon season may be due to less water availability, stagnation of water in the channels and deposition of salts at the bottom. This indicates that the surface water needs a water quality management to improve the water quality status.

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