

# Experimental Investigation of Drainage Water - A Case Study

R. Bhavani

JNTUA College of Engineering, Anantapur

**Abstract**— As Ananthapuramu is one of the drought prone area, it is suffering with lack of water for various purposes like domestic, agriculture, industries etc. The Drainage from the entire area of habitations of Ananthapuramu town (Andhra Pradesh, India) entering in to ‘Thadakaleru’ till the point of confluence at Singanamala tank has been considered for the present study. In the study area, drainage water is being used for agriculture purpose due to non availability of sufficient water. Samples from thirteen selected locations have been collected for testing. Out of thirteen locations, continuous flow along Nadimivanka has been considered from locations 4 to 13. Flow from locations 1 to 3 is joining between locations 8 and 9. The locations 1 to 8 are existing within the town area where there is a contamination due to habitations. From location 8 upto 13, the drainage is flowing freely without further contamination. The objective of study is to find various parameters like Sodium adsorption ratio (SAR), pH, Boron, Residual Sodium Carbonate (RSC), Turbidity etc., that are present in the drainage water. It has been observed that the values of various parameters are increasing for the samples 1 to 3 and 4 to 8 and are decreasing for the samples 9 to 13. It can be suggested that the crops which can tolerate the obtained ranges of parameters are to be selected.

**Key words:** Drainage Water, Residual Sodium Carbonate (RSC), Sodium adsorption ratio (SAR)

## I. INTRODUCTION

In general cultivation of crops requires water which can be supplied either by construction of storage structures or by lifting of subsurface water. In Ananthapuramu there were field channels carrying water from tanks to the fields for cultivation of crops. But slowly due to scarcity of rain the availability of water in the tanks is reduced, resulting in drying of drains. Also as the population is increased people started to divert the effluent from the houses, hotels, motels, hospitals etc., to these channels there by converting some of them to contaminated drains. These drains are carrying the contaminated water and it is inevitable for the farmers to use this contaminated water for cultivation. The main objective of the study is to find out the various parameters that are present in the contaminated water to check the suitability with respect to irrigation.

## II. STUDY AREA

The contaminated water from various sources of Ananthapuramu is entering into ‘Thadakaleru’ and in turn joins ‘Singanamala tank’. The area covered by the source of contaminated water and the path of flow upto Singanamala tank has been selected for present study. The location of the study area has been shown in fig. 1.

Drainage water from Thadakaleru is being diverted to different field channels to utilize for irrigation and the excess water is allowed to enter into Singanamala tank. Selected locations and the respective sources from which the drainage is flowing have been shown in table I.

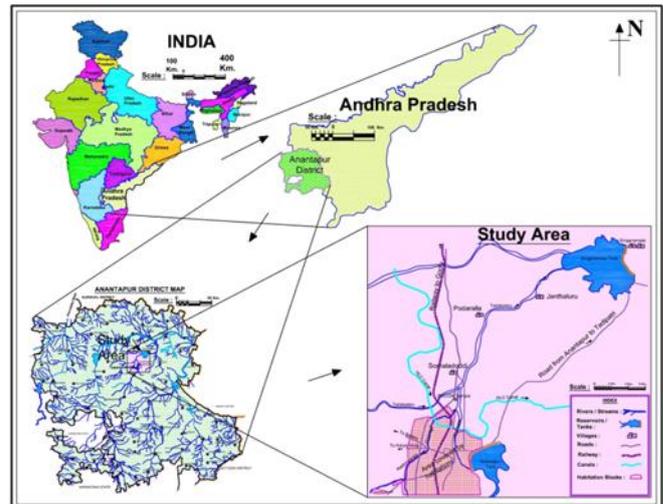


Fig. 1: Map showing the location of Study area

Sample No	Location	Sources
Samples along the Drain in the Town		
1	At Sangamesh point	Munna nagar, Sarada nagar etc.
2	At Iron bridge	Vidyuth nagar, Aravinda nager, Obuldev nagar, Ashok nagar, Sai nagar, etc.
3	Near Ananthapuramu RTC bus stand	Gandhi bajar, Khaja nagar, Old Town, Venugopal Nagar etc.
Samples along Nadimivanka		
4	Near Rudrampeta	Kattakinda palli, Rudrampeta etc.
5	Nadimivanka at Road crossing Near Police Training College (PTC)	Ram nagar, Maruti nagar, Rahamat nagar, Kovur nagar etc.
6	Nadimivanka at Somanath nagar Bridge	Indira gandhi nagar, Somanath Nagar, Shanthi nagar, RK nagar etc.
7	Nadimivanka at HLC canal Crossing	Revenue colony, Ramachandra nagar, Yerranela kottala etc.
8	Nadimivanka at railway bridge near Rajeev colony	Gaurav gardens, Ganga nagar, Sri Sri nagar, Priyanka nagar etc.
Samples along Thadakaleru after the confluence of Nadimivanka and the drainage from the town		
9	Thadakaleru near ISKCON Temple	Drainage from Nadimivanka and from Anantapuramu town (Samples 1 to 8 above)

10	Back side of TATA showroom	Free flow with no addition of contamination
11	Near Podaralla (v)	Free flow with no addition of contamination
12	Near Jantalur (v)	Free flow with no addition of contamination
13	Joining point at Singanamala tank	Free flow with no addition of contamination

Table 1: Locations And Sources Of Drainage Samples

Samples 1 to 3 have been collected along the Drain intended for surplus water from left flank of Anantapur tank (at present it is filled with drainage water due to rare surplus from the tank and increased population in the town). Samples 4 to 8 have been collected along Nadimivanka (at present it is filled with drainage water due to rare natural flows from the nearby catchment and increased habitations/ population along the vanka). After the confluence of drain from the town and Nadimivanka, the drainage water enters into free atmosphere where there is no addition of contamination and finally joins the Tadakaleru near ISKCON Temple. Samples 9 to 13 at different distances along Thadakaleru have been collected as the various chemical parameters may change with respect to time, temperature etc.

All the above thirteen locations have been shown in fig. 2.

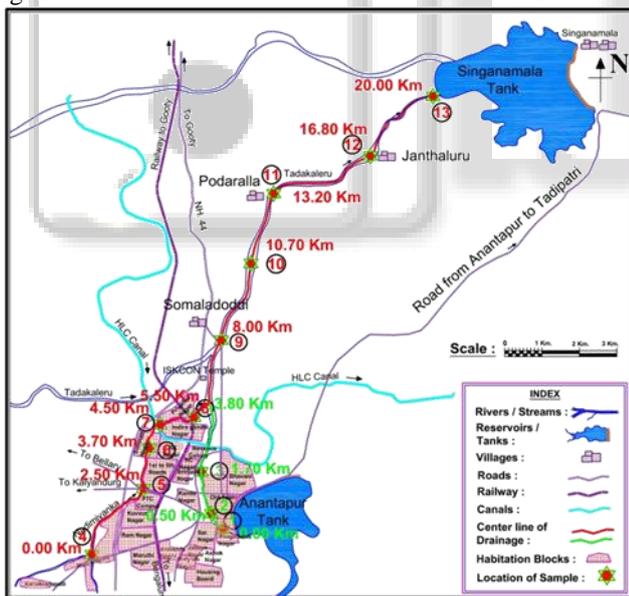


Fig. 2: Map showing locations of the samples

### III. INVESTIGATIONS

Drainage samples at all the above selected locations have been collected for 15 consecutive days and have been tested in the Laboratory to find pH, TDS, Turbidity, alkalinity, Total hardness, Chlorides, Sulphates, Nitrates, Iron, Sodium adsorption ratio, Residual Sodium Carbonate and Boron. The average values of results have been tabulated.

### IV. TEST PARAMETERS

pH: pH is defined as negative logarithm of hydrogen ion concentration.

TDS: Substances that are totally dissolved in water refer to TDS. It is an important parameter to be considered to test the suitability of water for various purposes like agriculture, domestic etc.

Turbidity: It refers to the presence of suspended solid particles like silt, organic matter etc., there by not allowing the light to pass through it.

Alkalinity: Acid neutralizing capacity of water is known as alkalinity. Higher alkaline waters may cause corrosion and also they affect aquatic life.

Total hardness: Hardness refers to the presence of minerals in water. If hard water is continuously used for agriculture after some time the land may become infertile.

Chlorides: The salts of sodium, calcium and potassium present in water refer to chlorides. Chlorides play a vital role in the determination of chemical oxygen demand.

Sulphates: Sulphates occur naturally in minerals like epsomite, gypsum etc. The presence of sulphates in water affects odour and taste.

Nitrates: Nitrates in water are necessary for plants and animals for a process of nitrogen cycle.

Iron: Iron is an essential element for living organisms especially for human nutrition.

Sodium adsorption ratio (SAR): This is a parameter with which the suitability of water for irrigation can be assessed. This can be calculated by using the formula.

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

Where Na, Ca and Mg stand for sodium, calcium and magnesium concentrations present in the sample.

Residual Sodium Carbonate (RSC): This is an important parameter which is to be considered to find the suitability of water for irrigation especially with respect to clayey soils. The formula to find RSC is

$$RSC = (CO_3 + HCO_3) - (Ca + Mg)$$

where CO<sub>3</sub>, HCO<sub>3</sub>, Ca and Mg stand for Carbonates, Bicarbonates, Calcium and magnesium concentrations present in the sample.

Boron: It is an important parameter which affects the growth of plants.

### V. RESULTS AND DISCUSSIONS

Drainage water is being used to irrigate more than 800 acres land in the village limits of Podaralla, Somanadoddi and Jantalur. Tested and calculated values for all the drainage samples collected along the Drain in the Town and along Nadimivanka (zones for accumulation of contaminated water) have been shown in tables II and III.

S. No.	Description	Samples along the drainage in the town		
		1	2	3
	Cumulative Distance in km	0	0.5	1.7
1	pH	8.4	8.5	8.7
2	Colour	Black	Black	Black

3	TDS in mg/litre	1688	1715	1798
4	Turbidity	15	16	20
5	Boron in mg/litre	0.80	1.00	1.10
6	Sodium adsorption ratio	6	8	7
10	Residual sodium carbonate in mg/litre	2.9	3.0	3.0
11	Alkalinity in mg/litre	640	680	700
12	Total hardness in mg/litre	400	460	500
13	Chlorides as Cl in mg/litre	224	308	352
14	Sulphates as SO <sub>4</sub> in mg/litre	280	302	320
15	Nitrates as NO <sub>3</sub> in mg/litre	21	23	26
16	Iron in mg/litre	0.16	0.17	0.19
17	Fluoride in mg/litre	1.46	1.50	1.65

Table 2: Tested And Calculated Values Of Samples Along The Drain In The Town

S. No	Description	Samples along 'Nadimivanka'				
		4	5	6	7	8
	Cumulative Distance in km	0	2.5	3.7	4.5	5.5
1	pH	8.3	8.4	8.5	8.5	8.6

2	Colour	Black	Black	Black	Black	Black
3	TDS in mg/litre	1478	1578	1590	1640	1651
4	Turbidity	12	14	15	17	19
5	Boron in mg/litre	0.68	0.82	0.86	0.92	0.99
6	Sodium adsorption ratio	3	3	5	6	7
10	Residual sodium carbonate in mg/litre	1.9	2.2	2.5	2.7	2.9
11	Alkalinity in mg/litre	540	640	645	665	670
12	Total hardness in mg/litre	429	432	440	450	483
13	Chlorides as Cl in mg/litre	250	275	310	316	330
14	Sulphate as SO <sub>4</sub> in mg/litre	274	284	289	310	320
15	Nitrate as NO <sub>3</sub> in mg/litre	22	23	24	24	25
16	Iron in mg/litre	0.17	0.18	0.20	0.21	0.22
17	Fluoride in mg/litre	1.40	1.44	1.54	1.56	1.64

Table 3: Tested and Calculated Values Of Samples Along Nadimivanka

Similarly the values for all the drainage samples collected along Thadakaleru after the confluence of the Drain in the Town with Nadimivanka (Zone of free flow without addition of contamination) have been shown in table IV. The cumulative distance from sample 4 (At Rudrampeta) has been continued upto sample 13 (Confluence with Singanamala tank).

S. No	Description	Samples along Thadakaleru after the confluence of the Drain in the Town with Nadimivanka				
		9	10	11	12	13
	Cumulative Distance in km	8.0	10.7	13.2	16.8	20.0
1	pH	8.5	8.4	8.3	8.2	8.1
2	Colour	Black	Black	Blackish blue	Blackish blue	Blackish blue
3	TDS in mg/litre	1658	1560	1478	1420	1318
4	Turbidity	18	15	10	9	8
5	Boron in mg/litre	0.97	0.76	0.58	0.47	0.4
6	Sodium adsorption ratio	6	4	3	2	2
10	Residual sodium carbonate in mg/litre	2.8	2.6	2.4	2.2	1.6

11	Alkalinity in mg/litre	660	640	640	620	590
12	Total hardness in mg/litre	480	420	380	368	362
13	Chloides as Cl in mg/litre	308	280	266	252	248
14	Sulphate as SO <sub>4</sub> in mg/litre	312	291	287	276	256
15	Nitrate as NO <sub>3</sub> in mg/litre	24	22	20	20	18
16	Iron in mg/litre	0.19	0.18	0.16	0.15	0.15
17	Fluoride in mg/litre	1.6	1.52	1.51	1.51	1.49

Table 4: Tested and Calculated Values of Samples Along 'Thadakaleru'

## VI. CONCLUSION

It has been observed that the values of various parameters are increasing for the samples 1 to 3 and 4 to 8 where there is a continuous addition of contamination due to presence of habitations. The values of the samples 9 to 13 are decreasing, since there is less chance for addition of contamination and more possibility for purification due to flow in free, natural atmosphere. Different crops will have different tolerable ranges of various parameters. Hence, it can be suggested that the crops which can grow with in these ranges can only be selected. Also, it can be suggested that the selection of crops should be based not only on quality of water but also the soil, since the soil properties may influence the production of crops.

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