Assessment of the Drinking Water Quality Sources, Westren Delta, West Godavari, Andhra Pradesh, India: A Case Study

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ABSTRACT

Most of the ecosystems are in the state of constant change at various spatial and temporal scales due to variety of socio-economic and environmental factors particularly in the developing nations like India. These changes are more extensive and occurring at faster rate in the highly productive and densely populated coastal environments as compared to that of deep inland portions. Physical, chemical and biological properties of Western Godavari Delta plays very much vital role on the economic development and other related issues than health and environment. Keeping in view of these issues, assessment of the drinking water quality has been taken as model study for understanding the quality aspects. A physico-chemical and micro-biological study in 120 villages of Godavari Western Delta has been conceded in three seasons to assess the quality of drinking water sources. Water samples are collected from canal, summer storage ponds, and from surface water before and after treatment, ground water before and after treatment; NTR Sujala / NGO supplied drinking water. The samples were analysed for turbidity, pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Hardness, Alkalinity, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia, Nitrites, Nitrates, Sodium, Potassium, Chlorides, MPN, TFC and E.Coli are measured as per standard A.P.H.A. methods. The resulted parameters were compared with the drinking water standards of W.H.O. and BIS: 10500. Although, piped-water is considered to be a safe and clean water source, the results were exceeded the drinking water guidelines and also super chlorination instead of proper monitoring of the supply system and leakages seems to be major causes of present problem.

KEY WORDS: Assessment, Drinking water, Monitoring, Potability, Public Health.

1. INTRODUCTION

Drinking water is one of the basic needs of life and essential for survival. Our essential water resources have proven themselves to be greatly resilient, but they are increasingly vulnerable and susceptible. Safe water has become scarce and will become even scarcer with the beginning of climate change. Water is fundamental to life, but many people do not have access to clean and safe drinking water and many die of waterborne bacterial infections (Banerjea, 1967; Chisty 2002; Raghuram, 2015). Water quality is the condition of the water body or water resource in relation to its designated uses. It can be defined in qualitative and or qualitative terms. The fresh water is of vital concern for mankind, since it is directly linked to human welfare. Water is one of the vehicles for transferring of wide range of diseases. Supply of safe, clean and portable drinking water to the community is utmost important in maintaining positive health measures.

Necessity of Water Quality Assessment: Water Quality Assessment is a vast program which consists of dividing the entire area under study into several habitations, identifying the sources and testing water quality and thus monitoring the water quality at source. The general process of evaluation of the physical, chemical and biological nature of water in relation to natural quality, human effects and intended uses, particularly which may affect human health and the health of the aquatic system itself is called water quality assessment. Water quality assessment includes monitoring to define the status of the water, to provide the basis for detecting trends and to provide the information enabling the establishment of cause-effect relationships (Dagaonkar and Saksena 1992; Damotharan, 2010).

The water which required for public water supply schemes should be potable or wholesome water i.e., fit for drinking purpose. The impurities in water are to be removed to a certain extent so that it does not prove harmful to the public health.

Study Area: The area of present study lies between 16°19'05.02" To 16°56'08.37" N Latitudes and 80°58'16.10" to 81°51'26.10" E Longitudes and covers entire Godavari Western Delta. The Study Area is situated in the Southern Part of West Godavari District. It is bounded in the East by Godavari River, North by Eluru Canal and West by Upputeru River & Kolleru Lake and South by Bay of Bengal. The Area Consists of a Total of 344 Villages and 09 Towns. All the Villages and Towns are met by Surface Water Resources. The entire area is drained by the Right Bank Canal Irrigation Network of Sir Arthur Cotton Barrage at Rajahmundry on River Godavari. The main canals in the study area include Eluru canal, Venkaiah Vayyeru, Undi, Attili, Right Bank Canals and Kakaraparru Channel.

2. MATERIALS AND METHODS

Water samples from different sources were collected from 120 villages of West Godavari, Western Delta in all the three seasons of a year and analyzed for physico-chemical and biological considerations. The samples collected were from canals, summer storage tanks, and treated water at source point and at consumer point (in case of canal water as source water). In case of ground water, samples were collected from open dug wells, hand pumps,

bore wells, overhead tanks and consumer points. Bottled water samples were also collected from source points before and after treatment. All these samples were collected for three seasons- winter, summer and rainy, except canal water in summer season (canals were closed in summer). The NGO supplied water samples were also collected before and after treatment and analyzed, for all the three seasons. All these samples were analyzed for P^H, TDS, EC, TH, TA, turbidity, ammonia, nitrite, nitrate, chlorides, sodium and potassium. The biological parameters like MPN, TFC and E.Coli were analyzed for all the samples by following the standard protocol (APHA).

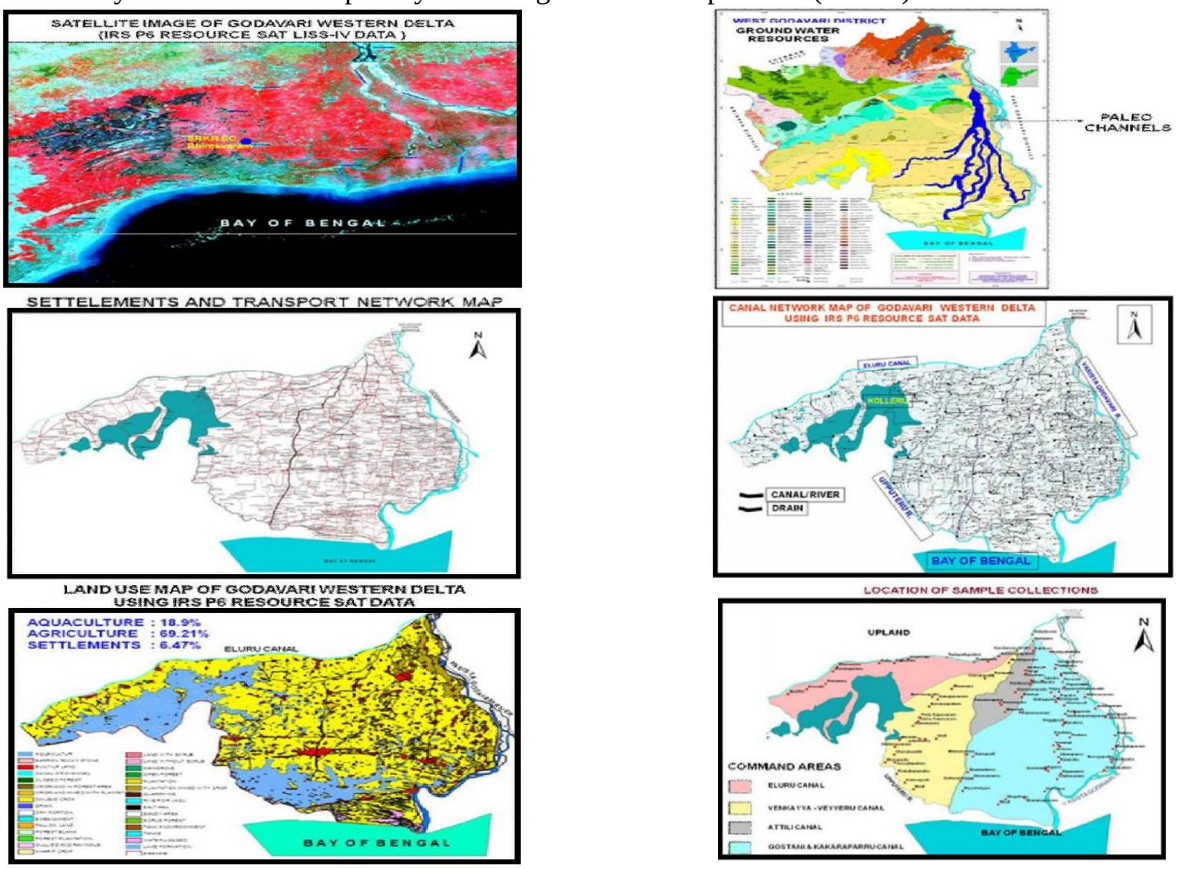

Figure.1. Image and maps of the study area

3. RESULTS AND DISCUSSIONS

Table.1. Summary: Averages of various sources of water Physico-chemical parameters

Parameter	Canal water	S.S.T (S.W)	PTW (SW)	Ground water	PTW (GW)
P^H	8.41	8.58	8.41	8.06	7.90
TDS(ppm)	180	265	257	675	845
EC(µS/cm)	256	379	376	975	1219
TH(ppm)	100	118	121	271	307
TA(ppm)	98	119	132	262	358
Turb.(NTU)	5.80	5.62	3.35	4.17	2.89
NH_3(ppm)	0.05	0.06	0.02	0.02	0.02
NO_2(ppm)	0.03	0.03	0.06	0.004	0.003
NO_3(ppm)	8.24	7.46	5.83	17.39	22.60
Na(ppm)	47	55	53	130	137
K(ppm)	2	5	4	15	20
Cl(ppm)	63.31	82.00	74.00	159.00	181.00
DO(ppm)	-	5.09	-	5.32	-
BOD(ppm)	-	4.10	-	2.33	-
COD(ppm)	-	16.80	-	14.60	-

The TDS of summer storage tank was increased by 47% in comparison to canal water. TDS of treated water was decreased by 3% in comparison to SS tank. But in case of ground water there is 25% increase in TDS from source water to treated water. The same is true with Electrical conductivity also. Total hardness increased by 2.5% in case of surface water whereas it is 13% in case of ground water. This may be due to over dosage of bleaching powder in overhead tanks of the ground water. Alkalinity increased by 21% from canal to summer storage tank and 10% from summer storage tank to treated water. This may be due to addition of coagulants and disinfectants of alkaline nature. In case of ground water the alkalinity increased by 36% from source water to treated water. Turbidity

of canal water is 3.2% higher than summer storage tank which is higher by 67% in comparison to treated water. In case of ground water the source water is 44% more turbid than treated water. Ammonia and nitrite values are low both in case of surface and ground water; however nitrate values of ground water are more in comparison to surface water. Nitrate values of canal water are more by 10% in comparison to summer storage tank and it is further decreased in treated water by 27% in comparison to summer storage tank. Sodium values of ground water are more than surface water. Sodium values of summer storage tanks are increased by 17% in comparison to canal water and decreased by 2% in treated water. In case of ground water there is an increase of sodium content in treated water by 5% in comparison to raw water. Potassium is present in surface and ground water in small quantities. However ground water contains more potassium than surface water. Chlorides are increased from canal water to summer storage tanks by 30% and decreased by 10% in treated water in comparison to summer storage tank. DO of ground water is slightly higher than canal water and BOD and COD values of surface water are more than ground water which indicates that the level of pollution of surface water is higher than ground water.

- Average values of pH of summer storage tanks has highest and R.O water has lowest. The order is

SST (SW)> Canal Water =PTW (SW)>GW>NGO (Without R.O)>PTW (GW) > NGO (R.O).

- TDS and EC values of Ground water (PTW) have highest and R.O water has lowest. The order is

GW (PTW) >GW > SST (SW)> PTW (SW)> NGO (without R.O) >Canal water > R.O water

- TH values of PTW ground water has highest and R.O water has lowest. The order is

PTW (GW)> GW> SST (SW)>PTW (SW)> canal water> NGO (without R.O)> NGO (R.O)

- Alkalinity values of PTW (GW) have highest values and R.O water has the lowest value. The order is

PTW (GW)> GW>PTW (SW)>SST (SW)> Canal water >NGO (without R.O)> R.O water.

- Turbidity of canal water has highest and R.O water has lowest. The order is

Canal water> SST (SW)> GW> PTW (SW)> PTW (GW)> NGO (without R.O)> R.O. water.

- Ammonia and nitrites of canal water and SST are higher and others are in very small amounts.
- Nitrates of PTW (GW) has highest and R.O water has least value. The order is

PTW (GW)>GW> Canal water >SST (SW)>PTW (SW)> NGO (without R.O)> R.O water.

- Sodium value of PTW (GW) has highest value and R.O. water has least value. The order is

PTW (GW)> GW> SST (SW) >PTW (SW)>NGO (without R.O)> Canal water > R.O. water

- Potassium values of treated ground water are high and R.O. water is low. The order is

PTW (GW)>GW>SST (SW)> NGO (without R.O.) > PTW (SW)> Canal water> R.O. water

- Chlorides of PTW (GW) has highest and R.O. water has lowest and the order is

PTW (GW)> GW>SST (SW)> PTW (SW)>NGO (without R.O.)> Canal water> R.O water

DO values of ground water are lower than surface water. Similarly BOD and COD values of Ground water are slightly higher than surface water. This shows in Western Delta of West Godavari District the aquifers are shallow and in most of the areas ground water is also polluted due to pollution of surface water.

Table.2. Suitability of drinking water from public treated plants in terms of biological Parameters in all 3 seasons

Parameter	Winter	Summer	Rainy
MPN/100ml	23%	22.6%	27%
TFC/100ml	41%	39%	40%
E.Coli CFU/1ml	61%	46%	70%

Biological parameters are more important for the assessment of drinking water quality. In both winter and summer, the drinking water supplied by public water treatment plants are not good in terms of MPN and only 23% potability is observed. In rainy season a slight improvement in the quality and it is just 27% of the total samples analyzed. In terms of TFC also it is around 40%.In terms of E.Coli the quality is minimum in summer, somewhat better in winter and further improved in rainy season.

Table.3. Suitability of drinking water from NGO/NTR supplied in terms of biological factors in all three seasons

Parameter	Winter	Summer	Rainy
MPN/100ml	30%	45%	27%
TFC/100ml	46%	69%	45%
E.Coli CFU/1ml	67%	85%	62%

The quality of drinking water supplied by NGO/ NTR organizations is also not very different from public treated water. It is minimum in rainy season with 27% followed by winter 30% and summer 45%.In terms of TFC also it is 45% and 46% in rainy and winter seasons and 69% in summer season. In terms of *E.Coli* it is 62% in rainy season followed by 67% in winter and 85% in summer season. Surprisingly public treated drinking water.

4. CONCLUSIONS AND RECOMMENDATIONS

Although piped-water is considered to be a safe and clean water source by the national government, WHO and BIS 10500 drinking water guidelines are exceeded at water supply stations in the selected study sites of the West Godavari Western Delta for pH, turbidity, Cl^-, MPN, *E. coli*, and total coli forms. In some points higher TDS, EC, TH, TA and Cl values are due to sea water intrusion. Furthermore, the quality of piped-water varies depending on location and intake source. Some piped-water supply stations that use groundwater resources were found to exceed drinking water guidelines for TDS, EC,TH, TA, NO_3 and Cl, although this was not observed for supply stations using surface water. Salts are more in summer months in ground water and crossed the national and international standards. Everyone can take action as countries and continents to pass laws that will make pollution harder and the world less polluted. Working together, we can make pollution less of a problem—and the world a better place.

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