GROUND WATER QUALITY IN HYDERABAD CITY ANDHRA PRADESH INDIA

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ABSTRACT

Quantity and quality are two vectors of ground water management. While former refer to as resource and the latter refer to its usefulness. The analytical data of 314 ground water samples of Hyderabad city indicate that, in general, most of the chemical constituents are within permissible limits in majority of samples. The electrical conductivity (EC) of ground water in areas around chemical industries are beyond consumer's acceptance. The nitrate content in ground water far exceeded the permissible limits in about 60% of the total area. The presence of high nitrates is mostly attributed to domestic pollution like sewage and solid waste. About 85% of the samples fall under very hard category.74% of the samples have chloride within desirable limits. Except in small isolated patches, the flouride content in ground water is within permissible limits. The SAR and RSC values indicate that the ground water is mostly fit for irrigation.

1.0 INTRODUCTION

Hyderabad is the fifth largest city in India surpassed in population only by Calcutta, Mumbai, Delhi and Chennai. It is the capital of Andhra Pradesh state with an area of around 1000 Sq.kms comprising Hyderabad (urban) district and the surrounding 9 municipalities of Ranga Reddy district. It lies on south and north banks of Musi river, a tributary of krishna river. The major land forms in the area are residual hills, peidmont inselberg complex, shallow to moderately weathered pediplains and vally hills. The surface elevation of the area is between 460 and 600 m amsl. The population of the city has increased by around 10 fold from 4.48 lakhs in 1901 to 42.73 lakhs inhabitants in 1991. The projected population of the city may reach 60 lakhs, 80 lakhs and 100 lakhs by 2001, 2011 and 2021 respectively.

The normal rainfall of the area is 780 mm and 76% of the total is contributed by SW monsoon. According to Koppen and C.W. Thornthwaite classifications, the climate falls into AW and CAW respectively. The area is underlain by oldest Archaean Group and by recent alluvium along stream courses. Ground water occurs under phreatic conditions in weathered residuum and under semi-confined to confined conditions in fractured, jointed and sheared zones. The thickness of weathered zone varies from place to place. Ground water development in the city is mostly by bore wells. Both surface and ground water resources are fully utilised to meet the water requirements of the city.

2.0 PROCESSES AFFECTING THE GROUND WATER COMPOSITION

Ground water derives its composition from a variety of processes, including dissolution, hydrolysis and precipitation, adsorption and ion exchange reactions, oxidation and reduction, gas exchange between ground water and atmosphere and biological processes. The most important among them is the mineral-water reaction. Thus, the composition of ground water mostly depends on the mineral composition of various rock types through which the ground water pass through. However artificial pollution sources like sewege, organic and other waste dumps, chemical dumps too cause considerable ground water pollution particularly in urban areas.

Hyderabad city is underlain by granitic rocks. Ground water in granitic areas is mostly Calcium and Sodium rich derived from the dissolution of plagioclase feldspar, which is a major constituent mineral found in the rock type.

3.0 RESULTS AND DISCUSSIONS

To study the quality of ground water in Hyderabad city, 314 samples were collected from shallow bore wells during October & November, 98 in L.B.Nagar Municipality and during February & March, 99 in rest of the area. The particulars of important constituent ranges, average ranges and ISI standards are shown in Table 1.

Table 1: Ranges of Different Chemical Constituents in Hyderabad City

Sl.No	Constituents	Range		General Range	ISI Standards	
		Min.	Max.		Desirable	Permissible
1.	pH	6.5	8.57	6.99 - 7.7	6.5 - 8.5	no relax.
2.	EC	200	7500	700 - 3000	750	3000
3.	TH	70	2780	150 - 1000	300	600
4.	Ca	14	720	50 - 300	75	200
5.	Mg	3.6	272	10 - 120	30	100
6.	Cl	3.5	1766	50 - 600	250	1000
7.	SO_4	4.8	1392	25 - 450	200	400
8.	NO_3	1.2	760	10 - 300	45	100
9.	F	0.17	3.3	0.5 - 1.7	1.0	1.5

Except pH & EC all are in mg/l.

ph

The pH of ground waters occurring in the area range from 6.50 to 8.57 while the general range is 6.90 to 7.7. The highest desirable limit of pH as per ISI standards for drinking purpose is 6.5 to 8.5. Except one sample located in HiTech City (Cyber Towers) all the samples are within the permissible range. The ground waters are mostly alkaline in nature.

Electrical Conductivity (EC)

The EC values of ground water in Hyderabad city ranges from 200 to 7500 micro Siemens/cm at 25^0C. The highest value of 7500 was recorded in a borewell located at Bhagyanagar function hall, Sirinagar, which is near to a chemical industry on Hyderabad - Vijayawada Road. The lowest value of 200 was recorded in a borewell located near to overhead tank in Saheb Nagar in L.B. Nagar municipality area. In general, the EC values ranges from 700 to 3000 micro Siemens/cm at 25^0C.

In all only 2% of the samples have EC beyond the permissible limit, whereas 6% of the samples have within desirable limit. While 92% of the samples have EC in the range of 750 to 3000 micro Siemens/cm at 25^0C i.e., desirable to permissible range.

The desirable limits of EC of 750 micro Siemens/cm at 25^0C (with respect to TDS) are present only in small isolated pockets around Nampally, Musheerabad, Cheralapalli, Kapra, Sainikpuri, HiTech City, Saidabad, Yakutpura, Pahadi Sharaf etc. The areas with the EC values beyond permissible limit (> 3000) are located mostly around industrial localities like Bolaram, Suraram, Jeedimetla, Yousufguda, Sanath nagar, Kukatpalli along north, south of Musi river, Saroornagar, Hayatnagar areas. In the majority of the area, the EC values are within permissible limits. The areal distribution of EC is shown in Fig 1.

Total Hardness (TH)

In Hyderabad city 15 % of the samples are within desirable limit and 29% of the samples have beyond permissible limit and 50% of the samples have within desirable to permissible limit. In all 85% of the samples are of very hard category and negligible in soft category. The highest value of 278 mg/l is recorded in Jeedimetla area and the lowest value of 70 mg/l is recorded in a borewell at Sahebnagar near overhead tank.

Calcium

The minimum and maximum values of calcium in the Hyderabad city are 14 and 720 mg/l while the general range is 50 to 300 mg/l. The lowest value is recorded at Sahebnagar at HUDA office. Where as the highest value is recorded at Jeedimetla area. Only in 14% of the samples it is less than 75 mg/l, in 71% of samples it is between 75 and 200 mg/l and in 15% of the samples it is beyond the maximum permissible limit of 200 mg/l.

Magnesium

As per ISI standards, the desirable limit for drinking water is 30 mg/l and maximum permissible limit is 100 mg/l. In the study area, Magnesium concentration ranges from 3.6 to 272 mg/l and in general, it ranges from 10 to 120 mg/l. Only 5% of the samples show concentrations of more than permissible limits of Magnesium i.e., 100 mg/l. 42% of samples have the desirable limit and 53% of the samples have the concentrations from desirable to permissible limits. More than permissible limits of Magnesium occur in Industrial areas at Jeedimetla, Sanathnagar, residential areas of Indiranagar and Chaitanyapuri.

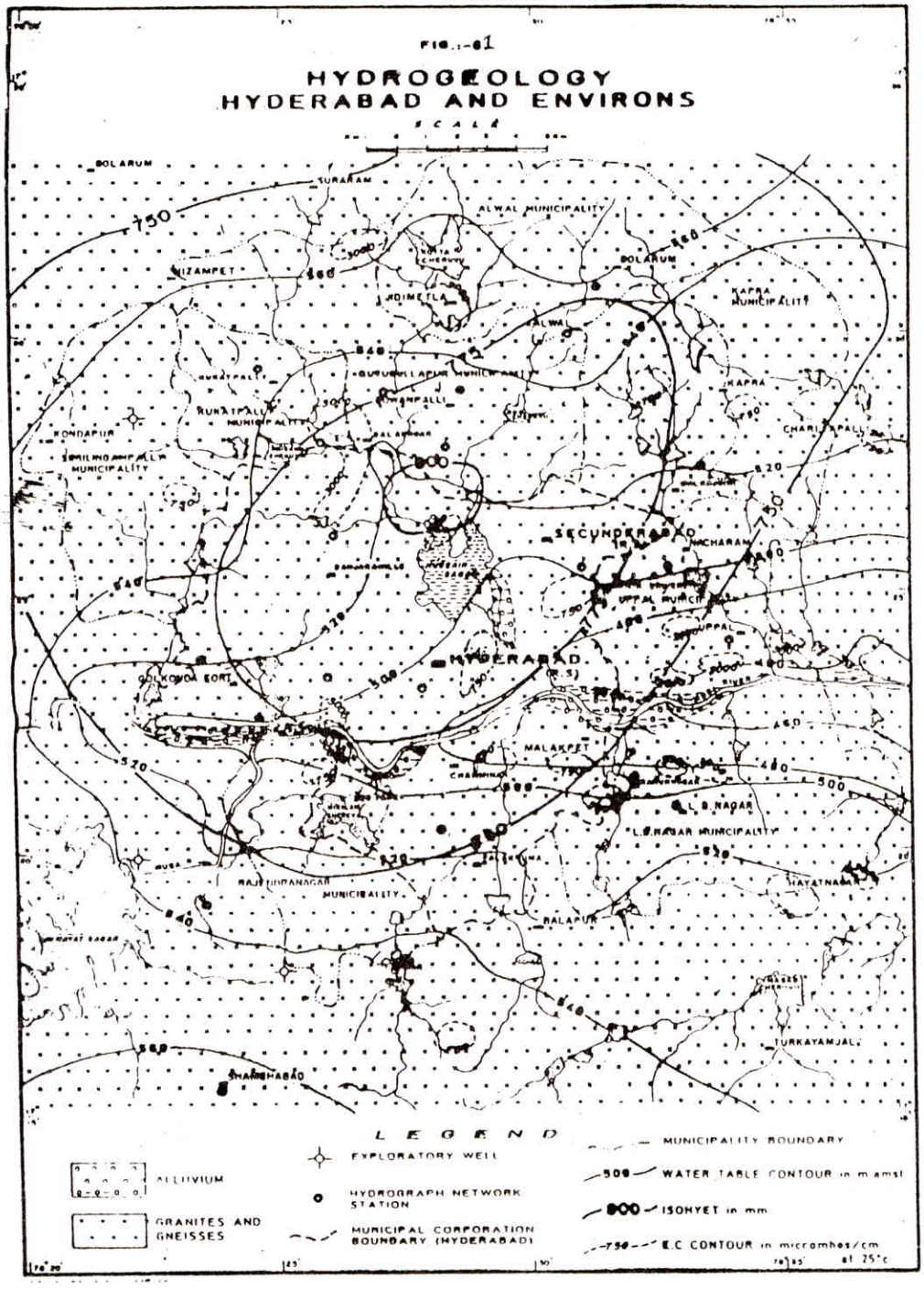

Fig. 1: Areal Distribution of EC in Hyderabad City

Sodium

The Hyderabad city has sodium concentrations ranging from 7.4 to 900 mg/l. However, in general, it ranges from 30 to 350 mg/l. The highest value was recorded at Siri Nagar in L.B. Nagar area and the lowest value recorded at Nanadanavanam colony in Kharmanghat Area.

Potassium

The concentrations of potassium in Hyderabad city ranges from traces to 183 mg/l and generally it ranges from 1 to 5 mg/l. The highest value of 183 mg/l was noticed at Bollaram Bazar in Cantonment area. The lowest value was noticed in Lab quarters. Khanchan Bagh area.

Carbonate and Bicarbonate

Generally, if the pH is between 4.5 to 8.2, the CO_2 is in the form of Bicarbonate. The carbonate content in ground water ranges from nil to 66 mg/l. Out of the total 314 samples only 4 samples have carbonate concentrations. The bicarbonate in ground waters ranges from 55 to 787 mg/l. The general range is from 150 to 600 mg/l. The highest value of bicarbonate occurs near Golnaka Bridge where as the lowest is at Saraswathi nagar in Gaddiannaram area.

Chloride

As per ISI standards the desirable limit for drinking water is 250 mg/l and the maximum permissible limit in the absence of alternate source is 1000 mg/l. Chloride values in Hyderabad city range from 3.5 to 1766 mg/l and the general range is 50 to 600 mg/l. The heighest value was recorded at Ramanthapuram area and the lowest value was recorded at Sahebnagar in L.B. Nagar Municipality area. In all only 3% of the samples are beyond permissible limits (>1000 mg/l) and 23% of samples have chloride ranging from 250 to 1000 mg/l. In majority of the samples (74%) chlorides are less than 250 mg/l. The areas where more than 1000 mg/l of chloride noticed was around Industrial localities of Jeedimetla, Sanathnagar, Bollaram and residential areas at Sirinagar and Amangal areas.

Nitrate

Natural ground water contains less than 5 mg/l of Nitrates. But the polluted waters contain high concentrations of nitrate. As per ISI norms, the nitrate concentration up to 45 mg/l is desirable limit for drinking. Beyond this limit, Mehtanoglobinemia takes place particularly in infants. The maximum permissible limit is 100 mg/l. The concentration of nitrate in Hyderabad city ranges from 1.2 to 760 mg/l. The general range is 10 to 300 mg/l. The highest value was recorded in a bore well at Sirinagar in L.B.Nagar Municipality area and the lowest value was recorded at Safilguda cross roads. The highest value may be due to pollution of ground water by SIRIS industry, which is located near the collection point. In the study area, 45% of samples contain more than 100 mg/l, 27% samples have nitrate concentrations between 45 and 100 mg/l and 28% of the samples have recorded less than 45 mg/l. The areal distribution of nitrate content in ground water in the area is shown in Fig - 2.

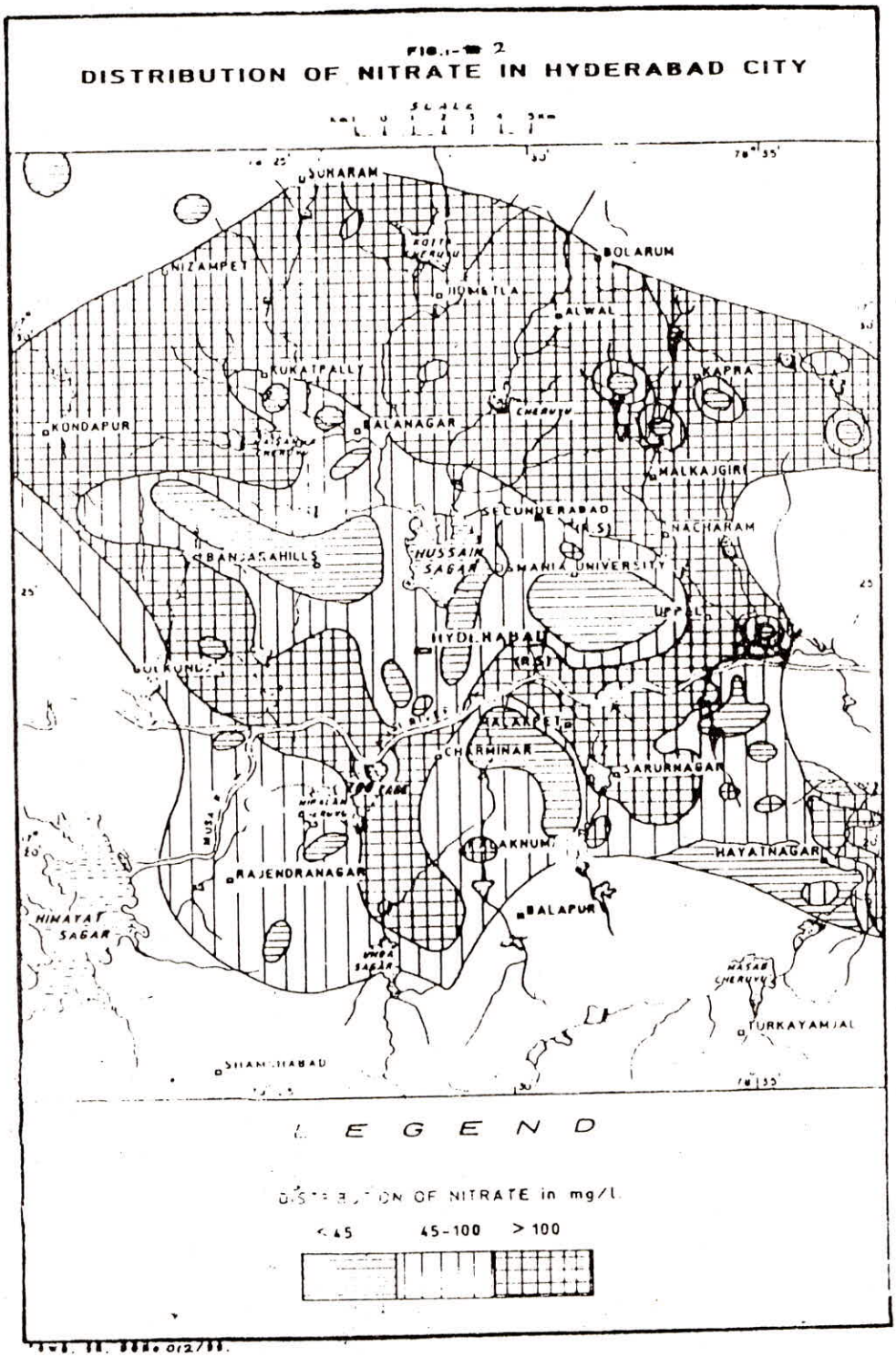

Fig. 2: Distribution of Nitrate in Hyderabad City

A perusal of Fig - 2 reveals that higher concentrations of nitrate (> 100 mg/1) occurs in industrial areas such as Bollaram, Alwal, Kattedan and residential areas such as Hyderguda, Athapur, Hayathnagar and Soroor nagar areas. Concentrations of nitrate from desirable to permissible limits (45 to 100 mg/1) occurs in isolated patches at Sanjeeva Reddy nagar, Erragadda, Yousufguda, Sanathnagar etc. Concentrations within desirable limits (<45 mg/1) occur in small isolated areas at Warasiguda, Musheerabad, Vidya nagar, Jubleehills, Banjara Hills and Ameerpet areas. Nearly 60% of the total area consists of nitrate concentrations beyond permissible limits and 25% of the area is under desirable to permissible limits. It is observed that the higher concentration of nitrate are observed mostly in the areas where sewerage system is not laid and organic materials were dumped openly, which indicates the polluting effect of sewrage waters and organic and other waste material dumps.

Sulphate

Ground water of Hyderabad city has sulphate concentrations ranging from 4.8 to 1392 mg/1. The general range is 25 to 450 mg/1. In all 90% of the samples show sulphate concentrations within desirable limits, that is less then 200 mg/1 whereas, 8% of the sample have concentrations ranging from 200 to 400 mg/1, (Permissible limit) and only 2% of samples show more than 400 mg/1 in isolated areas around Uppal, Sanathnagar, Saroornagar and also along Musi river.

Fluoride

The fluoride concentration in ground water of Hyderabad city ranges from 0.17 to 3.30 mg/1. The general range is 0.5 to 1.7 mg/1. The highest concentration was noticed in a borewell at Golnaka Bridge cross roads and the lowest value was recorded in a borewell in Musabagh in Amberpet area. In all 63% of samples have upto 1 mg/1. Whereas, 20% of samples have concentrations between 1.0 and 1.5 mg/1 and only 7% of sample have shows more than 1.5 mg/1. More than 1.5 mg/1 was noticed around Suraram, Kachiguda, Mettuguda, National Police Academy, Raghavendra nagar, Nacharam, Kharkhana, Tirumalgherry, HiTech city, Ameerpet and Balanagar areas. The areal distribution of Fluride is shown in Fig - 3.

4.0 GROUND WATER SUITABILITY FOR IRRIGATION PURPOSE

For evaluating the suitability of ground water for irrigation purpose, sodium, (sodium hazard), Bicarbonate (Bicarbonate hazard) and electrical conductivity play a major role.

Sodium hazard

Sodium concentration is very important in classifying irrigation water. Based on percent Sodium (% Na), out of 314 samples, 73 samples fall under excellent category (>20% Na), 140 samples belongs to good category (20 to 40% Na), 89 samples fall under permissible category, (40 to 60% Na), 9 samples fall under doubtful category and 3 samples fall under unsuitable category. According to Sodium Absorption Ratio SAR) out of 314 samples, 308 samples fall under excellent category. Three samples fall under good category and 3 samples fall under fair category.

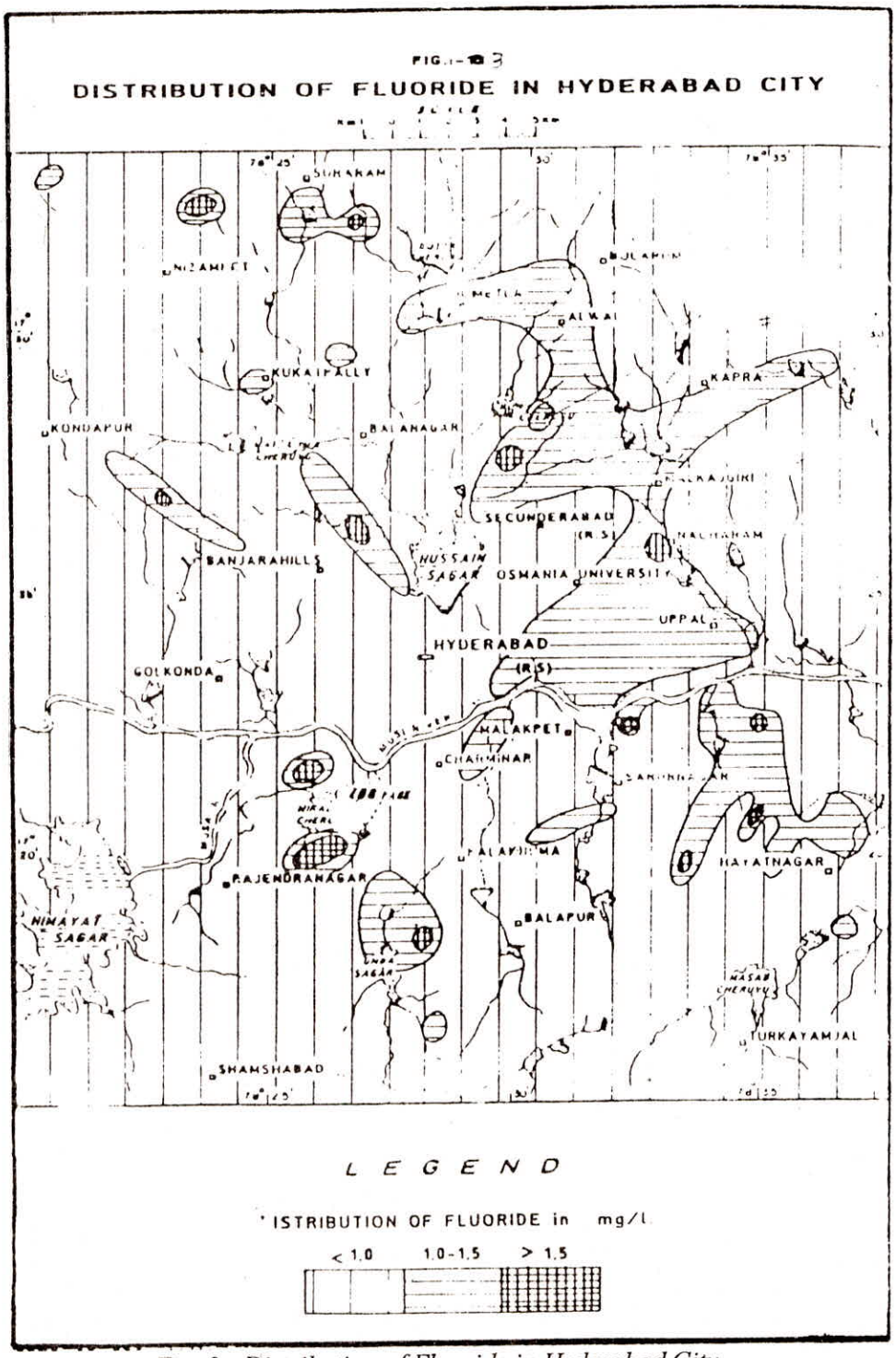

Fig. 3: Distribution of Fluoride in Hyderabad City

Bicarbonate Hazard

It is expressed in terms of Residual Sodium Carbonate (RSC). In Hyderabad city out of 314 samples, 296 samples are safe for irrigation, 8 samples fall under marginal category and 10 samples are not fit for irrigation category.

Electrical Conductivity

Based on the EC, the waters are classified as excellent, good, permissible, doubtful and unsuitable with the EC values <250, 250 to 750, 750 to 2000, 2000 - 3000 and > 3000 micro Siemens/cm at 25^0C respectively. In Hyderabad city out of 314 samples only one sample fall in excellent category, 20 samples fall in good category, 220 samples in permissible category, 48 samples fall in doubtful category and 25 samples are in unsuitable category. Unsuitable samples are mostly located around industrial localities.

5.0 CONCLUSIONS

It is concluded from the above discussion that in general most of the chemical constituents in ground water are within permissible limits in the majority of areas. However the nitrate concentration in over 60% of the area is more than permissible limits. It is attributed to domestic pollution like sewage and solid waste. Only isolated small patches have Flouride concentrations beyond permissible limits. The EC of ground waters in and around chemical factories is beyond consumer's acceptance. Most of the ground water is fit for irrigation.

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