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Groundwater characteristics of high Fluoride terrain and it's implication on human health: A case study of Bankapatti area of Nagaur district, Rajasthan, India.

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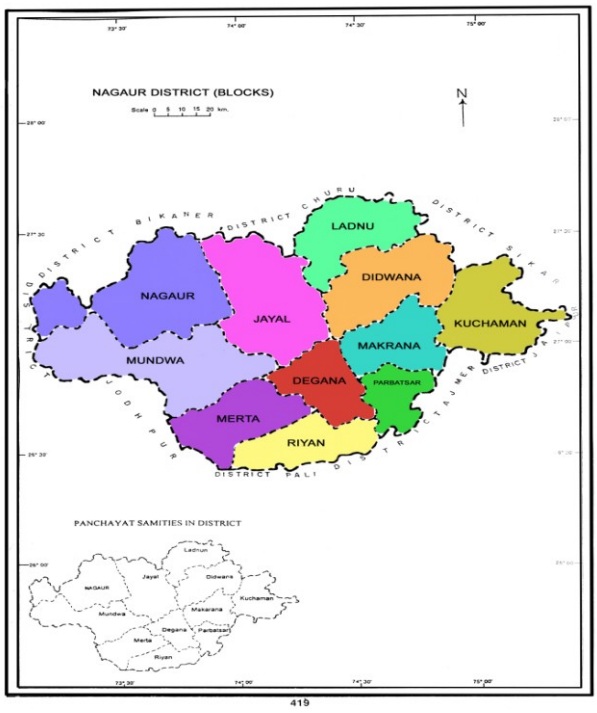
Abstract: *We have enough reserves of groundwater in Rajasthan but good quality potable water is limited. If we talk about its contamination and pollution by human activities, a major part of groundwater in its natural form has dissolved chemicals more than the limit prescribed by the National and International health agencies. Important chemicals that are hazardous to health, if intake in human body exceeds the prescribed permissible limit, include total dissolved solids (TDS), nitrate, sulphate, chloride and fluoride. Fluoride if present in a very small quantity in groundwater is essential for protection of enamel on teeth and normal growth of bones, a slight increase in its intake may causes serious danger to human health.The present study was carried in high Fluoride groundwater terrain of bankapatti area of nagaur district of Rajasthan in India with special emphasis on in take of high fluoride concentration groundwater by local people which is seen as indicator of different types of fluorosis.*

The enrichment of concentration of high fluoride in this limited areal extent of Banka Patti area of Nagaur district indicates that high residence time due to basin boundary configuration is plausibly main reason apart from litological control. During field survey, it is also established that consumption of high fluoride groundwater by local people of Bankapatti area of Nagaur distsrict are vulnerable to various kinds of fluorosis.
Key words: *Water, chemical & fluorosis etc.*

I. Location and Physiography



The Nagaur district occupying, geographically the heart of Rajasthan state (Map 01) covers an area of about 10,085 sq. kms. The district lies in between 26°25' N Latitude and 73° 10' to 75° 15' E longitude and comprising of arid and semi-arid regions. The Nagaur district divided in 8 blocks namely- Nagour, Didwana, Jayal, Makrana, Degana, Parbatsar, Ladnu and Merta where as Bankapatti area les mainly in Degana and Makrana blocks.

Geology and Hydrogeology of Nagaur District

Geologically, the area hosts a variety of rock formations ranging from the Archaean basement to the recent alluvium and sands of the great Thar desert. Although a major part of the area is covered with wind-blown sand and Quarternary deposits, good exposures of the Paleoproterozoic-Aravalli Supergroup, Mesoproterozoic Delhi Supergroup, Erinpura granitic gneisses, Malani Igneous Suite, Marwar Supergroup, sediments of Mesozoic and

Cenozoic periods also occur in the study area.Thegeological setup of the area is shown in table given below.

Geological Succession of Nagaur District (source GSI report)

Recent alluvium and sands of the Thar	
Quaternary Formations	
Tertiary formations	
Marwar Supergroup	Nagaur Group
	Bilara/Hanseran Group
	Jodhpur Group
Malani Igneous Suite of Rocks	
Erinpura Granitic Gneisses	
Mesoproterozoic Delhi Supergroup	
Palaeoproterozoic Aravalli Supergroup	
Archaean Basement : Banded Gneissic Complex	

Hydrogeologically, the district comprises of confined, semi-confined and unconfined aquifers. The classification of the hydrogeological units was based on groundwater conditions in different litho-units. The crystalline aquifers include Precambrian schists and gneisses, metasediments of Aravalli and Delhi Supergroups and rock of the Malani igneous Suits. On the other hand the consolidsated sediments comprise of rocks of the Marwar Supergroup i.e. sandstones of Jodhpur Group and Nagauar Group and limestones and dolomites of Bilara/ Hanseran Group. The unconsolidsated formations consist of Quaternary sand, clay, gravel and kankar which have been grouped under single name alluvium. The Bilara limestone and dolomite, Jodhpur sandstone, Nagaur sandstone and older alluvium are the principal source of groundwater in the district.

The Precambrian metamorphics occur in south eastern part of the district including Parbatsar and Makrana block and in central and northern parts including Didwana and Ladnu blocks. In these rocks groundwater occurs under phreatic conditions with depth of water varying between 3 meters to 49.9 meters. The yield of groundwater is comparatively poor.

Sandstone of the Jodhpur Group (Lower part of the Marwar Supergroup) occurs in Landnun block. Depth to water level in this unit varies from 7.55 meters to 74.7 meters with low to moderate yield.

Limestones, dolomites and shales of the Bilara/ Hanseran Group (Marwar Supergroup) occur in part of Ladnu blocks. This unit is an important potential aquifer. The wells show a yield from 18 to 540 m^3/day averaging 132 m^3/day. Depth to water level ranges from 4.9 meters to 80.94 meters, average being 39.54 meters.

Sandstones, siltstone, shales and evaporates of the Nagaur Group (Upper part of the Marwar Supergroup) occur in isolated patches within Didwana, and Degana blocks. The sandstones are hard, compact and coarse to fine grained in nature. Of course at places they become soft, friable and ferruginous with numerous fractures and joints. In this unit, yield ranges between 10 to 344 m^3/day, average being 80 m^3/day and depth to water table ranges from 3.2 to 80.00 meters, average is 38.45 meters.

Tertiary sandstone, particularly that of the Palana Formation extends in Degana block, this sandstone constitutes a good aquifer with the yield ranging from 18 to 648 m^3/day, averaging 128 m^3/day. In this formation depth to water table rages from 6 to 58 meters and average is 35 meters. Unconsolidsated to semi-consolidsated sands, silt, clay and kankar with lenses of gravel, together named as alluvium cover major part of the district including Kuchaman, Didwana, Degana, Pargatsar and Ladnu blocks. In Kuchaman, Didwama. Parbatsar and Degana blocks, older alluvium is the potential source of groundwater having yield of 12 to 720 m^3/day. Depth to water table ranges from 2.3 to 71.8 meter averaging 25.7 meter.

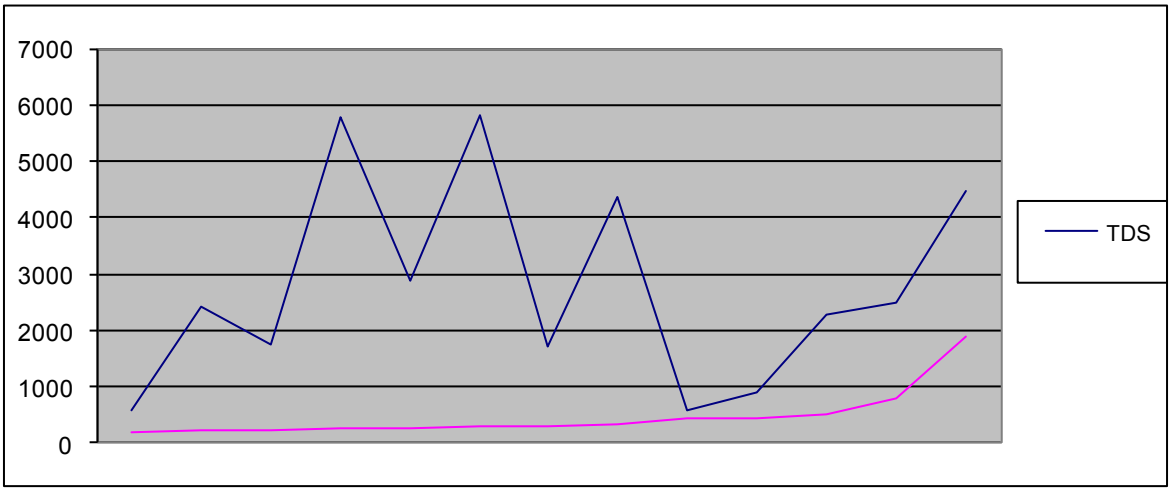
Chemical characteristics of groundwater

To undertake a systematic study of chemical parameters of groundwater, samples from key wells of Banka Patti area were collected and analyzed in the laboratory by using conventional methods for their chemical parameters as shown in table given below.

Lab No.	Well Location	E.C.	TDS	pH	Na^{+}	K^{+}	Ca^{+2}	Mg^{+2}	Cl^{-2}	SO_4^{-2}	CO_3^{-2}	HCO_3^{-}	NO_3^{-}	F
		µ/cm	*mg/L*	*Upper figures indicate meq/L & lower figures indicate mg/L*		*mg/L*								
	BLOCK - DEGANA													
1	ANTROLI-KALLAN	1900	1147	9	320	2	60	30	252	101	36	378	156	1.4
2	BAMNA-JANGIR	4900	2932	8	960	4	40	62	482	610	0	1318	115	2.8
3	BUTATI	2400	1381	8	440	11	58	24	269	72	12	842	73	6.48
4	CHANDRAN	8400	5275	8	1681	10	40	139	1603	874	0	976	440	1.68
5	GUNDISAR	13200	8420	8					3481	196			800	2.68
6	ITAWARA	2000	1158	8	320	6	32	49	128	101	0	598	224	2.08
7	JAWA	2200	1502						1369	100			130	7.8
8	KURI-KALLAN	2500	1637	8	275	8	4	167	177	331	0	366	492	0.563
9	KITALSAR	2900	1704	8	580	2	60	12	433	197	0	793	24	9.12
10	MOGAS	2700	1641	8	560	5	20	23	461	1216	0	464	124	9.04
11	NIMBOLA-KHURD	7100	4273	8	1161	5	84	221	1461	826	0	781	124	7.16
12	NIMBRI-KALLAN	2400	1372	8	440	3	32	29	99	269	24	805	72	2.08
13	PANCHRANDA	2400	1439	8	460	4	32	29	312	192	0	610	104	1.92
14	PUNDLOTA	3900	2468	8	820	3	18	49	652	447	0	732	112	11.04
15	PUNIYAS	2400	1443	8	460	3	34	33	142	192	0	866	146	-
16	ACHOJAI	7500	4780	8	1481	5	40	151	1560	106	0	1086	895	4.8
17	NIMBADI-CHANDAWAT	4100	2539	8	840	6	30	49	879	259	0	513	219	3.4
18	JALSU-NANAK	16400	11263	8					645	168			240	3.64
19	KIRODA	11800	7967	8					2127	100			798	2.48
20	HABCHAR	12200	8145	8					2269	399			475	3.92
21	CHOSALI	2100	1244	8	340	6	48	38	362	211	12	256	99	1.84
22	CHOLIYAS	19100	12900	8					2340	0			134	4.16
23	KWAL (PZ)	10200	7400	8					2766	174			66	5.4
	BLOCK - MAKRANA													
24	BARWALI	1900	1203	8	320	3	76	27	454	10	24	220	180	0.6
24	BESROLI	1900	1188	8	355	34	64	18	142	82	0	854	66	9.68
25	BHINYA-KALLAN	13100	874	8	-	0	60	0	71	0	0		395	2.6
26	BILLO	1300	817	8	135	4	60	69	142	154	0	366	70	0.32
27	BORAWAR	3800	2736	8	740	3	92	51	553	53	0	488	999	2.16
28	DJAMDMAWAS	3700	2365	8	740	2	12	86	610	178	0	805	334	4
29	GACJO[IRA	3900	9161	7	800	2	48	50	7552	72	0	757	258	5.28
30	GEDIA	5000	3132	8	840	2	120	83	950	413	0	268	590	8.64
31	JAKHALI	4580	2686	8	560	6	40	80	617	221	0	1330	196	2.8
32	JASWANTPUR	790	5217	8	1601	7	92	85	1291	485	0	952	1180	5.92
33	KHERISILA	2000	1194	8	410	6	20	17	383	10	12	464	104	7.76
34	LADPURA	5900	3812	8	1121	4	124	63	1135	269	24	525	810	4
35	MAKRANA	3500	2057	8	580	5	96	63	794	96	0	476	184	5.28
36	NOSARIYA	18100	12166	8	0	0	0	0	4609	0	0	0	160	7.76
37	ANI-GAON	2300	1331	8	460	6	24	16	298	5	0	708	168	8.4
38	KALWA	3900	2412	8	780	8	50	28	362	197	0	940	518	4
39	KALYANPUR	4800	2815	8	960	7	46	55	837	226	0	1159	105	4
40	MANANA	4600	2715	8	840	5	80	66	922	226	0	793	180	7.2
41	SURATRPURA	16500	11205	8	90	3	104	27	4184	432	0	1464	165	2.8
42	SIVRASHI	4600	2845	8	920	7	54	45	496	403	0	1147	345	12
43	MATA TEMPLE	2300	1331	8	460	6	24	16	298	5	0	708	168	8.4

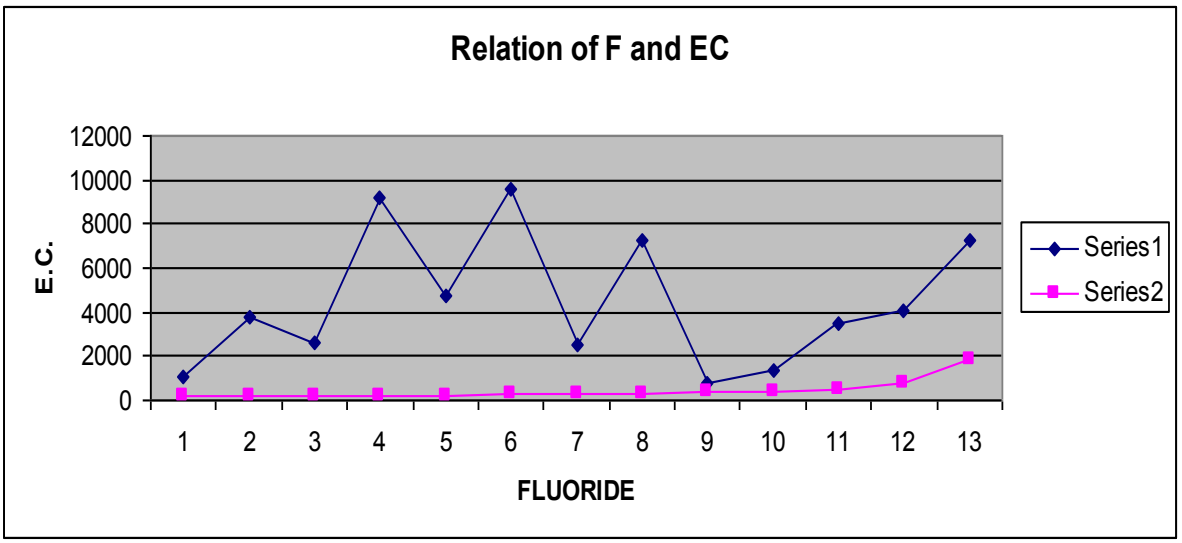
(1) ***Fluoride*** – Being essential in small amount for the protection of enamel on teeth and normal development of bones, fluoride should restrict between 0.82 to 1.5mg/liter in drinking water. Out of 43 key wells in the area, 20 in Degana block, 19 in Makrana block have fluoride content more than the prescribed permissible limit.

The analytical data of various parameters of groundwater are shown in figures 1 to 3 and further data are also plotted to establish correlation between fluoride concentration and other parameters as shown in charts 1 and 2 but it is revealed that there is neither positive nor negative correlation exists between fluoride and other parameters.



Relation of fluoride with TDS. (Fluoride values are expressed in multiple of 100

Chart No 01



(Fluoride concentration is expressed in scale of 1 unit = 100 units)

Chart No 02

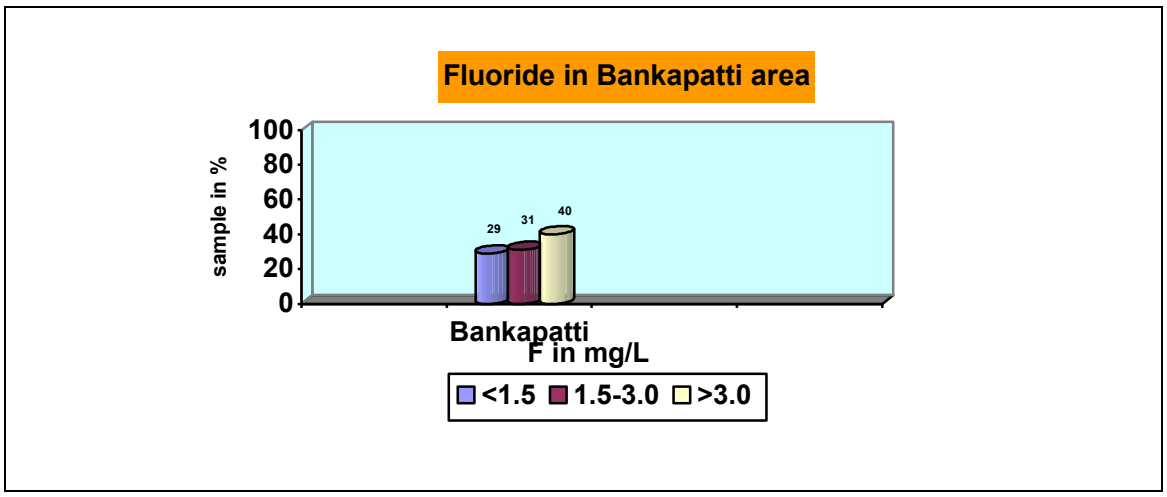


Fig---01

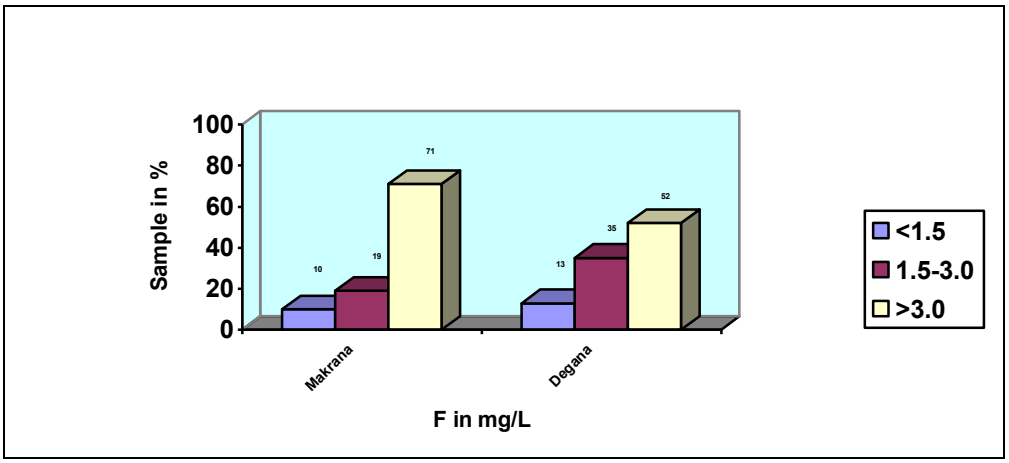


Fig-----02

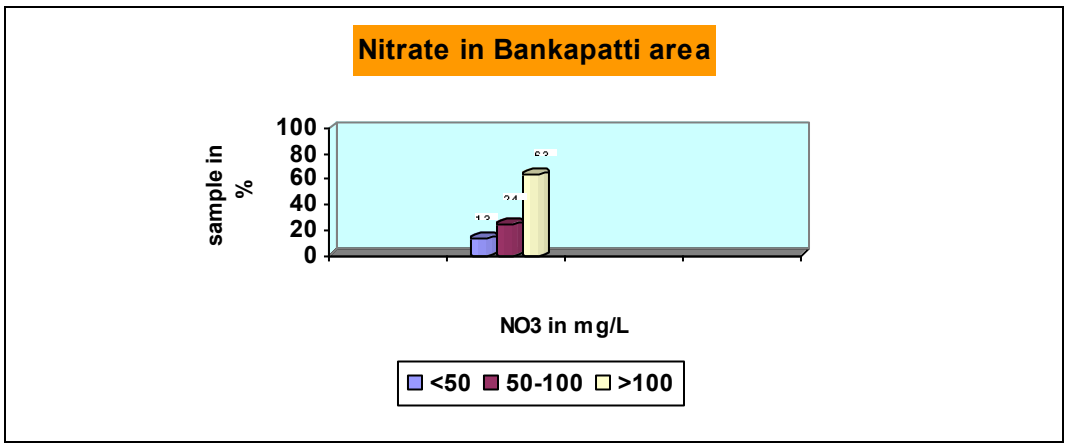


Fig---03

A old person from village gachhipura, knew fused due to effect of fluorosis

PHOTO-07

Mr. Jugal Kishore can not move his lags from knew beyond the limit.

PHOTO-08

PHOTO-01
Seviour dental fluorosis
Bansilal age 50 year village-Nimbari

PHOTO-02
Mohan from gedia having yellow teeth due to dental fluorosis

A old lady suffering from skeletal fluorosis her hands and beck show the effect

PHOTO-11

A old lady suffering from skeletal fluorosis her hands and beck show the effect

PHOTO-12

Plate 1

Fluorosis

Some villages in this area have been observed to have their entire population suffering from dental fluorosis The number of patients suffering from skeletal fluorosis is very large in some villages of this area where about 40 % of its total population has been suffering from skeletal flurosis. Some severely affected persons having fluorosis dieses are also shown above on plate 1.

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Remedial measures

As remedial measures, alternative source of drinking water with less fluoride content may be searched. This may include further lowering down of tube well and dug wells if the lower horizons (strata) contain water with less amount of fluoride, harvesting of rain water through conventional and modernized techniques to fulfill the drinking water demand or defluoridation techniques should be adopted. The two popular techniques (1) Nalgonda Technology and (2) Activated Alumina Technology have been suggested long back for defluoridation of drinking water. In the condition of high alkalinity Nalgonda Technology would be more appropriate, whereas in the case of high amount of total dissolved solids and hardness, Activated Alumina Technology should be preferred.

Overall general awareness towards fluoride problem and its hazardous effects on human health is the need of the time.

Under the Rajiv Gandhi Technology Mission on "Safe Drinking Water" a few defluoridation plants have been installed at a few villages in the district. But unfortunately, despite a very high cost of these plants, they are not in operation due to absence of day-to-day maintenance. In view of the presence of high fluoride in groundwater in a very large area, it would be quite economic to supply purified water for drinking and cooking purposes separately from available canal water in the State. This will increase the cost of supplying safe water but on the other hand we will save the expenditure that incurs in filtering the total quantity of water supplied, which is also used for other purposes like cleaning, washing, gardening etc. in addition to drinking and cooking purposes.

References

[1] Heron, A.M., 1953. The Geology of Central Rajputana. Mem. Geol Surv. India, 79(1) : 389.
[2] Kathleen Thiessen (2006) Fluoride and Human health, 132-145
[3] Maanju,S.K., Vyas, A., Paliwal, B.S., Mittal, G.S., Gaur,C.P., Khan H, Sinha,A.K., (2002): An appraisal of impact of high fluoride Grounwater on human health. A case study of Nagaur district, Rajasthan, India. International Conference Soil and Groundwater contamination and cleanup in arid countries 20-23 Jan. 2003.extanded Abst. P 29-30.
[4] Paliwal, B.S., 1988. Excess Fluoride content in Ground Water in the Central districts of Rajasthan State and its bearing on the human health. Sixth IWRA World Congress on Water Resources, Ottawa, Canda, 2: 303 A1.
[5] Paliwal, B.S., 1999. High Fluoride content in Ground Water : A curse to the human Health in the central part of Rajasthan, India. In : B.S. Paliwal (ed.), Geological Evolution of Northwestern India, Scientific Publishers (India) Jodhpur, 217-292.
[6] Raghunath, H.M. (1982). GROUND Water . Wiley Eastern Limited 1982, Daryaganj, New Delhi.
[7] Roy, A.B., Paliwal, B.S., Shekhwat, S.S., Nagori, D.K., Golani, P.R. and Bejarniay, B.R. (1988.) Stratigraphy of the Aravalli Supergroup in the type area. Mem. Geol. Soc. India 7: 121-138.
[8] Todd, D.K. (1980). Groundwater Hydrology. Jhon Wliey & Sons (SEA) Pvt. Ltd., Singapore.
[9] Unpubblished Ph.D. thesis of Dr. Ganpat Ram Jakhar, Ex. Research Scholar, Govt. Dungar College Bikaner.