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QUANTITATIVE ASSESSMENT OF PHYSICOCHEMICAL CONSTITUENTS AS FLUORIDE, IRON AND NITRATE CONTAMINATED DRINKING GROUNDWATER IN NASHIK DISTRICT, MAHARASHTRA, INDIA

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Abstract: *Rapid industrialization and advanced agricultural practices are in vogue. The use of water is also in large quantity. Groundwater sources get polluted by the industrial waste water and agricultural fertilizers. The examination of ground water quality with respect to pH, TDS, Fluoride, Iron and Nitrate content has been carried out in Nashik District of Maharashtra, India. Three different types of sources such as Dug well, Power pump and Hand pump were selected for sampling. Overall fifty samples were collected for the study. Iron was analyzed by using Atomic Absorption Spectrometer (AA 2001 model) and fluoride was measured by SPANDS method at 570 nm while nitrate concentration was found by the phenol-disulphonic acid method at 410 nm using UV-VIS Spectrophotometer, (Chemito UV2100 model). Fifty percent samples show high nitrate concentration (53-141mg/L); one sample from hand pump category shows 2.0 mg/L fluoride content and four samples from hand pump category show high contents of iron. Therefore, the study revealed that the groundwater sources in the study area are heavily polluted with nitrate and iron.*

Key words*: Groundwater, fluoride, iron and nitrate etc.*

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INTRODUCTION

We are well known about the importance of the water for living beings and also for plants. More than 50% population lives in urban areas and the percentage of this is increasing very rapidly day by day. Rapid urban population growth, industrialization and increasing agricultural techniques are putting severe strains on water resources and environmental protection capabilities of many cities particularly in developing nations[1]. So availability of clean groundwater resource for future generations is not only a regional problem but also a worldwide problem.

Now a day, very few clean drinking water sources are available and the polluted water are giving birth to public health concern worldwide. Hence, the percentages of water borne diseases are increasing. Safe and clean drinking water is very important for all living organism. Groundwater is generally considered as a safe source of drinking water but with increasing rate of modernization, agricultural practices and industrialization, the natural groundwater sources are getting polluted very fastly.

In India, sixteen states namely Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh have already been identified endemic to fluorosis[2]. Nitrate contamination in groundwater arises from intensive agriculture, use of chemical fertilizers, improper and unhygienic sanitation, landfills and irrigation of land by sewage effluents[3].Nitrate converted from nitrogenous fertilizers leaches into deep soil and percolates into the groundwater system.

Health hazards arising out of exposure to higher level of nitrate level can be many folds, viz. methaemoglobinemia of blue baby syndrome which may cause mortality by asphyxiation especially in newly born infants, gastrointestinal cancer, Alzheimer disease, absorptive-secretive functional disorders of the intestinal mucosa, multiple sclerosis and Non-Hodgkin's lymphoma, hypertrophy of thyroid etc[3].

Nashik district is one of the major district of Maharashtra. It is situated between 20.00 degree North latitude and between 73.78 degree East latitude. It covers an area about 312812 sq. km and receives an average rainfall between 2600 to 3000mm. The greater part of the district is under the wet farming. For increasing the crop yield, the farmers use large quantity of chemical fertilizers.

The present research work has been carried out to study the drinking water quality parameters with respect to pH, TDS, Fluoride, Iron and Nitrate in Nashik district, Maharashtra and to help people in developing strategics at local level for minimizing the risk.

SCOPE OF THE WORK

People are less bothered about quality of drinking water sources and hence it is directly related to the health problems. So our aim of the work is to give the information about the physicochemical parameters of groundwater sources by analyzing the water sample from local area.

MATERIALS AND METHODS

1. Sampling

Three types of groundwater sources like Dug Well, Power Pump and Hand Pump were chosen for the collection of samples. Total fifty samples were collected of which 11 were dug wells, 07 were power pumps and 32 were hand pumps.

2. Sampling Protocol and sampling methods

The protocols adopted for sampling were taken from the APHA[4]. Samples were collected in plastic containers. Iron was estimated by using Atomic Absorption Spectrometer (AA 2001 model). Fluoride was measured by the SPANDS method at 570 nm and nitrate content was measured by the phenol disulphonic acid method at 410 nm using a UV Visible Spectrophotometer, (Chemito UV 2100 model). The other parameters which were tested were pH and Total Dissolved Solids (TDS).

RESULT AND DISCUSSION

The results obtained for above said parameters of the tested samples are discussed below with graphical representation.

Water parameters are important to reflect the contamination of groundwater sources. As per the guideline of WHO, the range of the pH 6.5-8.5 is acceptable. In study area, 50 samples from different water sources show the pH range from 6.37 to 9.17 among which Dug well samples show pH range 6.53-7.54, the water samples from Power pumps show pH range 6.37-8.27 and the water samples from hand pumps show pH range 6.67-9.17.

Table1: Physicochemical parameters of Dug well water samples

Groundwater sources	Parameters				
	pH	TDS (mg/l)	Fluoride (mg/l)	Iron (mg/l)	Nitrate (mg/l)
DW_1	6.95	288	0.01	0.02	17
DW_2	6.93	124	0.17	0.04	03
DW_3	7.42	485	0.19	0.05	125
DW_4	7.35	185	0.09	0.03	03
DW_5	7.31	413	0.2	0.02	77
DW_6	7.54	330	0.03	0.03	43
DW_7	6.53	312	0.02	0.03	60
DW_8	7.5	352	0.24	0.05	28
DW_9	7.33	445	0.03	0.07	44
DW_{10}	7.44	461	0.64	0.09	41
DW_{11}	7.31	373	0.85	0.05	28

Table2: Physicochemical parameters of Power pump water samples

Groundwater sources	Parameters				
	pH	TDS (mg/l)	Fluoride (mg/l)	Iron (mg/l)	Nitrate (mg/l)
PP_1	7.52	161	0.07	0.03	06
PP_2	7.26	220	0.27	0.05	03
PP_3	7.34	552	0.15	0.03	101
PP_4	8.27	553	0.24	0.04	107
PP_5	7.62	282	0.36	0.03	14
PP_6	6.37	245	0.4	0.05	20
PP_7	6.91	339	0.11	0.06	24

Table3: Physicochemical parameters of Hand pump water samples

Groundwater sources	Parameters				
	pH	TDS (mg/l)	Fluoride (mg/l)	Iron (mg/l)	Nitrate (mg/l)
HP_1	7.45	408	0.27	0.05	74
HP_2	7.41	299	0.19	0.04	18
HP3	7.24	415	0.03	0.12	81
HP_4	7.19	424	0.2	0.08	89
HP_5	7.04	534	0.06	0.09	86
HP_6	7.03	592	0.24	0.08	93
HP_7	7.16	673	0.06	0.09	126
HP_8	7.12	661	0.02	0.07	88
HP_9	9.17	802	2.0	0.02	09
HP_{10}	7.86	551	0.12	0.28	104
HP_{11}	7.63	518	0.26	0.02	71
HP_{12}	6.67	426	0.06	0.09	69
HP_{13}	6.93	270	0.02	0.08	29

HP_{14}	7.06	424	0.28	0.04	41
HP_{15}	7.34	666	0.03	0.06	63
HP_{16}	7.39	649	0.02	0.14	42
HP_{17}	7.5	606	0.04	0.11	53
HP_{18}	7.53	449	0.05	0.05	29
HP_{19}	7.45	447	0.03	0.12	61
HP_{20}	7.2	427	0.2	0.06	42
HP_{21}	7.1	423	0.63	0.12	26
HP_{22}	7.13	754	0.29	0.14	141
HP_{23}	7.39	449	0.46	1.25	56
HP_{24}	7.4	504	0.39	0.18	30
HP_{25}	7.29	729	0.93	0.14	121
HP_{26}	7.17	658	0.29	0.09	140
HP_{27}	7.46	273	0.93	1.35	07
HP_{28}	7.19	507	0.89	1.1	71
HP_{29}	7.36	480	0.63	1.45	29
HP_{30}	7.9	600	0.02	0.06	74
HP_{31}	7.64	489	0.04	0.09	89
HP_{32}	7.93	175	0.31	0.04	05

Regarding Total Dissolved Solids (TDS) of water samples, all the sampling sources show the values in range 124-802 mg/L which are within the limit prescribed by WHO.

Out of the 50 samples, Sample HP_9 from hand pump shows the maximum content of fluoride i.e. 2.0 mg/L and remaining 49 samples show fluoride ranging from 0.01 to 0.93 mg/L which are within the prescribed limit given by WHO. The concentration of fluoride in the range of 0.8 to 1.20 mg/L is not harmful but if more than 1.5mg/L is reported to be harmful to the teeth and bone of human and animals. Fluoride has adverse effects on the brain, mostly in combination with aluminum, fluorosis, turns out to be the most widespread geochemical disease in India, affecting more then 66 million people including 6 million children under 14 years age[1].

Iron is usually present in groundwater sample. Water containing iron in traces does not pose any hazardous problem on human health. The iron content of the samples number HP_{23}, HP_{27}, HP_{28} and HP_{29} (collected from the hand pumps) show the higher concentration as 1.25, 1.35, 1.1, 1.45 mg/L respectively. As per the standard set by WHO and BIS, the permissible limit of iron is 0.3 mg/L. More than the 1.00 mg/L of iron in drinking water is unsuitable for drinking purpose.

Nitrates in drinking water, as such are not toxic to health and about 85% of ingested nitrates are rapidly adsorbed from gastrointestinal tract in normal healthy individuals and get excreted by the kidneys. But, if the nitrates are converted in to nitrites which occur commonly, the toxic effect are encountered and may cause potential health hazards[5]. According to WHO, the standard for nitrate is 45 mg/L. From the studied area, 50% sampling sites show high nitrate concentration.

Graphical representation of groundwater parameters for samples from types of different sources

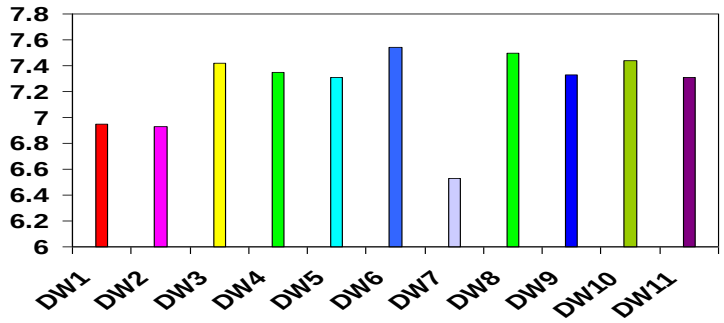

Figure 1. Content analysis of dug well samples with respect to pH

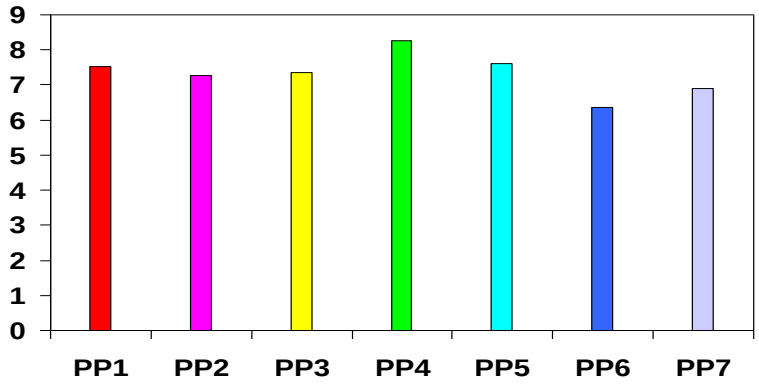

Figure 2. Content analysis of power pump samples with respect to pH

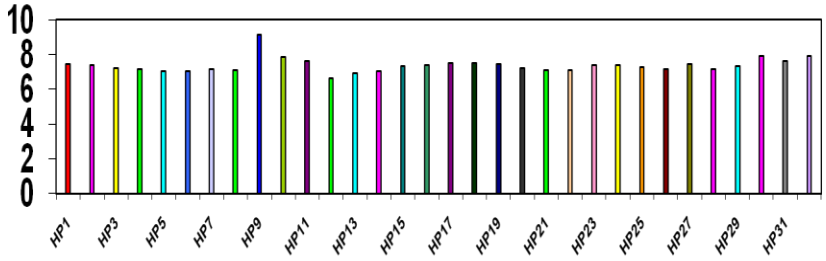

Figure 3. Content analysis of hand pump samples with respect to pH

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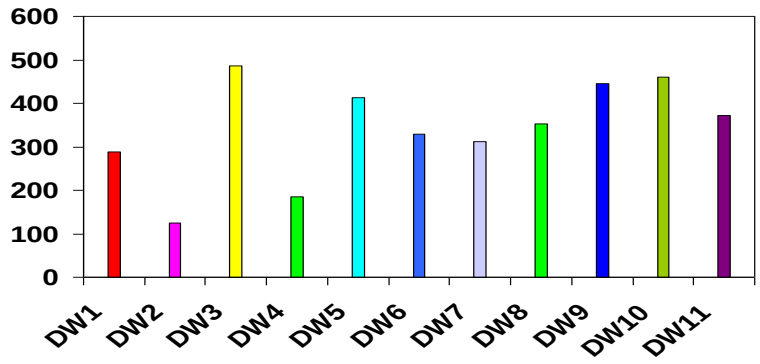

Figure 4. Content analysis of Dug Well sample with respect to TDS

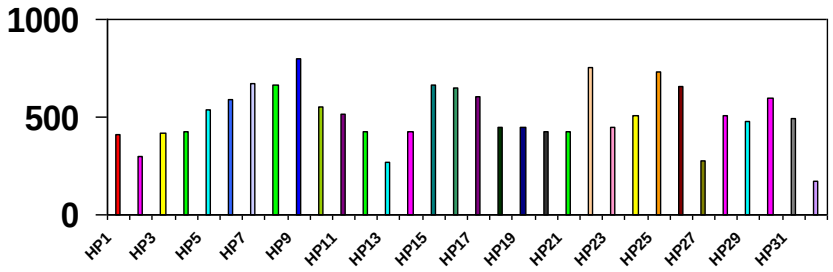

Figure 5. Content analysis of Hand pump samples with respect to TDS

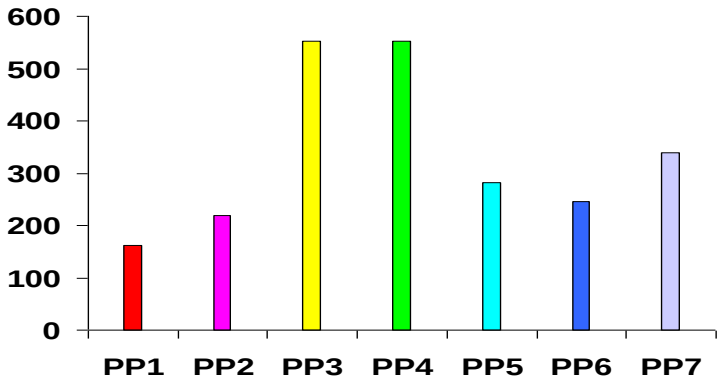

Figure 6. Content analysis of Power Pump samples with respect to TDS

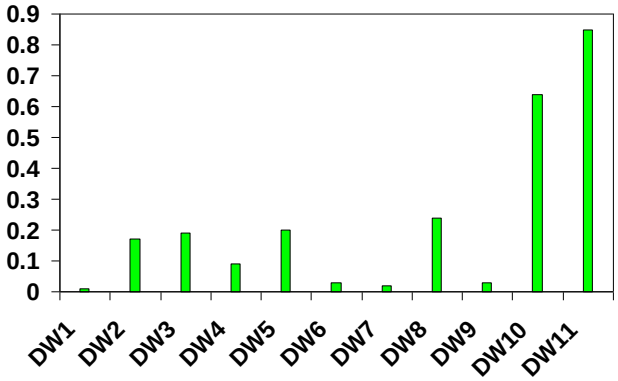

Figure 7. Content analysis of Dug Well sample with respect to Fluoride

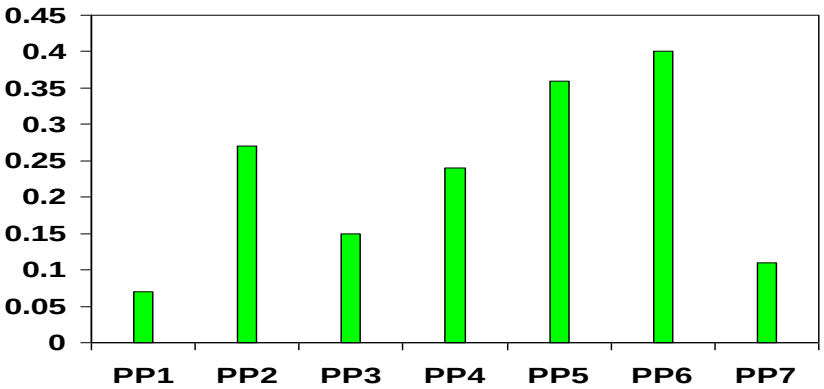

Figure 8. Content analysis of Power Pump samples with respect to Fluoride

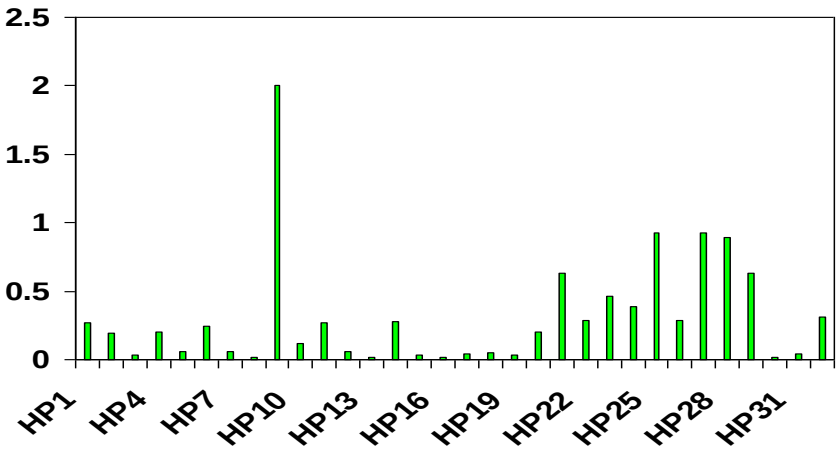

Figure 9. Content analysis of Hand Pump samples with respect to Fluoride

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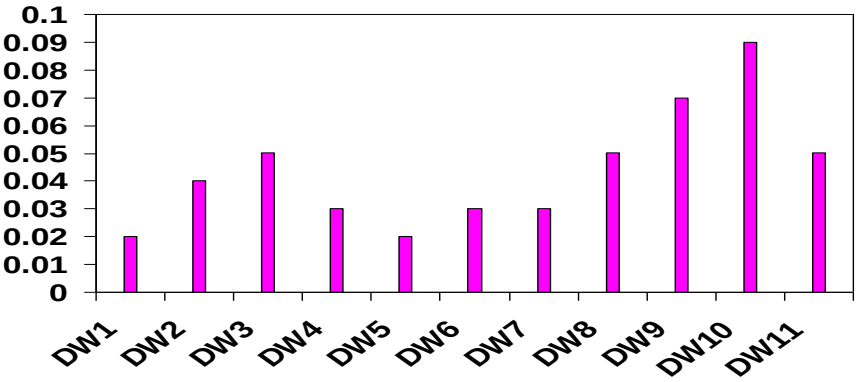

Figure 10.Content analysis of Dug Well samples with respect to Iron

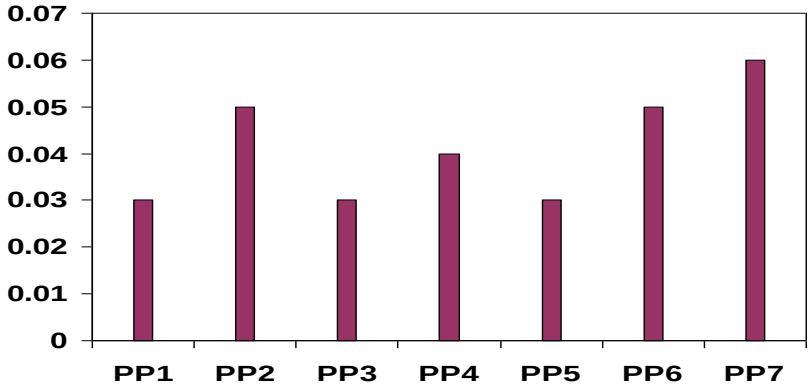

Figure 11. Content analysis of Power Pump samples with respect to Iron

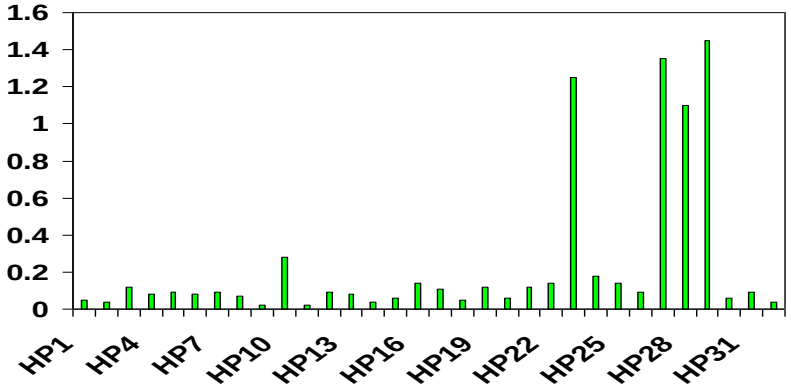

Figure 12. Content analysis of Hand Pump samples with respect to Iron

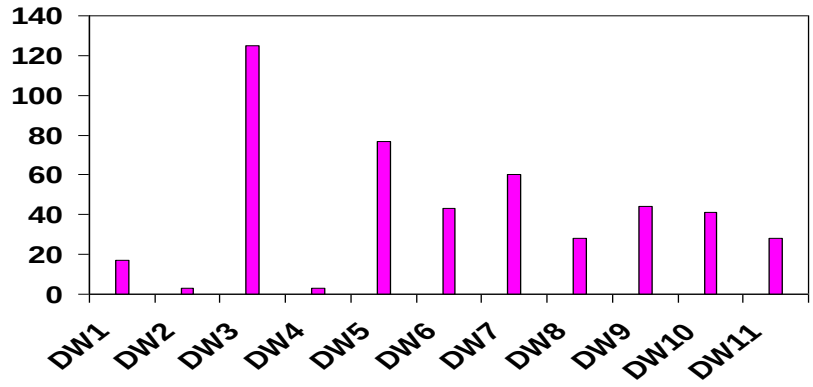

Figure 13. Content analysis of Dug Well samples with respect to Nitrate

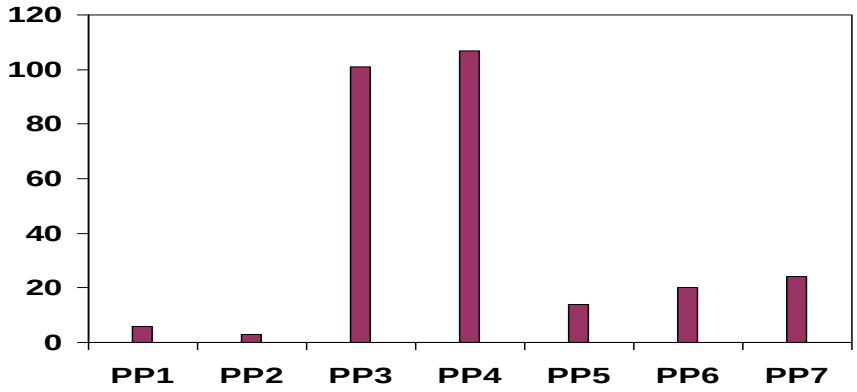

Figure 14. Content analysis of Power Pump samples with respect to Nitrate

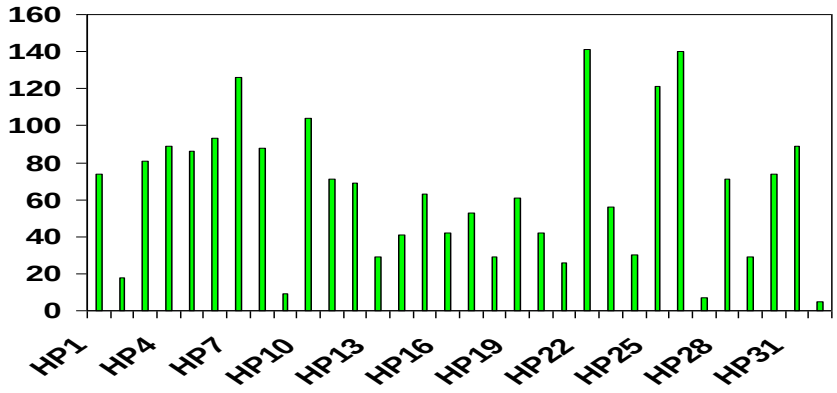

Figure 15. Content analysis of Hand Pump samples with respect to Nitrate

Conclusion

The groundwater parameters in the studied area are found to be unbalanced. The groundwater sources are polluted and affecting human health. 50% sampling sites contain high concentration of nitrates. Four sampling sites from Hand pump category are not safe for drinking purpose in relation to the concentration of Iron. For most of the samples, concentration of fluoride is within the permissible limits prescribed by WHO except sample HP_9. According to the study it can be suggested that the metals enter in to the groundwater

and create the water pollution and increase the health problem of human and animals. Hence it is important to do the proper management of the groundwater in the studied area immediately.

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