Assessment of Physico-Chemical Parameters of Ground Water in Some Encephalitis Affected Blocks of Gorakhpur District

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Abstract

A large area consisting of eastern part of Uttar Pradesh, western part of Bihar and Nepal is affected every year by the dreadly disease encephalitis. In recent years, the cases of Japanese Encephalitis (JE) have come down at very fast rate but Acute Encephalitis Syndrome (AES) is yet to be controlled. As enterovirus is supposed to be the main culprit of AES, it is necessary to investigate some important physico-chemical parameters of water quality with a view to look into any possible factors having linkage with enterovirus while it is ingested in human body with water-borne route. In the present study, an attempt has been made to investigate physico-chemical water quality parameters, pH, TDS, Total Hardness, Alkalinity, Acidity, Chloride, Free CO_2 and Fluoride in the water samples taken from shallow depth hand pumps and India Mark – II hand pumps located in encephalitis affected areas of Khorabar, Chargawan and Campierganj Blocks of Gorakhpur district. In each of these blocks, three villages were selected, and from each village two samples each from shallow depth hand pumps and India Mark – II hand pumps were taken and analyzed for selected physico-chemical water quality parameters. The seasonal variations in water quality were recorded in winter, summer and rainy seasons and depth of water table was also recorded. The data were analyzed separately for shallow depth hand pumps and India Mark – II hand pumps and the overall water quality status in accordance with regulatory standards was reviewed. Based on the findings, the suitable measures have been suggested and recommendations have been made.

"1. Introduction"

The pollution of the underground sources of drinking water, especially in outskirts of larger cities and villages has emerged as a major issue in many developing countries like India. For instance, trans-Yamuna areas of Delhi face drinking water pollution problem at regular intervals. There had been epidemics of cholera, dysentery and other diseases in recent years. This is mainly due to inadequate water supply in these areas. Ground water is threatened with pollution from seepage pits, refuse dumps, septic tanks, barnyard manures, transport accidents and different pollutants. Important sources of ground water pollution are sewage and other wastes otherwise. Raw sewage is dumped in shallow soak pits.

The contaminated water gives birth to water borne diseases like cholera, hepatitis, dysentery, etc. and is supposed to be a potential cause behind Acute Encephalitis Syndrome (AES) especially in area with high water table.

"2. Acute Encephalitis Syndrome (AES)"

The symptoms of the acute encephalitis syndrome are fever with altered sensorium and seizure. More than 100 types of different pathogens have been identified as agents of AES. In majority cases of acute encephalitis syndrome, there has been no specific medical treatment so far. AES was reported from 171 endemic districts in India from different states. Near about 375 million populations is at risk of AES in India. In Uttar Pradesh alone, 70-75% cases of encephalitis are observed. The etiology of AES, in 68-75% cases remains unknown. The World Health Organization (WHO), syndromic surveillance, aims to trace the patients of AES, reasons and treatment of AES.

2.1. Distribution of AES

The encephalitis has affected large areas of Uttar Pradesh, Bihar, Assam, A. P, Karnataka and Tamil Nadu and, mostly, the children below 14 years of age are the main victims. However, the Acute Encephalitis Syndrome was reported in eastern Uttar Pradesh in 1978 and, ever since then, large numbers of cases have been reaching various hospitals for treatment every year. The problem is so grave in nature that, in Gorakhpur district alone 14,412 cases have been reported so far including 3572 deaths and fatality rate 24.79%.

"4. Materials and Methods"

Considering the fact that water quality assessment includes physico – chemical and biological examination of water, the present study was planned to look into physico – chemical water quality parameters with a view to ascertain the possibility of any linkage of causative factors with the incidence of AES. With a view to assess physico-chemical parameters of groundwater in some encephalitis affected blocks of Gorakhpur district, a water quality sampling and testing plan was prepared, which included the assessment of various water quality parameters such as TDS, pH, alkalinity, acidity, hardness, free CO_2, fluoride and chloride concentration in ground water.

"5. Sample Collection and Analysis"

The study was carried out in encephalitis affected blocks of Gorakhpur district, to find out the physicochemical properties of ground water during different seasons. The groundwater samples were collected from three blocks, namely, Khorabar, Chargawan and Campierganj of Gorakhpur district at different locations. In each block, three villages were selected and, from each village, two hand pumps, one shallow depth hand pump and the other one deep hand pump i.e. India Mark – II were selected for study. The hand pumps chosen for the study were those being used by the families, where some cases of AES had been reported.

The samples were collected in polyethylene bottles of 1 L capacity. Before the collection of sample, the bottles were rinsed with distilled water for further analysis in laboratory. The tests were carried out in accordance with standard procedure.

"6. Results and Discussion"

The observed data were analyzed for assessing the seasonal variations, comparative status of shallow depth and India Mark - II hand pumps and compliance with respect to regulatory standards. The results are discussed below:

1) Fig. 1, 2 and 3 exhibit variations of different water quality parameters in Khorabar, Chargawan and Campierganj blocks in winter, summer and rainy seasons. Generally, the lower values are found in case of TDS, alkalinity, acidity, hardness and chloride in most of the samples taken from India Mark – II hand pumps as compared to shallow depth hand pumps.

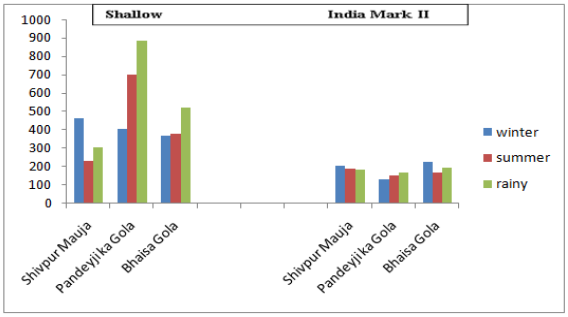

Fig.1.1. Variation in TDS

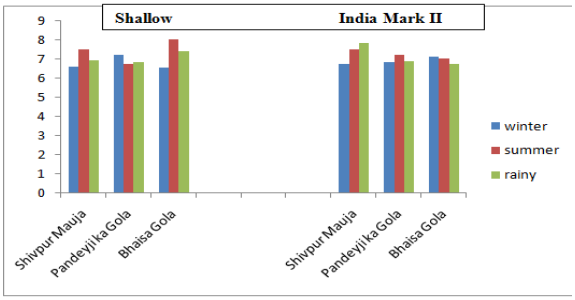

Fig.1.2. Variation in pH

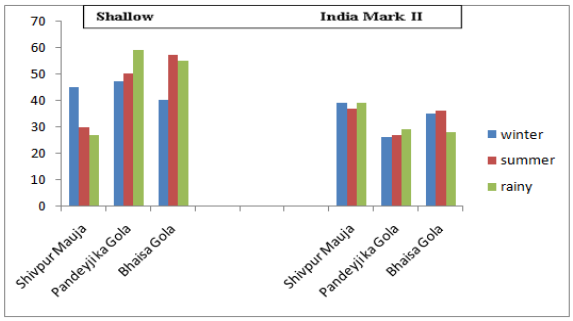

Fig.1.3. Variation in alkalinity

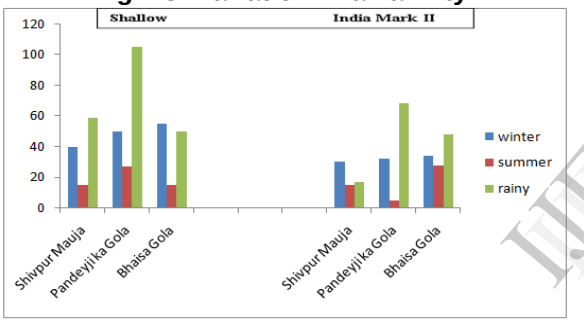

Fig.1.4. Variation in acidity

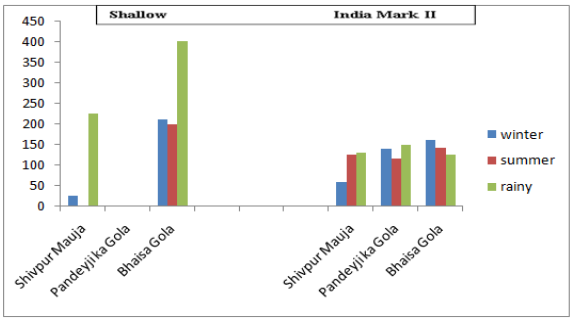

Fig.1.5. Variation in Total Hardness

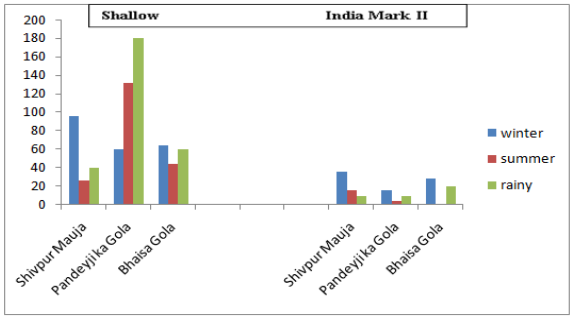

Fig.1.6. Variation in Chloride

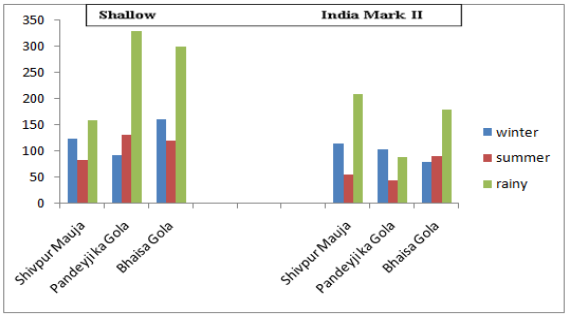

Fig.1.7. Variation in Free CO_2

"Fig.1. Khorabar Block: Seasonal Variation in Water Quality Parameters in Shallow Depth and India Mark – II Hand Pumps"

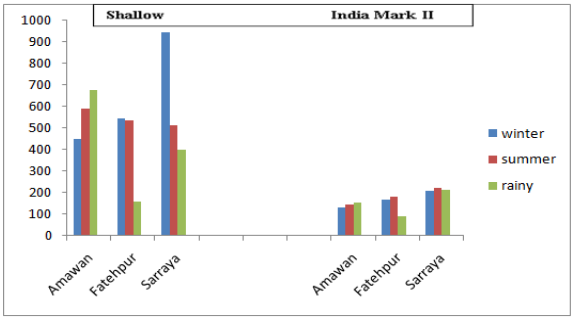

Fig.2.1. Variation in TDS

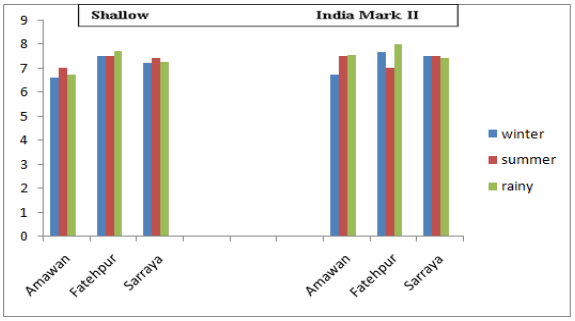

Fig.2.2. Variation in pH

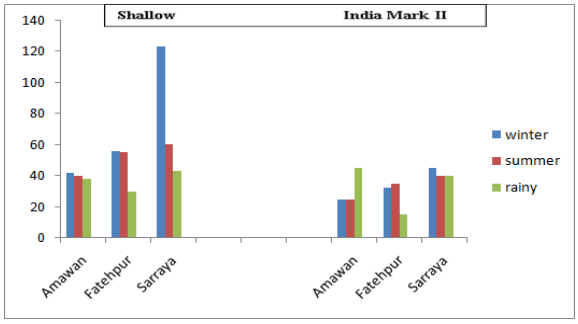

Fig.2.3. Variation in Alkalinity

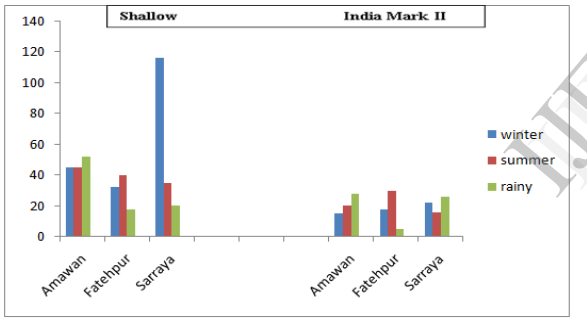

Fig.2.4. Variation in Acidity

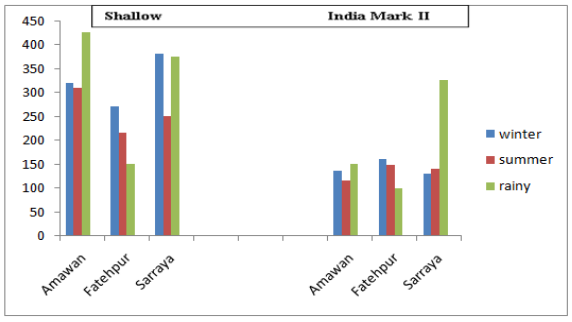

Fig.2.5. Variation in Total Hardness

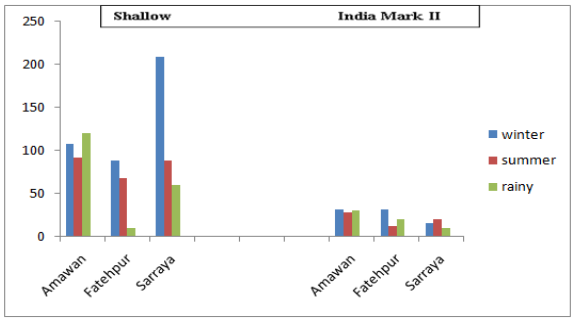

Fig.2.6. Variation in Chlorides

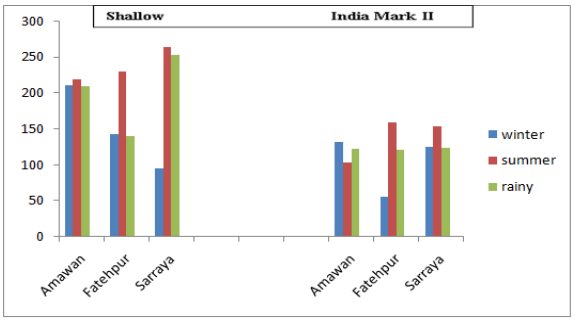

Fig.2.7. Variation in Free CO_2

"Fig.2. Chargawan Block: Seasonal Variation in Water Quality Parameters in Shallow Depth and India Mark – II Hand Pumps"

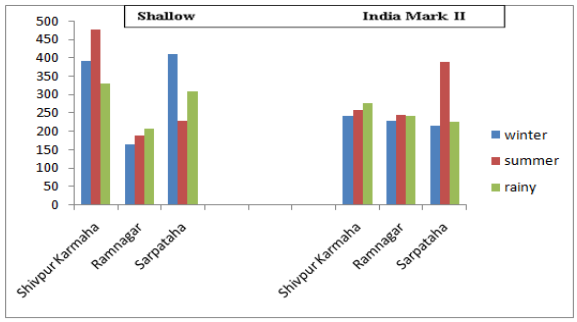

Fig.3.1. Variation in TDS

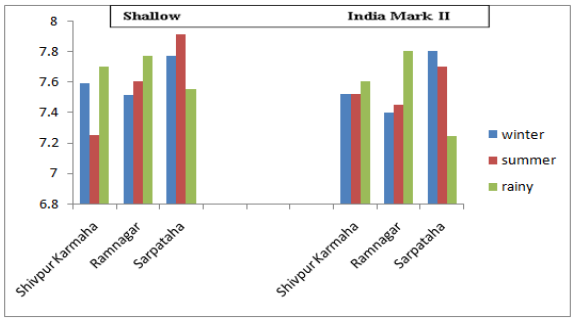

Fig.3.2. Variation in pH

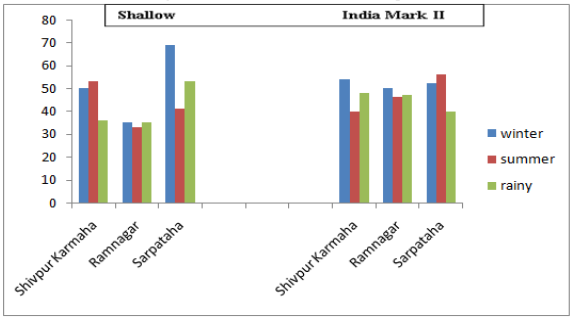

Fig.3.3. Variation in Alkalinity

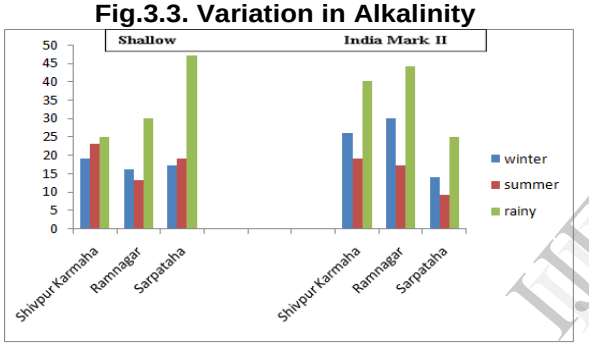

Fig.3.4. Variation in Acidity

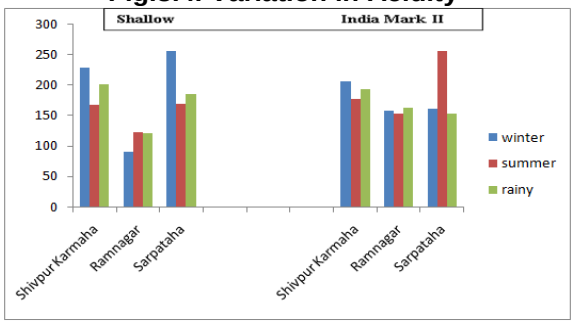

Fig.3.5.Variation in Total Hardness

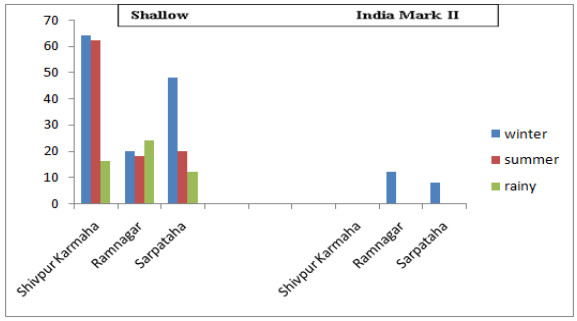

Fig.3.6. Variation in Chlorides

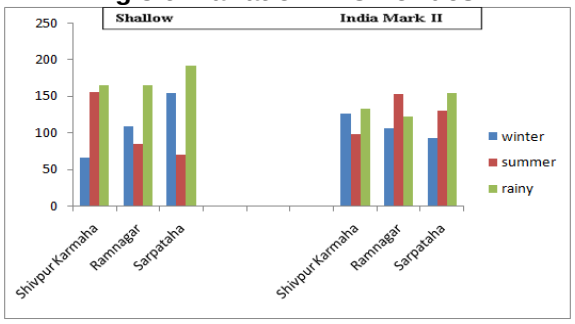

Fig.3.7. Variation in Free CO_2

"Fig.3. Campierganj Block: Seasonal Variation in Water Quality Parameters in Shallow Depth and India Mark – II Hand Pumps"

2) A glance at Fig. 1, 2 and 3 reveals that the water quality problem is generally found in respect of TDS and Total Hardness in some of the villages namely, Pandeyji Ka Gola and Bhainsa Gola of Khorabar Block and Amawa, Sarraya and Fatehpur villages of Chargawan Block.

3) It is also observed that the variation in respect of water quality parameters is generally high in case of shallow hand pumps. This may be attributed to the higher percolation of dissolved impurity laden rain water into the shallow aquifer zone.

4) The other parameters such as pH, alkalinity, and chloride concentration of ground water samples during all the seasons are found to be within the permissible limit.

5) Fluoride concentration is found to be zero in many samples excluding the sample from India Mark – II hand pumps of Shivpur Mauja of Khorabar Block and Shivpur Karmaha and Ramnagar of Campierganj Block and one shallow depth hand pump of Sarpataha village of Campierganj Block.

"Table.1. Block wise Fluoride Concentration"

Observation	Khorabar Block			Chargawan Block			Campierganj Block		
Fluoride mg/l	Shivpur Mauja	Pandeyji ka Gola	Bhaisa Gola	Amawa	Fathepur	Sarayan	Shivpur Karmaha	Ramnagar (Goshai Tola)	Sarpataha (Kabir Tola)
Shallow	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.8mg/l
India Mark II	0.62mg/l	Nil	Nil	Nil	Nil	Nil	0.4mg/l	1.2mg/l	Nil

6) Although free CO_2 is not a parameter prescribed by IS: 10500-1991 yet its presence is supposed to be indicative of the CO_2 acidity or else the outcome of bacterial respiration. While comparing the observed values with normally expected value of 50 mg/L, it is found that, excluding one source located in Pandeyji ka Gola of Khorabar Block the observed values of free CO_2 are more than 50 mg/L.

"Table.2. Compliance and Non-Compliance Status of Groundwater Samples"

Block	Sources	Winter	Summer	Rainy	Seasonal compliance status			Compliance status (%)	Overall compliance status		Parameters requiring attention
					Winter C/NC	Summer C/NC	Rainy C/NC		C %	NC %	
Khorabar	S.D.	3	3	3	3/0	2/1	½	66.6%	83.3	16.7	TDS, Total Hardness
	I.M. II	3	3	3	3/0	3/0	3/0	100%			
Chargawan	S.D.	3	3	3	0/3	0/3	½	11.1%	50	50	TDS, Total Hardness
	I.M. II	3	3	3	3/0	3/0	2/1	88.8%			
Campierganj	S.D.	3	3	3	3/0	3/0	3/0	100%	100	0	
	I.M. II	3	3	3	3/0	3/0	3/0	100%			

Where, C = Compliance and NC = Non-Compliance

7) It is also seen that the overall compliance level of shallow hand pumps is 66.6% and 11.1% in Khorabar Block and Chargawan Block respectively. Similarly, the compliance of India Mark – II hand pumps is found to be 100% and 88.8% in Khorabar and Chargawan Block respectively. It is also revealed that TDS and Total Hardness are the main parameters rendering non-compliance status to most of the hand pumps in Khorabar and Chargawan Blocks. At the same time, it is seen that the observed values of these parameters are certainly more than the permissible limit in some sources but these are not exceeding the limit prescribed for cause of rejection. Hence it may be necessary either to switch over to some alternative sources or to resort to suitable treatment.

8) The depth of water table is found to range from 2.51 m to 4.04 m in Khorabar Block, 3.0 m to 4.0 m in Chargawan Block and 3.03 m to 4.9 m in Campierganj Block. So, it is evident that shallow depth hand pumps are quite amenable to be affected by anthropogenic pollution on ground surface leading to downward percolation to shallow aquifer.

9) The analysis has shown that there is no linkage of Physico-chemical water quality parameters pH, TDS, Total Hardness, Alkalinity, Acidity, Chloride, Free CO_2 and Fluoride with the incidence of AES in the families using drinking water from hand pumps subjected to the study.

"7. Recommendations and Conclusion"

The assessment of physico – chemical parameters of water quality in three encephalitis affected blocks, namely, Khorabar Block, Chargawan Block and Campierganj Block of Gorakhpur district in winter, summer and rainy seasons has revealed that, excluding Campierganj Block, about 16.7% sources in Khorabar Block and 50% sources in Chargawan Block suffer from the problems relating to high concentration of TDS and Total Hardness. However, the observed values having being found less than the limit prescribed for cause of rejection. It is recommended that either alternative sources should be found out in lieu of such sources, or else, suitable treatment methodology should be adopted.

The study has re-affirmed that, generally, the water quality status of India Mark – II Hand Pumps is better than that of shallow depth hand pumps and it is also seen that the water quality of India Mark – II hand pumps is least affected by seasonal variation as compared to that of shallow depth hand pumps. The depth of water table in all the three Blocks is such that shallow depth hand pump can be usually affected by anthropogenic pollution. So, there is a need to create public awareness about water quality problems in the region and also to use

India Mark – II Hand Pumps as far as possible. As the physico-chemical water quality parameter of some of India Mark – II hand pump is also found to be higher than the permissible limit. It is recommended that cent-percent water quality monitoring should be taken up for all the sources before certifying them to be fit for drinking purposes.

Considering that the discharge of domestic wastewater through septic tanks and soak pits and location of sheds of domestic animals were the main sources of contamination in the vicinity of the hand pumps, there was a high risk of contamination for shallow hand pumps and also for India Mark – II Hand pumps not resting on adequate depth and provided with platform.

Similarly, water logging due to the absence of proper sanitary system, near the hand pump is also a source of water pollution. So there is a need to maintain adequate distance of hand pumps from animal sheds and water logged areas. With a view to overcome this problem, it is recommended that cemented platform should be provided necessarily around all the hand pumps. The construction of deep hand pumps should be taken up at prescribed depth while adopting necessary precautions against cross contamination.

8. References

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