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Comparative Study of Drinking Water of Three Different Schools of Damak, Jhapa

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Abstract

The health and well-being of society are measured by the quality of the water. Thus, it is the most important issues facing the entire planet today. The main aim of the work is to evaluate the WQI of three different school to check the quality of drinking water. The WQI value for Singha Devi Secondary, Oxford English and Himjyoti English are 45.36, 36.73 and 64.69 respectively. The water of Singha Devi and Oxford falls in good category whereas water of Himjyoti falls in poor category.Which shows that groundwater of Himjyoti is relatively contaminated. All these three waters are suitable for drinking, but certain treatment is required to retain their quality.

Keywords: Water quality, pollution, contamination, groundwater, School, Damak

Introduction

Groundwater offers many advantages over surface water because it undergoes natural filtration e.g. removal of pathogens and odor [1, 2]. As a result, it is considered as one of the purest forms of water available in nature and fulfills the entire demand for rural and urban people. When rain falls and seeps deep into the earth, it fills all the cracks, crevices, and porous spaces of an aquifer and becomes constant source of groundwater [3]. When compared to surface water, groundwater sometimes requires more effort and money to acquire. There is developing worry on decaying of groundwater quality due to geogenic and anthropogenic activities like wastewater from houses, discharges of sewage effluents, wastewater from houses, toxic metals from different sources and indiscriminate use of heavy metal containing fertilizers and pesticides in agriculture [4, 5].

In developing countries like Nepal, people heavily depends on groundwater instead of surface water due to the contamination by the anthropogenic activities for the household, agricultural, industrialization purposes and mostly for drinking [6]. Specially, in Terai region tube wells and wells are the groundwater sources as it is rich in agriculture. Once the groundwater is contaminated, it takes long time to restore the quality even if we stop the pollutants from the source, hence it is crucial to continuously check its quality and devise strategies for protecting it[7].The good quality of water is the index of good health and well- being of the society, so it is considered great concern all over the world. The purpose of the research work is to investigate the quality of water for safe drinking at different schools of Damak. The present work uses the Water Quality Index (WQI) to express the quality of water and to create the awareness among the public. Municipality and school authorities can take the advantage from this work to improve the water management system of the schools.

The WQI is evaluated using the relation given in Eq. (1). Detail information about the WQI can be obtained in our previous works [8-11].

$$\mathrm{WQI} = \sum_{i=1}^{n} (W_r \times Q_i) \ldots\ldots\ldots (1)$$

The categorization of WQI and status of water is performed according to the proposed scaling by Nayak and Mohanty, (2018) and presented in Table 1.

Table 1Water quality scaling and status [12]

WQI level	Water quality status
0-25	Excellent
26-50	Good
50-75	Poor
76-100	Very poor
Above 100	Unsuitable for any purposes

Materials and Methods

Damak is one of the developing cities of eastern part of Nepal with latitude and longitude of 26°10′41″N and 87°41′46″E.The Damak Municipality consists of ten administrative wards. Due to certain constrain, only three samples of tube well water from different schools located at different wards have been chosen to ensure that whether it is safe for drinking or not. Groundwater is the major source of drinking in schools for students. Tube wells are source of drinking in these three schools. In order to calculate quality of drinking provided by schools for students, samples were collected from Oxford English Secondary School, Damak–3, Himjyoti English Boarding School, Damak-9 and Singha Devi Secondary School, Damak-10, respectively. For the sample collection, bottles were rinsed first, tightly sealed after collection, and labeled on the spot. The samples were taken by pumping tube wells continuously after five minutes. All the samples were delivered to Laboratory of Nepal Batabaraniya Sewa Kendra, Biratnagar. The various standard procedures APHA methods were used to measure the thirteen different physico-chemical parameters depicted in Table 2.

Table 2 Results of different physicochemical parameters and methods of measurement

SN	Parameter	Units	Methods	Himjyoti	Singha Devi	Oxford
1	Turbidity	NTU	APHA-2130B	0.3	0	0
2	Fluoride	mg/L	APHA-2500D	0.36	0.06	0.34
3	Chloride	mg/L	APHA-2500B	25	12	4
4	Total Hardness	mg/L	APHA-2340	114	18	70
5	Total alkalinity	mg/L	APHA-2320	121.55	20.40	79.90
6	Iron (Fe)	mg/L	APHA-3111B	0.31	1.94	0.05
7	Manganese	mg/L	APHA-3111B	0.12	0.06	0.05
8	Sulphate	mg/L	APHA-4500	30	18	25
9	Calcium	mg/L	APHA-3500	27.25	4.01	16.03
10	Magnesium	mg/L	APHA-3500	11.18	1.94	7.29
11	pH	-	APHA-4500 H^+	6.3	5.91	6.3
12	EC	µS/cm	APHA-2510	455	183	261
13	TDS	mg/L	APHA-2540C	303	121	243

Results and Discussion

WQI of water samples collected from different schools was calculated using Eq. (1). For this purpose, assigned weighted varies from 1to 5 based on its importance in water quality. For example, EC was provided assigned weight of 5, turbidity, iron, sulphate, pH, TDS were provided assigned weight of 4, chloride was provided the assigned weight of 3, and rest of the parameters were provided the assigned weight of 2. Similarly, the standard values for each parameter were provided as recommended by WHO and NDWQS. Water sample of Himjyoti English School was highest value of WQI (64.69) and Oxford English School was lowest value of WQI (36.72).The WQI value of Singha Devi School was 45.36.The graphical representation of the WQI values of samples from different schools is depicted in Figure 1. The WQI values and status of different schools' water samples is given in Table 3.

The water quality of Singha Devi and Oxford lies in good categories whereas water quality of Himjyoti lies in poor category. The WQI lies in excellent category is excellent for drinking purpose and WQI value lies in good category can be used for drinking purpose with filtration. If WQI falls in poor category, it is not suitable for drinking purpose. However, certain technique is available to remove contamination.

Table 3 Water Quality Index and status of each sample

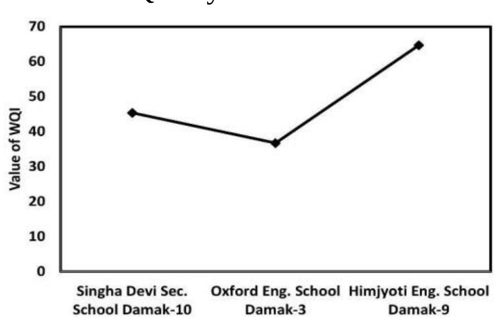

Figure 1: WQI value of groundwater from different school

WQI Level	Water quality status	School Name
0-25	Excellent	
26-50	Good	Singha Devi and Oxford
50-75	Poor	Himjyoti
76-100	Very poor	
Above 100	Unsuitable for any purposes	

The high WQI value of Himjyoti is due to the high concentration of turbidity, fluoride, manganese, chloride, TDS, and Total Alkalinity. This higher value may be due to the contamination or geological structure of source. It can be used for drinking purpose, but some treatment is required. All these values are within the desirable limit prescribed by WHO and NDWQS. Also, the WQI value of Singha Devi lies in good category with WQI value of 45.36. There is an excess of iron in drinking water, and it is very important parameter to determine the quality of water. Water with high concentration of iron is not suitable for drinking. This is caused by various reasons.

Rain can percolate through iron-rich soil or rock as a result, the iron is dissolved in the groundwater. Additionally, certain pipelines can corrode and release iron into groundwater. Acidic (low pH) solutions can increase the solubility of iron compounds. Singha Devi Secondary School is slightly acidic with pH value of 5.9. Higher value of iron may be due to the low pH. This problem can be solved by adding soda ash or sodium hydroxide in water which raise the pH of water to near neutral value [12]. There are numerous methods to remove iron from drinking water such as ion exchange, water softening, activated carbon, limestone treatment, oxidation by aeration, and ozonation followed by filtration[13].All these three water samples are suitable for drinking, but certain treatment is required to retain their quality. Based on this study, further concern on studying the quality of water and treatment to increase the quality of water of schools is very important. It is also important to manage the dumping from anthropogenic activities near school areas.

Conclusion

In the present study, the WQI of three different schools has been investigated from the thirteen different parameters. The WQI of Himjyoti, Singha Devi and Oxford were 64.69, 45.36 and 36.72, respectively. From this study, we revealed that the water quality of Singha Devi and Oxford schools lies in good categories whereas water quality of Himjyoti School lies in poor category.

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