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Detail Assessment of Physico-Chemical Properties of Perennial Spring Water within Aizawl City, Mizoram

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ABSTRACT

Water quality is the term used to express the suitability of water to sustain various uses or processes. Earth's water resources, including rivers, lakes, oceans, and underground aquifers, are under stress in many regions. Humans need water for drinking, sanitation, agriculture and industry; and contaminated water can spread illness and disease vectors, so clean water quality is both an environmental and a public health issue. Nowadays fresh water depend solely on letter physico chemical conditions. Analysis of physico chemical parameters of water is therefore essential, as it has great bearing on the explanation of metabolism of the aquatic ecosystem. So five perennial spring water sites were selected for sampling and analysis where most of the local people at the nearby locality consume the water for different household purposes in the north, east, west, south and central zone of Aizawl city. Six physico-chemical properties were selected for determining the quality of the water. Acidity was found highest in west and north zone and was minimum at the central zone of Aizawl. It was observed that water in all sites were highly turbid during the month of July 2017 and was most turbid in the north zone where the spring water in this area remain unprotected. The maximum dissolved oxygen value was found in the west zone on February 2017 throughout the sampling period where Biological Oxygen Demand was found to be highest in the north zone of Aizawl during the month of July 2017.

1. Introduction

Spring is a point where water flows out of the ground or any natural situation where water flows from an aquifer to the earth's surface. It is a component of the hydrosphere. A spring may flow the whole year or only sometimes. This depends on the water getting into the ground all of the time. A spring water may be the result of karst topography where surface water has infiltrated the Earth's surface, becoming part of the area groundwater. Perennial water resources is a water that has continuous presence in its bed all year round during years of normal rainfall. Perennial water body usually refers to mainly liquid fresh water, as opposed to intermittent or periodic water. Most water bodies vary in fullness according to the season, and according to the heaviness of precipitation and other factors during any given year. Also, the water level in many such water bodies as do not actually dry out, may nonetheless drop so drastically that their surface area is greatly reduced. They even may be split into several separate water bodies with dry land between, either arid or covered with vegetation. The internal ecology of such water may differ drastically between periods of drought and deep water(Lake,2011).

The groundwater eventually emerges from below the surface. The forcing of the spring to the surface can be the result of a confined aquifer in which the recharge area of the spring water table rests at a higher elevation than that of the outlet. The natural outputs from groundwater are springs and seepage to the oceans. (*Gleeson et al.,2012.)* Safe drinking water is essential to humans and other lifeforms even though it provides no calories or organic nutrients. (United States Geological Survey,2009). The quality of life is linked with the quality of environment,hence the biological components of fresh water depend solely on letters physico-chemical conditions. Analysis of physico-chemical parameters of water is therefore essential, as it has great bearing on the explanation of metabolism of the aquatic ecosystem.

1.1 Literature review:

The sensitivity of a water resource system to climate change is a function of several physical features and, importantly, societal characteristics. There are several indicators of water resource stress, including the amount of water available per person and the ratio of volume of water withdrawn to volume of water potentially available (Falkenmark and Lindh, 1976). It is difficult to draw quantitative conclusions about the impacts of climate change, for several reasons. Our analysis places particular priority on the characterisation of water scarcity in low- income countries of the tropic where the consequences of water scarcity are projected to be most severe (Jimenez-Cisneros et al. 2014) and where most of the global population now live (Gerland et al. 2014).

In countries where freshwater resources are scarce and under pressure, the assessment of freshwater resources is often complemented by an assessment of the available brackish water that can be used for specific purposes (desalination, some types of agricultural production) (Shiklomanov,1997).

The main water resources in Mizoram is the numerous perennial springs and the rivers. The groundwater resource is also utilized wherever possible. As per the census of India 2001, only 5% of the rural households enjoy water supply within their premises and about 75% of the households get water from their near premises. For majority of the households 47% the main source of water is spring water. In the state the gravity-based schemes are successful and sustainable. The hand pumps are not working properly and there are instances of excess iron from the hand pump. (Upadhyay and Lalroneiha 2014).

2. Methodology

Site selection: Pre-survey was done within Aizawl city and the list of water resources was short listed to five where one each of perennial spring water from five different zones was selected.

2.1 Description of study area/sites

Aizawl is the capital of the state of Mizoram in India. It is the largest city in the state. Aizawl is located north of the Tropic of Cancer in the northern part of Mizoram. It is situated on a ridge 1,132 metres (3715 ft) above sea level, with the Tlawng river valley to its west and the Tuirial river valley to its east. As of 2011 India census, Aizawl had a population of 293,416. Females constitute 50.61% of the population and males made up the remaining 49.39%.

For detailed investigation, a total of 5 strings within the Aizawl city were selected in different locations (i.e., (one site each in North, East,West , South and Central zone).

Site 1: BawngkawnTuikhur (Near Bezalel Workshop) in North zone, with coordinates - N 23˚45'16.7"; E 092˚43'41.0".
Site 2: TheihaiTuikhur, AremdVeng in East zone, with coordinates - N 23˚44'16.0" E 092˚43'14.6"
Site 3: Public Tuikhur, Govt. Complex (Beside Public Step), with coordinates - N 23˚43'50.5"; E 092˚41'39.3"
Site 4: SailoTui, Mission Veng in South zone, with coordinates - N 23˚43'08.6"; E 092˚42'54.6"
Site 5: Central - Zotui, Electric Veng (Near ESRA Drug Store) in central zone, with coordinates - N 23˚44'25.0"; E 092˚43'05.5" .

2.2 Sampling Method:

Sample was collected every 3rd week of the month between 7:00 AM – 10:00 AM by using sterilized sample glass bottles and were immediately covered and placed in a zip pouch for prevention of any bacterial contamination from outside environment and immediately taken to the laboratory for analysis.

Collection of water : Water collected by using specified sterilized sample bottles. Analysis of water.

2.3 Analytical Method:

2.3.1 Turbidity – for determining turbidity of the various water sample Nephelometer or turbidity meter was used which measures the intensity of light scattered at 90 degrees.

2.3.2 Oxidation reduction potential – Redox potential instruments are used to measure the oxidation reduction potential or the ability of a solution to act as an oxidizing agent, and to quantify the ion activity.

2.3.3 pH – A scientific instrument called pH meter was used to measure the hydrogen ion activity in water-based expressed as pH.

2.3.4 Acidity - Potentiometric titration method was used for determining the acidity of water sample where phenolphthalein was the indicator used and NaOH was the titrant used for analysis.

2.3.5 Alkalinity - Potentiometric titration method was used for determining the alkalinity of water sample. Methyl orange was the indicator used and 0.02N H_2SO_4 was the titrant used for titration method.

2.3.6 Dissolved oxygen - Winkler's iodide azide modified method was used for determining the dissolve oxygen content of water samples. 1ml of $MnSO_4$ followed by 1ml of alkali-iodide-azide reagent upto the brim was added to the water samples and after 30 minutes 2ml of conc. H_2SO_4 was added. 100ml of this solution was taken in a conical flask and 2 – 3 drops of starch indicator was added.The solution will then be titrated against Sodium thiosulphate solution (0.025N) till the blue color turns colourless.

2.3.7 Biological oxygen demand - for determining the biological oxygen demand Winkler's iodide azide modified method was used. The procedure employed for the analysis of biological oxygen demand was exactly the same as that of the procedure in dissolve oxygen determination but after 5 days incubation.

3. Results and conclusion

- A tables and graphical representation of the water samples for each parameters analysed are given in the above figures.
- In oxidation reduction potential the less contamination in the water the higher the value of ORP. The value of ORP was found to be highest in August 2017 at the east site i.e. 106.7 mV and the least value which is 12mV was found during May 2017 in central zone of Aizawl city.
- The samples were most turbid during the month of July 2017 and the highest value was found in the north zone where the water system was left uncovered and makes the water most turbid comparing to the other areas.
- pH was found to be neutral in all the sites. pH value was found maximum during the month of May 2017 and the minimum value was found in Aug. 2017
- The maximum dissolved oxygen value was found in the West zone throughout the sampling period with highest value of 8mg/l, whereas biological oxygen demand was found to be the highest in the north zone comparing to the other four sites and the maximum value was seen in July 2017.
- Alkalinity, which is the capacity of water to resist changes in pH that would make the water more acidic was found highest in January 2017 in the north zone and was lowest in September 2018 in the south site.

Acidity were found to be highest in west and north zone site of Aizawl city and reached the value up to 94 mg/l in December 2016 in the north zone and the minimum value was found in the central zone throughout the year. The least value of acidity was found to be 4mg/l in April 2017.

Table 1: Oxidation reduction potential

Samples	Sept 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug 2017
A- North	68.4	71.3	60	58	57	65	68	68	35	43.1	67	81.3
B-Central	62.1	59	27	12	14	13	37	33	12	67.3	72	89.8
C-East	78	55	80	87	71	54	84	98	60	79.9	80	106.7
D-South	63.5	49	67	76	70	42	64	88	58	66.5	80	90.4
E-West	66	62.4	40	71	63	55	72	82	41	63.7	80	89

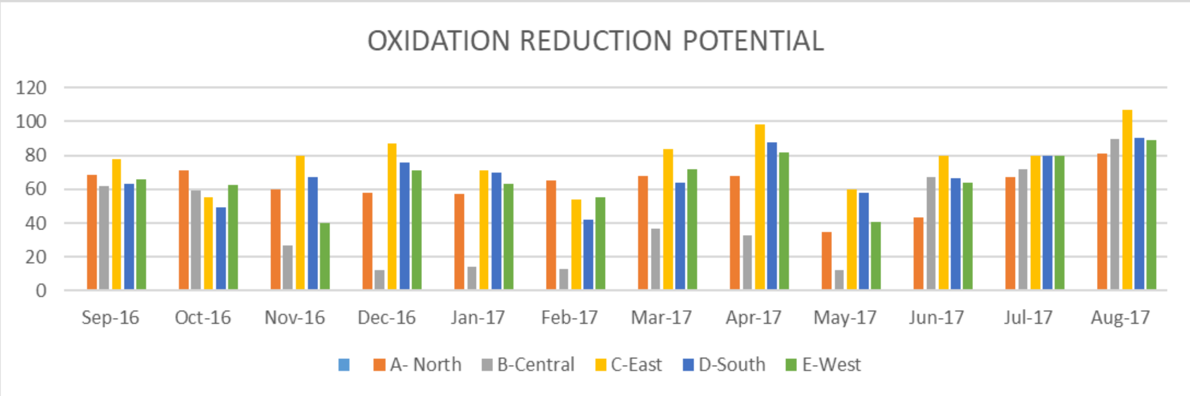

Fig. 1: Graphical representation of Oxidation reduction potential-μV

Table 2: Turbidity

Samples	Sept 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug 2017
A- North	1.3	0.9	0.7	0.6	0.6	0.4	0.3	0.4	0.9	0.9	2.3	0.5
B-Central	0.9	0.7	0.3	0.2	0.3	0.1	0.1	0.1	0.6	0.6	1.3	0.8
C-East	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.0	0.5	0.5	0.3	0.7
D-South	0.1	0.1	0.1	0.1	0.2	0.3	1.0	0.4	0.9	0.9	1.5	0.6
E-West	0.1	0.3	0.6	0.4	0.3	0.2	0.2	0.2	0.6	0.6	0.3	0.6

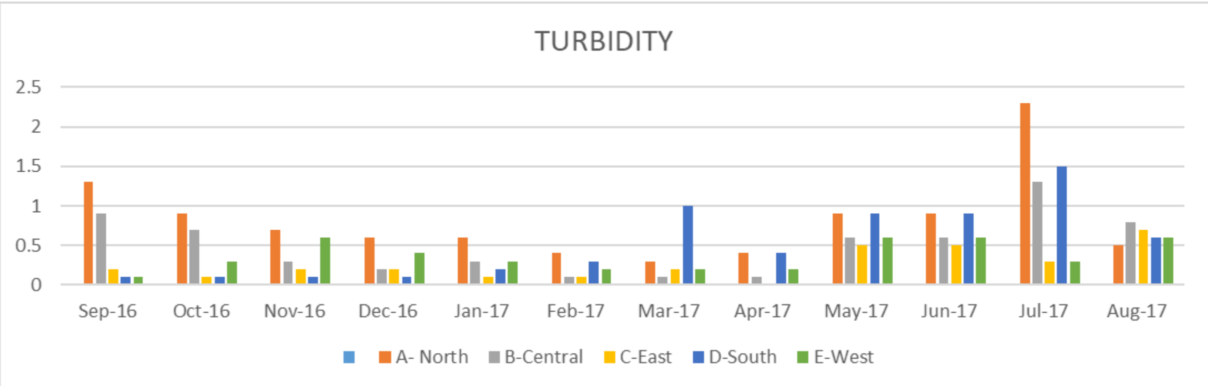

Fig. 2: Graphical representation of Turbidity

Table 3: pH

Samples	Sept 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug 2017
A- North	5.53	5.91	6.02	6.11	6.13	6.32	5.92	5.93	6.4	5.84	6.03	5.64
B-Central	5.82	6.04	6.57	6.87	6.84	6.97	6.45	6.53	**6.9**	5.43	5.99	5.50
C-East	5.11	6.10	5.67	5.64	5.89	6.05	5.63	5.45	6	**5.21**	5.83	**5.21**
D-South	5.50	6.25	5.99	5.82	5.91	6.10	5.85	5.62	6.1	5.44	5.86	5.49
E-West	5.44	5.99	6.17	5.88	6.03	6.33	5.85	5.74	6.2	5.50	5.81	5.51

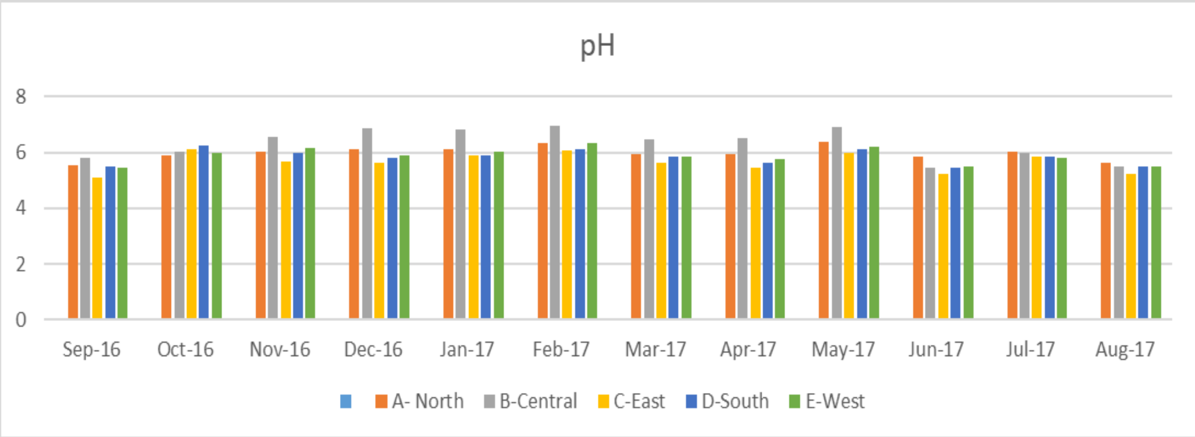

Fig. 3: Graphical representation of pH

Table 4: Dissolve Oxygen

SAMPLE	Sept. 2016	Oct. 2016	Nov. 2016	Dec. 2016	Jan. 2017	Feb. 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug. 2017
A- North	3.8	1.7	2.75	3.4	1.4	3.1	0.7	1.15	2.75	2.4	1.85	2.15
B-Central	5.5	4	5.6	4.4	4.2	7.6	4.8	2.5	5.6	3.55	2.85	3.5
C-East	3.5	3.9	4.8	3.9	3.8	7.2	4.7	2.2	4.8	3.25	2.4	3.4
D-South	2.4	3.6	4.5	3.6	3.4	6.9	5	2.1	4.5	2.8	1.85	2.6
E-West	6.6	4	5.9	6.4	4.5	8.0	5.1	3.0	**5.9**	3.85	2.15	3.8

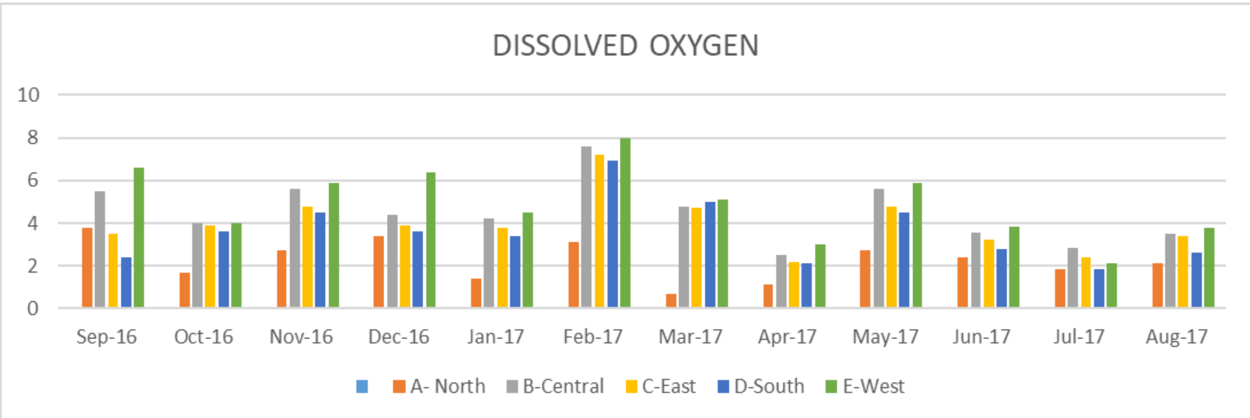

Fig. 4: Graphical representation of Dissolve oxygen

Table 5: Biological Oxygen Demand

Samples	Sept 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug 2017
A- North	2.7	2.3	2.4	2.1	2.8	2.6	3.1	2.7	3.2	3.3	4.2	3.65
B-Central	0.9	1.2	1.0	1.7	1.1	0.9	1.3	2.0	2.3	2.85	3.15	2.4
C-East	2.2	2	1.9	2.3	1.9	0.4	1.5	2.5	2.4	3. 05	3.9	3.5
D-South	2	1.9	1.7	2.2	1.6	0.2	1.2	2.4	2.3	3	3.8	3.3
E-West	0.6	1	0.9	0.6	1.0	0.5	1.0	1.8	0.5	1.5	2.3	2.15

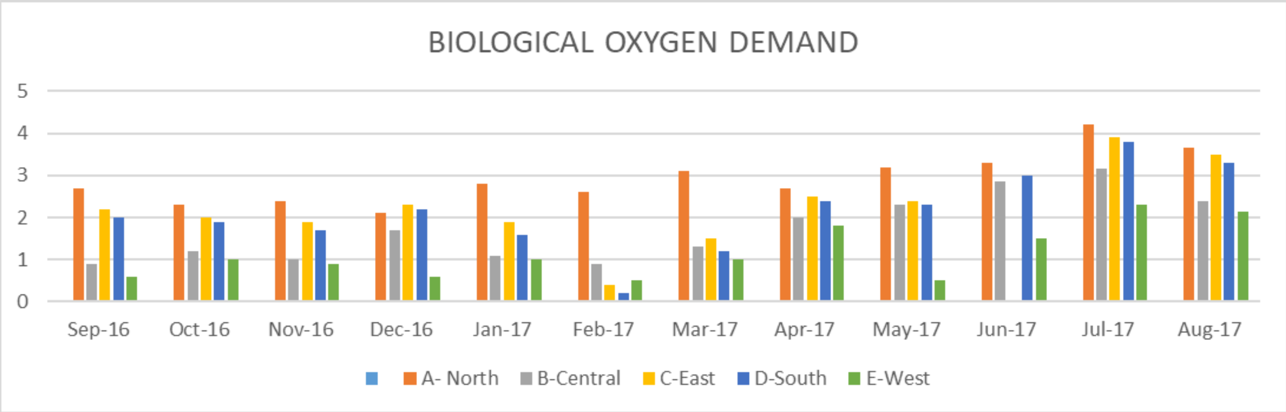

Fig. 5: Graphical representation of Biological oxygen demand

Table 6: Alkalinity

SAMPLE	Sept. 2016	Oct. 2016	Nov. 2016	Dec. 2016	Jan. 2017	Feb. 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug. 2017
A- North	54	44	62	78	99	67	68	40	24	27.6	23	16
B-Central	26	25	16	17	6	12	19	10	13	12.6	10	9.5
C-East	24	33	26	27	21	25	23	18	5	14.3	8.5	9.5
D-South	3	37	40	38	41	32	31	29	10	17	14	11.5
E-West	34	41	48	54	68	54	44	38	12	18	14.5	12

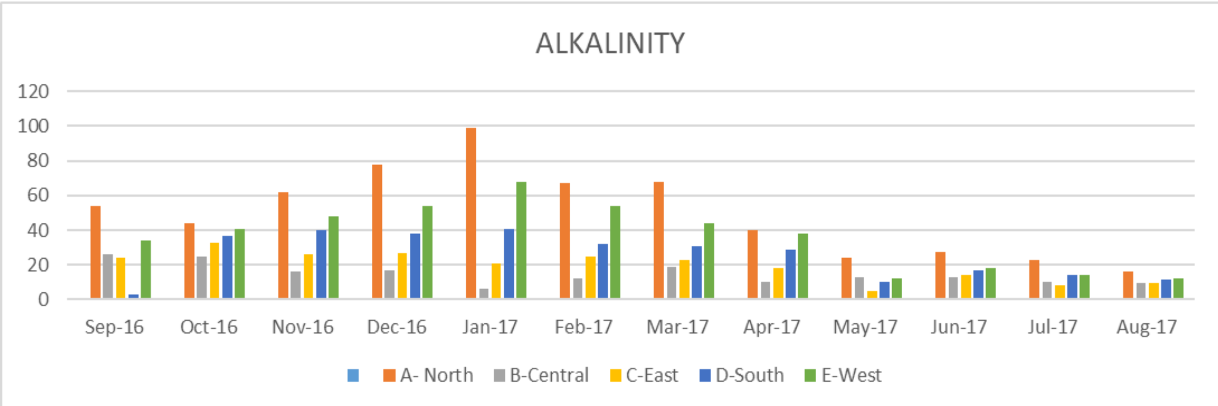

Fig. 6: Graphical representation of Alkalinity

Table 7: Acidity

SAMPLE	Sept. 2016	Oct. 2016	Nov. 2016	Dec. 2016	Jan. 2017	Feb. 2017	March 2017	April 2017	May 2017	June 2017	July 2017	Aug. 2017
A- North	63	61	64	94	53	31	92	28	21.5	42	59.5	93.5
B-Central	14	11	5	14	5	3	12	4	5	21	13.5	47
C-East	53	47	35	60	46	12	36	14	16.5	25	34.5	63
D-South	48	40	31	61	51	9	28	11	18.5	26.5	43	63.5
E-West	72	64	40	81	63	41	47	19	23	29	52	69.5

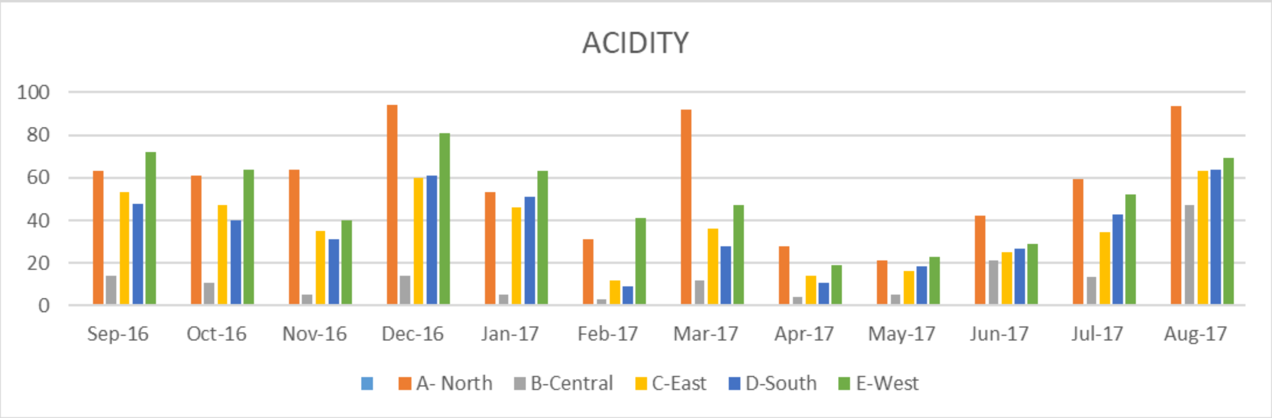

Fig. 7: Graphical representation of Acidity

4. Conclusion

It can be concluded that the water samples that has been studied bears a good water quality and were all remain below their permissible limits for each particular parameters. But for drinking purposes the water required treatment for purification. So we can declare the spring water selected for qualitative analysis was good enough for consumption of household purposes if not for drinking purposes.

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