APPLICATION OF WATER QUALITY INDEX (WQI) METHOD TO ASSESS THE WATER QUALITY OF DALA TOWNSHIP, YANGON REGION, MYANMAR

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Abstract

Nowadays, water quality issues have become a significant concern due to the growth of population, urban expansion and technological development. The current study is conducted to investigate the water quality status of Dala Township, using the Water Quality Index (WQI) method. The WQI was used to aggregate the diverse parameters into a single term that is helpful for the selection of appropriate treatment technique to meet the drinking water standard. In this study, the WQI of ground and surface water samples were evaluated by analyzing the various parameters such as pH, total hardness, total dissolved solid, conductivity, chloride, nitrate, sulphate, calcium, dissolved oxygen and biological oxygen demand. The WQI values for all the samples were found in the range of 51 - 78. The highest value of WQI was observed in the river water sample and the lowest WQI value was observed in ground water sample. Results of the assessment confirmed that the WQI values of all the water sources are high and they are not suitable for direct consumption.

Keywords: Water Quality Index (WQI), drinking water standard, parameters

Introduction

Unsafe drinking water is one of the main problems in developing countries. Scarcity of clean and potable water often hit various parts of the world due to the dry season and pollution of water resources. Nowadays, water quality issue has become a significant concern due to the growth of population, urban expansion and socio-economic development (Kumar et al., 2005).

Seawater intrusion into the surface water and ground water sources is a serious problem in coastal regions worldwide. Dala Township is located on the opposite side of Yangon downtown across Yangon River which runs from Yangon to the Gulf of Martaban of the Andaman Sea. The township has a total land area of 224 square kilometers and consists of 24 wards and 23 village tracts (including 54 villages). It has a population of 172,857 people living in 37,912 households. Ground water is not trusted as a source for drinking water due to the salt intrusion. Therefore, most of the people in this area rely on fresh water ponds for drinking water. When the rainwater collecting in ponds it dries out seasonally, local people have to use salty ground water or fresh water brought across from Yangon River. Nowadays, local residents obtain YCDC water distribution system but it is still insufficient (https//:www. mmtimes.com/ dala-residents).

This study is intended to assess the quality of water for drinking purposes in Dala Township using the Water Quality Index (WQI) method. WQI is the most effective method to monitor the surface as well as ground water pollution. It provides a single number that expresses the overall water quality based on the different parameters (Selvam et al., 2014). There are so many types of WQI methods. Some of the most commonly used methods to evaluate the WQI are Weight Arithmetic Water Quality Index (WAWQI), the Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI), Oregon Water Quality Index (OWQI) and Nemerow Pollution Index. In this study, the calculation of WQI was done using the Weight Arithmetic Water Quality Index (WAWQI) method.

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Materials and Methods

Sampling

Ground water samples were collected from three tube wells in Kamakasit Quarter, Set Myay Quarter and Nyaung Gone Village, Dala Township, Yangon Region. Surface water samples were taken from ponds and Yangon River nearby Kamakasit Quarter, Set Myay Quarter and Nyaung Gone village, Dala Township, Yangon Region.

Tube well water samples were collected at a depth of 50 ft, 60 ft and 80 ft after 2 minutes of pumping to obtain the deep water as the test sample using (1 L) capacity with screwed cap polyethylene bottles previously cleaned with deionized water. Pond water samples were collected at a depth of 2 ft below the surface level to avoid surface debris using (1 L) capacity stainless steel sampling bottle previously cleaned with deionized water and transferred to the (1 L) capacity with screwed cap sterilized polyethylene bottle. River water samples were collected at a distance of about 20 ft from the riverbank and at a depth of 5 ft below the surface of the river using (1 L) capacity stainless steel sampling bottle previously cleaned with deionized water. Then it was readily transferred to the (1 L) capacity with screwed cap sterilized polyethylene bottle. After collection, each bottle was clearly marked the name and date of sampling. Then the collected sampling bottles were placed in an ice box with ice cubes to main the temperature at 4^{o}C and immediately transported to the laboratory (APHA 2005). Water samples were collected from September 2019 to March 2020 (during monsoon and post-monsoon seasons). The location map of sampling site is shown in Figure (1).

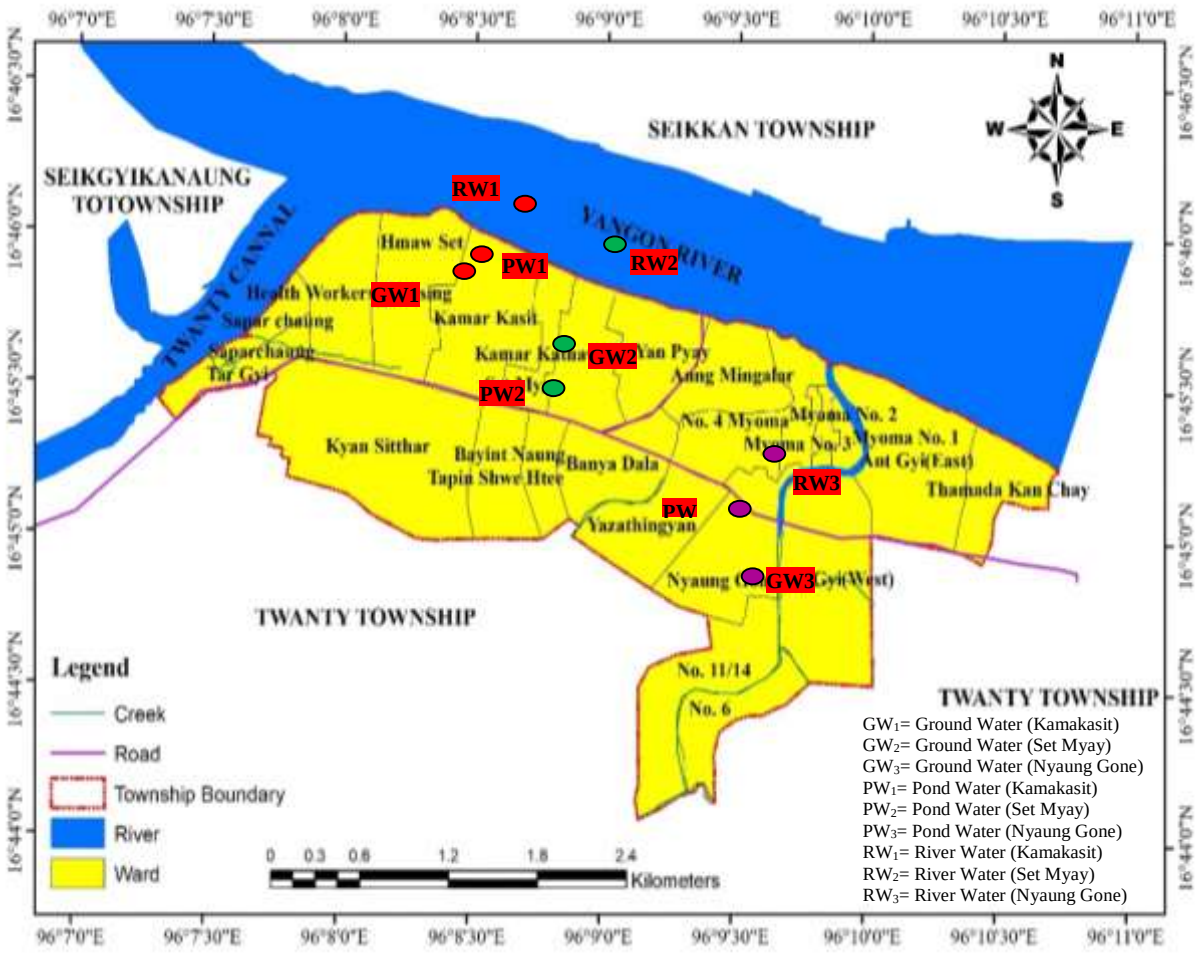

Figure 1 Location Map of Sample Collection Area

Analysis of Water Sample

For the assessment of water quality, ten important parameters were determined such as pH, total hardness, total dissolved solid (TDS), conductivity, chloride, nitrate, sulphate, calcium, dissolved oxygen (DO) and biological oxygen demand (BOD) and compared with the WHO Drinking Water Standard. Parameters were analyzed by using the LaMotte pH 5 Plus Meter (5-0035-01), LaMotte Con 6 Plus Conductivity Meter (5-0038-02), LaMotte TDS 6 Meter (5-0036-02), LaMotte Smart 3 Colorimeter (1910) and DO and BOD Meter (HANNA HI5421).

Assessment of Water Quality by WQI Method

WQI is an effective method to assess the quality and ensure the sustainable safe use of water for drinking purposes. It integrates several water quality parameters into a mathematical equation that rates the water quality with number (Yogendra & Puttaiah, 2008). In this study, ten important parameters were chosen for the calculation of WQI and has been calculated by using the recommended WHO Drinking Water Standard. The calculation of the WQI was done using Weighted Arithmetic Water Quality Index (WAWQI) method (Brown et al., 1972). WQI is in the following form:

$$WQI_{WA} = \sum W_i Q_i / \sum W_i$$

where W_i is the relative weight of i^{th} parameter and Q_i is the water quality rating scale of i^{th} parameter. The value of W_i and Q_i are calculated using the following equation:

$$W_i = k / S_i$$

$$k = 1/ \sum S_i$$

$$Q_i = 100 \left[(V_i - V_{id})/ (S_i - V_{id})\right]$$

where V_i is the observed value or measurable value of the i^{th} parameter, k is the proportionality constant, S_i is the standard permissible value of the i^{th} parameter and V_{id} is the ideal value of the i^{th} parameter in drinking water. In that case, all the ideal values V_{id} are taken as zero for drinking water except pH and DO. For pH, V_{id} is 7.0 and a standard maximum permissible value is 8.5 mg/L. Therefore, the quality rating scale for pH is calculated as follows:

$$Q_{ipH} = 100 \left\lfloor(V_{ipH} - 7.0) / (8.5 - 7.0)\right\rfloor$$

where V_{ipH} is the observed value of pH. For DO, V_{id} is 14.6 mg/L and the standard maximum permissible value for drinking water is 5 mg/L. Therefore, its quality rating scale is calculated as follows:

$$Q_{iDO} = 100 \left[(V_{iDO} - 14.6) / (5.0 - 14.6)\right]$$

where V_{iDO} is the observed value of dissolved oxygen. The WQI value can be categorized into five classes: ranking between 0 - 25 represents excellent water quality, ranking between 25 - 50 represents good water quality, ranking between 51 - 75 represents poor water quality, ranking between 76 - 100 represents very poor quality and above 100 represents water is excessively polluted and unsuitable for drinking.

Results and Discussion

In this study, the suitability of water quality for domestic purpose was assessed based on WQI values. The principal factor in calculating the WQI is the selection of water quality parameters. Parameters having low permissible limits are more harmful to the water quality because a slight increase affects these values to a great extent. In this investigation ten parameters

such as pH, total hardness, total dissolved solid, conductivity, chloride, nitrate, sulphate, calcium, DO and BOD were analysed.

Dala Township is located in the lower part of the Ayeyarwady delta region. Due to the proximity of the Andaman Sea (about 34 kilometers), the majority of the streams that flow in the lower delta are characterized by a high level of salinity. Firstly, Table (1) shows the characteristics of ground water samples. It could be seen that pH, nitrate and BOD values of ground water samples fall within the acceptable limit. Therefore, the ground water sources of the study area were microbially safe but total hardness, sulphate and calcium content do not fall within the standard limit. EC is directly related to the dissolved ions present in the water. TDS designates the general nature of water quality or salinity. Water containing above 500mg/L is regarded undesirable for domestic uses. Similarly, Chloride in excess of 100mg/L imparts a salty taste and concentration in excess of 100mg/L may cause physiological damage (River, 2011). Observed TDS, EC and chloride values of ground water samples ranged between 1805 - 3400 mg/L, 3610 - 6800 µS/cm and 1580 - 3110 mg/L respectively and significantly higher than the standard limit. It could be revealed that the ground water sources were severely intruded with salt. The vast amount of TDS, EC and chloride content were found in the tube well water of Kamasit Quarter (GW_1) because it is the nearest place to the Yangon Riverbank and located in the downstream area.

Table 1 Characteristics of Ground Water Samples

Sr No.	Parameters	GW_1	GW_2	GW_3	Standard Values*
1.	pH	6.9±0.21	6.72±0.92	7.1±0.14	6.5 - 8.5
2.	Total Hardness (mg/L)	372±45	305±58	288±21	200
3.	TDS(mg/L)	3400±62	1805±54	3140±46	500
4.	EC(µS/cm)	6800±71	3610±85	6280±73	1000
5.	Chloride(mg/L)	3110±65	1580±53	2780±44	250
6.	Nitrate(mg/L)	0.10±0.03	0.12±0.01	0.12±0.006	10
7.	Sulphate(mg/L)	404±31	256±23	391±17	200
8.	Calcium(mg/L)	80±7	106±12	98±10	75
9.	DO(mg/L)	3.4±0.1	3.7±0.13	3.2±0.05	>5
10.	BOD(mg/L)	1.38±0.039	1.32±0.03	1.41±0.09	<5

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev

The quantity of total oxygen dissolved in a water body is expressed as dissolved oxygen (DO) and its concentration depend on physical, chemical and biological activities of the water body. Estimation of DO is essential in surface water pollution control. The total amount of oxygen required by aerobic microorganisms for complete degradation of organic wastes present in a water body is termed as biological oxygen demand (BOD). When BOD levels are elevated, DO levels decrease because of the oxygen that is available in the water is being consumed by the microorganisms (https://www.coursehero.com/file/37889371 /BOD forwebsite-1pdf/).

Table (2) shows the characteristics of surface water samples; pond water and river water sources. It could be observed that physico- chemical properties of pond water sources fall within the permissible limit but BOD levels slightly higher than the standard limit. The highest BOD level (6.59 mg/L) was found in the pond water sample of Nyaung Gone Village. River water sources are mostly contaminated with dissolved ions and organic matter due to the tidal effect and human activity. According to the results, the highest BOD level (7.3 mg/L) was found in the river water sample of Set Myay Quarter. Moreover, TDS, EC and chloride values of river water samples ranged between 899 - 1873 mg/L, 1797 - 3746 µS/cm and 428 - 902 mg/L respectively and

significantly higher than the standard limit. The present analysis revealed that DO level of the pond and river water fall within the acceptable limit but BOD levels slightly higher than the permissible limit. Therefore, it could be assumed that pond water and river water sources were slightly contaminated with organic matter and the direct consumption of this source is not safe for drinking purpose.

Table 2 Characteristics of Surface Water Samples

Sr No.	Parameters	PW_1	PW_2	PW_3	RW_1	RW_2	RW_3	Stand -ard Values*
1.	pH	6.79±1.1	6.97±0.9	6.82±1.3	7.2±0.1	7.1±0.04	7.2±0.12	6.5 - 8.5
2.	Total Hardness (mg/L)	54±7	49±8.9	57±8	121±29	188±31	130±15	200
3.	TDS(mg/L)	185±18	163±27	189±11	899±70	1281±41	1873±68	500
4.	EC(µS/cm)	370±22	326±17	378±14	1797±55	2562±67	3746±82	1000
5.	Chloride (mg/L)	25±5	21±3.6	32±2.4	470±47	428±75	902±88	250
6.	Nitrate (mg/L)	0.12±0.02	0.09±0.001	0.12±0.016	0.19±0.04	0.28±0.08	0.2±0.034	10
7.	Sulphate (mg/L)	0.04±0.013	0.08±0.003	0.09±0.006	7.2±4.3	6.5±2.01	9.6±3.5	200
8.	Calcium (mg/L)	17±1.01	21±1.82	25±0.15	64±6.3	89±8.7	69±5.9	75
9.	DO(mg/L)	6.17±2.6	6.28±3.1	5.97±2.8	6.63±3.5	6.58±2.1	6.78±3	>5
10.	BOD (mg/L)	6.25±2.2	6.4±3.43	6.59±3.1	7.02±3.5	7.3±2.1	6.8±3.7	<5

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev

Tables (3), (4) and (5) show the calculated values of WQI for the ground water. The WQI value of ground water samples were found in the range of 51- 63. According to the WQI value, the ground water samples were found to be poor of category because they contain a high content of dissolved ions depending on the soil conditions of water passage.

Table 3 Calculation of Water Quality Index Value of Ground Water from Kamakasit Quarter (GW_1)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight(W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	6.9	6.5 - 8.5	0.181	- 6.67	-1.21
2.	Total Hardness(mg/L)	372	200	0.0077	186	1.43
3.	TDS(mg/L)	3400	500	0.0031	680	2.108
4.	EC(µS/cm)	6800	1000	0.00154	680	1.047
5.	Chloride(mg/L)	3110	250	0.0062	1244	7.713
6.	Nitrate(mg/L)	0.10	10	0.154	1.0	0.154
7.	Sulphate(mg/L)	404	200	0.0077	202	1.56
8.	Calcium(mg/L)	80	75	0.021	106.4	2.234
9.	DO(mg/L)	3.4	>5	0.308	116.7	35.9
10.	BOD(mg/L)	1.38	<5	0.308	27.6	8.5
				$\sum W_i = 1$		$\sum W_i Q_i$=59
$WQI = \sum W_i Q_i / \sum W_i$= 59						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Table 4 Calculation of Water Quality Index Value of Ground Water from Set Myay Quarter (GW_2)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight(W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	6.72	6.5 - 8.5	0.181	-18.6	-3.37
2.	Total Hardness(mg/L)	305	200	0.0077	152.5	1.174
3.	TDS(mg/L)	1805	500	0.0031	361	1.119
4.	EC(µS/cm)	3610	1000	0.00154	361	0.556
5.	Chloride(mg/L)	1580	250	0.0062	632	3.918
6.	Nitrate(mg/L)	0.12	10	0.154	1.2	0.185
7.	Sulphate(mg/L)	256	200	0.0077	128	0.986
8.	Calcium(mg/L)	106	75	0.021	141.3	2.97
9.	DO(mg/L)	3.7	>5	0.308	114	35
10.	BOD(mg/L)	1.32	<5	0.308	26.4	8.13
				$\sum W_i = 1$		$\sum W_i Q_i$=51
$WQI = \sum W_i Q_i / \sum W_i$= 51						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Table 5 Calculation of Water Quality Index Value of Ground Water from Nyaung Gone Village (GW_3)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight(W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	7.1	6.5 - 8.5	0.181	6.67	1.207
2.	Total Hardness (mg/L)	288	200	0.0077	144	1.108
3.	TDS (mg/L)	3140	500	0.0031	628	1.947
4.	EC(µS/cm)	6280	1000	0.00154	628	0.967
5.	Chloride (mg/L)	2780	250	0.0062	1112	6.894
6.	Nitrate(mg/L)	0.12	10	0.154	1.2	0.185
7.	Sulphate(mg/L)	391	200	0.0077	195.5	1.505
8.	Calcium(mg/L)	98	75	0.021	130.67	2.744
9.	DO(mg/L)	3.2	>5	0.308	118.75	36.58
10.	BOD(mg/L)	1.41	<5	0.308	28.2	8.69
				$\sum W_i = 1$		$\sum W_i Q_i$=63
$WQI = \sum W_i Q_i / \sum W_i$= 63						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Tables (6), (7) and (8) show the calculated values of WQI for the pond water. The WQI value of pond water samples were found in the range of 64- 68. According to the WQI value, the pond water samples were also found to be poor of category because BOD level do not fall within the permissible limit. Although the dissolved ions content in pond water were low, the BOD level were higher than that of ground water and river water.

Table 6 Calculation of Water Quality Index Value of Pond Water from Kamakasit Quarter (PW_1)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight(W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	6.79	6.5 - 8.5	0.181	-14	-2.534
2.	Total Hardness(mg/L)	54	200	0.0077	27	0.21
3.	TDS(mg/L)	185	500	0.0031	37	0.1147
4.	EC(µS/cm)	370	1000	0.00154	37	0.057
5.	Chloride(mg/L)	25	250	0.0062	10	0.062
6.	Nitrate(mg/L)	0.12	10	0.154	1.2	0.185
7.	Sulphate(mg/L)	0.04	200	0.0077	0.02	0.00015
8.	Calcium(mg/L)	17	75	0.021	22.67	0.476
9.	DO(mg/L)	6.17	>5	0.308	87.8	27.042
10.	BOD(mg/L)	6.25	<5	0.308	125	38.5
				$\sum W_i = 1$		$\sum W_i Q_i$=64
$WQI = \sum W_i Q_i / \sum W_i$= 64						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Table 7 Calculation of Water Quality Index Value of Pond Water from Set Myay Quarter (PW_2)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight (W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	6.97	6.5 - 8.5	0.181	-2	-0.36
2.	Total Hardness(mg/L)	49	200	0.0077	24.5	0.189
3.	TDS (mg/L)	163	500	0.0031	32.6	0.101
4.	EC(µS/cm)	326	1000	0.00154	32.6	0.050
5.	Chloride (mg/L)	21	250	0.0062	8.4	0.052
6.	Nitrate(mg/L)	0.09	10	0.154	0.9	0.139
7.	Sulphate(mg/L)	0.08	200	0.0077	0.04	0.0003
8.	Calcium(mg/L)	21	75	0.021	28	0.588
9.	DO(mg/L)	6.28	>5	0.308	86.7	26.7
10.	BOD(mg/L)	6.4	<5	0.308	128	39.4
				$\sum W_i = 1$		$\sum W_i Q_i$=67
$WQI = \sum W_i Q_i / \sum W_i$= 67						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Table 8 Calculation of Water Quality Index Value of Pond Water from Nyaung Gone Village (PW_3)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight(W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	6.82	6.5 - 8.5	0.181	-12	-2.172
2.	Total Hardness(mg/L)	57	200	0.0077	28.5	0.22
3.	TDS (mg/L)	189	500	0.0031	37.8	0.117
4.	EC(µS/cm)	378	1000	0.00154	37.8	0.058
5.	Chloride (mg/L)	32	250	0.0062	12.8	0.079
6.	Nitrate(mg/L)	0.12	10	0.154	1.2	0.185
7.	Sulphate(mg/L)	0.09	200	0.0077	0.045	0.0003
8.	Calcium(mg/L)	25	75	0.021	33.33	0.699
9.	DO(mg/L)	5.97	>5	0.308	89.9	27.7
10.	BOD(mg/L)	6.59	<5	0.308	132	41
				$\sum W_i = 1$		$\sum W_i Q_i$=68
$WQI = \sum W_i Q_i / \sum W_i$= 68						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Tables (9), (10) and (11) show the calculated values of WQI for the river water. The WQI value of river water samples were found in the range of 76 - 78. According to the WQI value, the river water samples were found to be very poor of category because they were also contaminated with dissolved solids and BOD level were higher than the acceptable limit. It indicated that river water sources were contaminated with dissolved ions and organic matter. Therefore, it is unsuitable for direct consumption.

Table 9 Calculation of Water Quality Index Value of River Water from Kamakasit Quarter (RW_1)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight (W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	7.2	6.5 - 8.5	0.181	13.3	2.41
2.	Total Hardness(mg/L)	121	200	0.0077	60.5	0.47
3.	TDS (mg/L)	899	500	0.0031	179.8	0.56
4.	EC(µS/cm)	1797	1000	0.00154	179.8	0.277
5.	Chloride (mg/L)	470	250	0.0062	188	1.166
6.	Nitrate(mg/L)	0.19	10	0.154	1.9	0.29
7.	Sulphate(mg/L)	7.2	200	0.0077	3.6	0.028
8.	Calcium(mg/L)	64	75	0.021	85.3	1.791
9.	DO(mg/L)	6.63	>5	0.308	83	25.6
10.	BOD(mg/L)	7.02	<5	0.308	140	43
				$\sum W_i = 1$		$\sum W_i Q_i$=76
$WQI = \sum W_i Q_i / \sum W_i$= 76						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Table 10 Calculation of Water Quality Index Value of River Water from Set Myay Quarter (RW_2)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight (W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	7.1	6.5 - 8.5	0.181	6.67	1.207
2.	Total Hardness(mg/L)	188	200	0.0077	94	0.72
3.	TDS (mg/L)	1281	500	0.0031	256	0.794
4.	EC(µS/cm)	2562	1000	0.00154	256	0.395
5.	Chloride (mg/L)	428	250	0.0062	171.2	1.061
6.	Nitrate(mg/L)	0.28	10	0.154	2.9	0.45
7.	Sulphate(mg/L)	6.5	200	0.0077	3.25	0.025
8.	Calcium(mg/L)	89	75	0.021	118.67	2.492
9.	DO(mg/L)	6.58	>5	0.308	84	26
10.	BOD(mg/L)	7.3	<5	0.308	146	45
				$\sum W_i = 1$		$\sum W_i Q_i$=78
$WQI = \sum W_i Q_i / \sum W_i$= 78						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

Table 11 Calculation of Water Quality Index Value of River Water from Nyaung Gone Village (RW_3)

Sr No.	Parameters	Observed values (V_i)	Standard Values* (S_i)	Unit Weight (W_i)	Quality Rating Scale (Q_i)	$W_i Q_i$
1.	pH	7.2	6.5 - 8.5	0.181	13.33	2.413
2.	Total Hardness(mg/L)	130	200	0.0077	65	0.5
3.	TDS(mg/L)	1873	500	0.0031	374.6	1.161
4.	EC(µS/cm)	3746	1000	0.00154	374.6	0.577
5.	Chloride(mg/L)	902	250	0.0062	360.8	2.237
6.	Nitrate(mg/L)	0.2	10	0.154	2	0.308
7.	Sulphate(mg/L)	9.6	200	0.0077	4.8	0.037
8.	Calcium(mg/L)	69	75	0.021	92	1.932
9.	DO(mg/L)	6.78	>5	0.308	81.5	25
10.	BOD(mg/L)	6.8	<5	0.308	136	42
				$\sum W_i = 1$		$\sum W_i Q_i$=76
$WQI = \sum W_i Q_i / \sum W_i$= 76						

*W.H.O (2017), "Guideline for Drinking Water Quality." WHO/SDE/WSH/03.04/09/Rev/

A comparative analysis for all the water samples are shown in Figure (2). As a result, all the WQI values of water samples fall within the poor and very poor categories. Therefore, the effective water treatment method for the study area was needed for domestic purposes. For reducing the dissolved ions level, the water will be treated with ion exchange method, lime soda softening method, capacitive deionization method and reverse osmosis membrane can be used. The BOD level can be reduced by using the chemicals, advanced oxidation process and membrane bioreactor can be used.

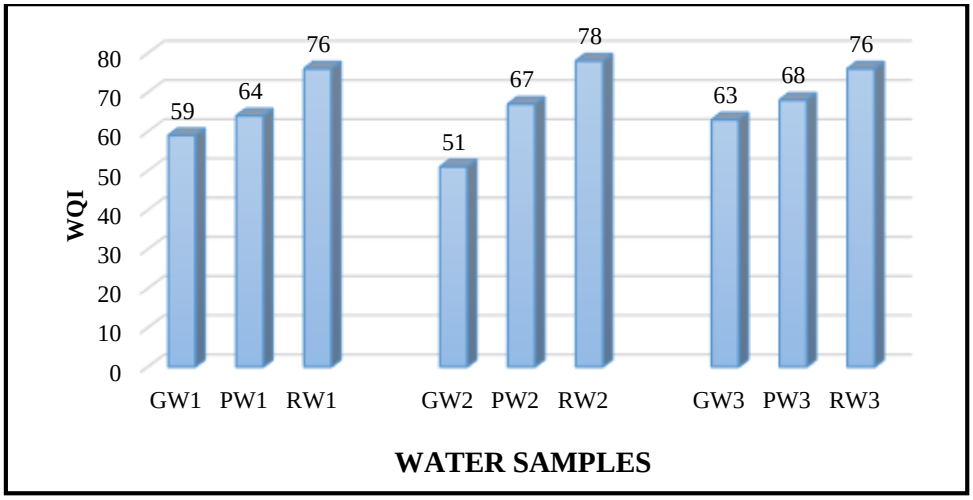

Figure 2 Water Quality Index of Water Samples

Conclusion

Improvement of water supply structures and water treatment system are possible solutions to improve the quality of drinking water. In Dala Township, the ground water sources were mostly contaminated with dissolved solids and considerably higher than the acceptable range of WHO Drinking Water Standard. The BOD level of pond water sources slightly higher than the standard value but the other remaining parameters fall within the acceptable limit. Moreover, the river water sources were also contaminated with dissolved solids and BOD level were higher than the acceptable limit. Based on the observed WQI value, it can be concluded that the overall water quality of Dala Township was impair and the effective water treatment systems are required to develop for the community residents of this area.

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