Journal of Chemical, Environmental and Biological Engineering
2018; 2(2): 74-81
http://www.sciencepublishinggroup.com/j/jcebe
doi: 10.11648/j.jcebe.20180202.16
ISSN: 2640-2645 (Print); ISSN: 2640-267X (Online)

Assessment of Ground and Surface Water Quality for Irrigation at Dumki, Patuakhali in Bangladesh

Tanvir Ahamed Hira[1], Mohammad Kabirul Islam[1], Nowrose Jahan Lipi[2], Mohammad Monirul Islam[1, *], Mohammad Isfatuzzaman Bhuyan[2], Mahbuba Ferdous[1]

[1]Department of Soil Science, Patuakhali Science and Technology University, Dhaka, Bangladesh

[2]Department of Agronomy, Patuakhali Science and Technology University, Dhaka, Bangladesh

Email address:
monirulpstu1@gmail.com (M. M. Islam)

[*]Corresponding author

To cite this article:
Tanvir Ahamed Hira, Mohammad Kabirul Islam, Nowrose Jahan Lipi , Mohammad Monirul Islam, Mohammad Isfatuzzaman Bhuyan, Mahbuba Ferdous. Assessment of Ground and Surface Water Quality for Irrigation at Dumki, Patuakhali in Bangladesh. *Journal of Chemical, Environmental and Biological Engineering*. Vol. 2, No. 2, 2018, pp. 77-81. doi: 10.11648/j.jcebe.20180202.16

Received: October 14, 2018; **Accepted**: November 7, 2018; **Published**: January 7, 2019

Abstract: Water is one of the most valuable natural resource on earth but its quality is very much important and its quality as well as its utilization for irrigation. The present observation was carried out to find out the quality of 50 ground and surface water samples collected from 5 unions at Dumki upazila under Patuakhali district. The chemical analysis of water samples including pH, EC, K^+, Na^+, PO_4^{3-} and SO_4^{2-}. The pH of ground and surface water were 7.22 to 8.47 and 6.56 to 8.51. The EC of ground and surface water were 620 to 4400 and 160 to 590 μScm^{-1}. The EC of ground water was higher than the surface water. The PO_4^{3-} concentration of ground and surface water were 0.12 to 0.80 and 0.0531 to 0.4248 mgL^{-1}. The SO_4^{2-} concentration of ground and surface water were 3.33 to 18.76 mgL^{-1} and 5.504 to 17.364 mgL^{-1}. The concentration of $PO_4^{3-}$and SO_4^{2-} in all collected water samples were within the safe limit for irrigation and the concentration of Na^+ of ground and surface water were 40.35 to 83.63 mgL^{-1} and 13.54 to 26.73 mgL^{-1}. The Na^+ concentration was higher in ground water than the surface water. K^+ concentration of the ground and surface water were 4.11 to 29.79 mgL^{-1} and 11.64 to 89.73 mgL^{-1} respectively. The K^+ concentrations of ground and surface water were not the safe limit for the irrigation. The SO_4^{2-} concentration in this area was estimated within the safe limit for drinking.

Keywords: Ground Water, Surface Water, Irrigation, Dumki, Patuakhali, Bangladesh

1. Introduction

Water quality for irrigation is an important criterion for successful crop production as it contains different toxic ions in varying concentrations. Irrigated agriculture is dependent on water of useable quality. If low quality of water is used for irrigation, toxic elements may accumulate in the soil thus deteriorating soil properties. In Bangladesh, major part of arable land is under rain fed ecosystem. But the rainfall is not sufficient for dry season. This is why; farmers face acute shortage of irrigation water during dry season and use water from both surface and underground sources. Besides agricultural point of view, water of desirable quality is absolutely essential for drinking, domestic and industrial purposes. Thus, water quality assessment is most significant for irrigation.

Water is one of the most valuable natural resources on earth but its quality is of prime importance. Because the chemical constituents of water determine its quality as well as its utilization for irrigation, industrial and domestic usages. The main soluble constituents are Ca^{2+} Mg^{2+}, Na^+ and K^+ as cations and Cl^-, SO_4^{2-}, CO_3^{2-} and HCO_3^-, PO_4^{3-} as anions. Out of the soluble constituents, $Ca^{2+,}$ Mg^{2+}, Na^+, $Cl^{-,}$ $SO_4^{2-,}$ HCO_3^- and B^+ are of prime importance in judging the water quality for irrigation.

Water contains certain potentially toxic ions such as B^+, Na^+, Cl^- etc. The concentrations of these toxic ions in irrigation water are particularly important because many crops are susceptible to even extremely low concentrations of these elements [3].

Some systematic investigations on the water quality in some selected sites of Bangladesh, viz, Shahzadpur, Meherpur, Kalihati, Khagrachari, Phulpur, Madhupur, Muktagacha, Trishal and Pangsha thana have been conducted [1]. Most of the chemical analyses of these investigations confined within pH , EC, Ca^{2+}, Mg^{2+}, K^{+}, CO_3^{2-}, HCO_3^{-}, Cl^{-}, SO_4^{2-}, NO_3^{-}, Fe^{2+}, B^{+} and Na^{+}. Now a days, toxic elements are very important for irrigation, drinking, livestock and industrial purposes. In fact, there is very less Laboratory for systematic assessment of water quality in Bangladesh.

The total land area of Dumki upazila under the district of Patuakhali is 92.46 square kilometers. There are five (5) unions of the Dumki upazila, which are the Angaria, Lebukhali, Muradia, Sreerampur, and Pangasia. The study area under the AEZ 18 (Young Meghna Estuarine Floodplain). In the study area surface water sources (pond, canal, and river) are used for irrigation and aquaculture and ground water (deep tube-well specially hand tube-well) is used for drinking without judging chemical quality. Therefore, considering national importance of pond or surface water reservoir and groundwater for irrigation, aquaculture and drinking purpose with chemical quality.

In the study area, hand tube well waters are mainly used for drinking purpose and waters from both surface and ground sources are mainly consumed by livestock.

2. Methods

Water samples for quality assessment are analyzed for chemical constituents. An attempt has been taken to analyze ground and surface water samples collected from the Dumki upazila under the district of Patuakhali.

Collection and Preparation of Ground and Surface Water Samples

Ground water and surface water samples were collected from selected sites of Dumki Upazilla. Fifty (50) ground water and surface water samples were randomly collected from 5 Unions. Twenty four (24) ground water samples and twenty six (26) surface water samples were collected during dry season from February 28 to March 03, 2016 following the procedures mentioned by [6]. The water samples were collected from both surface and underground sources (Table 1).

Water samples were collected in 250 ml plastic bottles. These bottles were cleaned with dilute hydrochloric acid and then washed with tap water followed by distilled water. Before sampling, bottles were again rinsed 3 to 4 times with water to be sampled. The collected samples were tightly sealed immediately to avoid exposure to air. Samples were collected at running condition of hand tube well after pumping sufficient quantity of water. All water were colorless, odorless, tasteless and free from turbidity at the time of sampling. The water samples after proper marking and labeling were carried to the central Laboratory, at Patuakhali Science and Technology University, for testing and were kept in a clean, cool and dry place. Samples were filtered through Whatman no. l filter paper to remove undesirable solid and suspended materials. The analysis was conducted within few days. The pH and EC immediately taken while carried to the samples at central Lab of Patuakhali Science and Technology University. water samples were protected against bacterial infestation either by adding 2-3 drops of pure toluene.

Figure 1. *Ground water samples.*

Figure 2. *Surface water samples.*

Table 1. *Detail Information Regarding Surface Water and Ground Water Sources of Dumki Upazilla : Angaria Union.*

Sample Number	Sampling location		Sources	Depth (ft.)	Season
	Union	Village			
AS 1	Angaria	Satani	PW	-	Dry Season
AS 2	,,	Angaria Bazar	PW	-	,,
AS 3	,,	Angaria Bazar	CW	-	,,
AS 4	,,	Patabunia	RW	-	,,
AS 5	,,	Kadamtala	RW	-	,,

Sample Number	Sampling location		Sources	Depth (ft.)	Season
	Union	Village			
AG 1	Angaria	Satani	HTW	550	Dry Season
AG 2	,,	Satani	WW	45	,,
AG 3	,,	Angaria Bazar	HTW	1000	,,
AG 4	,,	Angaria Bazar	HTW	760	,,
AG 5	,,	Kadamtala	HTW	850	,,

AS=Angaria Surface Water, AG=Angaria Ground water
HTW=Hand Tube Well Water, RW=River Water
CW= Canal Water, PW= Pond Water
WW=Well Water

Table 2. *Detail Information Regarding Surface Water and Ground Water Sources of Dumki Upazilla : Lebukhali Union.*

Sample Number	Sampling location		sources	Depth (ft.)	Season
	Union	Village			
LS 1	Lebukhali	Notun Bazar	CW	-	Dry Season
LS 2	,,	Purano Bazar	PW	-	,,
LS 3	,,	Lebukhali	RW	-	,,
LS 4	,,	Lebukhali	PW	-	,,
LS 5	,,	Lebukhali	CW	-	,,
LS 6	,,	Kartik Pasha	PW	-	,,
LG 1	Lebukhali	Lebukhali	HTW	1000	Dry Season
LG 2	,,	Lebukhali	HTW	1200	,,
LG 3	,,	Kartik Pasha	HTW	1250	,,
LG 4	,,	Kartik Pasha	HTW	1200	,,

LS=Lebukhali Surface Water, LG=Lebukhali Ground Water

Table 3. *Detail Information Regarding Surface Water and Ground Water Sources of Dumki Upazilla: Muradia Union.*

Sample Number	Sampling location		Sources	Depth (ft.)	Season
	Union	Village			
MS 1	Muradia	Mozumder Hat	PW	-	Dry Season
MS 2	,,	Kalbari Hat	CW	-	,,
MS 3	,,	Amirhossain Hat	RW	-	,,
MS 4	,,	South Muradia	PW	-	,,
MS 5	,,	North Muradia	CW	-	,,
MG 1	Muradia	Mozumder Hat	HTW	1000	,,
MG 2	,,	Kalbari Hat	HTW	1200	,,
MG 3	,,	Mozumder Hat	HTW	1000	,,
MG 4	,,	Souith Muradia	HTW	1250	,,
MG 5	,,	North Muradia	HTW	900	,,

MS=Muradia Surface Water , MG=Muradia Ground water

Table 4. *Detail Information Regarding Surface Water and Ground Water Sources of Dumki Upazilla : Pangasia Union.*

Sample Number	Sampling location		Sources	Depth (ft.)	Season
	Union	Village			
PS 1	Pangasia	Dhopar Hat	CW	-	Dry Season
PS 2	,,	Dhopar Hat	PW	-	,,
PS 3	,,	South Pangasia	PW	-	,,
PS 4	,,	Pangasia Madrasha	CW	-	,,
PS 5	,,	Tokta Khali	PW	-	,,
PG 1	Pangasia	Dhopar Hat	HTW	1000	Dry Season
PG 2	,,	South Pangasia	HTW	1250	,,
PG 3	,,	South Pangasia	HTW	1200	,,
PG 4	,,	Tokta Khali	HTW	1000	,,

PS =Pangasia Surface Water, PG=Pangasia Ground Water

Table 5. *Detail Information Regarding Surface Water and Ground Water Sources of Dumki Upazilla : Sreerampur Union.*

Sample Number	Sampling location		Sources	Depth (ft.)	Season
	Union	Villages			
SS 1	Sreerampur	Jamla	PW	-	Dry Season
SS 2	,,	Gabtali	CW	-	,,
SS 3	,,	North Sreerampur	PW	-	,,

Sample Number	Sampling location		Sources	Depth (ft.)	Season
	Union	Villages			
SS 4	,,	North Sreerampur	PW	-	,,
SS 5	,,	Dumki	PW	-	,,
SG 1	Sreerampur	Jamla	HTW	1000	,,
SG 2	,,	Gabtali	HTW	850	,,
SG 3	,,	North Sreerampur	HTW	800	,,
SG 4	,,	Nortrh sreerampur	HTW	800	,,
SG 5	,,	Dumki	HTW	1000	,,

SS =Sreerampur Surface water, SG=Sreerampur Ground water
HTW=Hand Tube Well Water, RW=River Water
CW= Canal Water, PW= Pond Water
WW=Well Water

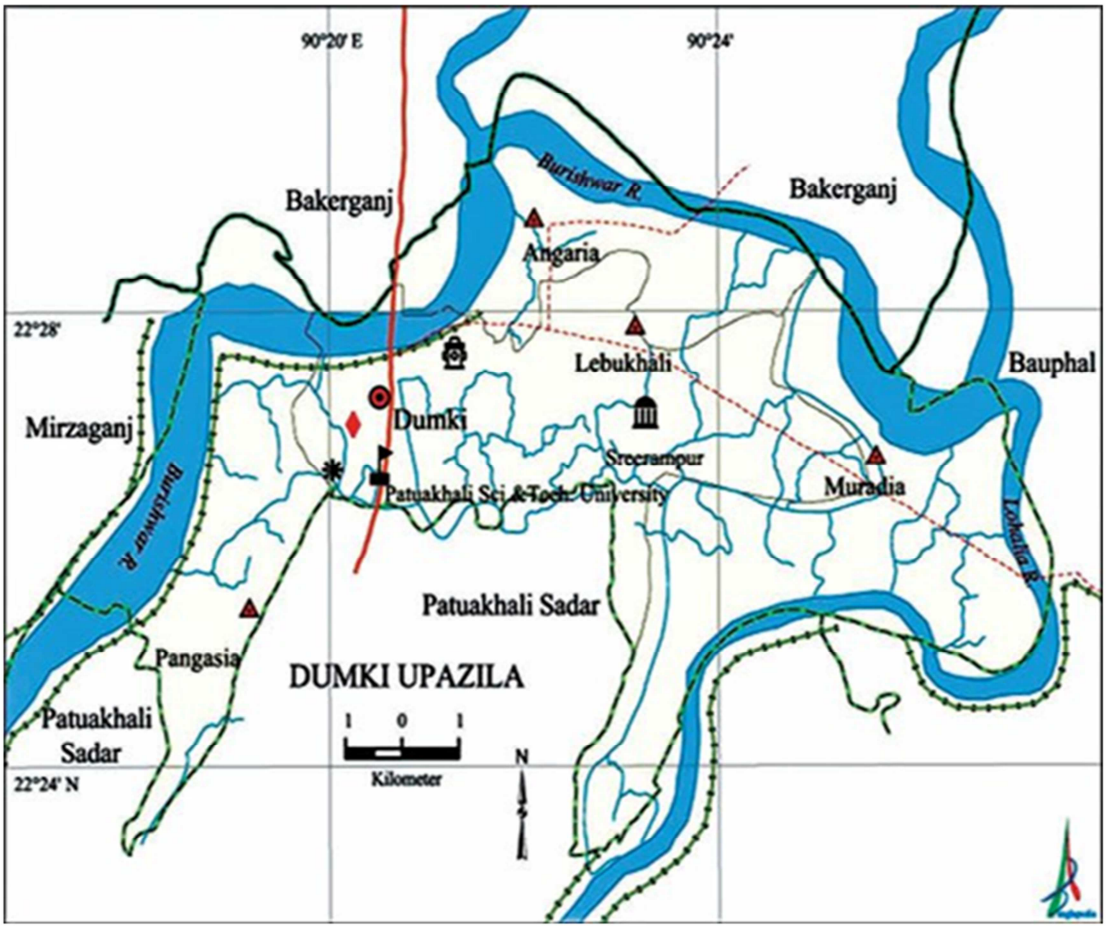

Figure 3. *The detailed ground water and surface water sampling sites have been presented.*

3. Analytical Methods

The chemical constituents considered for analysis were as follows:

i) pH
ii) Electrical conductivity (EC)
iii) Phosphorus (PO42-)
iv) Sulphate (SO42-)
v) Potassium (K+)
vi) Sodium (Na+)

3.1. Determination of pH

The pH of water samples were determined electrometrically following the procedure using pH meter (WTW- pH-522 Model) in the central Laboratory of PSTU. According to [9] the acceptable limit of pH for drinking water is 7.00 to 8.50. On the basis of this limit, the ground water samples of the study area were suitable for drinking but surface water samples were unsuitable for drinking purpose.

3.2. Determination of Electrical Conductivity (EC)

The EC of collected water samples was determined electrometrically using conductivity meter (Model WTW-521). According to the method mentioned by [7].

3.3. Deteremination of Sulphate (SO_4^{2-})

According to the method mentioned by [8] the ground and surface water of the study area might not be problematic for drinking and these water can be safely used for drinking purposes without any toxic effect to SO_4^{2-} content.

Sulphate of water sample was estimated turbimetrically using bariumchloride ($BaCl_2.2H_2O$) as turbimetric agent. Exactly 10 ml water sample was taken in a 50 ml volumetric flask followed by addition of 10 ml acid seed solution and one gm barium chloride ($BaCl_2$) crystal. After proper mixing the white turbity was measured at 535 nm wave length with the help of a spectrophotometer (Model Spetronic Genesys TM_5) following the methods of [10].

3.4. Determination of Potassium (K^+) and Sodium (Na^+)

Potassium and Sodium were determined with the help of a flame emission spectrophotometer (Model Jenway PFP7) by using potassium and sodium filters respectively. The samples were done to filtrated by Whatman No: 42. Then samples were aspirated into a gas flame was carried out in a carefully controlled and reproducible conditions. The air pressure was fixed at 10 psi. The desired spectral line was isolated using interference filters; the intensity of light was 422 nm, 589 nm and 766 nm for the elements of potassium and sodium respectively. The present emission was recorded following the methods by [4].

3.5. Determination of Phosphate (PO_4^{3-})

Phosphate was analyzed colometrically but stannous chloride according to the procedure outlined by [2]. Stannous choloride ($Sncl_2.H_2O$) reagent was added as a reducing agent which developed blue color complex with the reduction of heteropolycomplex formed by coordination of molybdate and phosphate ions. The samples were filtred through Whatman No: 42 and then exactly 20 ml sample water was taken in a 100 ml volumetric flask followed by the addition of 4 ml sulphomolibdic acid and then shake few times, and then distilled water was taken 2/3 of the volumetric flask, Six (6) drops of stannous chloride was added, if the blue color develop then phosphorous is present on the sample

3.6. Statistical Analysis

Statistical analysis of the data generated out of the chemical analysis of water samples were done with the help of a scientific calculator (Casio Super FX-100D) following standard procedure as described by[5]. Correlation studies also performed following the standard method of computer programme (SSPS).

4. Results

Table 6. *pH, EC and concentration of PO_4^{3-}, SO_4^{2-}, K^+, Na^+ in ground water collected in dry season.*

Sample Number	Sources of Water	pH	EC (μScm^{-1})	PO_4^{3-} (mg L^{-1})	SO_4^{2-} (mg L^{-1})	K^+ (mg L^{-1})	Na^+ (mg L^{-1})
AG 1	HTW	8.26	1080	0.27	12.56	8.56	48.76
AG 2	W	7.22	1330	0.32	5.12	29.79	41.77
AG 3	HTW	8.29	920	0.80	16.43	5.14	49.20
AG 4	,,	7.82	4400	0.12	15.74	15.75	83.63
AG 5	,,	8.35	720	0.23	9.46	4.45	40.35
LG 1	,,	8.47	1020	0.32	3.33	5.82	48.23
LG 2	,,	8.36	1090	0.24	10.39	7.88	48.05
LG 3	,,	8.43	960	0.36	17.98	5.14	45.58
LG 4	,,	8.46	980	0.18	16.74	6.16	44.78
MG 1	,,	8.23	820	0.21	10.00	6.51	44.78
MG 2	,,	8.26	760	0.15	14.11	6.16	51.33
MG 3	,,	8.38	650	0.23	13.80	4.11	48.67
MG 4	,,	8.15	620	0.25	17.21	6.16	51.77
MG 5	,,	8.15	660	0.32	12.33	7.53	50.62

HTW= Hand Tube Well Water, W=Well , LG= Lebukhali Ground Water AG= Angaria Ground Water, MG= Muradia Ground Water

Sample Number	Sources of Water	pH	EC (μScm^{-1})	PO_4^{3-} (mg L^{-1})	SO_4^{2-} (mg L^{-1})	K^+ (mg L^{-1})	Na^+ (mg L^{-1})
PG 1	HTW	8.37	770	0.26	8.53	4.45	47.79
PG 2	,,	8.27	840	0.27	6.98	6.16	50.18
PG 3	,,	8.38	800	0.31	4.88	4.45	44.25
PG 4	,,	8.33	820	0.22	18.76	5.48	49.38
PG 5	,,	8.31	810	0.37	14.73	4.79	51.42
SG 1	,,	8.36	730	0.23	11.24	4.45	48.85
SG 2	,,	8.31	720	0.25	15.58	4.79	47.43
SG 3	,,	8.26	900	0.31	11.78	5.14	50.53
SG 4	,,	8.36	980	0.33	5.50	4.79	54.69
SG 5	,,	8.33	780	0.26	12.95	4.45	50.53
Range		7.22 to 8.47	620 to 4400	0.12 to 0.80	3.33 to 18.76	4.11 to 29.79	40.35 to 83.63
Mean (n=24)		8.254583	1006.67	0.28	11.92	7.01	49.69
Sd ($\pm$)		0.256	741.301	0.13	4.47317	5.41	7.94

HTW=Hand Tube Well water, PG=Pangasia Ground Water,
SG=Sreerampur Ground Water

Table 7. *pH, EC and concentration of PO_4^{3-}, SO_4^{2-}, K^+, Na^+ in surface water collected in dry season.*

Sample Number	Sources of Water	pH	EC (μScm^{-1})	PO_4^{3-} (mg L^{-1})	SO_4^{2-} (mg L^{-1})	K^+ (mg L^{-1})	Na^+ (mg L^{-1})
AS 1	PW	7.23	530.0	0.336	10.543	39.04	17.96
AS 2	PW	7.70	320.0	0.301	9.147	25.00	26.73
AS 3	CW	7.92	360.0	0.327	6.977	14.04	18.23
AS 4	RW	8.51	350.0	0.252	13.876	13.70	14.69
AS 5	CW	7.58	380.0	0.261	12.946	19.52	22.30
LS 1	CW	8.26	320.0	0.327	17.364	12.33	19.47
LS 2	PW	7.62	360.0	0.341	12.636	25.68	16.81
LS 3	RW	8.43	330.0	0.288	14.496	11.64	16.90
LS 4	PW	7.66	360.0	0.173	10.930	36.99	21.33
LS 5	CW	7.51	530.0	0.283	11.550	48.29	20.88
LS 6	PW	7.53	590.0	0.177	9.767	89.73	13.54
MS 1	PW	6.56	250.0	0.252	9.767	39.04	26.64
MS 2	CW	8.07	340.0	0.071	12.481	21.23	17.79
MS 3	RW	8.29	250.0	0.226	10.155	15.07	19.91
MS 4	PW	7.57	320.0	0.336	14.574	39.73	20.00
MS 5	CW	7.92	360.0	0.323	11.008	24.32	18.32
PS 1	CW	7.45	380.0	0.053	12.636	26.37	19.73
PS 2	PW	8.02	360.0	0.150	10.155	16.10	19.56
PS 3	PW	7.25	210.0	0.252	12.481	27.40	18.41
PS 4	CW	8.30	260.0	0.363	15.426	12.33	19.03
PS 5	PW	7.37	280.0	0.252	14.729	36.30	16.55
SS 1	PW	7.14	180.0	0.323	11.318	34.93	16.02
SS 2	CW	8.10	330.0	0.252	12.403	41.10	22.74
SS 3	PW	7.73	250.0	0.425	10.000	49.66	20.62
SS 4	PW	7.17	160.0	0.274	5.504	27.74	19.03
SS 5	PW	8.47	240.0	0.221	5.659	15.75	19.73
Range		6.56 to 8.51	160 to 590	0.0531 to 0.4248	5.504 to 17.364	11.64 to 89.73	13.54 to 26.73
Mean (n=26)		7.7446154	330.8	0.2631	11.482	29.35	19.34
Sd (±)		0.483	101.7	0.0858	2.837	16.92	3.04

PW=Pond water, CW= Canal water,
AS=Angria surface water, LS=Lebukhali surface water, PS=Pangasia surface water RW=River water
MS=Muradia surface water PS=Pangasia surface water
SS=Sreerampur surface water

5. Discussion

The ionic constituents such as PO_4^{3-}, SO_4^{2-}, K^+, Na^+ in the water sample of the study were observed have been presented in Table 2-3 in this chapter. The salient features of the analysis have been discussed in the light and support of relevant research findings wherever applicable. The results have been discussed under the following headings.

pH:

The pH of ground water in dry season ranged from 7.22-8.47 indicating the slightly alkaline in nature with the mean value of 8.25 (Table 2). The pH of 5 samples were lower than the mean value and rest 19 samples were higher than the mean value. The standard deviation of ground water samples was 0.256.

The pH of surface water samples ranged from 6.56-8.51 in dry season indicating neutral to alkaline in nature with the mean value 7.74 (Table 3). The pH of 15 samples were lower than the mean value. The pH of 11 samples were higher than the mean value in dry season. The standard deviation was 0.483 in dry season (Table 3). Among all the water samples the highest pH value 8.51 was obtained in the sample no. AS 4 it was river water, collected from Angaria union, Patabunia bazar adjacent river. and the lowest value 6.56 was obtained in the sample no. MS 1 it was pond water, collected from Muradia Union, *Mozumder Hat adjacent pond. Electrical Conductivity (EC):*

The electrical conductivity of ground water samples in dry season ranged from 620 to 4400 μScm $^{-1}$ with the mean value of 1006.67 μScm^{-1} (Table 2). The EC value of 19 samples were lower than the mean value, and rest 5 samples were higher than the mean value. The standard deviation of ground water samples was 741.301 (Table 2).

The EC value of surface water samples ranged from 160 to 590 μScm $^{-1}$ with the mean value 330.8 μScm^{-1} (Table 3). The EC value of 12 samples were higher than the mean value, and rest 14 samples were lower than the mean value. The standard deviation was 101.7dry season (Table 3).

Ionic Constituents:

The ionic constituents like PO_4^{3-}, SO_4^{2-}, K^+, Na^+ of the water samples were analyzed. The ion present in all samples in relation to irrigation water quality has been discussed as follows:

Phosphate (PO_4^{3-}):

The phosphate concentration of ground water samples in dry season ranged from 0.12 to 0.80 mgL^{-1} with mean value of 0.28 mgL^{-1} (Table 2). The PO_4^{3-} concentration of 15 samples were lower than the mean value, rest 9 samples were higher than the mean value. The standard deviation was 0.13 (Table 2).

The PO_4^{3-} concentration of surface water samples ranged

from 0.0531 to 0.4248 mgL^{-1} in dry season with the mean value of 0.2631 mgL^{-1} (Table 3). The PO_4^{3-} concentration of 13 samples were higher than the mean value. and rest 13 samples were lower than the mean value. The standard deviation was 0.0858 (Table 3).

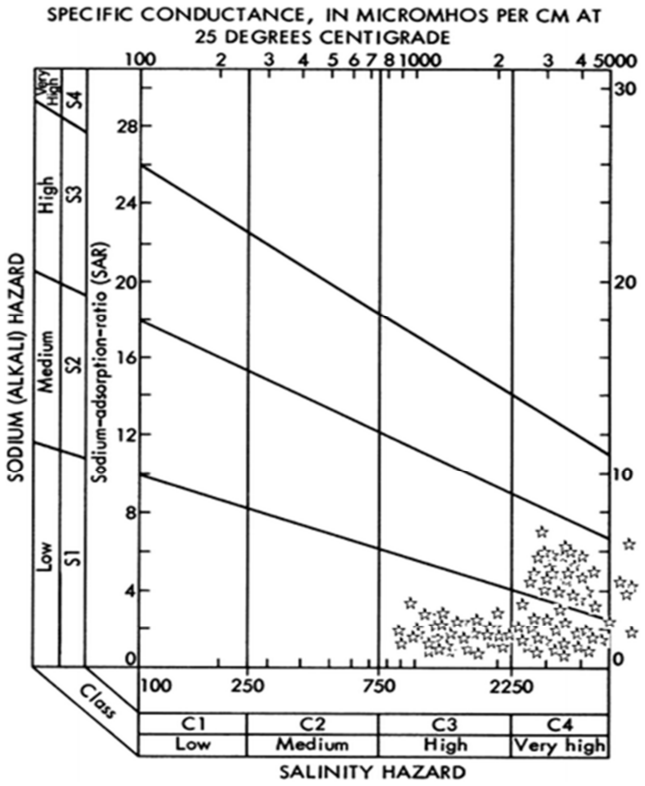

Figure 4. *Diagram for the classification of irrigation waters.*

Sulphate (SO_4^{2-}):

The concentration of sulphur of ground water samples in dry season ranged from 3.33 to 18.76 mgL^{-1} with the mean value of 11.92 mgL^{-1}.(Table 2). The SO_4^{2-} concentration of 11 samples were lower than the mean value, and rest 13 samples were higher than the mean value. The standard deviation was 4.47 (Table 2).

The SO_4^{2-} concentration of surface water samples ranged from 5.504 to 17.364 mgL^{-1} in dry season with the mean value of 11.482 mgL^{-1}. (Table 3). The SO_4^{2-} concentration of 13 samples were lower than the mean value, and rest 13 samples were higher than the mean value. The standard deviation was 2.837

Sodium (Na^+):

The sodium concentration of ground water samples in dry season ranged from 40.35 to 83.63 mgL^{-1} with the mean value 49.69 (Table 2). The Na^+ concentration of 9 samples were higher than the mean value and rest 15 samples were lower than the mean value. The standard deviation was 7.94 (Table 2).

The sodium concentration of the surface water samples ranged from 13.54 to 26.73 mgL^{-1} with the mean value 19.34 mgL^{-1} (Table 3). The sodium concentration of 13 samples were higher than the mean value. and rest 13 samples were lower than the mean value. The standard deviation was 3.04 (Table 3). The ground water study were higher Na^+ content than the surface water.

Potassium (K^+):

The potassium concentration of ground water in dry season ranged from 4.11 to 29.79 mgL^{-1} with the mean value of 7.01 mgL^{-1} (Table 2). The K^+ concentration of 5 samples were higher than the mean value, and rest 19 samples were lower than the mean value. The standard deviation was 5.41 (Table 2).

The K^+ concentration of surface water samples ranged from 11.64 to 89.73 mgL^{-1} in dry season with the mean value 29.35 mgL^{-1} (Table 3). The K^+ concentration of 10 samples were higher than the mean value. and rest 16 samples were lower than the mean value. The standard deviation was 16.92 (Table 3).

6. Conclusion

The suitability of water for drinking purpose was assessed on the basis of pH and SO_4^{2-} contents. On the basis of pH contents, only ground water samples of the study area were suitable for drinking but the surface water samples were unsuitable for drinking. The SO_4^{2-} contents in all the water samples were within the safe limit for drinking.

From the present investigation, it is concluded that ground and surface water used for irrigation at Dumki upazilla are not suitable considering all the criteria. It was found that all the ground water samples were unsuitable for irrigation and the surface water samples would not create problem for irrigating crops grown in the study area but in some samples, Na^+, K^+ were found as pollutants for irrigation. In the study area, surface water samples were problematic for drinking due to specific pollutant. Finally, it may be suggested that the ground water of the study area should not be used for irrigation purpose due to salinity. and the surface water should not be used for drinking purpose.

Acknowledgements

The authors thank Mohammad Kabirul Islam, Associate Professor, Department of Soil Science, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh for his valuable suggestions and cordial cooperation.

References

[1] Ahmed, M.; Talukder, M. S. U. and Majid, M. A. 1993. Quality of Groundwater for Irrigation in Muktagacha Area. Journal of the Institution of Engineers, Bangladesh 21(3): 91-98.

[2] APHA (American Public Health Association)1995. Standard Methods for the Erarnination of Water and Waste Water . 19th edn. Pub. by American Water Works Association (AWWA) &Water Environmental Federation (AWWA). pp. 1-12 to 3-55.

[3] Bohn, H. L., McNeal, B. L. and 0' Conner, G. A. 1985. Soil Chemistry. 2nd Edn. John Wiley and Sons. New York. pp. 239-245.

[4] Golteman, H. L. and Clymo, R. S. 1971. Methods for Chemical Analysis of fresh water IBP Handbool NO. Blackwell Scientific Publications Oxford and Endenbough. pp. 42-46.

[5] Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for Agricultural Research.2nd edn. An International Rice Research Institute Book. A Wiley-Interscience publication, New York. pp. 442-443.

[6] Hunt, D. T. E. and Wilson, A. L. 1986. The Chemical Analysis of Water –General Principles and Techniques, 2nd edn. The Royal Society of Chemistry, Cambridge, pp. 29-43.

[7] Tandon, H. L. S, (Fd.) 1995. Methods of Analysis of Soils, Plant, Waters and Fertilizers. Fertilizer Development and Consultation Organization, New Delhi. pp. 84-90.

[8] USEPA (United states Environmental protection Agency). 1975. Federal Register, 40 (248): 59566-59588.

[9] Who (World Health Organization).1971. International standards for drinking water. In Karanth, K. R., Ground water Assesment Development and Management. Tata McGraw-Hill publishing Comp. Ltd., New Delhi, India, pp.248-249.

[10] Wolf, B. 1982. A comprehensive system of Leaf Analysis and its use for diagnostic crop nutrient Status. Communication in Soil science and plant analysis, 13 (12): 1044-1045.