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Spatial Distribution, Changes, Uses and Water Quality of Small Water Bodies in Ghiduari Mouza

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Abstract
Small water bodies (e.g. Pond, Dighi, Doba, Khal, Beel) are one of the most productive ecosystems. Different types of small water bodies are present and more useful in the study area. This study was conducted to explore the spatial distribution pattern of small water bodies, its size, shape and depth, function, water quality, different uses and changes in characteristics over time and space. Since Bangladesh there are some researches about small water bodies based on region or mouza but specific spatial small water body's information can not get in small scale. By this research small scale data about small water body's different aspects are being explored. The data are collected from the primary and secondary sources. For collecting primary data, questionnaire survey and water samples are collected to explore the small water body's characteristics with water quality by laboratory test. Result showed that water bodies are perennial in nature, rectangular shape, associated with settlement, commonly used for various purposes, changes of small water bodies according to time. Different laboratory tests are conducted on specific physiochemical (Color, Odor, Temperature, P^H, Salinity, EC, TDS, TSS, Turbidity, Hardness, DO, BOD and TOC) parameters to know the water quality of these small water bodies. The water quality condition of small water bodies indicate that study areas small water bodies water quality not so bad and not so good but moderately polluted. Though there is no any toxic industry surrounding small water body's areas but water quality of these water bodies are deteriorating for various reasons day by day. Priorities should be given on small water body's protection, preservation, water quality and management of water body's resources.

Key Words: Small water bodies, Characteristics analysis, Water quality, Environmental impacts.

Introduction
Water is an essential resource for life on earth. We drink it, bathe in it, fish in it, keep cool with it, irrigate the plants, produce energy with it and also use it for transportation and recreation (Kudesia, 1990). Even though Bangladesh is famous, from ancient times, for its abundance of water from various sources, one of the major problems that the country has been suffering for decades is the scarcity of safe water. Safe water has long been a key public health and environmental issue. Recognition of the importance of water quality to health dates hack to ancient times (Gain, 1998). A small water body is the collective term for marshes or Beel, Dighi, Pond, Doba, Khal, and similar wetland. It's located mainly near agriculture and settlement area. In Bangladesh various uses of small water bodies are seen. Small water bodies play an important part in socio-economical sector in Bangladesh.

Huda in 2004 worked on small water bodies using remote sensing processes and he identified shape, size, character, origin and development, area, depth, ownership, maintained, uses, and timing period etc. of the small water bodies in Shahajadpur upazila. (Kudesia , 1990) Various types of pollution are occurring in man's life due to interference with nature. These various

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sources of pollution have caused mental order, skin ailments, stomach, diseases, blindness and genetic changes; he also explained the techniques for the detection of pollutants have been described in very lucid style so that a common man may understand them. Saika in 2009 investigated the water quality of Dhaka city lakes. She worked in the residential areas of Dhaka City where a scarcity of open spaces is but all four planned major residential areas are endowed with water bodies/lakes. Presence of lakes in the residential areas is an advantage as it enhances the beauty of the area, influences the microclimate with its cooling effect at night while the banks of the lakes are utilized for recreational purposes. But by his study is found that the water qualities of the lakes are deteriorating seriously day by day. Das (2000) in his paper exhibited the present status of fresh water wetland of the country, evaluated the environmental impact of various development activities on wetlands and prepared recommendation for future action program. Gain in 1998 discussed in his book about the environment laws in Bangladesh and some selected environmental issues. He also included the causes and consequences of environmental issues and citizens, response to those there environmental issues.

At present Small water bodies are in threatening situation. Moreover, the quality of water is a vital concern for mankind since it is directly linked with human life but water quality of small water bodies are deteriorating day by day. So, various kind of research about small water bodies and its water quality is very important for conservation and proper using of small water bodies. The main aim of the study was to monitor the small water bodies characteristics and water quality of Ghiduari Mouza under Netrokona District with its environmental impact on rural life.

Materials and Methods

Location of the Study area: The study area is Ghiduari mouza which is situated in Sarmaisa union of Atpara upazila under Netrokona District. There are various types of water bodies found in this mouza. Some parts of the mouza are surrounded by the river. The relative location of Ghiduari mouza is the north of Konapara mouza, Mostapur is in the West, Sarmaisa mouza closed to east side of Ghiduari mouza and Kismatara Mouza in the south direction. The absolute location of study area is between 24°81′ and 24°82′ north latitudes and between 90° 80′ to 90°82′ east longitudes.

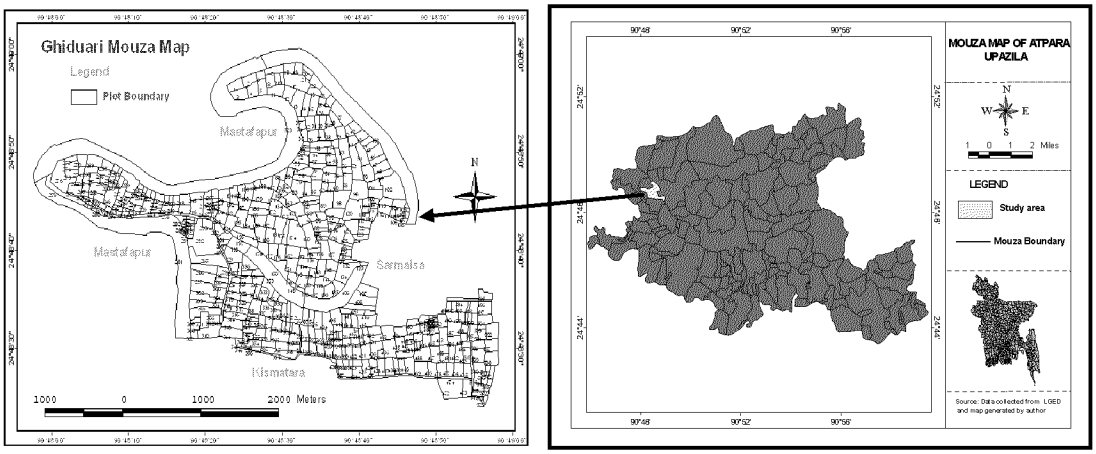
Sources of Data Collection:

- Primary Sources
  - Informal Interview
  - Water Sample Collection and GPS Survey
- Secondary Sources
  - Different journals, reports, research papers, searching wave site Google and others published and unpublished documents of government and non government.
  - Image of the research area downloaded from Google Earth, mouza maps and population data collected from union, climatic data collected from nearby weather station.
  - Map and reports from relevant organization such as Zila land office, Local Union Parisad, SPARRSO, LGED, SRDI, Department of Geography and Environment of J.U etc.

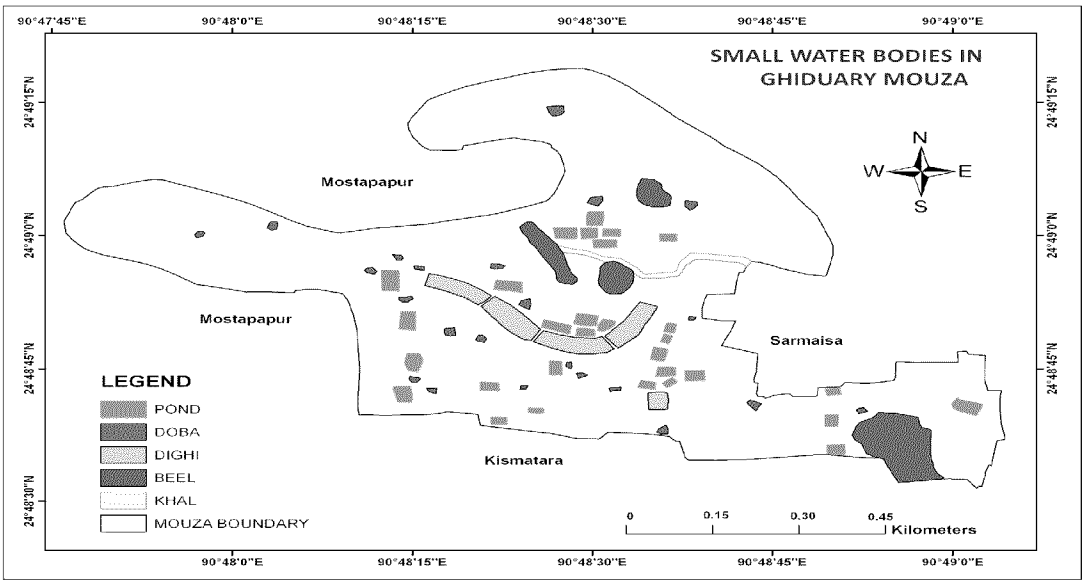
Water Quality Measurement Method:

Sample Collection: 1 liter of water was taken for each sample of dry season of the study areas small water bodies. Two samples from each type of small water bodies and the total 10 samples

were taken for test in the Institute of Nuclear Science and Technology (INST) Lab of Bangladesh Atomic Energy Commission (BAEC).



Map 1: Location of the study area inside the Upazila Mouza Map.



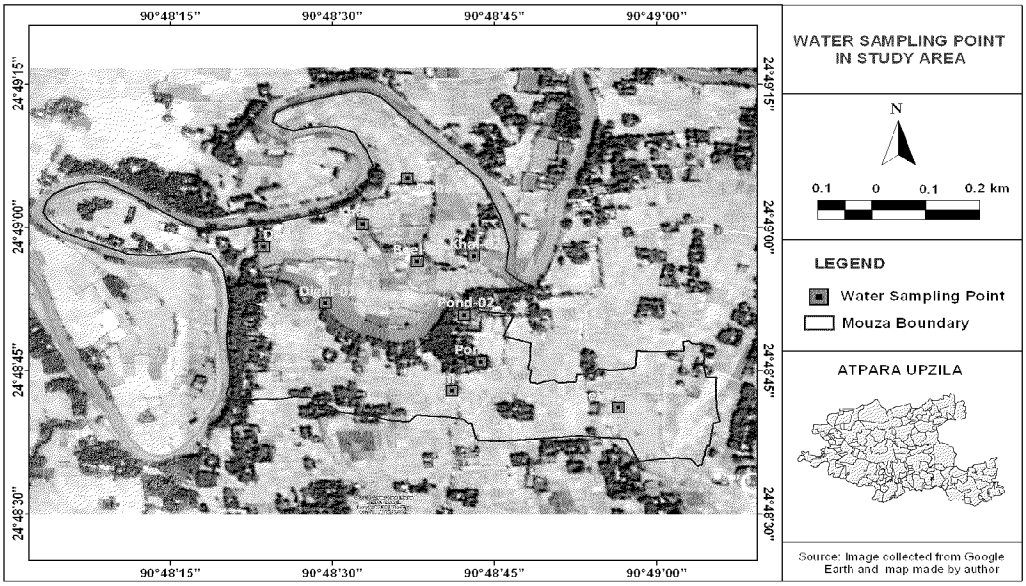
Map 2: Spatial distribution of the small water bodies of Ghiduari Mouza.

Sampling Area: To perform a fruitful analysis, from each category of small water bodies two sample are taken for analysis of dry season (January) water from the study area of Ghiduari Mouza, Atpara Upazila, Netrokona District.

Table 1: Location and geographical position of the sampling points

Category of small water bodies	Absolute Location	
	Latitude	Longitude
Dighi-1	24°48'50.01"N	90°48'22.84"E
Dighi-2	24°48'41.73"N	90°48'35.04"E
Pond-1	24°48'44.04"N	90°48'38.52"E
Pond-2	24°48'49.74"N	90°48'35.98"E
Doba-1	24°49'7.12"N	90°48'31.04"E
Doba-2	24°48'58.26"N	90°48'15.20"E
Beel-1	24°48'38.52"N	90°48'52.92"E
Beel-2	24°48'56.90"N	90°48'32.00"E
Khal-1	24°49'1.73"N	90°48'24.83"E
Khal-2	24°48'57.23"N	90°48'37.56"E

Source: GPS Survey and Google Earth



Map 3: Goggle earth map of sampling point of small water bodies in study area.

Sample Analysis: P^H of the water samples were measured at field by using digital P^H meter (P Selecta, Aenor).Temperature was also taken at field by using Degree Centigrade Thermometer. Other physical properties of water include color, turbidity, odor and solids content, chemical

properties of the environmental water are generally hardness, oxygen demand and organic matter and the presence of the variation trace elements and biological parameters of water were tested in the Isotope Hydrology Division of Institute of Nuclear Science and Technology (INST) Lab of Bangladesh Atomic Energy Commission (BAEC).

Result & Discussion

A. Various Aspects of SWB

Different categories of small water bodies are identified in the study area. Among those Ponds are the highest number which is 30 and then Dobas 23, Dighi 5, Beel 4, and Khal 1 are respectively in next. Main water sources of SWBs are flood and precipitation. During flood all water bodies are filled with water and that water carried throughout year and by the time rainfall water also stored in SWBs. Water also transferred from tube well and deep tube well to nearest doba and pond. Beel is another source of water for SWBs (Figure 1).

The water bodies which are found in Ghiduari Mouza among them maximum are seasonal. The depth of water bodies are measured with bamboo stick attached with measured tape. The place where mean elevation is less in comparison of other places, the depth is more in that particular place. The average depth of khal, pond, and doba are comparatively similar.

Most of the small water bodies are associated with settlement. The pond, khal, beel and a few dobas are associated with agriculturul land. There are many water bodies located beside road. Construction of road may be the reason behind of its location (Figure 02).

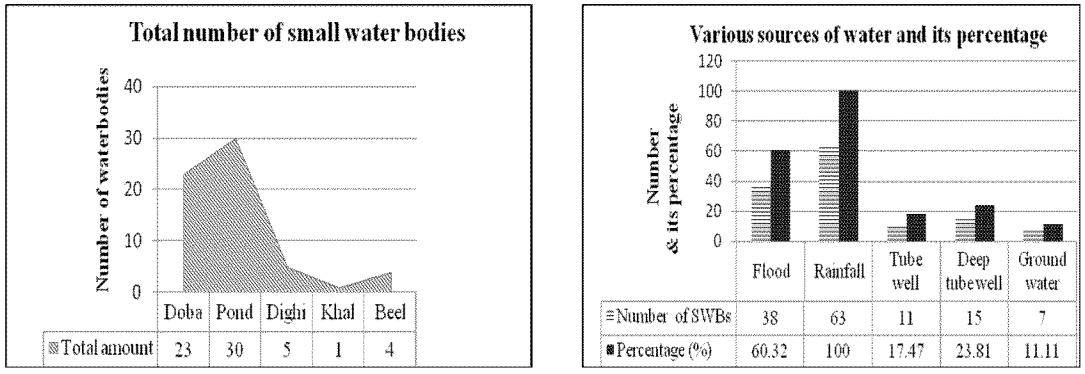


Figure 1: Total Number and Sources of small water bodies.

There are 63 small water bodies are indentified in study area. It includes permanent and seasonal water bodies. Previously the SWBs are used in many purposes such as fish cultivation, bathing, cattle bathing, cloth washing, household purpose, cattle feeding, irrigation, jute retting, cooking water, and many more. Now-a-days small water bodies are highly used mainly fish culture, bathing, washing cloth, cattle bathing, and irrigation etc.

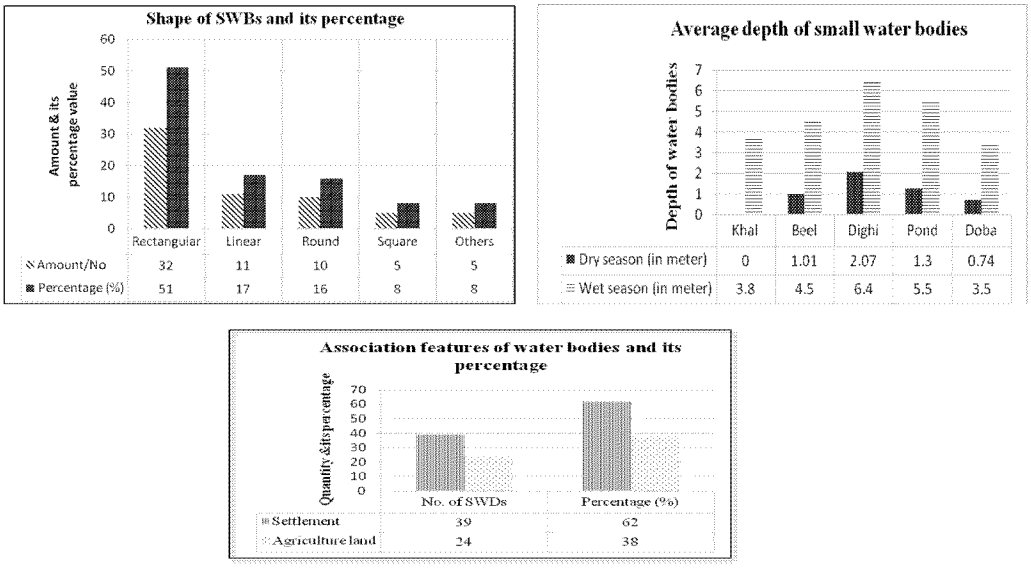


Figure 2: Shape, Average depth and Association Features of small water bodies.

Table 2: Major uses of small water bodies over change of time

Major use	1971	1981	1991	2001	2011
Drinking	◄	———	►		
Bathing	◄	———	———	►	
Household purposes	◄	———	———	———	►
Fisheries	◄	———	———	———	►
Aquaculture	◄	———	———	►	
Cloth washing	◄	———	———	———	►
Cattle bathing and feeding	◄	———	———	———	►
Irrigation	◄	———	———	►	
Jute Processing	◄	———	———	———	►
Duck raising	◄	———	———	———	►
Others	◄	———	———	———	►

Source: Authors (2011)

Changes occurred in water bodies' size, shape and depth

The small water body's environment of the study area is changing rapidly due to presence of various factors over period of time. Degradation of small water bodies has caused several problems including extinction and reduction of wildlife, extinction of many indigenous wild and domesticated rice varieties, loss of many indigenous aquatic plants, herbs, shrubs and weeds, loss of natural soil nutrient, loss of natural water reservoirs and of their resultant benefits.

Table 3: Nature of changes of SWBs and its changing percentage

Changes of water bodies	No. of water bodies	Time Scale	Percentage (%)
Size	25	30 years	73.02
Shape	10	20 years	36.51
Depth	28	41 years	88.87

Source: Authors (2011)

B. Water Quality of SWB

P^H indicates alkalinity or acidity in the water. A pH scale indicates the strength of acids and alkalis. It runs from 1-14. All acids have a P^H less than 7. Lower P^H in water is harmful for the aquatic life. In the same way, high P^H value of water may cause irreversible damage to the aquatic environment. It is found that most of small water bodies P^H value within standard value of surface water. The P^H value of pond and dighi are below 7. On the other hand, the P^H value of doba, dighi and beel are more than 7 (Figure 3).

Salinity is the saltiness or dissolved salt content of a body of water. Research provides that there is a little amount of salinity in small water bodies. Salinity is not found in pond and dighi because these two types are closed water bodies. On the other hand, there is a little amount of salinity in doba, beel and khal. Khal has a linked with river that's why amount of salinity is high then beel and doba. For drinking and agriculture purpose, the standard limit of salinity recommended by DoE is 1.5-6 ppm. In this case, small water bodies salinity amount is lower than the lower limit of DoE recommendation (Figure 3).

Electric Conductivity (EC) is usually used for indication the total concentration of the ionized constituents of water. In the figure -4 STD-1 refers to the standard value of DoE of EC of irrigation and fishing water which is 750 µS/cm DoE. Again STD-2 refers the standard value of EC of drinking water which is 700 µS/cm. It is found that most of the small water bodies EC values are lower than the standard value of irrigation, fishing, and drinking water. The EC values of pond and dighi are lower than the doba, beel and khal EC values. In the category of small water bodies highest EC value is found in khal and lowest in dighi.

Total Dissolved Solid (TDS) is very important physical parameters to determine the water quality because TDS in water may cause bad odor, taste and also may promote favorable condition for growth of pathogenic bacteria. The standard value of TDS of surface water is 500 mg/L by the DoE. Moreover, TDS value of drinking water is 1000 mg/L and irrigation water is

2000 mg/L by the department of Environment of Bangladesh. Small water bodies are under the category of surface water. From the research, it is found that most of the TDS values of small water bodies water are lower than the standard value of surface, drinking and irrigation water but TDS value of doba is higher than the standard limit of surface water (500 mg/L) (Figure 4).

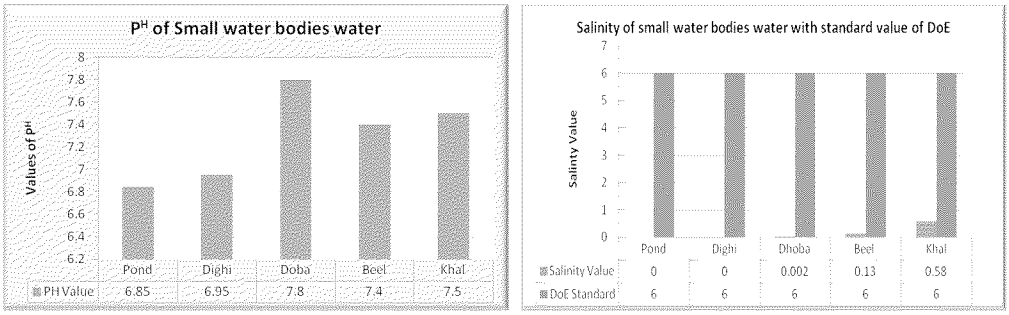


Figure 3: P^H and Salinity of Small Water Bodies water with standard value of DoE.

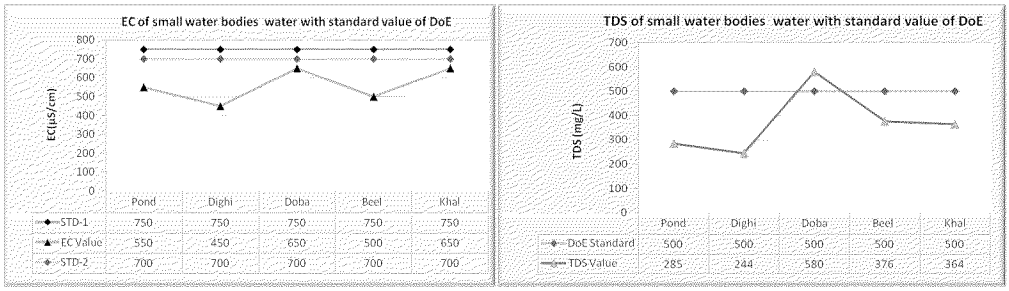


Figure 4: EC and TDS of Small Water Bodies water with standard value of DoE.

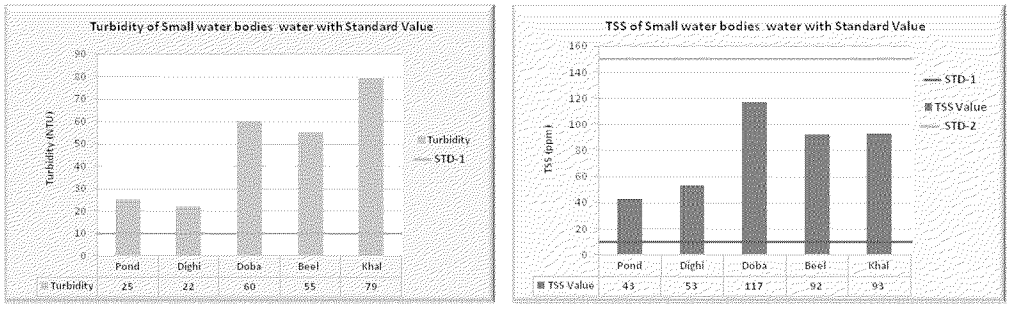


Figure 5: Turbidity and TSS of Small Water Bodies water with standard value of DoE.

Turbidity is the physical properties of water quality measurement. It is the determination of water's opaque or crystallite. From the figure -5, STD-1 represent the Department of Environment (DoE) recommended standard value of turbidity of drinking water which is 10 NTU. Most of turbidity values of small water bodies which are found from the analysis are higher than

the standard value of drinking water. In this case, the turbidity values of doba, beel and khal are higher than the turbidity values of Pond and dighi. Among the small water bodies, the highest turbidity value in khal and lowest turbidity value in dighi

Total Suspended Solids (TSS) is a water quality measurement usually abbreviated TSS. This parameter was at one time called Non-Filterable Residue (NFR), a term that refers to the identical measurement: the dry-weight of particles trapped by a filter, typically of a specified pore size. TSS is an important factor for drinking water as well as fish culture. It is found from the data that most of TSS values of surface water are higher than the standard value of TSS of drinking water. On the other hand, all values of small water bodies are lower than the generally standard value of surface water (150 mg/L). Among the small water bodies, TSS value of doba is high which is 117 mg/L, then beel and khal where as pond TSS values is low which is 43 mg/L (Figure-5 of TSS)

Hardness is the sum of the calcium and magnesium expressed as an equivalent amount of calcium carbonate (CaCo3). From the figure-6 of Hardness, STD-1 represents the DoE recommended standard value of surface water Hardness which is 300 mg/L. Moreover, a standard value of Hardness of drinking water is 200-500 mg/L by DoE. From the analysis it can be said that all of the small water bodies hardness values are within standard values of surface water but very lower in the case of drinking water standard. Hardness of doba, beel and khal are comparatively lower than the hardness of values of pond and dighi. Among the small water bodies, the highest value of hardness is in dighi and lowest value of hardness in doba.

Dissolved Oxygen (DO) is essential to all forms of aquatic life including that organism responsible for the self-purification processes in natural waters. From the figure-6 of DO, STD-1 represents the DoE standard value of DO of Surface and Drinking water which is 6 ppm. Again, STD-2 states the DoE standard value of DO of recreation, irrigation and fishing water which is 5 ppm . From the data analysis it is found that the values of DO of pond, dighi and doba is lower than the standard value of surface and drinking water where as the values of beel and khal is higher. Among the small water bodies, the highest DO value is in beel and lowest DO value is in doba.

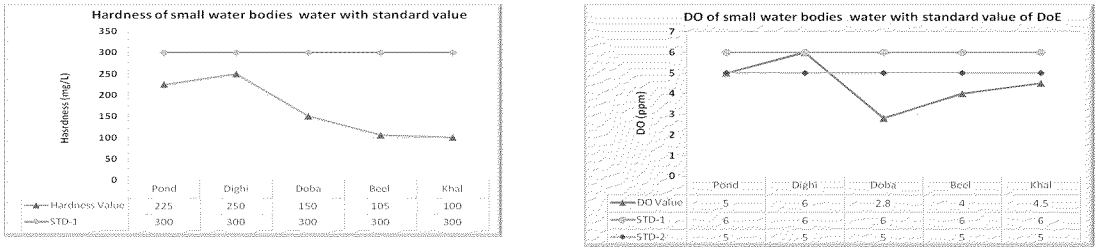


Figure 6: Hardness and DO of Small Water Bodies water with standard value of DoE.

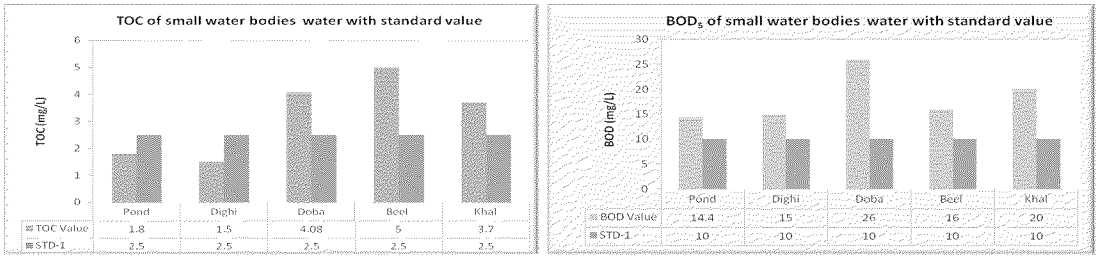


Figure 7: TOC and BOD of Small Water Bodies water with standard value of DoE.

Total Organic Carbon (TOC) is the amount of carbon bound in an organic compound and is often used as a non-specific indicator of water quality or cleanliness of pharmaceutical manufacturing equipment. There is no standard value of TOC of surface water by the DoE. Surface water TOC varies place to place. From the figure of 7 of TOC STD-1 refers to the standard value of agricultural water of TOC by the GoB which is 2.5 mg/L. From the data it is found that TOC values of small water bodies are higher than the standard values of agricultural water except pond and dighi. TOC values of the beel, khal and doba are comparatively high than dighi and pond. Among the small water bodies, highest TOC value is in beel and lowest value in dighi. As there is no any industry surrounding small water bodies of the study area, so TOC value is not so much high.

Biochemical Oxygen Demand (BOD_5) is an index of the biodegradable organic present. There is no standard value of BOD of surface water by the DoE. Surface water BOD varies place to place. In the above chart STD-1 refers to the standard value of agricultural water of BOD by the GoB which is 10 mg/L. From the data it is found that all of the BOD values of small water bodies are higher than the standard values of agricultural water. Among the small water bodies, highest BOD value is in doba and lowest value in pond (Figure-7 of BOD).

Environmental Impacts Due to Water Quality

Small water bodies play vital role in agricultural and socio-economic sector of rural people. But number, size and shape of small water bodies are reducing day by day with deteriorating its water quality. The water quality condition of small water bodies which is found from the Laboratory analysis indicate that study area small water bodies water quality not so bad and not so good but moderately polluted such as values of P^H, Salinity, TDS, Hardness are within standard values on the other hand the values of Turbidity, DO, EC, BOD and TSS are not within standard values. Though there is no any toxic industry surrounding small water bodies areas of the study area but water quality of these water bodies are deteriorating for various reasons day by day. There are some bad impact of the moderated polluted water on surrounding environment which are discussed below-

a. Impacts on Aquatic Flora and Fauna

The inorganic compounds undergo different chemical and bio-chemical interaction in the water system and also impart different harmful effects on aquatic flora and fauna. As a result, aquatic floras and faunas are decreasing in water bodies alarmingly. Repeated direct and indirect

discharge of these unwanted toxic materials such as pesticide, excess use of chemical fertilizer in the agricultural field and different chemical which are used for fisheries purposes in excess to the surrounding water bodies brings the failure of the self-cleansing mechanism of water system that's is why values of BOD, EC, TOC, TSS and DO are not within standard values. As a result, aquatic floras and faunas are decreasing in water bodies alarmingly.

b. Impacts on Fisheries Resources and Endangered Fishes

The amounts of fisheries resources in study areas small water bodies especially in beel, khal and doba are drastically reduced and many are no more seen. Uses of chemical fertilizer, uses of pesticides, drying up small water bodies, river channel transformation, over fishing, water pollution, and ecological stress, shortage of food, habitat destruction, and bio-diversity loss are the major factor in depleting the fish varieties. Moreover, physical loss, shrinkage and modification of aquatic habitat for fish and other organisms are said to be one major another factors in depleting the fish varieties. Massive schemes converting traditional fish breeding and grazing grounds into agricultural fields and increased inappropriate and indiscriminate use of chemical inputs in agriculture are very threatening to indigenous fish species. Moderately Pollution of the small water bodies has its impacts on aquatic fish resources in study area.

Table 4: The list of present fisheries resources and endangered fishes

List of the present fisheries resources	List endangered fishes
Ruhu, Katla, Mrigal, Kalbaus, Magure, Shoal. Aire, Bele, Boal, Koi, Silvercarp, Grasscarp,Nilotica,TalapiaAfrican,Magure, Thai Sharputi, Pangus	Big Phali, Dhala, Nandina, Sweet Pabda Nait Koi, Big Golsha, Big Prawn, Big Khailsha, Khaira, Baspata, Deshi Red Magure, Red Darkini, Butchi, Gojar, Learg Chanda, Ghainna, Meni, Patka, Star Baiem, Bata, Ghagot, Pach Choka

Source: Questionnaire Survey 2011

c. Damage of Vegetation and Reduce Fertility of Land

Important vegetation are also affecting by the chemical waste which are using in agricultural and others works through the polluted water. In addition, the fertility rate of the land is decreasing at alarming rate by the polluted water in the study area.

d. Effects on Agriculture Sector

Now a days in dry season, agricultural activity is not possible without water. In this case, beel, khal, dobas water is used for agricultural purposes. But lack of proper quality and scarcity of water for agricultural purposes, cultivation is hampering. Moreover, using polluted water for agricultural purposes causing directly and indirectly several disease and food poisoning.

e. Impact on Human Health

Polluted water causes health effect on human body in several ways in the study area. The adverse effects of polluted water cause for water born disease, diarrhea, dysentery, malfunctioning of liver and gastrointestinal tract, kidney damage, menagerie change etc. Different waste is affecting the

fish of the small water bodies. The health of the local people who use polluted water bodies water is being affected by the different water born diseases, skin diseases etc.

Main Sources of Water Pollution in the study area

There are some sources of water pollution which are polluting study areas small water bodies water quality. The major sources of water pollution are below:

Agricultural Effluents

- Water Pollution by Fertilizer
- Water Pollution by Agricultural Chemicals
- Water Pollution by Storm Water

Natural Pollutants

- Domestic Waste
- Excessive use for washing cloth, bathing and cleaning domestic animals
- Poultry Farming on Small Water Bodies
- Domestic Sewage
- Fisheries System

Findings

- Most of the small water bodies are perennial in nature.
- Pond is the most dominant feature in the study area and after that Doba, Dighi, beel and khal.
- The maximum water bodies shape is rectangular and the lowest percentage is dually circular shape and other types of shape. The khal is linear shape.
- Most of the small water bodies are associated with settlement & some also associated with agricultural land.
- Main water sources of SWBs are flood and precipitation. Water also transferred from tube well and deep tube well to nearest doba and pond.
- Small water bodies are highly used mainly fish culture, bathing, washing cloth, cattle bathing, and irrigation etc.
- The most changing percentage is the depth then size and shape because of flood and sedimentation, drainage, agriculture, settlement and some other causes like climate, unplanned government development activities, and many more.
- Water quality of small bodies is nearest standard though some parameters are highly deviated from standard level such as turbidity, DO, EC but these indicate that water of small bodies are polluting day by day.

Recommendations

- Priorities should be given on small water bodies protection, preservation and management of water bodies resources.
- The land use regulation can be formulated so that planning, design and construction of infrastructures take into consideration of flood and water bodies resources management.
- Adopting and implementing plenty and appropriate National Wetland Policy through people's participation and participatory enforcement through targeted groups.
- Preventing activities which diminish water bodies/natural habitats of fish and encouraging promotional measures.

- Implementations of awareness development program involving people's participation through media, seminar etc and some government and non-government organizations should be more involved in conservation of small water bodies.

Conclusion

Since in Bangladesh there is some research about small water bodies based on region or mouza but specific spatial small water body's information can not get in small scale. By this research small scale data about small water body's different aspects are explored. This research will be more helpful to other researchers who want to study about this and also policy makers of water resources management. Small water bodies' resources and its water quality have suffered considerably from the impact of burgeoning human population, including direct extraction and habit loss. The impact of human interference has been particularly damaging to the fragile ecosystem and sustainability of this area. As a whole, degradation of small water bodies has caused several problems including extinction and reduction of wildlife, extinction of many indigenous wild and domesticated rice varieties, loss of many indigenous aquatic plants, loss of natural water reservoirs and of their resultant benefits, increase in the occurrence of flooding and degeneration of water bodies based ecosystems, occupations, socio-economic institutions and cultures. Moreover, study areas small water bodies are polluting day by day for various reasons. In the study area to maintain and protect the water bodies from the destruction and deterioration of its water quality, should take proper steps that may be with the help of government and other Non-Government organizations.

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