# A comparative study on the water and soil quality of Laskar and Deluti union, Paikhgachha Upazila, Khulna


**By**

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This Thesis Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science (B. Sc.) in Environmental Science and Disaster Management (ESDM)


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**DHAKA, BANGLADESH**


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# Approval

This thesis report titled **"A comparative study on the water and soil quality of Laskar and Deluti union, Paikhgachha Upazila, Khulna",** submitted by Tanvir Hossain Sifat to the Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU), has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science (B.Sc.) in Environmental Science and Disaster Management (ESDM) and approved as to its style and contents. The presentation has been held on 18th April of 2023.

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# DECLARATION

I hereby state that I have carried out this work under the supervision of **Dr. Mahfuza Parveen, Associate Professor** of the Department of **Environmental Science and Disaster Management (ESDM), Daffodil International University,** I declare that no research project has been presented to other parties or any aspect of this research project for any degree.

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# DEDICATION

***This work is dedicated to***
***My Family (specially my father and mother),***

***Upoma (Tania Islam),***

***Mishmi,***

***Zawhar Dudayev Brother,***

***&***

***The Coastal People of Bangladesh***


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At last, I want to give thank Zawhar Dudayev Brother, who helped me to understand the basic concepts of research work.



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## Abstract

Salinity intrusion is a major issue for those who live near the coast in Bangladesh. The purpose of this study is to evaluate the salinity of various farmland and pond water; soil in two unions within the Paikhgachha upazila, which is situated in Bangladesh's southwest coastal region. Three bottles of water samples (each, 500 ml bottle), and one bag of soil samples were taken from each sampling region to maintain a high level of accuracy. This research of aquaculture water bodies revealed significant salinity, extremely high TDS levels, a wide range of EC, and various alkalinity ranges. Laskar and Deluti union agricultural areas, ponds, and aquaculture water bodies have an almost average pH. People in the Laskar Union are unable to consume surface water for drinking, as has been seen. People make an investment to purchase drinking water. The study will assist social workers, researchers, and policymakers in achieving various sustainable goals.


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# List of Symbols & Abbreviations

| **Symbol/Unit** | **Name of the Symbol or Unit** |
|---|---|
| Km | Kilometers |
| Ppm | Parts per Million |
| Ppt | Parts per Trillion |
| µS/cm | Microsiemens per Centimeter |
| m | meter |
| mg/L | Milligram per Liter |

| **Abbreviations** | **Full form of Abbreviations** |
|---|---|
| LP- | Laskar's Pond |
| LA- | Laskar's Agricultural Land |
| LG- | Laskar's Aquaculture |
| DP- | Deluti's Pond |
| DA- | Deluti's Agricultural Land |
| DG- | Deluti's Aquaculture |


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# Chapter 1: Introduction:

## 1.1. Background:

One of the nations deemed to be most susceptible to climate change is Bangladesh(Alam & Islam, 2018). Disaster is always a possibility in coastal areas. Often, it occurs in coastal regions as a result of nature, but occasionally, people experience disasters as a curse. Extreme weather conditions like cyclones and coastal storms, as well as long-term dangers from coastal erosion and sea level rise, pose challenges to coastal settlements. 19 districts of Bangladesh are situated in the coastal belts which cover almost 32% of the total area of the country(Parvin et al., 2017). Coastal agricultural sectors have already been impacted by sea level rise, particularly in low-lying coastal locations(Alam & Islam, 2018). The south-western part of Bangladesh's coastal districts (Khulna; Bagerhat; Sathkhira) threatened a lot of issues, like Cyclone; Salinity intrusion; Tidal floods; and Sea level rise. For these reasons, people have been suffering many problems there. In Bangladesh, over 30% of our total cultivable land is along the coastal belt and it covers about 20% of the total land area of our country(Rahman et al., 2014). But, day by day the agricultural land is losing productivity due to high soil salinity and also losing moisture content due to high temperature. People don't get potable water for drinking because of salinity intrusion. They have been also affected by Cholera, diarrhea, giardiasis, dysentery, typhoid fever, E. coli infection, and like most these types of water-related diseases. Salinity intrusion due to reduction of freshwater flow from upstream, salinity affected by groundwater, and fluctuation of soil salinity are major concerns now(Hoque et al., 2013). Coastal aquaculture in Bangladesh mainly consists of two shrimp species (Penaeus monodon and Macrobrachium rosenbergii) and crabs. Shrimp farming within the levees and river channels along the coast was a traditional practice in the southwestern area of Bangladesh(Deb, 1998). At a time, willingly a small number of farmers started to use saline water for making 'gher' (local name) for shrimp farming. It started to grow slowly in a commercial mode of aquaculture In the middle of the 1970s(Tutu, 2006) due to higher demand in the international market, the higher economic return from small investments, and favorable government policies(Alauddin & Tisdell, 1998). Then, the southwest coastal region of Bangladesh turned into the 'shrimp zone' of the country as the major share of brackishwater shrimp produced in Bangladesh comes from this region(Datta et al., 2010). After a few years, some people were tending to aquaculture farming to use the saline water forcefully. They thought that salinity was a blessing for them. And they were capturing Agriculture land for converting to aquaculture farming. Generally, aquaculture farming needs comparatively less labor than crop-based farming. For this reason, agricultural farmers had been jobless. Their livelihood was at a stake. Some farmers didn't want to give up their lands. But, powerful parties or political people had been pressuring them to take the land. Finally, they did it. So, there were various types of problems. (And then, people wanted to move the other areas to get more facilities and search for a better life. People were forced to migrate from these areas to a nearby city or capital due to income and food poverty resulting from the adverse impacts of climate change. It was an internal migration). Presently, several newspapers published that some barrages are going to break for aquaculture activity. Because the owners of aquaculture are taking pipes in the middle point of the barrages. As a result, when the river goes to fulfill with water then the barrages are hampered and broken down. Nearly all villages flooded at that time. And saline water comes from village people. They don't get fresh water there.


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If they drink it, they face many water-related diseases. So, they can't use the water in their regular life. Besides, after a cyclone or any natural disaster, a lot of aquaculture farms go too flooded and all fish into the rivers. A small number of years ago, two cyclones (known as *Aila* and *Sidr*) hit the southwest region of the country. These natural events have brought changes environmentally and socially in this region. The agriculture sector in general and in particular fisheries have been affected by these catastrophes(Islam et al., 2016).

## 1.2 Problem Statement:

The salinity of the soil and water has been rising alarmingly over the past couple of decades. The main causes of the rise in soil and water salinity in Bangladesh's coastal region are sea level rise brought on by climate change and the widespread practice of shrimp farming close to the coast. Sea level rise inevitably has an impact on the coastal regions' natural ecology and biodiversity. The richness of indigenous plant species is being severely impacted by the entrance of saline water into the inland(Basar, 2012).

Cultivable regions close to the ocean are not utilized for agricultural production because of the salinity. The greatest obstacle to plant and crop growth is the elevated salinity. As a result, there is a reduction in overall agricultural output and plant growth in the coastal region, and the soil becomes unproductive for growing crops and plants. Hence, increased salinity close to the coast is a significant issue that restricts the production of food grains in our coastal zones(Mahmuduzzaman et al., 2014).

Anisuzzaman *et al.*, (2015) were Using primary data gathered from the four upazillas of Khulna, namely Batiaghata, Dacope, Dumuria, and Paikgacha, they have investigated to study the determinants of switching from rice farming to shrimp culture in coastal zones of the Khulna district. The purpose of switching from rice production to shrimp farming has been better understood according to this study. Also, it has shown significant causes shifting, which may be of interest to academic academics and policy makers. In many cases, coastal farmers lack the wisdom to choose the best adaptation strategy. Since the majority of farmers in Bangladesh's coastal regions and elsewhere are illiterate or have less education, they frequently lack the scientific foundation for farming techniques. Obviously, there is a danger of making an agricultural option that is incorrect. On numerous cases, farmers have been forced to transfer from rice to shrimp farming on sites that were better suited for rice. And finally they told that, concerned organizations including the Department of Agricultural Extension, Ministry of Fisheries, and Ministry of Agriculture have a part to play in minimizing danger that could result from changing decisions in these circumstances.

## 1.3 Justification of this study:

Significant studies already have been conducted on the Khulna Coastal Area. A few Upazila have already undergone various water quality tests. I've chosen to evaluate the water quality in the two unions of Paikhgachha upazila. I also made an effort to analyze the pond, the agricultural field, and the water quality used for fisheries farming. Finally, I have included a comparison of the water quality between two unions (Laskar and Deluti) of Paikhgachha upazila.


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## 1.4 The study's objectives:

1· To evaluate the current situation and variations of water quality between two unions (Laskar and Deluti) of Paikhgachha upazila.

2. Assessing the salinity of soil between Laskar and Deluti unions.

## 1.5 Water Quality Assessment:

### 1.5.1 Salinity:

The amount of dissolved salts in the water is measured as salinity. When flows are low, salinity is often at its maximum and rises as water levels fall. TDS (Total Dissolved Solids) is a unit of measurement for the quantity of dissolved salts in water. EC (Electrical Conductivity) is a unit of measurement for the ability of a substance to act as a conduit or medium for electricity. Compared to purer water, saltier water runs on electricity more easily. Urban and agricultural runoff containing salt, fertilizers, and organic materials are sources of salinity. Clearing vegetation and the subsequent rise in the water table are two land use issues associated to high saline levels. Other issues include inappropriate irrigation, subsurface leakages, and runoff including dissolved solids from manufacturing, wastewater, agricultural, and storm water. Salinity changes between high and low tide will occur in areas near the tidal limit of rivers that empty into the sea.

### 1.5.2 pH:

The pH of the water is one of its most important characteristics. It is defined as the negative logarithm of the concentration of hydrogen ions in a solution. How basic or acidic a solution is expressed by an arbitrary number. Actually, a measure of how basic or acidic water is is its pH. In basic water, more hydroxyl (OH) ions are present, while more hydrogen (H+) ions are present in acidic water. From 0 to 14, the pH scale has a neutral value of 7. An acidic solution has a pH under 7, while a base solution has a pH beyond 7. At 25°C, pure water has a pH close to 7.0, making it neutral. 5.6 (slightly acidic) is the pH of typical rainfall, which is caused by the presence of atmospheric carbon dioxide. The pH limits for drinking water that are safe for home use and the requirements of living things are 6.5 to 8.5.

### 1.5.3. Total Dissolved Solids:

Solids can be suspended or in solution in water(Metcalf, 2003). The two different sorts of solids can be distinguished by passing a water sample through a glass fiber filter. By definition, the dissolved solids flow through the filter with the water while the suspended solids are kept on top of the filter(Clesceri et al., 1989). The solids will remain as a residue if the filtered component of the water sample is put in a tiny dish and allowed to evaporate. Often, this substance is referred to as total dissolved solids(Clesceri et al., 1989).

According to the TDS content per liter, water can be categorized as follows:

1. 1500 mg/L TDS for freshwater;


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2. 1500–5000 mg/L TDS for brackish water;

3. Salinity of water (>5000 mg/L TDS).

### 1.5.4. Electrical Conductivity:

A solution's capacity to carry or conduct an electrical current is gauged by its electrical conductivity (EC), which is the case for water. Because ions in solution carry the electrical current, conductivity rises as ion concentration rises. As a result, it is one of the key factors used to assess whether water is suitable for irrigation and firefighting.

These units are used to measure it:

Micromhos/cm in American units

SI units are expressed in milliSiemens/m (mS/m) or deciSiemens/m (dS/m)

Where (1 dS/m = 1000 mS/m) = 10 umho/cm.

A poor conductor of electricity is pure water. This is how water typically conducts:

Water that is 5.5- 106 S/m pure;

Water for drinking: 0.005– 0.05 S/m;

5 S/m is for seawater.

### 1.5.5. Alkalinity:

Water's ability to be alkaline is contingent upon the presence of particular compounds such bicarbonate ions, carbonates, and hydroxide ions. There is no chemical in the water. Alkalinity would be described as "the ionic strength of a water body; a measure of the capability of the water body to neutralize acids and bases and so maintain a relatively steady pH level." In simpler terms, when acidic water has been added to the water body, for example, by acid rain or an acid spill, water with high alkalinity will vary in its own acidity less. There aren't any established standards for alkalinity; alkalinity fluctuates as a result of variations in geology.

### 1.6 Soil Salinity Assessment:

A type of land deterioration known as soil salinity occurs when salts build up in the soil profile to the point where they significantly impact infrastructure or plant development. Salinity results in an adverse hydrological environment and limits normal crop yield(Haque, 2006). Seasonally high salt concentration in the soil's root zone is the principal barrier to increasing crop yield in coastal settings. Specifically in the latter half of the dry (winter) season, when the riverside flow of fresh water becomes very low, the salts enter onshore by rivers and channels. By flooding the soil with salty river water or through seeping into the ground, salts infiltrate the soil and concentrate in the top layers of the soil through evaporation. The groundwater may become more salinized as a result of the saline river water, making it unusable for irrigation. For the growth of crops, soil fertility is crucial. The soil fertility in Bangladesh's coastal regions is often fairly low. Soil nutrients have an impact on plant growth in addition to salinity.


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# Chapter 2: Literature Review:

The relative amount of salt in soil or water is known as salinity. Often, it is expressed in ppt (parts per thousand). The proportional amount of salts dissolved in the water is known as salinity. River water becomes salty and is known as river water salinity when salty water from the ocean travels inland through a river. And it comes to near the surface water, then the surface water also make salty. Salinity therefore occurs or increases as a result of the saline water incursion, or the passage of saline water from the sea ashore(Gain et al., 2007).

Bangladesh is a deltaic country with 147,570 km2 total land area, including 29,000 km2 of coastline. Around 30% of the land is arable in that large coastal area (Haque, 2006). Actually the coastal belt's saltwater invasion accelerates salinization of the water and soil, which could have a negative impact on coastal agriculture, forestry, and fisheries(Le Dang et al., 2014). The influence of salt intrusion on coastal agriculture and its related impact on food security were studied by Miah *et al.* (2020). The study's primary concentration was limited to Jessore, Khulna, Satkhira, and Bagerhat. In order to complete the entire work for this review study, secondary data sources were utilized. Pupils learn the reasons for the details of saline intrusion in coastal water and land. Unplanned gher growth is among the main causes of rising salinity, according to their analysis. The security of our food supply is significantly impacted by the deterioration of agricultural lands. Because it is less economical and the yield is unclear due to the lack of saline-tolerant rice cultivars, individuals have no interest in growing crops.

There has also a study which is conducted by Matin *et al.*, (2016). The current shrimp culture scenario in the Khulna, Satkhira, and Bagerhat districts of the Khulna division is attempted to be critically reviewed in this study. The assessment offers a list of the critical elements influencing the nation's shrimp culture. Shrimp farming has a negative impact on the environment in a number of ways, including chemical use, water pollution, and soil salinization, reduced river flow capacity due to sedimentation, contamination of ground and surface water, and altered hydrological conditions. The research showed that, about 80–90% of the population in these coastal districts depends on shrimp farming for their life and livelihood. Data and information from the most recent fieldwork have been gathered through questionnaire surveys. Interviews have been conducted with nearby people and local shrimp farmers. Moreover, tests on the quality of the soil and water have been done. There are a few interrelated causes behind the decline in shrimp production. They include mostly unplanned shrimp farming, rising soil and water salinity, a lack of access to medicine, a new shrimp farming method, and inadequate government support for environmentally sustainable shrimp farming. In order to further advance the nation's shrimp culture, several recommendations have been made. The preliminary analysis indicates that the nation's current culture of shrimp requires proper adherence to the national policies and strategies the government has established for the food and agriculture sectors.


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Raba, Kumar and Proshad were conducted to study about the variability of soil and water salinity at Paikgachha upazila of Khulna district in Bangladesh (2017). They were investigated soil and water pH and electrical conductivity (EC)). In this study the Paikhgachha upazila's Bhodra River's inside and outer polders, as well as a few particular crop areas, were sampled for soil. Water samples were frequently taken from various sites and locations across Paikgachha upazila (pond water and deep tube-well water).

Salinity-induced livelihood stress was studied by Abedin, Habiba and Shaw (2013) in coastal Bangladesh. They learn some of the main causes of saline water from many previously published works. According to their study, the presence of excessive salt on the soil and water of coastal Bangladesh is due to a number of factors, including sea-level rise, the Farakka barrage, increased shrimp farming, tidal floodings, excessive groundwater use, etc. They also discussed the negative impact of rising salinity on local residents' access to safe drinking water, agriculture, fisheries, ecosystems, and way of life. To lessen the detrimental effects of salt, they offer various adaption tactics.

The trajectory of recent changes in coastal land-use was examined by Parvin *et al.*, (2017). There, the causes of changes in land usage were emphasized. In addition, it emphasizes the effects of coastal land-use changes and their related effects on food, agriculture, and water supply. According to their study, there has been a considerable change in coastal land use during the past 50 years. Since then, natural disasters, saline intrusion, polarization, and intense shrimp farming have changed the entire coastal region of Bangladesh. They discovered that the acreage used for shrimp farming significantly rose from 2.34% to 31.5% between 1980 and 1995. As shrimp farming became more popular because it was so much more profitable than other types of farming at the time, agricultural land began to disappear. The invasion of salinity and the forced transfer of land ownership were key factors in this change in land usage.

Kabir *et al.*, (2016) studied coastal Bangladesh's farming adaptability to environmental change. The study's primary objective was to compare the profitability, risk, and sustainability of shrimp culture and agriculture. For the study, two communities in Khulna were chosen. Due to its guaranteed profitability, people began raising shrimp on agricultural grounds during the dry season. Subsequently, residents encountered a number of issues, including the infiltration of soil salinity and the detrimental effects of shrimp farming. They have begun using a modified cropping strategy since 2009. The architecture of the shrimp pond has been altered, saline-tolerant rice species have begun to be planted, the soil salt has been flushed with rainwater prior to rice cultivation, and the soil has been dried off after rice has been harvested. The authors' examination of the market revealed that the current farming system is more practical and financially successful.


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# Chapter 3: Methodology:

## 3.1 Study Area:

2 unions of Paikgachha upazila are situated in the Khulna district. They are Laskar and Deluti unions. Laskar union's Latitude is 22° 36' 60'' North and its Longitude is 89° 24' 56'' East. Deluti's Latitude is 22° 38′ 29.04″ North, and Longitude is 89° 25′ 16.32″ East.

### 3.1.1. Laskar Union's map:

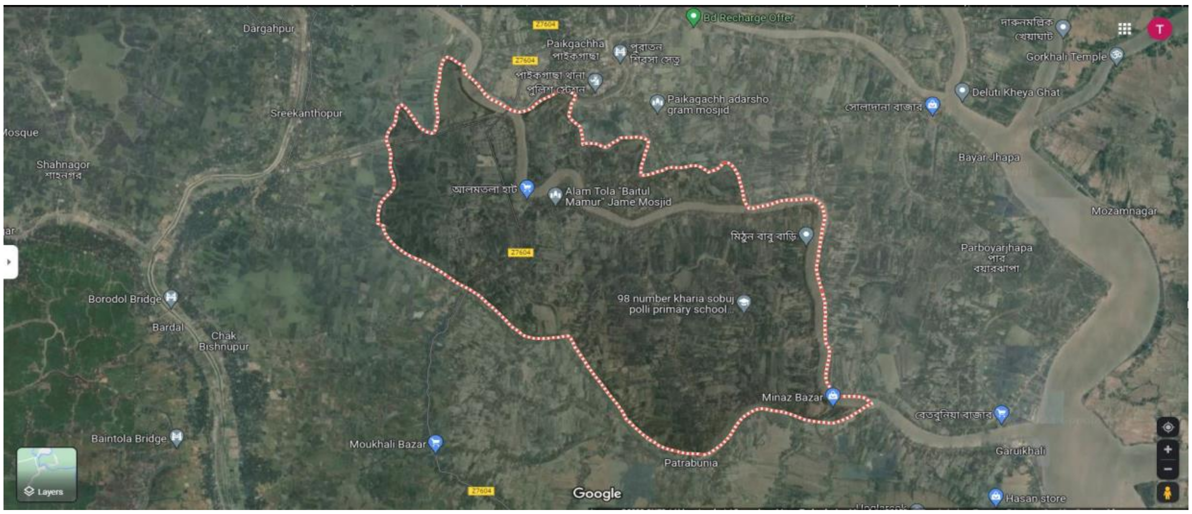


Figure 1: Laskar Map

### 3.1.2. Deluti union's map:

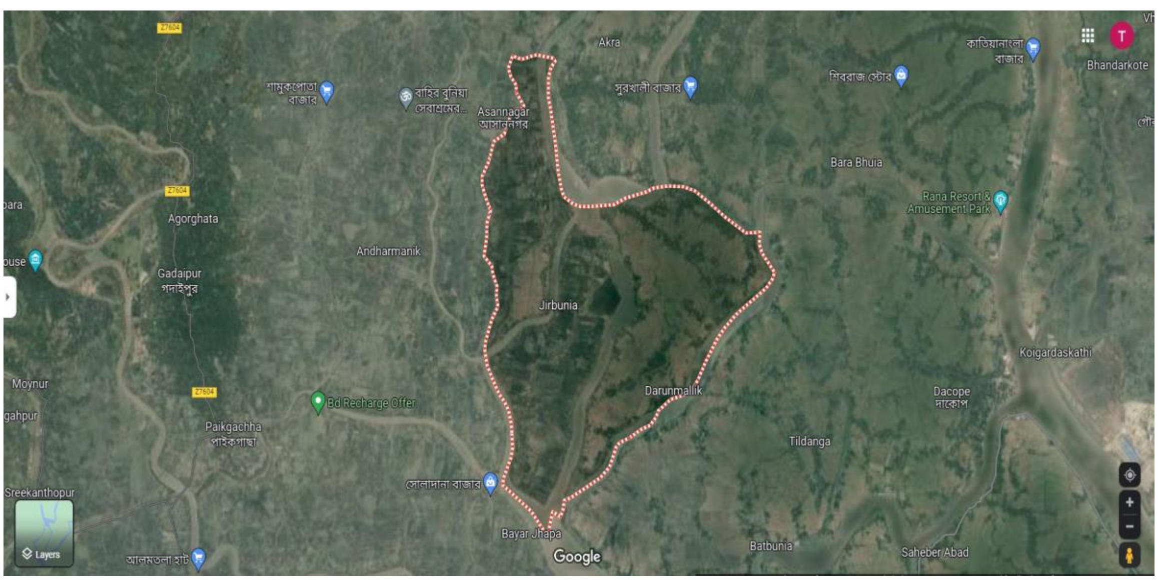


Figure 2: Deluti Map


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### 3.1.3. Sampling Area, Laskar Union:

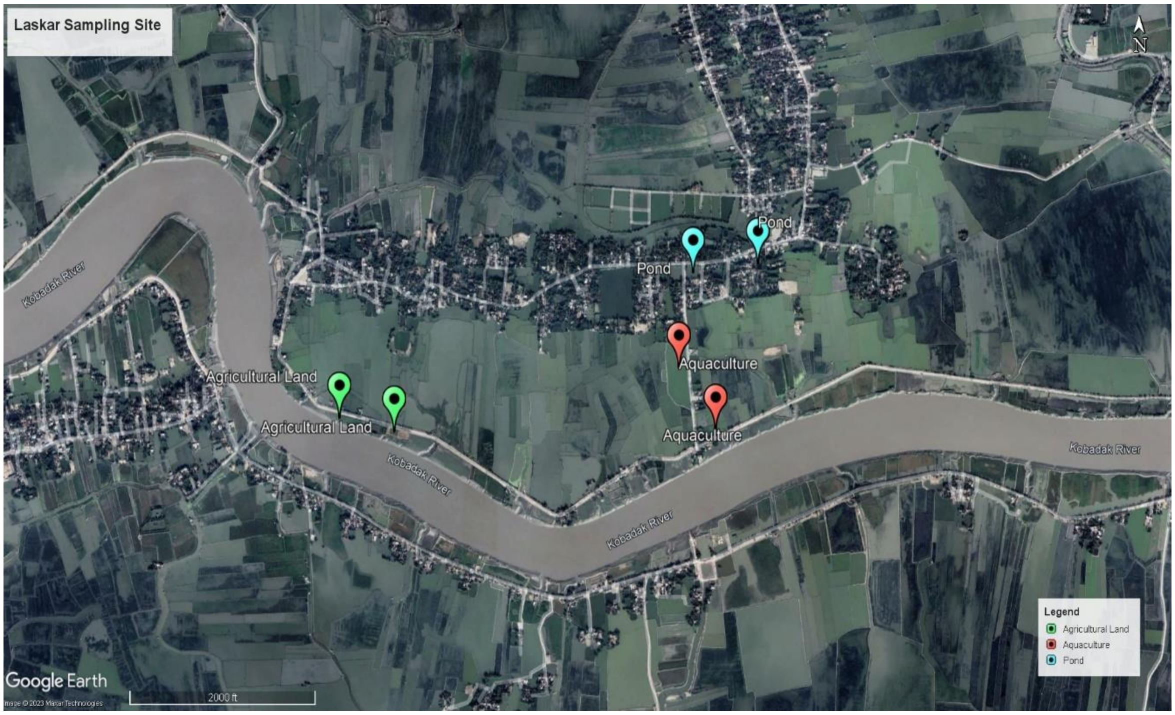


Figure 3: Sampling Area, Laskar Union

Table 1: Sampling points Coordinate (Laskar):

| **Laskar Union (Region)** | **Latitude & Longitude** |
|---|---|
| Pond 1 | 22°34'2.71"N, 89°20'1.34"E |
| Pond 2 | 22°34'1.81"N, 89°19'53.92"E |
| Agricultural Land 1 | 22°33'46.20"N, 89°19'19.67"E |
| Agricultural Land 2 | 22°33'47.54"N, 89°19'13.39"E |
| Aquaculture 1 | 22°33'52.46"N, 89°19'52.29"E |
| Aquaculture 2 | 22°33'46.36"N, 89°19'56.50"E |


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### 3.1.4. Sampling area, Deluti union:

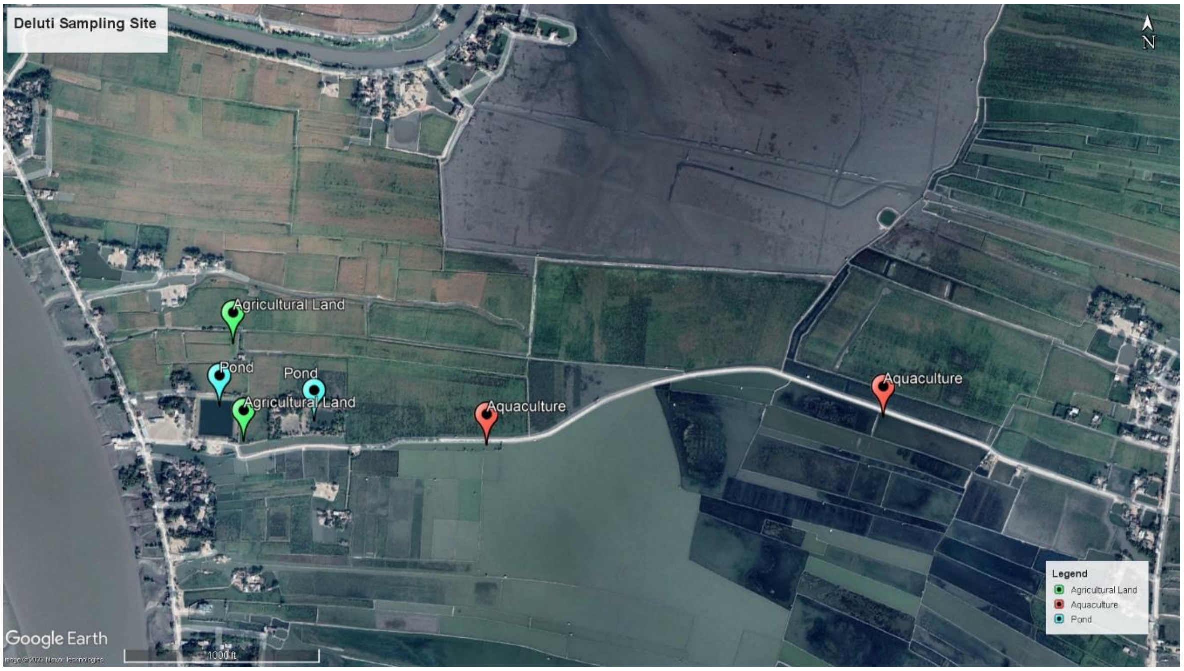


Figure 4: Sampling area, Deluti union

Table 2: Sampling points coordinate (Deluti):

| **Deluti Union(Region)** | **Latitudr & Longitude** |
|---|---|
| Pond 1 | 22°35'58.09"N, 89°23'37.45"E |
| Pond 2 | 22°35'58.84"N, 89°23'32.29"E |
| Agricultural Land 1 | 22°36'2.00"N, 89°23'33.03"E |
| Agricultural Land 2 | 22°35'57.09"N, 89°23'33.61"E |
| Aquaculture 1 | 22°35'56.89"N, 89°23'46.87"E |
| Aquaculture 2 | 22°35'58.29"N, 89°24'8.51"E |

### 3.2 Water Sample Collection Procedure:

The fieldwork was conducted in October (2022) within a few days. Firstly I went to Laskar Union and next was to Deluti union. I gathered a total of 18 water samples from each union. The locations included two aquacultures, two ponds, and two agricultural fields. These were taken 3 times from each location. I collected 36 samples in all.

### 3.3 Soil sample Collection Procedure:

A trowel was used to collect six soil samples from each union. Those locations were 2 aquacultures, 2 ponds, and 2 agricultural areas. 12 bags of soil in total were gathered from 2 unions.


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### 3.4 Soil sample preparation:

1. Every soil sample Diluted by distilled water in 1:5 form, soil:distilled water suspension following 1 h of end-over-end mixing (Mahmuduzzaman et al., 2014).
2. soil sample : distilled water - 50 g : 250 ml
3. And filtered the mixer water from soil by Whatman filter paper.

### 3.5 Laboratory Experiment:

#### 3.5.1. Physical parameters:

The 36 water samples were individually examined for physical characteristics including Water Salinity, Electrical Conductivity (EC) and Total Dissolved Solids (TDS). In the Environmental Science and Disaster Management (ESDM) Laboratory at Daffodil International University (DIU), Ashulia, Savar, these experiments were being conducted. For lab testing 40 ml water was taken from each sample of 500 ml. From 2 unions of total samples were 36. There was used Portable Salinity Refractometer for the measurement of water salinity. TDS values of the 36 water samples were measured separately using a HANNA pH/EC/TDS/Temperature Meter (HI9814). The EC value of the water sample was measured individually using a HANNA EC Tester (HI98304).

#### 3.5.2. Chemical parameters:

The pH levels of the 36 water samples were also repeatedly measured using a HANNA Ph/EC/TDS/Temperature Meter (HI9814). Titrimetric alkanity measurement was performed by titrating samples (25 ml from per sample) against a standard solution of 0.01N HCl.

Alkalinity test process:

1. 25 ml sample.

2. 2 drops of phenolphthalein. (Turns light pink)

3. Add HCl until color disappears.

4. 1 drop of Methyl orange. (Turns yellow)

5. Add HCl until color changes.

$$\text{Total Alkalinity} = (\text{Total HCl (ml)} \times 1000) / \text{sample (ml)}$$


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### 3.5.3 Instruments:

Table 3: Instruments:

| Category | Parameters | Name or Model |
|---|---|---|
| **Instruments** | Salinity | Portable Salinity Refractometer |
| | TDS | HANNA Ph/EC/TDS/Temperature Meter (HI9814) |
| | EC | HANNA EC Tester (HI98304) |
| | pH | HANNA pH meter (HI9814) |
| **Software's** | Mapping | Google Earth Pro |
| | Statistics | Microsoft Excel 2016 |


Figure 5: MRC Salinity refractometer, Hanna HI98304 DiST®4 EC-Tester & Hanna HI9814 Multiparameter GroPro pH/EC/TDS/°C (From left)


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# Chapter 4: Result and Discussions:

### 4.1.1. Salinity of Laskar Union:

Table 4: Salinity of Laskar Union:

| Sample Area | Salinity (ppt) | Standard DEV | Average |
|---|---|---|---|
| **LP1a** | 0.5 | 0.58 | 1.17 |
| **LP1b** | 1.5 | | |
| **LP1c** | 1.5 | | |
| **LP2a** | 1 | 0.29 | 0.83 |
| **LP2b** | 0.5 | | |
| **LP2c** | 1 | | |
| **LA1a** | 2.5 | 0.58 | 1.83 |
| **LA1b** | 1.5 | | |
| **LA1c** | 1.5 | | |
| **LA2a** | 1.5 | 0.51 | 1.07 |
| **LA2b** | 1.2 | | |
| **LA2c** | 0.5 | | |
| **LG1a** | 7 | 0.5 | 6.5 |
| **LG1b** | 6.5 | | |
| **LG1c** | 6 | | |
| **LG2a** | 9 | 1 | 10 |
| **LG2b** | 10 | | |
| **LG2c** | 11 | | |

Table 5: Standard Salinity Ranges:

| Salinity range(ppt) | Salinity Class |
|---|---|
| 1.28-2.56 | Very slight saline |
| 2.62-5 | Slightly saline |
| 5.1-7.6 | Moderately saline |
| 7.6-10.2 | Strongly saline |
| >10.2 | Very strongly saline |

Source: The standardized of salinity values, (M. Matin et al., 2016).


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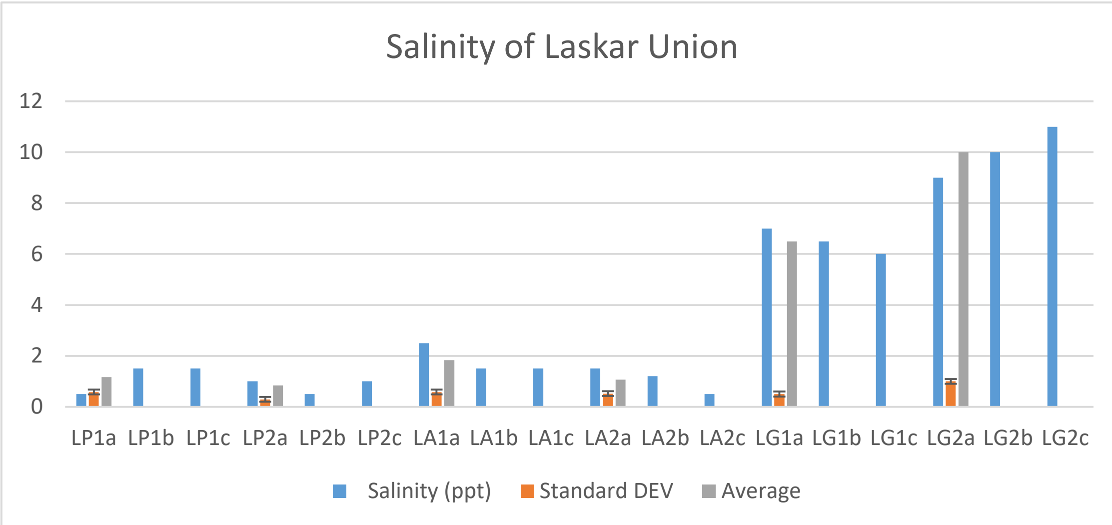


Figure 6: Salinity of Laskar Union

LP- Laskar's Pond

LA- Laskar's Agricultural Land

LG- Laskar's Aquaculture

The two charts demonstrate that the saline ranges in these fishery farmed water bodies are moderate and high. One has 6.5, and other one is 10. While the first aquaculture water body is slightly salinized(M. A. Matin et al., 2016), the second is strongly so. Ponds and agricultural lands contain relatively minimal salinity in their water bodies.


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## 4.1.2. Salinity of Deluti Union:

Table 6: Salinity of Deluti Union:

| Sample Area | Salinity (ppt) | Standard DEV | Average |
|---|---|---|---|
| **DP1a** | 3 | 0.29 | 3.18 |
| **DP1b** | 3 | | |
| **DP1c** | 3.5 | | |
| **DP2a** | 1.5 | 0.40 | 1.57 |
| **DP2b** | 1.2 | | |
| **DP2c** | 2 | | |
| **DA1a** | 1.5 | 0.5 | 1 |
| **DA1b** | 1 | | |
| **DA1c** | 0.5 | | |
| **DA2a** | 0.1 | 0.49 | 0.43 |
| **DA2b** | 0.2 | | |
| **DA2c** | 1 | | |
| **DG1a** | 8.5 | 0.29 | 8.67 |
| **DG1b** | 8.5 | | |
| **DG1c** | 9 | | |
| **DG2a** | 8.5 | 1.08 | 8.98 |
| **DG2b** | 8.2 | | |
| **DG2c** | 10.2 | | |

Table 7: Standard Salinity Ranges:

| Salinity range(ppt) | Salinity Class |
|---|---|
| 1.28-2.56 | Very slight saline |
| 2.62-5 | Slightly saline |
| 5.1-7.6 | Moderately saline |
| 7.6-10.2 | Strongly saline |
| >10.2 | Very strongly saline |

Source: The standardized of salinity values, (M. Matin et al., 2016).


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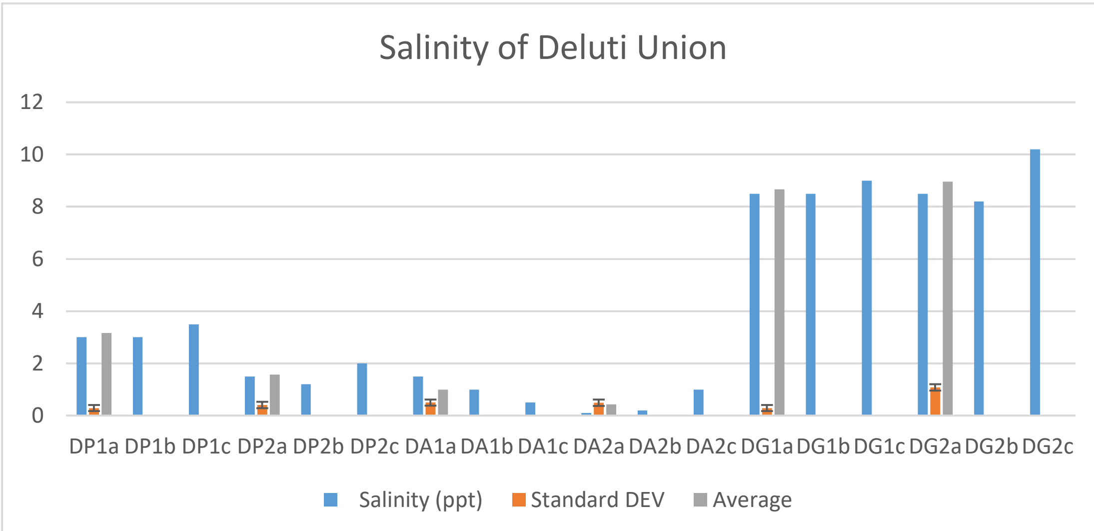


Figure 7: Salinity of Deluti Union

DP- Deluti’s Pond

DA- Deluti’s Agricultural Land

DG- Deluti’s Aquaculture

The figure demonstrates that the salinity ranges in these aquaculture fisheries are nearly identical. One has 8.67 ppt, whereas the other has 8.98 ppt. They have strong saline in water(M. A. Matin et al., 2016). 3.18 ppt, or slightly saline, is present in one pond. Water bodies on agricultural lands have very slight salinity.


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### 4.2.1 pH of Laskar Union:

Table 8: pH of Laskar Union:

| Sample Area | pH | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| LP1a | 7.9 | 0.26 | 8.2 | 6.5 - 8.5 |
| LP1b | 8.4 | | | |
| LP1c | 8.3 | | | |
| LP2a | 8.4 | 0.2 | 8.6 | |
| LP2b | 8.8 | | | |
| LP2c | 8.6 | | | |
| LA1a | 8.9 | 0.31 | 8.57 | 6.5 - 8.5 |
| LA1b | 8.3 | | | |
| LA1c | 8.5 | | | |
| LA2a | 8.7 | 0.21 | 8.53 | |
| LA2b | 8.3 | | | |
| LA2c | 8.6 | | | |
| LG1a | 8.2 | 0.25 | 8.47 | 6.5 - 8.5 |
| LG1b | 8.7 | | | |
| LG1c | 8.5 | | | |
| LG2a | 8.6 | 0.12 | 8.67 | |
| LG2b | 8.8 | | | |
| LG2c | 8.6 | | | |

Source: The standardized pH values, (DoE, 1997)

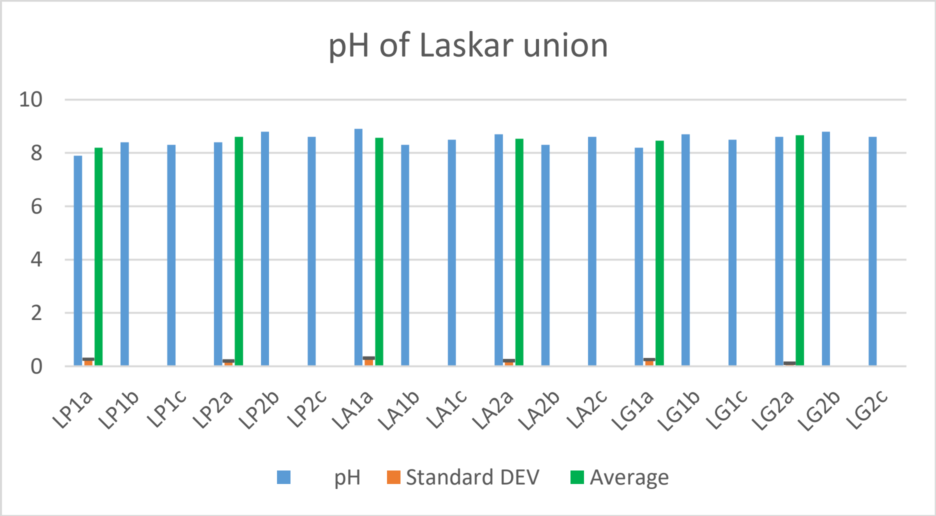


Figure 8: pH of Laskar Union


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LP- Laskar's Pond

LA- Laskar's Agricultural Land

LG- Laskar's Aquaculture

The graph demonstrates that in Bangladesh's Loshkor union, two ponds are discovered to have pH levels of 8.2 and 8.6, whereas samples of water from agricultural lands have pH values of 8.57 and 8.53. In addition, pH levels in fishery pond water samples range are 8.47 and 8.6. All of the bodies of water had pH values that are higher than Bangladesh's typical range of 6.5 to 8.5. Alkalinity, soil erosion, and excessive fertilizer and pesticide use are among the variables that may contribute to high pH values in water bodies.

### 4.2.2 pH of Deluti Union:

Table 9: pH of Deluti Union:

| Sample Area | pH | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| **DP1a** | 7.9 | 0.17 | 8.1 | 6.5 - 8.5 |
| **DP1b** | 8.2 | | | |
| **DP1c** | 8.2 | | | |
| **DP2a** | 8.3 | 0.15 | 8.47 | |
| **DP2b** | 8.6 | | | |
| **DP2c** | 8.5 | | | |
| **DA1a** | 8.8 | 0.05 | 8.73 | 6.5 - 8.5 |
| **DA1b** | 8.7 | | | |
| **DA1c** | 8.7 | | | |
| **DA2a** | 8.6 | 0.26 | 8.9 | |
| **DA2b** | 9 | | | |
| **DA2c** | 9.1 | | | |
| **DG1a** | 7.9 | 0.1 | 8 | 6.5 - 8.5 |
| **DG1b** | 8 | | | |
| **DG2c** | 8.1 | | | |
| **DG2a** | 8.6 | 0.21 | 8.76 | |
| **DG2b** | 8.7 | | | |
| **DG2c** | 9 | | | |

Source: The standardized pH values, (DoE, 1997)


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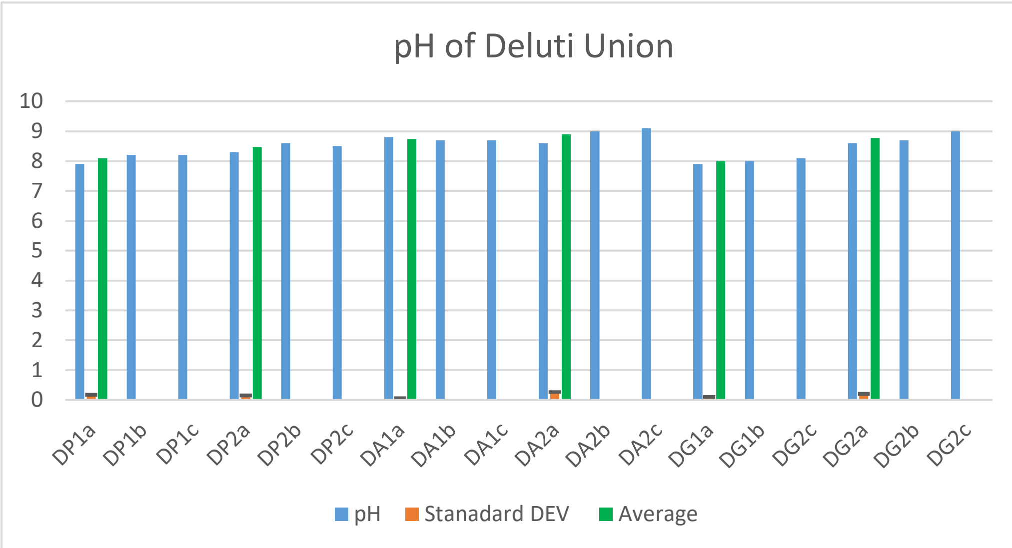


Figure 9: pH of Deluti Union

DP- Deluti's Pond

DA- Deluti's Agricultural Land

DG- Deluti's Aquaculture

The graph demonstrates that the pH of the water in the various ponds, agricultural farms, and fisheries in Bangladesh's Deluti Union varies. The pH of the two ponds is 8.1 and 8.47, while the pH of the agricultural lands is 8.73 and 8.9. pH values in the fishery ponds water ranged between 8 and 8.76. It is significant to remember that Bangladesh's normal range for all irrigation, fishing, and natural water is between 6.5 and 8.5. Thus, it is crucial to frequently check the pH levels of these water bodies and, if necessary, take corrective action to keep them within safe and tolerable parameters.


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### 4.3.1. TDS of Laskar Union:

Table 10: TDS of Laskar Union:

| Sample Area | TDS (ppm) | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| LP1a | 1240 | 17.32 | 1260 | 1000 mg/l |
| LP1b | 1270 | | | |
| LP1c | 1270 | | | |
| LP2a | 660 | 0 | 660 | |
| LP2b | 660 | | | |
| LP2c | 660 | | | |
| LA1a | 1350 | 5.77 | 1353.33 | 450 - 2000 mg/l |
| LA1b | 1360 | | | |
| LA1c | 1350 | | | |
| LA2a | 1040 | 20.81 | 1063.33 | |
| LA2b | 1080 | | | |
| LA2c | 1070 | | | |
| LG1a | 5440 | 160 | 5440 | 0 - 1000 mg/l |
| LG1b | 5600 | | | |
| LG1c | 5280 | | | |
| LG2a | 8000 | 532.66 | 7546.67 | |
| LG2b | 6960 | | | |
| LG2c | 7680 | | | |

Source: The standardized TDS values, (DoE, 1997)

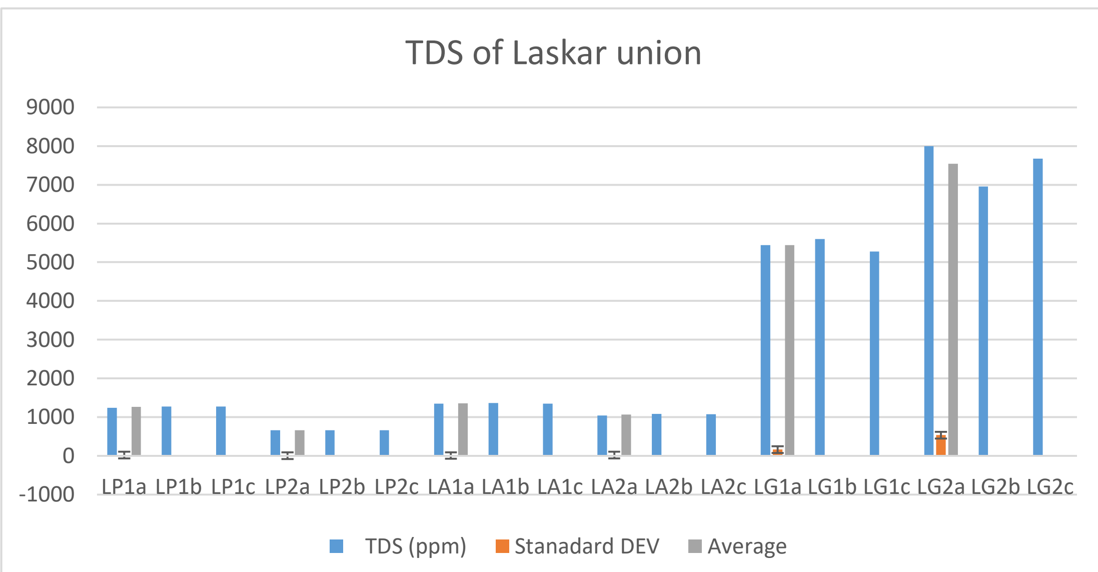


Figure 10: TDS of Laskar Union


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LP- Laskar's Pond

LA- Laskar's Agricultural Land

LG- Laskar's Aquaculture

Total dissolved solids, or TDS, is a term used to describe the combined concentration of inorganic and organic materials found in water. The graph shows firstly, TDS (Total Dissolved Solids) values from 2 ponds water of Loshkor Union are 1260 ppm and 660 ppm, respectively. These numbers are higher above the typical limit of 1000 ppm, which shows that the ponds' water quality is inadequate. Secondly, the TDS values for the water on the agricultural lands are also greater than the advised range of 450 to 2000 ppm, at 1353.33 and 1063.33 ppm, accordingly. These values indicate that these agricultural lands' water quality is similarly subpar. Additionally, the TDS levels in the aquaculture water bodies are frighteningly high at 5440 ppm and 7546.67 ppm, in both, which is far higher than the recommended range of 0-1000 ppm.

### 4.3.2. TDS of Deluti Union:

Table 11: TDS of Deluti Union:

| Sample Area | TDS (ppm) | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| **DP1a** | 3360 | 201.32 | 3173.33 | 1000 mg/l |
| **DP1b** | 2960 | | | |
| **DP1c** | 3200 | | | |
| **DP2a** | 1340 | 0 | 1340 | |
| **DP2b** | 1340 | | | |
| **DP2c** | 1340 | | | |
| **DA1a** | 940 | 0 | 940 | 450 - 2000 mg/l |
| **DA1b** | 940 | | | |
| **DA1c** | 940 | | | |
| **DA2a** | 350 | 20 | 370 | |
| **DA2b** | 370 | | | |
| **DA2c** | 390 | | | |
| **DG1a** | 6320 | 211.66 | 6160 | 0 - 1000 mg/l |
| **DG1b** | 6240 | | | |
| **DG2c** | 5920 | | | |
| **DG2a** | 6320 | 486.62 | 6640 | |
| **DG2b** | 6400 | | | |
| **DG2c** | 7200 | | | |

Source: The standardized TDS values, (DoE, 1997)


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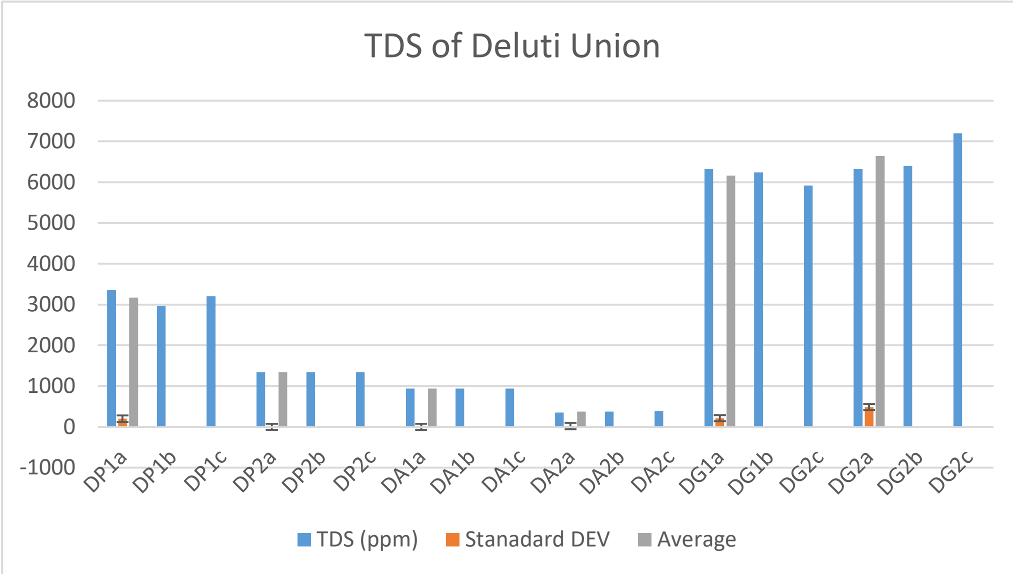


Figure 11: TDS of Deluti Union

DP- Deluti's Pond

DA- Deluti's Agricultural Land

DG- Deluti's Aquaculture

The TDS levels differ greatly between the two ponds, two agricultural fields, and two fishing ponds owned by Deluti Union. Both of the two ponds' TDS readings 3173.33 ppm and 1340 ppm are over the recommended limit of 1000 ppm. TDS concentrations in one of the ponds are very high. With values between 370 and 940 ppm, the TDS levels in the water on agricultural lands are acceptable. At values of 6160 ppm and 6640 ppm, the TDS levels in the two fishery ponds, however, are alarmingly high and considerably over Bangladesh's legal limit of 0-1000 ppm.


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### 4.4.1. EC of Laskar Union:

Table 12: EC of Laskar Union:

| Sample Area | EC (µs/cm) | Stanadard DEV | Average | Standard Value |
|---|---|---|---|---|
| LP1a | 2900 | 25.16 | 2873.33 | 700 µs/cm |
| LP1b | 2870 | | | |
| LP1c | 2850 | | | |
| LP2a | 1500 | 15.27 | 1486.67 | |
| LP2b | 1490 | | | |
| LP2c | 1470 | | | |
| LA1a | 3120 | 20.81 | 3113.33 | 1200 µs/cm |
| LA1b | 3130 | | | |
| LA1c | 3090 | | | |
| LA2a | 2430 | 30.55 | 2463. 33 | |
| LA2b | 2470 | | | |
| LA2c | 2490 | | | |
| LG1a | 11310 | 75.05 | 11313. 33 | 800-1000 µs/cm |
| LG1b | 11240 | | | |
| LG1c | 11390 | | | |
| LG2a | 16540 | 244.40 | 16753.33 | |
| LG2b | 17020 | | | |
| LG2c | 16700 | | | |

Source: The standardized EC values, (DoE, 1997)

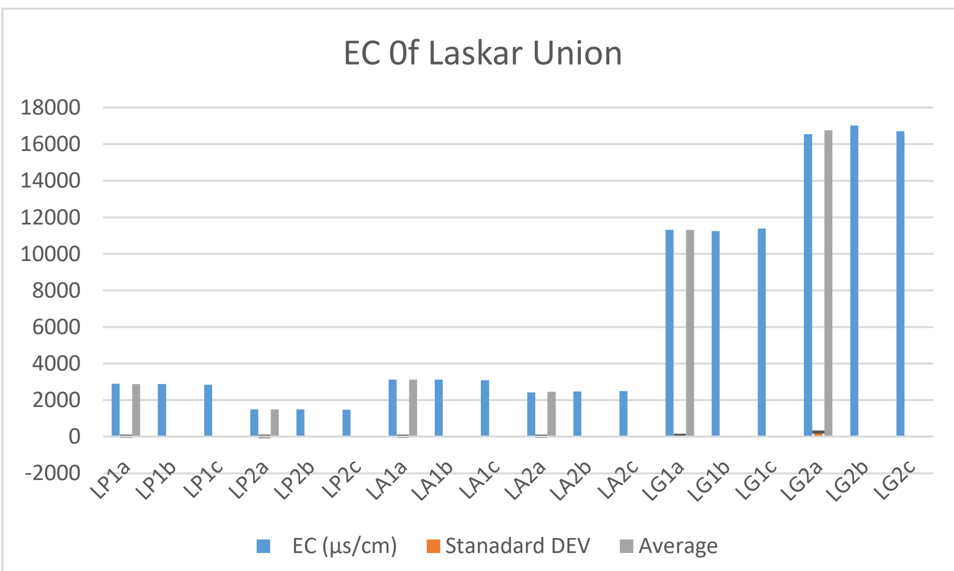


Figure 12: EC of Laskar Union


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LP- Laskar's Pond

LA- Laskar's Agricultural Land

LG- Laskar's Aquaculture

A measure of water's electrical conductivity (EC) reveals the existence of dissolved ions by showing how well it can carry an electrical current. The two ponds owned by Loshkor Union have EC values of 2873.33 µs/cm and 1486.67 µs/cm, both of which are higher than the typical EC value for ponds of 700 µs/cm. The EC limit of 1200 µs/cm is also exceeded by two agricultural sites, where the water has EC values of 3113.33 and 2463.33. The two fishery ponds also had EC values that are significantly higher above the typical EC range of 800-1000 µs/cm for aquaculture water bodies, reaching 11313.33 µs/cm and 16753.33 µs/cm accordingly. Such high EC levels are dangerous for aquatic life and can affect plant development and soil fertility, among other issues, in agriculture.

### 4.4.2. EC of Deluti Union:

Table 13: EC of Deluti Union:

| Sample Area | EC (µs/cm) | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| **DP1a** | 7390 | 112.69 | 7520 | 700 µs/cm |
| **DP1b** | 7580 | | | |
| **DP1c** | 7590 | | | |
| **DP2a** | 3150 | 49.32 | 3116. 67 | |
| **DP2b** | 3140 | | | |
| **DP2c** | 3060 | | | |
| **DA1a** | 2180 | 10 | 2170 | 1200 µs/cm |
| **DA1b** | 2160 | | | |
| **DA1c** | 2170 | | | |
| **DA2a** | 830 | 10 | 840 | |
| **DA2b** | 850 | | | |
| **DA2c** | 840 | | | |
| **DG1a** | 14910 | 210.79 | 14783.33 | 800–1000 µs/cm |
| **DG1b** | 14540 | | | |
| **DG2c** | 14900 | | | |
| **DG2a** | 15260 | 87.36 | 15356.67 | |
| **DG2b** | 15430 | | | |
| **DG2c** | 15380 | | | |

Source: The standardized EC values, (DoE, 1997)


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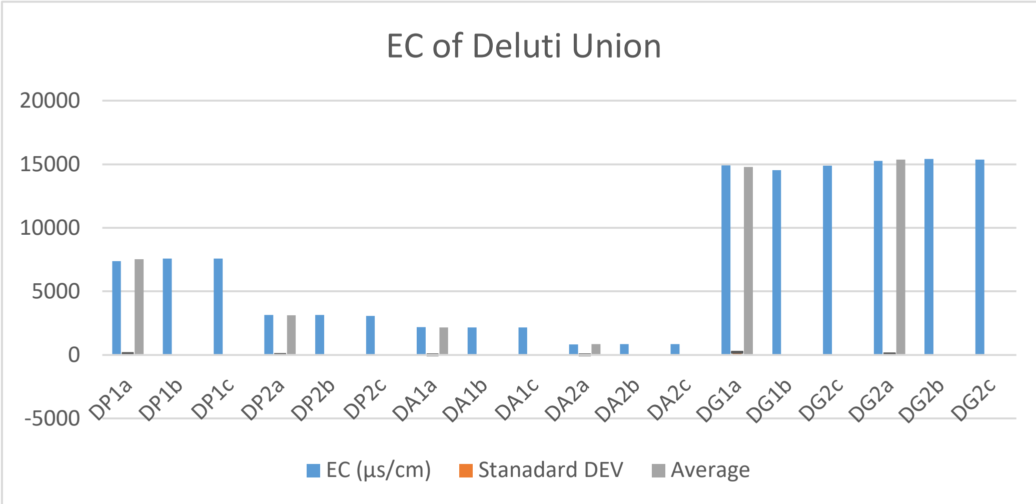


Figure 13: EC of Deluti Union

DP- Deluti's Pond

DA- Deluti's Agricultural Land

DG- Deluti's Aquaculture

This chart shows that, the EC values in the two ponds owned by Deluti Union are 7520 and 3116. 67 **µ**s/cm, both of which are significantly higher than the typical EC value of 700 **µ**s/cm for ponds. Likely exceeding the EC limit of 1200 **µ**s/cm is water on one of the two agricultural lands, with an EC value of 2170 **µ**s/cm. The two fishery ponds also exhibit EC values that are significantly higher than the typical EC range of 800-1000 **µ**s/cm for aquaculture water bodies, at 14783.33 µs/cm and 15356. 67 µs/cm, respectively. Such high EC levels are dangerous for aquatic life and can affect plant development and soil fertility, among other issues, in agriculture. Thus, it is essential to act quickly to lower the EC values and preserve clean, safe water bodies.


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### 4.5.1. Alkalinity of Laskar Union:

Table 14: Alkalinity of Laskar Union:

| Sample Area | Alkalinity(mg/L) | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| **LP1a** | 404 | 6.92 | 400 | 20 – 200 mg/l |
| **LP1b** | 392 | | | |
| **LP1c** | 404 | | | |
| **LP2a** | 256 | 4.61 | 258.67 | |
| **LP2b** | 256 | | | |
| **LP2c** | 264 | | | |
| **LA1a** | 216 | 6.11 | 222.67 | 100 - 500 mg/l |
| **LA1b** | 224 | | | |
| **LA1c** | 228 | | | |
| **LA2a** | 164 | 23.43 | 190.67 | |
| **LA2b** | 208 | | | |
| **LA2c** | 200 | | | |
| **LG1a** | 244 | 10.58 | 248 | 50 – 300 mg/l |
| **LG1b** | 260 | | | |
| **LG1c** | 240 | | | |
| **LG2a** | 200 | 4 | 204 | |
| **LG2b** | 208 | | | |
| **LG2c** | 204 | | | |

Source: The standardized Alkalinity values, (DoE, 1997)

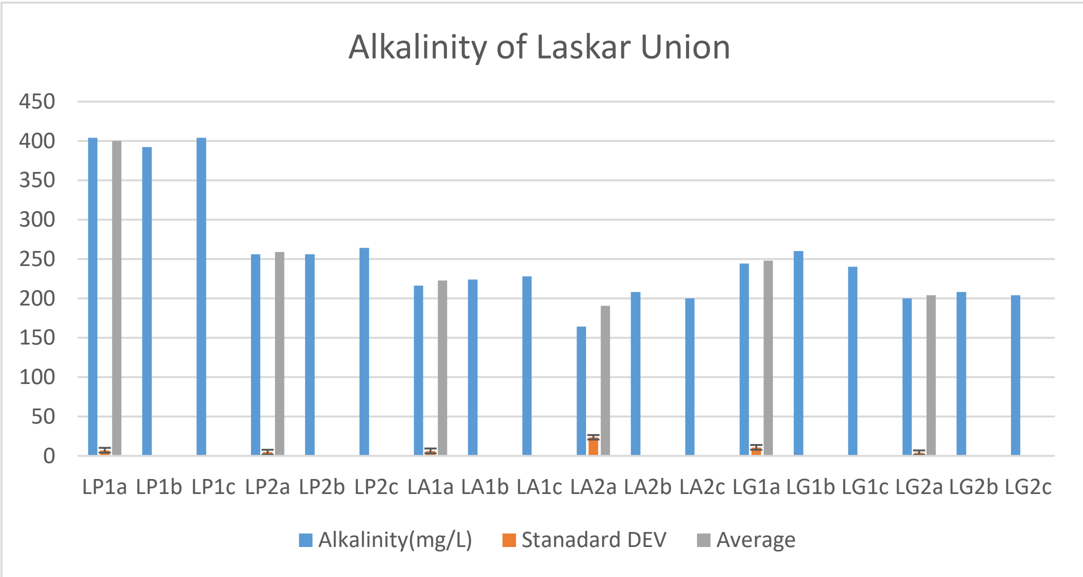


Figure 14: Alkalinity of Laskar Union


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LP- Laskar's Pond

LA- Laskar's Agricultural Land

LG- Laskar's Aquaculture

A steady pH is maintained in aquatic environments by the water's ability to neutralize acids, which is measured by alkalinity. Here the chart shows, alkalinity levels in the two ponds owned by Loshkor Union are 450 and 258.67 mg/L, respectively, exceeding the typical range of 20–200 mg/L for ponds. Parallel to this, the alkalinity values in aquaculture water bodies are 248 and 204 mg/L, which fall within the typical range of 50-300 mg/L. However, the water alkalinity levels in two agricultural areas are 222.67 and 190.67 mg/L, accordingly, which are within the permitted range of 100-500 mg/L for agricultural lands. It is crucial to remember that excessive alkalinity levels have the potential to alter aquatic ecosystems significantly, damaging fish and other aquatic creatures, for example.

### 4.5.2. Alkalinity of Deluti Union:

Table 15: Alkalinity of Deluti Union:

| Sample Area | Alkalinity (mg/L) | Standard DEV | Average | Standard Value |
|---|---|---|---|---|
| DP1a | 208 | 4 | 212 | 20 – 200 mg/L |
| DP1b | 216 | | | |
| DP1c | 212 | | | |
| DP2a | 132 | 4 | 136 | |
| DP2b | 140 | | | |
| DP2c | 136 | | | |
| DA1a | 296 | 0 | 296 | 100 - 500 mg/L |
| DA1b | 296 | | | |
| DA1c | 296 | | | |
| DA2a | 172 | 14.42 | 168 | |
| DA2b | 152 | | | |
| DA2c | 180 | | | |
| DG1a | 240 | 4.61 | 234.67 | 50 – 300 mg/L |
| DG1b | 232 | | | |
| DG2c | 232 | | | |
| DG2a | 304 | 6.11 | 310.67 | |
| DG2b | 312 | | | |
| DG2c | 316 | | | |

Source: The standardized Alkalinity values, (DoE, 1997)


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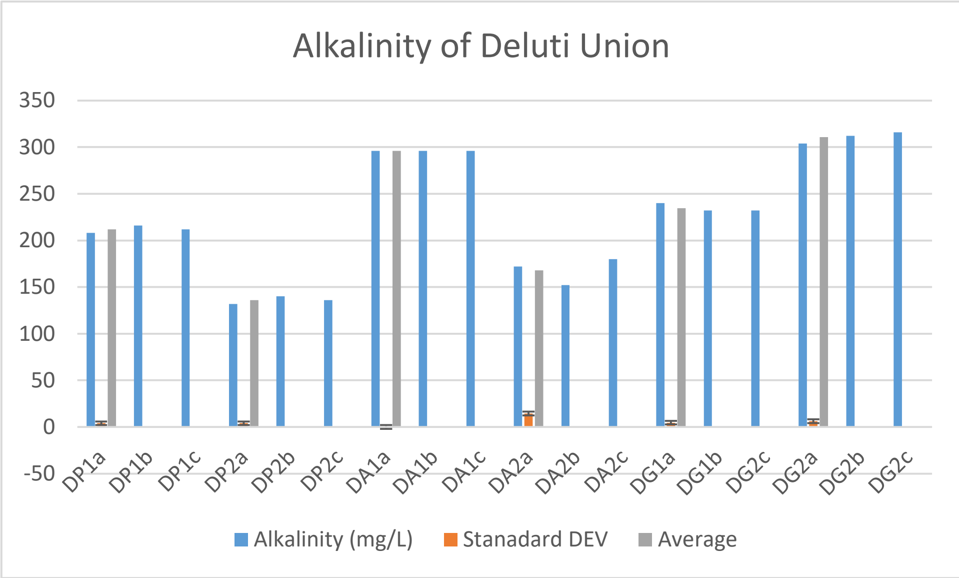


Figure 15: Alkalinity of Deluti Union

DP- Deluti's Pond

DA- Deluti's Agricultural Land

DG- Deluti's Aquaculture

The alkalinity levels in the two ponds owned by Deluti Union are 212 and 136 mg/L, however, and both fall within the permissible range of 20-200 mg/L for ponds. The water alkalinity levels in two agricultural areas are 296 and 168 mg/L, respectively, which are within the permissible range of 100-500 mg/L for agricultural grounds. Last but not least, the alkalinity values for aquaculture water bodies are 234.67 and 310.67 mg/L, which are within the typical range of 50-300 mg/L. For fish and other aquatic species to thrive and survive, the right alkalinity levels are essential.


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### 4.6.1. Alkalinity Comparison of Ponds Water:

Table 16: Alkalinity Comparison of Ponds Water:

| Sample Area | Alkalinity |
|---|---|
| **Laskar P1** | **400** |
| **Laskar P2** | **258.67** |
| **Deluti P1** | **212** |
| **Deluti P2** | **136** |

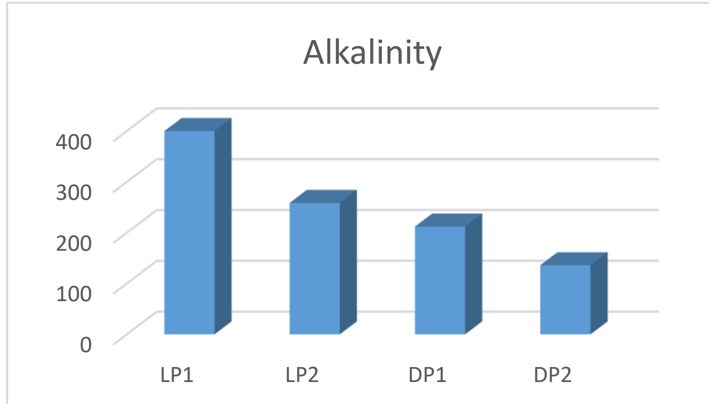


Figure 16: Alkalinity Comparison of Ponds Water

The chart shows that Laskar union's one Pond alkalinity is 400 mg/L, and it is the highest value of this chart. Here the number two's of Deluti pond Alkalinity is 136, and it is the lowest value in this chart. The standard value of natural water alkalinity is 20 – 200 mg/L. Laskar union's ponds have already crossed the limit. And also there has included one Deluti's pond.

### 4.6.2. Alkalinity Comparison of Agricultural Lands Water:

Table 17: Alkalinity Comparison of Agricultural Lands Water:

| Sample Area | Alkalinity |
|---|---|
| **Laskar A1** | **222.67** |
| **Laskar A2** | **190.67** |
| **Deluti A1** | **296** |
| **Deluti A2** | **168** |

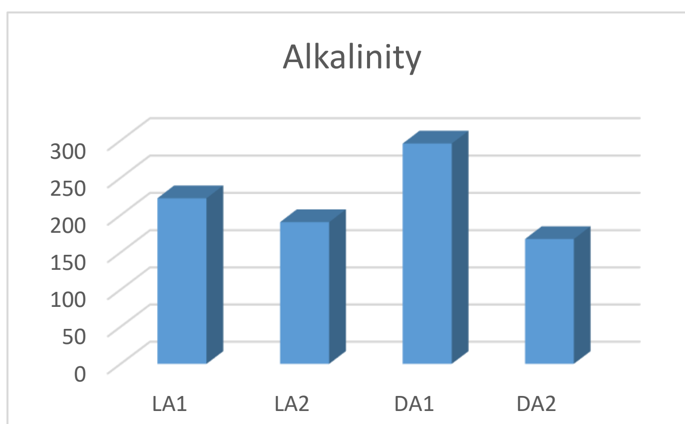


Figure 17: Alkalinity Comparison of Agricultural Lands Water


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The chart describes that Deluti's one agricultural water body has high alkalinity. It is 296 mg/L. Also the lowest amount of alkalinity comes from Deluti's second number of agricultural water body. The standard value of irrigation water alkalinity is 100 – 500 mg/L. So, all have in there acceptable ranges.

### 4.6.3. Alkalinity Comparison of Aquaculture Water Bodies:

Table 18: Alkalinity Comparison of Aquaculture Water Bodies:

| Sample Area | Alkalinity |
|---|---|
| Laskar G1 | 248 |
| Laskar G2 | 204 |
| Deluti G1 | 234.67 |
| Deluti G2 | 310.67 |

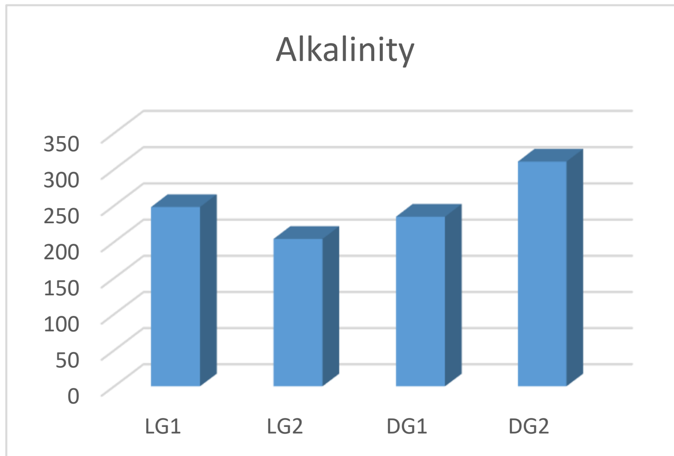


Figure 18: Alkalinity Comparison of Aquaculture Water Bodies

The chart shows that Deluti union's one aquaculture water body has 310.67 mg/L alkalinity. And it is the highest value of this chart. And the lowest one is Laskar union's 204 mg/L. The standard value of aquaculture water body's water alkalinity is 50–300 mg/L. There one has already crossed the limit, which is in Deluti union. .


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### 4.7.1. Electro Conductivity Comparison of Ponds Water:

Table 19: Electro Conductivity Comparison of Ponds Water:

| Sample Area | EC |
|---|---|
| **Laskar P1** | **2873.33** |
| **Laskar P2** | **1486. 67** |
| **Deluti P1** | **7520** |
| **Deluti P2** | **3116. 67** |

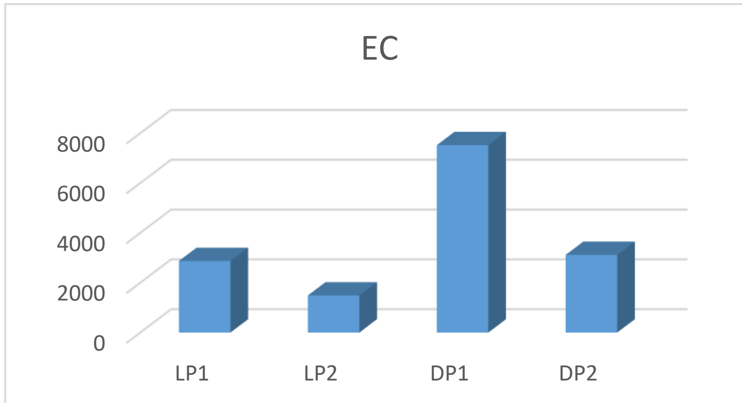


Figure 19: Electro Conductivity Comparison of Ponds Water

This chart shows that one Deluti union's Pond Electro Conductivity is 7520 µs/cm. and it is the highest value of this chart. And the Laskar union's Pond has 1486.67 µs/cm Electro Conductivity. It is the lowest value of this chart. . The standard value of natural water body's is 700 µs/cm. They all are already crossed the limit of acceptable ranges. And all have very high ranges.

### 4.7.2. Electro Conductivity Comparison of Agricultural Lands Water:

Table 20: Electro Conductivity Comparison of Agricultural Lands Water:

| Sample Area | EC |
|---|---|
| **Laskar A1** | **3113.33** |
| **Laskar A2** | **2463.33** |
| **Deluti A1** | **2170** |
| **Deluti A2** | **840** |

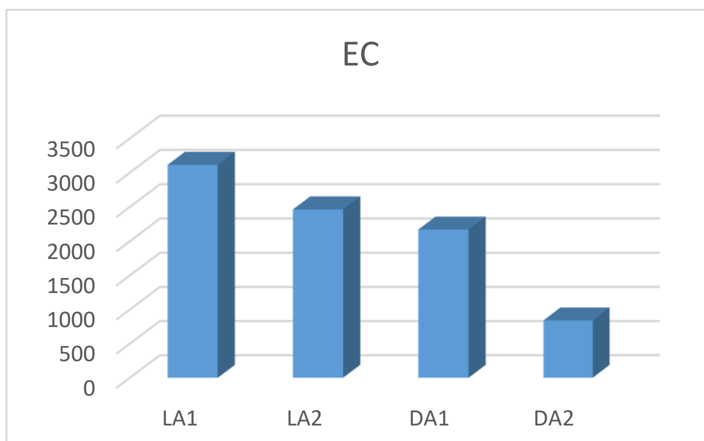


Figure 20: Electro Conductivity Comparison of Agricultural Lands Water


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This chart describes that Laskar's one agricultural water body Electro Conductivity has 3113.33 µs/cm Electro Conductivity. And it is the highest value of this chart. The Deluti's number two of agricultural water body has 840 µs/cm Electro Conductivity, which is the lowest value of this chart. The standard value of agricultural or irrigation is 1200 µs/cm. Without one, all are crossed the standard limit here.

### 4.7.3. Electro Conductivity Comparison of Aquaculture Water Bodies:

Table 21: Electro Conductivity Comparison of Aquaculture Water Bodies:

| Sample Area | EC |
|---|---|
| **Laskar G1** | **11313.33** |
| **Laskar G2** | **16753.33** |
| **Deluti G1** | **14783.33** |
| **Deluti G2** | **15356.67** |

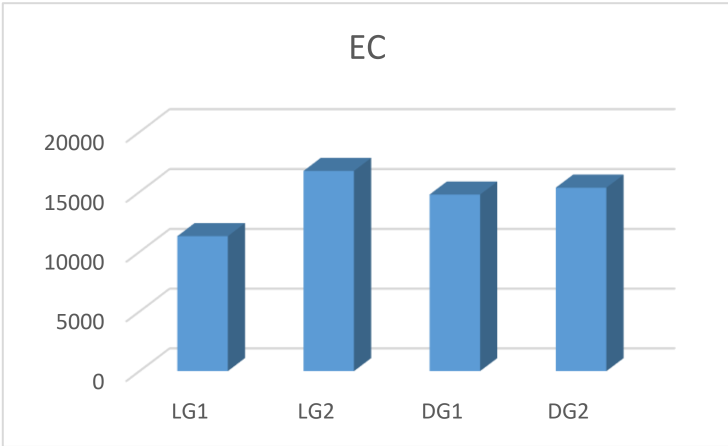


Figure 21: Electro Conductivity Comparison of Aquaculture Water Bodies

This chart demonstrates that Laskar's one aquaculture water body has 16753.33 µs/cm Electro Conductivity. And it is the highest value of this chart. Here all have high ranges Electro Conductivity. The standard value of Electro Conductivity is 800–1000 µs/cm.


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### 4.8.1. Total Dissolved Solid Comparison of Ponds Water:

Table 22: Total Dissolved Solid Comparison of Ponds Water:

| Sample Area | TDS |
|---|---|
| Laskar P1 | 1260 |
| Laskar P2 | 660 |
| Deluti P1 | 3173.33 |
| Deluti P2 | 1340 |

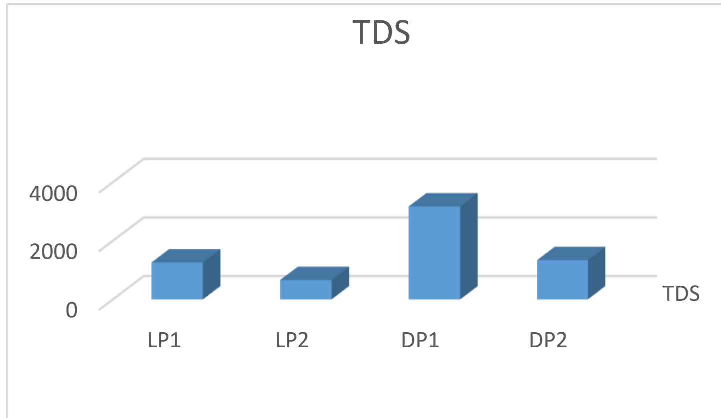


Figure 22: Total Dissolved Solid Comparison of Ponds Water

This chart shows that one Deluti Pond has 3173.33 ppm Total Dissolved Solids. And it is the highest value of this chart. Laskar union's Pond has the lowest Total Dissolved Solids, which is 660 ppm. The standard value for that 1000 ppm. 3 ponds water TDS have already crossed the limit, one is in very high range.

### 4.8.2. Total Dissolved Solids Comparison of Agricultural Lands Water:

Table 23: Total Dissolved Solids Comparison of Agricultural Lands Water:

| Sample Area | TDS |
|---|---|
| Laskar A1 | 1353.33 |
| Laskar A2 | 1063.33 |
| Deluti A1 | 940 |
| Deluti A2 | 370 |

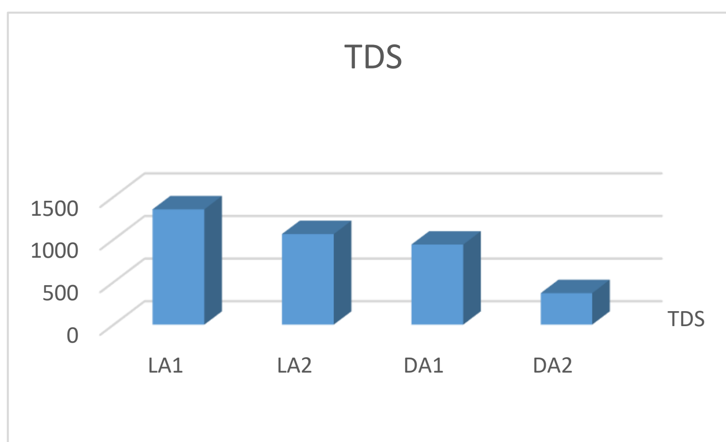


Figure 23: Total Dissolved Solids Comparison of Agricultural Lands Water


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The chart shows that Laskar's one agricultural water body has 1353.33 ppm Total Dissolved Solids. And it is the highest value of this chart. The second of Deluti's Agricultural water body has 370 ppm Total Dissolved Solids which is the lowest value of this chart. The standard value of Total Dissolved Solid is 450 – 2000 ppm. Here all are in there acceptable ranges.

### 4.8.3. Total Dissolved Solid Comparison of Aquaculture Water Bodies:

Table 24: Total Dissolved Solid Comparison of Aquaculture Water Bodies:

| **Sample Area** | **TDS** |
|---|---|
| **Laskar G1** | **5440** |
| **Laskar G2** | **7546.67** |
| **Deluti G1** | **6160** |
| **Deluti G2** | **6640** |

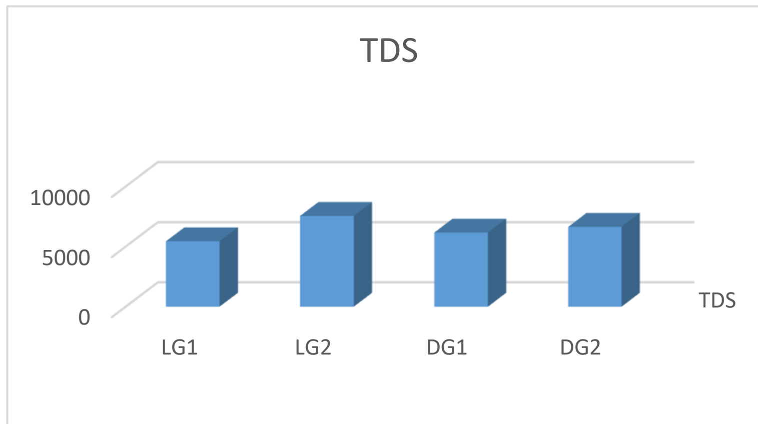


Figure 24: Total Dissolved Solid Comparison of Aquaculture Water Bodies

The chart shows that Laskar's one aquaculture water body has 7546.67 ppm Total Dissolved Solids. And it is the highest value of this chart. The second of Deluti's aquaculture water body has 6640 ppm Total Dissolved Solids which is the second highest value of this chart. The standard value of Total Dissolved Solid is 0 –1000 ppm. Here all are break the acceptable ranges of TDS.


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### 4.9.1. pH Comparison of Ponds Water:

Table 25: pH Comparison of Ponds Water:

| Sample Area | pH |
|---|---|
| Laskar P1 | 8.2 |
| Laskar P2 | 8.6 |
| Deluti P1 | 8.1 |
| Deluti P2 | 8.46 |

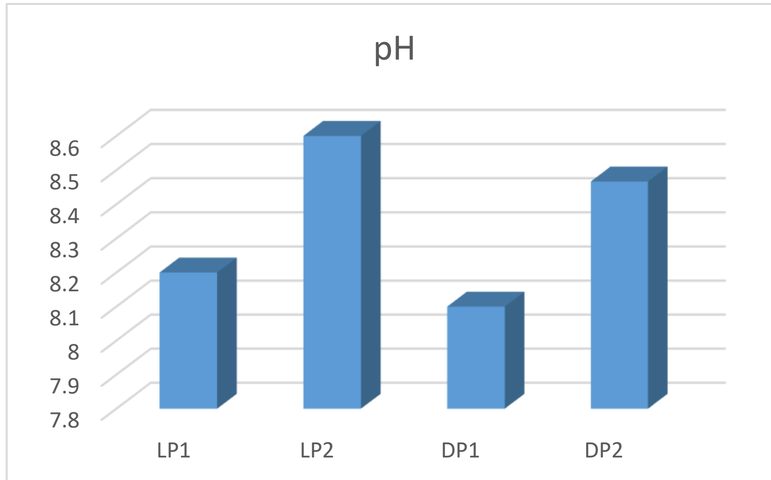


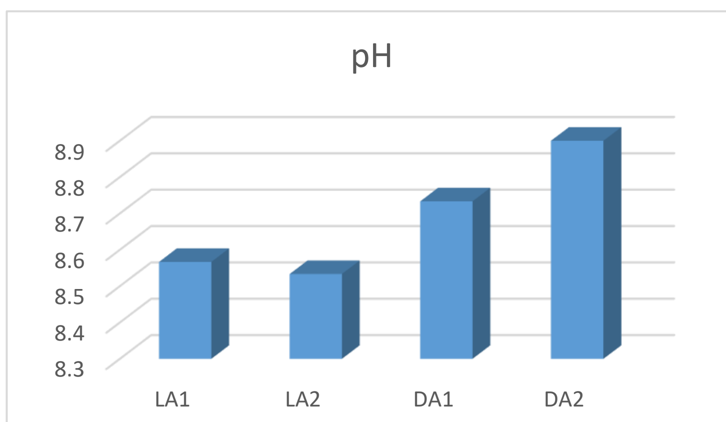

Figure 25: pH Comparison of Ponds Water

The chart shows that one Laskar's Pond has 8.6 pH value. And it is the highest value of this chart. Deluti has the lowest pH of Pond value, which is 8.1 of this chart. The standard value for natural water is 6.5 to 8.5 in Bangladesh. They all are in here almost acceptable ranges.

### 4.9.2. pH Comparison of Agricultural Lands Water:

Table 26: pH Comparison of Agricultural Lands Water:

| Sample Area | pH |
|---|---|
| Laskar A1 | 8.56 |
| Laskar A2 | 8.53 |
| Deluti A1 | 8.73 |
| Deluti A2 | 8.9 |





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The chart shows that Deluti's Agricultural water bodies have already crossed the limit. They are 8.73 and 8.9. 8.9 is the highest value of this chart. And Agricultural water bodies of Laskar union's pH values are almost same. They are 8.56 and 8.53.

### 4.9.3. pH Comparison of Aquaculture Water Bodies:

Figure 26: pH Comparison of Agricultural Lands Water

| Sample Area | pH |
|---|---|
| Laskar G1 | 8.46 |
| Laskar G2 | 8.67 |
| Deluti G1 | 8 |
| Deluti G2 | 8.76 |

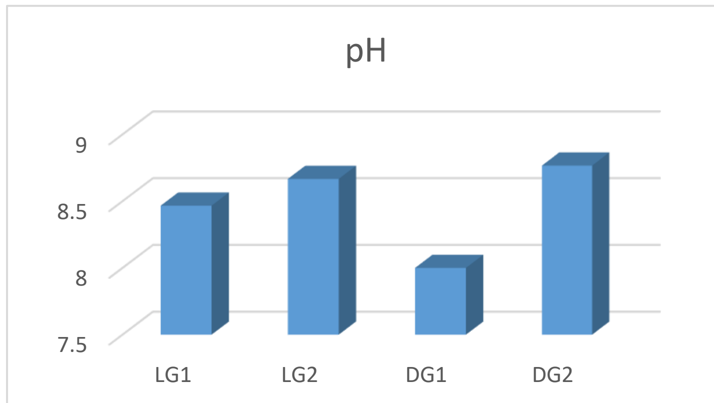


Figure 27: pH Comparison of Aquaculture Water Bodies

Table 27: pH Comparison of Aquaculture Water Bodies:

The chart describes that one Deluti union's aquaculture water body pH is high. That is 8.76. And also the Deluti union's other aquaculture water body's pH value is 8, which is the lowest amount of pH in this chart. In Laskar union's aquaculture Water bodies' pH are 8.46 and 8.67. They are approximately under the range limit.


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### 4.10.1. Salinity Comparison of Ponds Water:

Table 28: Salinity Comparison of Ponds Water:

| Sample Area | Salinity |
|---|---|
| Laskar P1 | 1.167 |
| Laskar P2 | 0.83 |
| Deluti P1 | 3.167 |
| Deluti P2 | 1.56 |

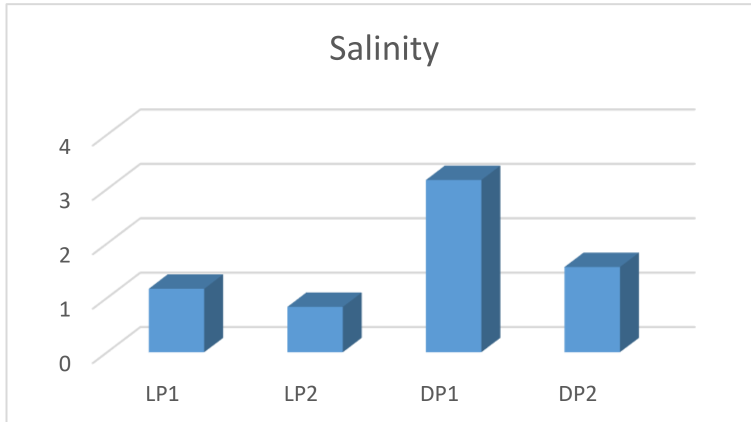


Figure 28: Salinity Comparison of Ponds Water

This chart shows that Deluti union's Pond water body has 3.167 ppt, which is the highest value of this chart. It is slightly saline. Without it, others are there very slight saline. The lowest value in Laskar union, which is 0.83 ppt.

### 4.10.2. Salinity Comparison of Agricultural Water Bodies:

Table 29: Salinity Comparison of Agricultural Water Bodies:

| Sample Area | Salinity |
|---|---|
| Laskar A1 | 1.83 |
| Laskar A2 | 1.07 |
| Deluti A1 | 1 |
| Deluti A2 | 0.43 |

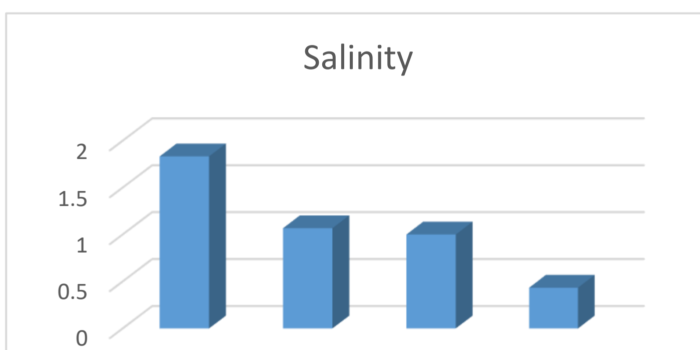


Figure 29: Salinity Comparison of Agricultural Water Bodies


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The chart shows that Laskar and Deluti union’s salinity ranges of agricultural water bodies. All are they very close. 1 ppt to 2 ppt, their values. There all have actually very slight saline.

### 4.10.3. Salinity Comparison of Aquaculture Water Bodies:

Table 30: Salinity Comparison of Aquaculture Water Bodies:

| Sample Area | Salinity |
|---|---|
| Laskar G1 | 6.5 |
| Laskar G2 | 10 |
| Deluti G1 | 8.67 |
| Deluti G2 | 8.96 |

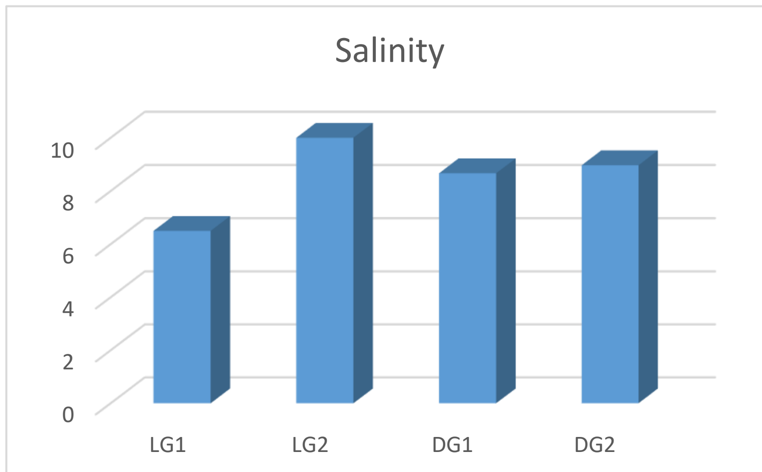


Figure 30: Salinity Comparison of Aquaculture Water Bodies

This chart shows that one Laskar’s aquaculture water body has strong salinity, which is 10 ppt. It is the highest value of this chart. Also the Loshkor’s other aquaculture has 6.5 ppt of salinity level, which is moderately saline. In Deluti has 8.6 ppt an 8.96 ppt. Those are also strong saline.


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## 4.11. Soil Salinity comparison between 2 unions:

Table 31: Soil Salinity comparison between 2 unions:

| Sample Area | Salinity |
|---|---|
| Laskar G1 | 2.1 |
| Laskar G2 | 4 |
| Laskar P1 | 0.5 |
| Laskar P2 | 0.4 |
| Laskar A1 | 1.2 |
| Laskar A2 | 0.4 |
| Deluti G1 | 1.2 |
| Deluti G2 | 3.8 |
| Deluti P1 | 1.4 |
| Deluti P2 | 2.3 |
| Deluti A1 | 1.6 |
| Deluti A2 | 1.3 |

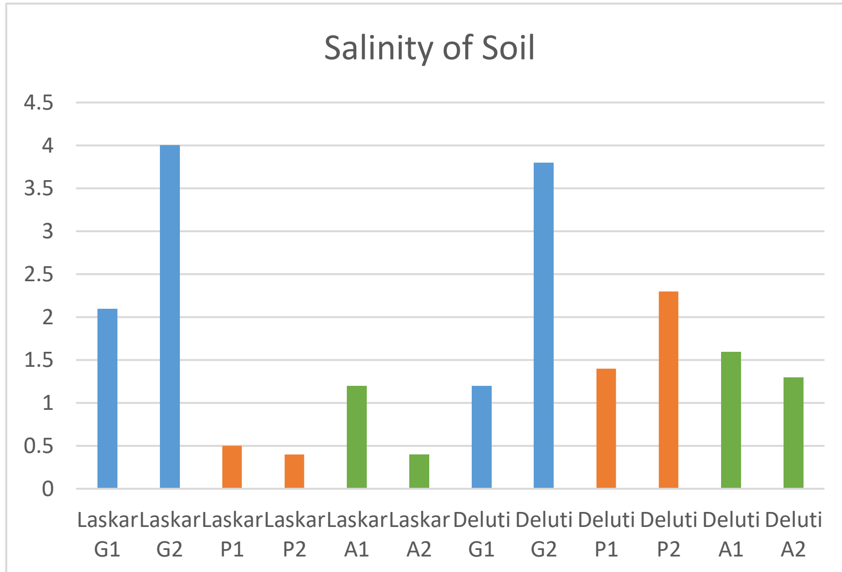


Figure 31: Comparison of Soil Salinity between 2 unions

The graph shows that the aquaculture in Laskar Union has highly salinized soil. Salinity in the second aquaculture soil is 4 ppm. And the first one has 2.1 Other Hand, as demonstrated in the same example by Deluti Union. There's second aquaculture has high salinity from Deluti's one number of aquaculture soil salinity. Also, it demonstrates the low soil salinity of Laskar's ponds. The first and second ponds at Deluti have salinities of 1.4 and 2.3, accordingly. Laskar's 0.5 ppm and 0.4 ppm, those are low from Deluti union. The soil in agricultural lands is salty. Laskar Union's second land provides high salinity. Laskar has 1.2 and 4 ppm. And Deluti has 1.6 ppm and 1.3 ppm.

## 4.12 Recommendation:

Aquaculture farming is growing there day by day. Individuals are attempting to transition away from agricultural operations in order to gain significant rewards. They use river's saline water for continuing aquaculture activates. The analysis confirms that the aquaculture farming industry has a high salt level. The agricultural industry can handle salty coastal locations. The other water quality criteria are the same (TDS, EC). Thus, action must be taken right away to maintain the high quality of the water.


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### 4.13 Study findings:

1. The government must take steps to reduce the Laskar and Deluti unions involved in aquaculture farming. If that isn't possible, the government can instruct them to start farming in sweet water.

2. The government should try to understand the local people in order to increase the agricultural lands because there are relatively few of them in the Laskar union. Several villagers in Deluti don't try to utilize salt water on their farmland.

### 4.14 Study limitations:

1. People won't find nearly enough drinking water there. So, they must transport fresh water in a water pot.

2. Researchers may find sampling challenging at times because not all locations are comparable. As a result, they should mentally prepare before gathering the sample.

# Chapter 5: Conclusion:

The necessity of ending fisheries farming in those places was confirmed by this study. These kinds of activities were established by illiterate individuals in the past for greater benefits. But, it is becoming more damaging to the environment every day. Also, these farming waters and soils are authorized close to ponds and agricultural lands. Everyone is going to become salty. There, the surface water is going to risk for worse. The aquaculture industry is expanding quickly, which is a sign of economic progress. Yet, it also raises the possibility of salt incursion and biodiversity loss. Without a doubt, the coastal region's ability to food itself is threatened by the disruption of agricultural growth. Government should create and adopt a sustainable land use strategy to protect coastal agricultural lands.


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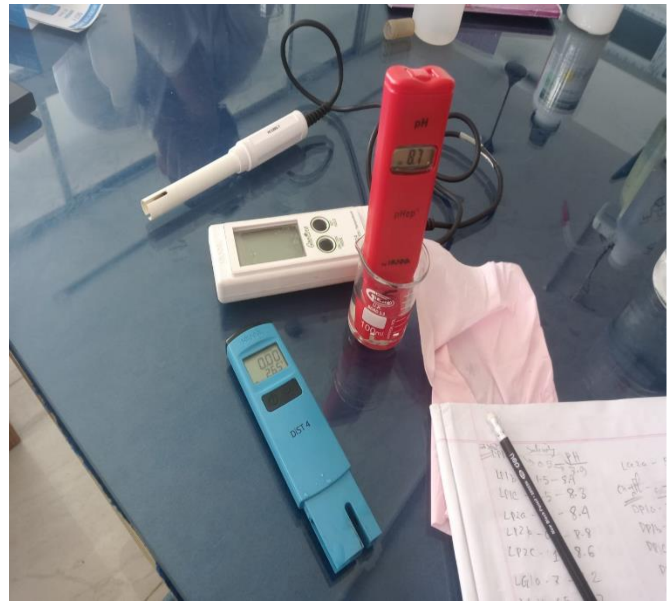
# Index:

Salinity Test



EC, TDS, pH meter

Alkalinity Test

Soil measurement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Soil Sample preparation

Soil sample collection

Sample marking

Fisherman


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