Effects of Disposed-water from Barapukuria Coal Mine, Dinajpur, Bangladesh on Agriculture and Aquaculture

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Abstract. The environment is a prime concern in the mining industry because of its adverse impact on the solid, liquid, and gaseous surroundings. These three parts of the environment are directly connected to agricultural production. As the Barapukuria coal mine is located in the agricultural zone, its effects can be crucial. Previously, the impacts of the subsidence of the Barapukuria coal mining area were studied. So far, there is no significant study regarding its effects on agriculture. This research has focused on the impacts of the disposed water from the Barapukuria coal mine on the nearer aquaculture and agricultural fields. Therefore, the BOD, COD, DO, pH, TSS, TDS, SS, residual chloride, hardness, alkalinity, carbon, sodium, calcium, magnesium, iron, potassium, sulphate, etc., being present in the disposed-water were analyzed in this study. The values of BOD, COD, DO, pH, TSS, TDS, and TS were lied in the best optimum range to cultivate crops and fisheries. It is also found that the disposed-water of the Barapukuria coal mine is tolerable for agriculture.

1. Introduction
In this present world, the population is increasing in a booming way. Besides, the balance of the environment is degrading galloping with it [1-2]. Therefore, this degradation of the environment directly jumps to the human being through some specific fields. In most cases, this field is the agricultural sector [3-4]. In agriculture, the effect of a little change in the environment is spectacularly large. Now, the fact is, environmental degradation is a very elaborate sphere. It might be affected by many causes. Some might be human-caused, and some might be natural. Human-caused degradations are generated by industrialization, especially by an unprocessed human, chemical, industrial, and nuclear waste. However, all of these degradations can be processed by applying engineering recycling and reproduction systems through governmental regulations. But another major cause of environmental pollution, with which the people of the world are struggling, is mining extraction. The fact is that we cannot but approve of the terrible impact of mining extraction. In many areas around the world, the extraction process has been running out for years. Therefore, their massive effects on the environment have also been occurring.
in the same way [5]. These effects cause tons of agricultural production loss and harm human beings' lives and all the living beings related to that ecology.

Production of natural resources through mining processes draw negative impacts on ecological and social sectors [6]. From the beginning of a mining operation, it produces dust and radiation, which directly impacts the surrounding environment. Some studies claimed that long term mining operations are responsible for the disappearance of river, lake and forest [7]. However, Hota and Behra showed that coal mining activities positively and negatively impacted rural households [8]. A continuous mining operation disposed of million gallons of wastewater to the nearby locality, which degrade the agricultural field's soil and the water of the aquaculture [9]. Several studies also discovered that groundwater quality is also facing degradation due to some harmful metallic substances with more than tolerable limits.

Mining significantly coal mining is increasing year by year, and the highest impact is implemented in the agricultural system [11]. The situation is terrific, no doubt. Hence, it is a crying need to take immediate measures to reduce this effect. First, it is necessary to calculate how much pollution can be caused by each mining field and its actual impact on the nearer locality. In Bangladesh, a vast population of around 160 million demands a considerable volume of energy. So, the energy use growth rate is increasing day by day [12]. Hence, the energy demand is a crucial issue in this country that has no way to be neglected. In this circumstance, the running of coal mining is a crying need here. However, the effects on the environment caused by the run of this coal mine should also be considered. In Bangladesh, the Barapukuria coalfield is the only field where coal mining is running out. This field is the only running internal source of the coal energy generation of this country. Therefore, this coalfield needs to take responsibility to match up the whole countries' energy demand. However, the impact on the environment caused by this field is also a considerable matter. Therefore, at first, it should be found out how much influence is generated on the environment by this mining field. In this research, the data related to aquaculture and agriculture (water) at the Barapukuria Mining field's nearer locality has been collected. Thoroughly analyzing these data, it is decided whether running this mining field in this location is environmentally distressful or not.

2. Geographic location, methods and data collection

2.1. Geographic Location
Barapukuria coalfield is the only mining field in Bangladesh on which production is going on. The field is located at Parbatipur, an Upazila of Dinajpur District in the Rangpur Division, Bangladesh. Parbatipur is located at 25°39′12″N and 88°54′56″E. It has 53,146 households and a total area of 395.1 km². Saidpur upazila on the north, Phulbari upazila on the south, Badarganj upazila on the east and Chirir Bandar upazila on the west. Figure 1 represents the geographic location of the studied area.
To analyze the effects of the Barapukuria coal mine on the environment, the following analyses are conducted.

2.2. Biological Oxygen Demand (BOD)
The Biological Oxygen Demand (BOD) is mainly correlated to enough oxygen in water and soil sample to make the biological living being alive in that sample. The amount of oxygen in the sample must remain in an optimum condition. The greater or lesser value of oxygen than the optimum may cause a respiratory problem to the biological beings. Hence, BOD's value must be remaining in the optimum standard value, which is up to 50 ppm [14].

2.3. Chemical Oxygen Demand (COD)
The Chemical Oxygen Demand (COD) indicates the necessary chemical composition in the water, air, and soil samples. These chemicals are mainly organic and inorganic materials that lie in the sample, which is required to preserve the environment and pH of water and soil balanced to live the living beings. The optimum level of this COD value is up to 200 ppm [15].

2.4. Dissolved Oxygen (DO)
The DO is the measure of dissolved oxygen in any sample. It is the minimum amount of oxygen particle that is needed to dissolve in water. The optimum value of DO lies from 4.50 to 8.00 ppm [16]. This measure is essential to make the water sample used for any purpose.

2.5. Total Solid (TS)
TS means total solid particles lie in a water sample. This solid particle consists of two types of particles. The first one is Total Dissolved Solids (TDS) particles in ppm, and the second one is Total Suspended Solid (TSS) particles in ppm. The accumulated solid particles are called TS and are measured in ppm. The optimum amount of TS that needs to lie in the water sample is 2100 ppm in total [17].
2.6. Total Dissolved Solid (TDS)
Total Dissolved Solids (TDS) are the solid particles in colloidal form and mixed in the water in all ratios. They cannot be separated from the water sample through filtering; boiling is needed to separate the solution's particles. The presence of these types of particles in the optimum amount is significant to make the water drinkable. It is also very substantial to make the water usable for farming and doing fisheries activity. Exceed the optimum level of these particles is not desirable.

2.7. Suspended Solid (SS)
The presence of suspended solid is termed SS. This term is also significant to make the water drinkable. After analyzing the data mentioned earlier, some additional compound analyses have also been performed that are specially related to agriculture and aquaculture farming. All these tests were performed in the laboratory of BCSIR, Dhaka, and Laboratory of Department of Environment, Bogra (DOB). The results of these tests that have been found out in the laboratory are given in table 1, table 2, and table 3.

3. Data analysis and discussion
3.1. Deviation determination
Following the provided data, table 1, table 2 and table 3 indicate the deviation of the essential compounds badly needed to agriculture and aquaculture comparing to the standard value.

Table 1. Obtained parameter of 1207 Coal Face 1, open off cut water

| Chemical Parameters | Laboratory test value (mg/L) | Standard Value | Comments |
|---------------------|-------------------------------|----------------|----------|
| pH                  | 7.48 (no unit)                | 6.5-8.5 (WHO,1984) | Within the tolerable limit of agriculture and livestock |
| Na                  | 20.00                         | 200 (WHO,1984)   |          |
| K                   | 4.55                          | 12 (BWPCB,1976)  |          |
| Ca                  | 19.40                         | 200 (WHO,1984)   |          |
| Mg                  | 7.34                          | 150 (WHO,1984)   |          |
| Al                  | <0.05                         | 0.2 (WHO,1993)   |          |
| Fe                  | 0.32                          | 50 (WHO,1984)    |          |
| Cl                  | 1.63                          | 250 (WHO,1993)   |          |
| CO₃                  | No detectable                |                |          |
| SO₄                  | 12.00                         | 500 (WHO,1984)   |          |
| AS                  | <0.005                        | 0.01 (WHO,1984)  |          |

Table 2. Obtained parameter of 1214 Coal Face 2, open off cut water

| Chemical Parameters | Laboratory test value (mg/L) | Standard Value | Comments |
|---------------------|-------------------------------|----------------|----------|
| pH                  | 7.34 (no unit)                | 6.5-8.5 (WHO,1984) |          |
| Na                  | 28.60                         | 200 (WHO,1984)   |          |
| K                   | 8.32                          | 12 (BWPCB,1976)  |          |
| Ca                  | 45.40                         | 200 (WHO,1984)   |          |
| Mg                  | 14.30                         | 150 (WHO,1984)   |          |
| Al                  | 0.95                          | 0.2 (WHO,1993)   |          |
| Fe                  | 7.46                          | 50 (WHO,1984)    |          |
| Cl                  | 1.93                          | 250 (WHO,1993)   |          |
| CO₃                  | No detectable                |                |          |
| SO₄                  | 68.00                         | 500 (WHO,1984)   |          |
| AS                  | <0.005                        | 0.01 (WHO,1984)  |          |
Table 3. Outside Boundary Drain Water (obtained from BCSIR)

| Name of the Test | Obtained value (mg/l) | Standard Value (mg/l) |
|------------------|-----------------------|----------------------|
| TS               | --                    | 2100                 |
| DO               | 7.78                  | 4.50-8.00            |
| BOD              | 2.53                  | 50                   |
| Oil & Grease     | 6.88                  | -                    |
| TDS              | ----                  | 2100                 |
| TSS              | 156                   | 150                  |

3.2. Impacts determination

In a word, the impacts of the coal mining operation can be generalized in some specific categories. Each of all types has a remarkable influence on human life. Significantly, the farming sector is greatly influenced by this operation, whatever it is about agriculture or aquaculture or even cattle and poultry farming. Nevertheless, some other impacts of coal mining operations can also be put into consideration. One and the most crucial of them is land subsidence.

Considering all the impacts mentioned above, here is some discussion about all the significant effects of the Barapukuria coal mine on the nearer locality, farming, and others' human economy. This whole discussion has been organized in some categories below.

3.2.1. Impacts on agricultural farming.

To say about agricultural farming, Dinajpur (the region of Barapukuria coal minefield) can be specialized in paddy, potato, mustard, and in the fourth the jute production. Among them, the paddy can be given the most important as it is the main crop of that region. Hence, if there is any coal mine impact, the paddy field will face the most significant effect. However, in the first portion of this discussion, the impact of every property of soil that can affect paddy production because of the coal mining operation will be discussed elaborately.

For that, we ought to know about the essential properties of soil needed for paddy production at first. The value of the pH of the water used for irrigation purposes is the basic need for paddy cultivation. The electric conductivity (EC) got in the irrigated water is another basic need. About the inorganic materials needed for paddy cultivation, Na, K, Ca, Mg, Al, Fe, Cl, CO₃, As, SO₄ can be said as some of the essential materials in the irrigated water. Moreover, the presence of turbidity, Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) in the irrigated water are also some vital part of paddy cultivation. In some steps, the discussions with all these properties are given below.

Electric conductivity (EC):

When an excess number of salts gather and accumulate at the root area of any crop, crop production is adversely affected. Therefore, the salinity of the water, which will be used for irrigation, should be determined. The most popular indirect method for calculating the amount of salt content present in the irrigation water is measuring its EC value. A higher EC value indicates the presence of greater value of salt contents in the water. Generally, the EC values are expressed using deci Siemens per meter (dS/m) unit [18].

However, the water used for irrigation has a long-range of total salinity levels. The irrigation water comes from snow-fed rivers, shows a total salinity level within 0.5 to 0.6 dS/m. This value usually becomes from less than 1 dS/m to higher than 12 or 15 dS/m for groundwater. For seawater, the value is about 50 dS/m as it is highly saline. If the salinity of irrigation water is higher, then the possibility of production reduction is also higher.

The data, tested in the Department of Environment, Bogra (DOB), found that the EC in the water, extracted from the Barapukuria coal minefield, is 390 µS/cm before the treatment. But this water is not allowed directly to go to the irrigation field without treatment. After the treatment, the EC is found 370
µS/cm, which indicates the optimum rate of salinity in the water extracted from the coalfield. Hence, this water does not possess any crucial impact on the yield of paddy or other crops in the nearer locality.

**pH:**

PH is the Hydrogen ions' density present in any sample whatever it might be a water or soil sample. Hydrogen ion density is a crucial parameter to detect the acid and base condition of that sample. The detection of acid or base is mainly significant because it shows whether the water or soil sample's behaviour to the living beings relies on that soil or water. If the acidic condition gets higher than the moderate, it will not be possible to live any living being in that soil or water because of decay. On the other hand, a primary environment is also very harmful because of its extreme reducing activity. Hence, a moderate rate of both acidic and basic properties is desirable in any soil or water sample. As the rate of this acidic and basic condition is measured by pH, the pH value must be remaining in a desirable condition. The desired value of pH for drinking water is 6.5 to 8.5 (WHO,1984). That means this rate show both the optimum availability of acid and base in the water and soil sample. If the pH is 7.00 that means, there is neither acid nor base in the sample. When the value increases from 7.00 to 8.00 or 9.00 or more, it refers to the increasing rate of basic properties.

On the other hand, the decreasing value from 7.00 (6.00 or 5.00 or less) shows the presence of acidic materials at an increasing rate. Nothing of these is acceptable for any kind of living being as well as cultivation or farming. Therefore, the presence of an optimum value of pH is a crying need.

Though most of the plants can withstand a wide range of pH values, they cannot tolerate the soil's higher acidic environment. The acidic environments make the soil mineral dissolved and increase the metal ion's concentrations to a toxic level. On the other side, the higher alkaline environments decrease the soil minerals solubility and create deficiencies of necessary nutrients. A little deficiency in the required nutrients inhibits the growth of the plants.

However, the goal of managing pH is not just achieving value. The aim is to maintain an optimum pH environment where there are enough nutrients and no toxic materials for the plants. These favourable environments are achieved when the pH value remains between 5.8 and 6.5. So far, few plants need an exceptional acidity environment [19]. The pH of water extracted from the Barapukuria coalfield is about 7.34 (1214 coal face) (BCSIR) and 7.48 (1207 coal face) (BCSIR). This value of pH is acceptable in the sense that as the bacteria like actinomycetes need 7-7.5 pH to develop oxygen in the yield field, this value of pH will come to a generous side of the overall paddy and other cultivation of the nearer locality.

**Sodium (Na):**

The chlorophyll production slightly deviates from the change of the sodium ion. The change in water efficiency also gets a slight difference in the shift of sodium ion. However, it can be said that 17 mg/g of sodium ion is the optimum condition for any paddy field. The results tested by BCSIR also showed that the amount of sodium in the water extracting from the 1207 face coalfield and the 1214 coalfield of Barapukuria are 20.00 and 28.60, respectively. Those are very close to the optimum condition. Hence, the water will not adversely impact the decline of the paddy production of the nearer community of the Barapukuria coal minefield.

**Potassium (K):**

Sometimes, some common nutritional disorders are observed in lowland rice production. However, potassium fertilizers help to omit these types of issues, such as rice bronzing, etc. Moreover, it increases the resistance capability of the plants to some pests and diseases. K deficiency usually appears between the beginning of internode elongation and seed heading. Developing symptoms include stunted plants with thin stems and a dark green colour, necrotic spots at leaf tips progressing to the leaf base, including drying of leaf edges, sterile flowers, and root damage. K plays essential roles in protein synthesis, enzyme activation, photosynthesis, stomatal movement, osmoregulation, energy transfer, cation-anion balance phloem transport, and stress resistance [20].
Barapukuria coal mine did not make any lack or excess of potassium contentment in its extracted water, which went to the nearer paddy field as the source of irrigation. The test occupied by BCSIR showed that potassium contentment in the extracted water from the Barapukuria coal mine was about 4.55 mg/l at coal face 1207 and 8.32 mg/l at coal face 1214, respectively. However, the highest limit for the optimized value is about 12 mg/l [21].

**Calcium (Ca):**

Calcium is a source of immobile nutrition for any plant whatever it is a rice plant (*Oryza Sativa*) or the other else. It patronizes the growing activity of a plant. The xylem sap of a plant is only supplied by calcium, and this sap is the base of plane widening. As the source of plant mobilization, calcium mobilizes the older tissue of the plants. As a cause of that, the cell wall of the plant gets hardened and healthy. Another business of calcium that also bears tremendous significance is its transpiration activities. When the transpiration gets reduced, the instant calcium starts to reduce the tissues’ rapid growth to make a balance with the reduction of transpiration [22].

Calcium is the weapon of soil to reduce salinity. The removal of carbohydrates is mobilized in the presence of calcium. All the cell acids of a plant get nutrients from calcium. In total, calcium plays a vital role in balancing the chemical properties of soil, reducing soil salinity, and providing plants' proper nitrification.

Barapukuria coal mine field extracts the water without making any deficiency of calcium content lies in it. BCSIR tests that the calcium contentment in 1207 and 1214 coal face in the Barapukuria coal mine extracted water contains 19.40 mg/l and 45.40 mg/l, respectively, while the standard limit of calcium presence is below 200 mg/l [23].

**Magnesium (Mg):**

The principal deed of magnesium is to alive the growth cycle of a plant. This process is managed by specific stages like several enzyme activities in plant, assimilation, protein synthesis, balancing the cellular pH, and the cation-anion balance activation [24]. Each step is directly depended on the availability of magnesium. The magnesium in a plant is generally sourced by the irrigated water which is applied on. Hence, the proper amount of magnesium in the irrigated water is a must to regulate all the important deeds covered with magnesium.

According to BCSIR, the presence of magnesium in the extracted water of the two faces, in specific coal face 1207 and coal face 1214 at Barapukuria coal minefield is 7.34 and 14.30 mg/l, respectively, where the highest limit of the presence of magnesium in any water sample is 150 mg/l [23]. Hence, magnesium is supplied to irrigation water without an exceeding limitation.

**Sulfate (SO$_4^{2-}$):**

Sulfate is one of the most important constituents for straw-like plants like rice, jute, etc., which are some prime plants in the nearer locality of Barapukuria coal minefield. The prime deed of Sulphur or SO$_4^{2-}$ ion increases the chlorophyll production and protein synthesis [25]. Also, the plant structures and functions are depended on it. There is less chance to get enough Sulphur from the irrigation water. Most of the Sulphur comes to the plants through the implementation of sulfate fertilizer. Nevertheless, the higher the amount of Sulphur remains in the irrigated water, the lower the amount of fertilizer is needed.

BCSIR shows that the amount of Sulphur was approximately 12.00 and 68.00 mg/l in the water of 1207 and 1214 coal face, respectively. The optimum value certified by WHO, 1984 is 500 mg/l in this case. Therefore, there is no more than the usual amount of Sulphur in the coalfield's water; instead, it is optimum to apply an economical amount of Sulphur fertilizer.

**Arsenic (As):**

Arsenic comes with irrigation water to the soil and degrades the grains production. Some reports suggested that for groundwater irrigation, the As-soil concentration is higher during the winter season
than in the summer [26-27]. However, the addition of As through the irrigation water to soil also increases As concentration in the grains [28].

Drinking As containing water (>0.05 mg/L) for a long time may cause unexpected death sometimes, as it enters the human body through different foods containing it. For example, the remaining in the rice creates considerable health hazards to its consumers. Continuous consumption of As-infected rice causes a series of health issues such as cancer in the liver, bladder, lung, skin, kidney, and some skin diseases. The consumption of As contaminated rice straw by cattle increases the As contamination in meat and milk, which also a medium for entering the human body [29].

However, the amount of As found by BCSIR in the 1207 and 1214 coal face extracted water is below 0.005 mg/l, which is an impressive sign for the irrigation water to the nearer paddy field.

**Chloride (Cl)**

Balancing the presence of Chloride ion is a precondition for planting. It generates both positive and negative effects on the plants simultaneously. Photosynthesis, the osmotic adjustment, occurs in the presence of an appropriate amount of chloride. On the contrary, the plant is affected by chlorine toxicity when chlorine's presence exceeds the plant's tolerable limit, and yield reduction occurs significantly.

As chloride is bearing negative charges, it does not get attached to the soil particles and moves with the water flow. Therefore, it is significant to check the irrigation water's chloride concentration before entering grain fields. Generally, low to medium saline water contains 100-300 mg/L chlorine anions [30].

Table 4 and table 5 are showing the susceptibility range and effects of chloride-containing water on different crops. These tables summarized that the chloride concentration of irrigation water less than 150 mg/L is safer for most crops. The Chloride ion presence in the extracted water of Barapukuria coal mine 1.63 and 1.93 mg/L in the coal face of no1207 and 1214, respectively. This value is significantly within the optimum limit such that it neither exceeds the tolerable limit of the plant nor touch the toxicity level. Instead, it meets ups at least amount, which is essential for photosynthesis and osmotic activities.

| Chloride (ppm) | Effects on crops                      |
|---------------|--------------------------------------|
| <70           | Safer                                |
| 70-140        | Only sensitive plants exhibit injury.|
| 141-350       | Mid-range tolerable plants exhibit injury.|
| >350          | Exhibit severe issues.               |

Table 5. Susceptibility levels for various crops to foliar injury from chloride-containing water [31].

| Cl concentration | Range  | Foliar injury for crops       |
|------------------|--------|-------------------------------|
| <175 (mg/L)      | Low    | Apricot, plum, tomato        |
| 175- 350 (mg/L)  | Medium | Pepper, potato, corn          |
| 351- 700 (mg/L)  | High   | Alfalfa, barley, sorghum      |
| >700 (mg/L)      | Excessive | Sugarbeet, sunflower     |

3.2.2. Impacts on fish farming. In fish farming, some extensively important required components should be in the water with a definite range. The more or less of that amount of the necessary element might cause severe degradation of fishes' birth and growth. Even in many cases, the early termination of life might occur. To get rid of this, the fast and foremost task is to ensure the essential components to trigger fish farming and shrink the possibility of adverse products.

The first deed will know about the essential elements for fishing that must lie at the farming ponds' desired rate to combat that. The crucial parameter is pH for fish farming which shows the acidic and basic properties of the water. Some other equally essential parameters are the amount of As, SO\textsubscript{2}\textsuperscript{2-}, Ca, and Mg presence in the water. Additionally, COD (Chemical Oxygen Demand), BOD (Biological
Oxygen Demand), and suspended and dissolved solids in the water are also important. As these refer to the total fish-farming conditions of a pond processed for aquaculture. A brief discussion is drifted below concerning all the essential parameters of fish-farming:

**pH:**
Fish lives in water and depends on water for breathing, growing, feeding, excreting wastes, and reproduction. Hence, understanding the physiochemical qualities of water is crucial for successfully operated aquaculture.

Table 6 represents the effects of pH on fishes. It summarizes that both the significantly lower and higher pH values are harmful to aquatic organisms. Lower pH levels help to release the metals from the sediments. These metals can affect the fish's metabolism processes. A higher pH value helps to denature the cellular membranes and harms fishes. Moreover, it converts most of the ammonium atoms to ammonia, and this toxic ammonia can kill the fishes.

The above discussion emphasizes the importance of pH for aquaculture. Most of the fishes cannot survive for a long time in the water whose pH is above 11 or below 4. The suitable pH range for fishes is between 6.5 and 9. The pH of the water exerted by the Barapukuria coal mine was within a range of 7.34 to 7.48. These values indicate that this water is safer and suitable for fish farming.

| pH Range | Effects on Fish |
|----------|----------------|
| 4        | Acidic death point |
| 4-5      | No reproduction   |
| 4-6.5    | Slow growth       |
| 6.5-9    | Suitable ranges for fish reproduction |
| 9-10     | Slow growth       |
| >11      | Alkaline death point |

**Calcium and Magnesium (Ca and Mg):**

Nutrients such as magnesium, calcium are essential for the excellent growth rate of fishes. Fishes can get nutrients from their food or the surrounding water. However, the presence of nutrients should be optimum because much Ca and Mg increases the hardness of the water.

For freshwater, in most cases, the alkalinity and hardness remain within the following range < 5 mg/L to > 150 mg/L. BCSIR reported that the amount of Mg and Ca presented in the 1207 and 1214 coal mine face is 7.34 and 14.30 mg/L, respectively. This value lies below 100 mg/L, and it should not put any adverse effect to change the natural content of magnesium and calcium lies in the pond water.

**Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), and Chemical Oxygen Demand (COD):**

Biological oxygen demand (BOD) means the amount of oxygen used by a different microorganism. It is believed that when the oxygen concentration becomes less than 5 ppm, then most of the fishes cannot survive for a long time [33]. According to BCSIR, the BOD in the coal mine field extracted water is 2.53 mg/l which is less than 50 mg/l or 50 ppm, in a safer range for fish cultivation. Besides, the amount of dissolved oxygen (DO) according to BCSIR is 7.78 mg/l which is greater than the least desirable limit for fish culture, 5 mg/l. Hence, this extracted water did not provide any adverse condition in this case. The report of the test supplied by DOB (Department of Environment, Bogra) showed that the number of COD in the outside boundary drain water of the Barapukuria coal minefield is 54 mg/l after treatment. Compared with the optimum value, 200 mg/l, this value of COD is in a desirable range.
4. Conclusion
To meet the increasing energy demand, Bangladesh needs to focus on the production of underground natural resources. Due to the limited reserves, this country has to continue the coal production from its only running coalfield. However, environmental rules and regulations are getting strict. Moreover, some ecological regulatory organizations are raising questions on the ecological feasibility of Barapukuria coalfield. Therefore, this research determined its impacts on agriculture and aquaculture. According to the discussion, it is concluded that the effects of discharged water from the Barapukuria coal mine on agriculture and fish farming are negligible. The logical and scientific explanation in favour of this conclusion has been discussed thoroughly in this research paper. Almost all the parameters that refer to the pond's conditions or agriculture water were in a safer range. This water can fairly mix with the water for irrigation and aquaculture and work instead of creating any ecology degradation. The values of BOD, COD, DO, pH, TSS, TDS, and TS were lied in the best optimum range to cultivate crops and fisheries. Therefore, it can be said that the mining discharged water from Barapukuria is environmentally and ecologically feasible for agriculture and aquaculture and to lead on. However, this research only focused on the impacts of disposed water. Future research should be on determining the environmental impact on soil and air.

Nomenclature
As       Arsenic
BOD      Biological oxygen demand
Ca       Cancium
Cl⁻      Chloride
COD      Chemical oxygen demand
DO       Dissolved oxygen
EC       Electrical conductivity
Mg       Magnesium
Na       Sodium
SO₄²⁻    Sulfate
SS       Suspended solids
TS       Total solid
TDS      Total dissolved solids

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