

ASSESSING THE WATER, SEDIMENT AND SOIL QUALITY OF *MAYUR* RIVER, KHULNA, BANGLADESH

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1.1. Background of the study

Khulna is located in south-western Bangladesh at 22°49'0"N 89°33'0"E on the bank, Bhairab River. It covers a total area of 59.57 km², while the district itself is about 4394.46 km². It lies south of Jessore and Narail, East of Satkhira, West of Bagerhat and North of the Bay of Bengal. It is a part of the largest delta in the world. In the southern part of the delta lies the Sundarbans, the world's largest mangrove forest. The city of Khulna is in the northern part of the district, and is mainly an expansion of trade centers close to the Rupsha and Bhairab River and characterized by Ganges tidal floodplains with low relief, criss-crossed by rivers and water channels, and surrounded by tidal marshes and swamps.

The *Mayur* river is located in south-western Bangladesh and downstream of the well-known Ganges delta region. The *Mayur* river, which is now frequently cited as Dead River is very important for Khulna city that belongs to this extensive area. *Mayur* river is important from numerous points of view like irrigation purposes, dispatching media of municipal sewer and its dumping ground as well, but due to human interruption the natural flow of the river is totally retarded and the river is completely converted in to a feeder channel. The 10 valve sluice gates on the city protection dam control the current and flow of water courses of the *Mayur* and from 1990s encroachment of the river was started by some illegal fishermen and soil traders. Now the sluice gates are not maintained properly. The geochemical nature of the coastal river like the *Mayur* river in southwest Bangladesh hasn't received prior attention yet. Study of the hydro-pedospheric geochemical nature of the *Mayur* river is therefore essential as water, sediment and soil quality assessment are much crucial for long term effects on sustainable soil environment.

This river is now dominated by upstream flow and anthropogenic activity and is subjected to continuous exposure of domestic effluents and waste disposal from riverside establishments. Consequently, the water quality is assumed to be deteriorated. In fact, deterioration of water is very much subjected to land use change. Land use change is known to influence the biochemistry of watersheds (Deocampo, 2004; Tardy *et al.*, 2004; Grimm *et al.*, 2003). As land use has changed from unaltered natural landscape to agriculture and urban uses, forests and wetlands have been lost; road density has increased; surface runoff has increased and anthropogenic chemical and wastewater inputs have increased (Breward, 2003; Parr and mason, 2003; Wayland

et al., 2003). Most of the rivers in the urban areas of the developing world are the end points of effluents discharged from the industries and city dwellers. Human activities are considered as the great influential factor for changing the chemistry of river properties and thus affect its existing ecological system because the human population has increased rapidly in coastal regions throughout the world in recent years (Alongi, 1998).

1.2. Scope of study

Aquatic ecosystems perform valuable environmental functions like nutrient recycle, ground water recharge, stream flow maintenance, habitat for flora and fauna and provide recreation for people. Structural changes in these complex and dynamic ecosystems will have significant effect on its functioning. These structural changes take place due to unplanned developmental activities without holistic approach on watershed basis. These effects could be cumulative and its assessments are required for remedial measures. To assess these impacts due to river valley, the present study is undertaken in *Mayur* river, Khulna, Bangladesh. This is done through assessing the water, sediment and soil quality by analytical methods.

1.3. Objectives

The present research has been carried out for assessing of chemical characterization of the *Mayur* River's water, sediment and soil. Detailed objectives are:

- to assess the quality of the water of *Mayur* river
- to assess the quality of sediments and the degree of contamination
- to study whether the adjacent soils of the river bank undergone any serious pollution or not

2. Literature review:

Water, sediment and soil ecosystems play a vital role in sustaining all life forms performing useful functions in the maintenance of the overall balance of nature. The water quality is impaired due to non-point source of pollution.

2.1. Water quality

Rivers are the most important freshwater resource for man. Social, economic and political development has been largely related to the availability and distribution of freshwaters contained in riverine systems. River systems can be considered as arteries of the land supplying life giving water to an abundance of organisms whilst at the same time supporting modern civilizations (King *et al.*, 2003). The term water quality was coined with reference to the quality of water required for human use (i.e. drinking, agricultural and industrial purposes). This term entirely human perspective does not hold true for all aquatic organisms or ecosystems (Dallas and Day, 1993). A more modern approach is to consider water quality as the combined effect of the physical attributes and chemical constituents not only in the water but upon all aspects of the aquatic environment (King *et al.*, 2003). A major threat to aquatic ecosystems which can be lead to severe pollution problem is nutrient enrichment. Nutrients are important building blocks for healthy aquatic ecosystems and are generally non-toxic even in high concentrations; however this can change with alterations in environmental parameters such as pH and temperature (Medikizela and Day, 2001). Increased nutrient levels (especially nitrogen and phosphorus) can result in over stimulated growth of aquatic weeds and algae and can ultimately lead to oxygen depletion resulting in a eutrophic system. The occurrence of nutrients in aquatic ecosystems is closely linked to activities in the catchment, such as natural weathering, agricultural runoff and disposal of untreated or partially treated wastes (Nirmala, 1984).

Nutrients are essential elements for the primary productivity of any aquatic ecosystem and include nitrogen and phosphorus among others. The nutrient dynamics are influenced by different factors such as the weather, geology and soil type, drainage pattern and weathering processes. Nutrients occur in various sources and forms. Within the aquatic ecosystems, phosphorus and nitrogen roles can vary (Howarth, 1988). Nitrogen occurs in numerous forms such as dissolved molecular nitrogen, a large number of organic compounds such as amino acids,

amines, proteins, nitrates, nitrite and ammonium (Yalcinet *al.*, 2005). Sources of nitrogen include precipitation falling directly into the lake surface, nitrogen fixation in the water and sediments, input from the surface and ground water recharge. In marine ecosystems, nitrogen is the limiting nutrient for phytoplankton growth (McCarthy, 1981), while phosphorus, using frequently is a limiting nutrient in fresh water system (Howarth, 1988).

The deterioration of water quality has led to the destruction of ecosystem balance, contamination and pollution of ground and surface water resources. Water quality degradation worldwide is due mainly anthropogenic activities which release pollutants into the environment thereby having an adverse effect upon aquatic ecosystems. Water quality can be regard as a net work of variables (pH, oxygen concentration, temperature etc.) that are linked and co linked; any changes in these physical and chemical variables can affect aquatic biota in a variety of ways(Adekunle and Eniola, 2008).

The concentrations of many water quality constituents are related to stream flow, but the relationships differ depending on the constituents and input sources. In stream concentrations of constituents that reach a stream via overland flow often increase when stream flow increases. In contrast, point source inputs to a water body are usually relative constant and therefore, an increase in flow may result in a decrease in concentration due to a dilution effect. To facilitate an assessment of changes in water quality due to human activities within a watershed, flow induced variability must be removed(McCarthy, 1981).

According to the Canada-wide Framework for Water Quality Monitoring, “water quality” is a term used to describe the physical, chemical, and biological characteristics and conditions of water and aquatic ecosystems. It is a term used to describe both the relative state of the aquatic environment, and is used to assess the presence and abundance of specific parameters. Water quality is therefore measured with a variety of physical, chemical and biological variables which may be qualitative (indices or ratings of environmental risk and health) or quantitative (measurements or amounts of specific indicators or parameters). However the term is used, water quality is in a constant state of flux, changing from season to season, year to year, or even throughout a single day(Medikizela and Day, 2001).

The ‘state’ of water quality in the natural environment is most often assessed in two general ways: 1) as a measurement of the health of the aquatic environment (often reported as a

qualitative health rating, such as stressed/unstressed or high/medium/low risk) and 2) the degree to which the water is suitable for specific purposes: namely, agricultural use (crop irrigation and watering livestock), recreational use (swimming, boating, fishing), drinking use (as treated or untreated water) or its use in aquatic ecosystems (When assessing the suitable). Differentiating between natural and anthropogenic sources of water quality contamination is challenging enough, but even for the same type of contaminant source, there are additive upstream to downstream impacts that must be considered as well. These are the impacts that result in cumulative effects or changes in overall water quality due to specific individual activities that combine with other past, present or future activities across space. As water in river systems flows from upstream to downstream, the impact of upstream activities on downstream water quality correspondingly accumulates (Yalcinet *al.*, 2005).

Rivers are the most important freshwater resource for man. Unfortunately, river waters are being polluted by indiscriminate disposal of sewerage, industrial waste and plethora of human activities, which affects their physico-chemical characteristics and microbiological quality (Koshy and Nayar, 1999).

Industrial wastes that alter the water pH and provide excessive bacterial nutrients often compromise the ability of natural processes to inactivate and destroy pathogens (Gerardi and Zimmerman, 2005). The extent of discharge of domestic and industrial effluents is such that rivers receiving untreated effluent cannot provide the dilution necessary for their survival as good quality water sources. The transfer of unfavorable releases from industries is detrimental to human and animal health and safety (Adekunle and Eniola, 2008). Disposal of sewage wastes into a large volume of water could increase the biological oxygen demands to such a high level that all the available oxygen may be removed and consequently causing the death of all aerobic species e.g. fish (Maduka, 2004). Prevention of river pollution requires effective monitoring of physico-chemical and microbiological parameters (Chandra and Singh, 2006). In most countries, the principal risks to human health associated with the consumption of polluted water are microbiological in nature (WHO, 1997).

Water quality is neither a static condition of a system, nor can it be defined by the measurement of only one parameter. There is a range of chemical, physical and biological components that

affect water quality. These variables provide general indication of water pollution, whereas others enable a direct tracking of pollution sources (UNEP, 2000).

Ouyang *et al.* (2006) carried out a study to assess impact of urbanization on river water quality in the Pearl River delta economic zone, china. They found that the river has been undergoing a rapid urbanization since the reformation and opening of china in 1978. This process plays a significant impact on the urban environment, particularly river water quality. The main goal of this present study is to assess the impact of urban activities especially urbanization on river water quality for the study area. Some land sat images from 2000 were used to map the areas of different pollution levels of urban river sections for the study area. In addition, an improved equalized synthetic pollution index method was utilized to assess the field analytical results. The result indicates that there is a positive correlation between the rapidity of urbanization and the pollution levels of urban river water. Compared to the rural river, urban river water was polluted more seriously. During the urban development process, urbanization and urban activities had a significant impact on the river water quality.

Berner and Berner (1987) were concerned with the role of water in the global water cycle. This book has been concerned with the origin of physical constituents dissolved in and transported by natural water. They found that the global chemical cycle of some major elements at the earth surface are intimately interconnected with the hydrological cycle. They just pointed out these elemental cycles on a global basis. In analyzing river water chemistry, they used Piper diagram (Piper, 1944) and Gibbs diagram (Gibb's, 1970) and plotted the database (dissolve solute load data from world major rivers) on that. Comparing the chemistry of those rivers' water they become able to make a trend of world's river water chemistry. He mentioned that the sources of major ions in water can be defined by plotting the samples according to the variation of weight ratio $\text{Na}^+ / (\text{Na}^+ + \text{Ca}^{2+})$ in meq/l as a function of the TDS in ppm. According to him, the major mechanism controlling the water chemistry is rock weathering, precipitation and evaporation-crystallization. He also stated that solutes enter river water from both natural and anthropogenic sources, with rainfall, rock weathering, and evaporation-precipitation process being the most important natural contributors to solute levels in rivers which were supported by Gibbs (1970), Feth (1971), Kilham (1990) and Webb and Walling (1992). He again mentioned from Meybeck (1983) that in general, the rainfall dominated water had Na^+ and Cl^- as major ions; the

weathering dominated water had high Ca^{2+} and HCO_3^- concentration. And the evaporation/crystallization dominated water was characterized with high Na^+ and Cl^- content.

Bahar and Reza (2010) conducted a study to evaluate the hydro-chemical characteristics of shallow groundwater in coastal region (Khulna) of southwest Bangladesh have been evaluated based on different indices for drinking or irrigation uses. Water samples were collected from 26 boreholes and analyzed for major cations and anions. Other chemical parameters like pH, electrical conductivity (EC), and total dissolved solids were also measured. They found salinity, total hardness and sodium percentage (Na %) indicate that most of the ground water samples are not suitable for irrigation as well as for domestic purposes and far from drinking water standard. They suggested that the brackish nature in most of the ground water is due to the seawater influence and hydrogeochemical processes.

Sundaray *et al.*, (2009) conducted a study on river water quality: Mahanadi River estuarine system, India where he found that hydrochemistry of surface water (pH, electrical conductivity, nitrate, phosphate, potassium, sulfate, calcium, magnesium, iron, chloride, bicarbonate, carbonate, total dissolved solids and total suspended solids) to assess the quality of water for agriculture purpose. The river water was free from nitrate-nitrogen hazard and has much less osmotic pressure and residual sodium carbonate values. Further there was no complete precipitation of calcium and magnesium in the study area. In case of quality assessment, some basic ideas on analyzing chemical parameters are mentioned below.

2.1.1.pH

pH has its great influence on the chemical and biological properties of liquids, hence its determination is very important. It is one of the important parameters in water chemistry and is defined as $-\log [\text{H}^+]$ and measured as intensity of acidity or alkalinity on a logarithmic scale ranging from 0 to 14. If free H^+ are more it is expressed as acidic (i.e. $\text{pH} < 7$) and if OH^- ions are more than it is expressed as alkaline (i.e. $\text{pH} > 7$). pH is important for acid-base neutralization, water softening, precipitation, coagulation, disinfections and corrosion control. pH less than 7 (acidic) has significance from public health point of view and creates corrosion and interferes in the water softening process. pH greater than 7 (alkaline) is mainly due to carbonates and bicarbonates and hence poses a problem of scale formation, hardness, etc. In natural water, pH is governed by the equilibrium between carbon dioxide / bicarbonate /

carbonate ions and ranges between 4.5 and 8.5 although mostly basic. Wastewater and polluted natural waters have pH values lower or higher than 7 based on the nature of the pollutant (Ramachandra *et al.*, 2012).

2.1.2. Electrical Conductivity (EC)

Conductivity (specific conductance) is the ability of water to conduct an electric current. It is measured in desi-Siemens per meter and depends on the total concentration, mobility, valency of ions and the temperature of the solution. Electrolytes in a solution disassociate into positive (cations) and negative (anions) ions and impart conductivity. Most dissolved inorganic substances are in the ionized form in water and contribute to conductance. The conductance of the samples gives rapid and practical estimate of the variation in dissolved mineral content of the water supply (Ramachandra *et al.*, 2012).

Conductance is defined as the reciprocal of the resistance involved and expressed as mho or Siemens (s).

$$G = \frac{1}{R}$$

Where, G – conductance ($\text{ohm}^{-1} = \text{mho} = \text{Siemens}$)

R – Resistance (ohm)

2.1.3. Phosphate

Phosphate's role in promoting plant growth actually makes it a dangerous pollutant when dumped in excessive quantities into aquatic ecosystems. In fact, plants have so much difficulty that the chemical is a limiting nutrient. The rate at which plants can grow and reproduce is limited by the amount of usable phosphate in the soil or water (for aquatic plants). When extra phosphorous was added to water due to anthropogenic activities, it creates a condition called Eutrophication that can wipe out aquatic ecosystems.

Eutrophication is characterized by a rapid growth in the plant population (an algal bloom). The presence of phosphates in virtually every detergent, including household cleaners and laundry soap, fertilizer run-off from agriculture and landscaping, decomposition of organic matter continues to be a major source of phosphate pollution. Animal wastes can also add significant amounts of phosphate to water (Ramachandra *et al.*, 2012).

2.1.4. Potassium

Potassium is found in low concentrations (<10 mg/L) in natural waters since rocks, which contain potassium, are relatively resistant to weathering. It is usually found in ionic form and the salts are highly soluble. Though found in small quantities it plays a vital role in the metabolism of fresh water environment (Ramachandraet *al.*, 2012).

2.1.5. Sulfates

Sulfates are commonly found in all natural waters, particularly those with high salt content. Besides industrial pollution and domestic sewage, biological oxidation of reduced sulfur also adds to sulfate content. It is soluble in water and imparts hardness with other cations. Sulfate causes scaling in industrial water supplies and odor and corrosion in wastewater treatment processes due to its reduction to H₂S. Its main source is industrial discharge that contains sulfate salts and domestic wastes (heavy use of detergents) (Ramachandraet *al.*, 2012).

2.1.6. Calcium and calcium plus magnesium

The presence of calcium (fifth most abundant) in water, results from passage through or over deposits of limestone, dolomite, gypsum and other calcium bearing rocks. Calcium contributes to the total hardness of water and is an important micronutrient in aquatic environment. It is measured by EDTA titrimetric method. Small concentration of calcium carbonate prevents corrosion of metal pipes by laying down a protective coating. But increased amount of calcium precipitates on heating to form harmful scales in boilers, pipes and utensils (Ramachandraet *al.*, 2012).

2.1.7. Iron

Iron is the fourth most abundant element by weight in the earth's crust. In water it occurs mainly in the divalent and trivalent state. Iron in surface water is generally present in the ferric state. The concentration of iron in well-aerated water is seldom high, but under reducing condition, which may exist in some groundwater, lake and reservoir and in the absence of sulfate and carbonate; high concentration of soluble ferrous iron may be found. It is determined by colorimeter with an operating range of 400 to 700 nm (Ramachandraet *al.*, 2012).

2.1.8. Chlorides

The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl⁻). Otherwise high concentrations may indicate pollution by sewage or some industrial wastes or intrusion of seawater or other saline water. It is the major form of inorganic anions in water for aquatic life. High chloride content has a deleterious effect on metallic pipes and structures, as well as agricultural plants. In natural freshwaters, high concentration of chlorides is regarded as an indicator of pollution due to organic wastes of animal origin (animal excreta have higher chlorides along with nitrogenous wastes). Domestic sewage and industrial effluents also bring chlorides into the water. Chloride content above 250 mg/L makes water salty. However, a level up to 1000 mg/L is safe for human consumption. High level results in corrosion and non-palatability (Ramachandraet *al.*, 2012).

2.1.9. Total Dissolved Solids (TDS)

Dissolved solids are in dissolved state in solution (having particle size less than 10⁻⁹m). Low concentrations of dissolved substances have no significant influence on the water quality but at high concentrations impair the water quality and suitability of water for various applications such as domestic, industrial and agricultural purposes. It has an overall effect on the living creatures like humans, aquatic and terrestrial organisms. Excessive concentrations increase water turbidity, affects photosynthesis, absorbs more heat, enriches nutrient status of water, etc. (Ramachandraet *al.*, 2012).

2.1.10. Total Suspended Solids (TSS)

Solids that remain in suspension like silt, sand, clay and phytoplankton etc. form the total suspended solids. Similar to TDS, it interferes in the quality of the water (Ramachandraet *al.*, 2012). Total suspended solids (TSS) include all particles suspended in water which will not pass through a filter. Suspended solids are present in sanitary wastewater and many types of industrial wastewater. There are also nonpoint sources of suspended solids, such as soil erosion from agricultural and construction sites.

As levels of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life. Suspended solids absorb heat from sunlight, which increases water temperature and

subsequently decreases levels of dissolved oxygen (warmer water holds less oxygen than cooler water). Some cold water species, such as trout and stoneflies, are especially sensitive to changes in dissolved oxygen. Photosynthesis also decreases, since less light penetrates the water. As less oxygen is produced by plants and algae, there is a further drop in dissolved oxygen levels (http://www.michigan.gov/documents/deq/wb-npdes-TotalSuspendedSolids_247238_7.pdf).

It is essential to compare the laboratory data with standard nutrient value for determining the water quality. A table of water content standard nutrient value usual range in irrigation for agriculture is given below.

Table 2.1The table shows the common irrigation water quality evaluation.

Water parameter	Symbol	Usual range in irrigation water	
Electrical Conductivity	EC	0 – 3	dS/m
Total Dissolved Solids	TSS	0 – 20	%
Calcium	Ca ²⁺	0 – 0.2	%
Magnesium	Mg ²⁺	0 – 0.05	%
Bicarbonate	HCO ₃ ⁻	0 – 0.1	%
Chloride	Cl ⁻	0 – 0.3	%
Sulfate	SO ₄ ²⁻	0 – 320	ppm
Nitrate	NO ₃ ⁻	0 – 10	ppm
Phosphate	PO ₄ ³⁻	0 – 2	ppm
Potassium	K ⁺	0 – 2	ppm

(Source: FAO corporate document repository)

2.2. Sediment quality

Sediment is the loose sand, clay, silt and other soil particles that settle at the bottom of body of water (Davies and Abowei, 2009). The erosion of bedrock and soils leads to accumulation of sediments of past or on-going natural and anthropogenic processes and components. Sediment is a habitat and major nutrient source for aquatic organisms. Sediment analysis is important in evaluating qualities of total ecosystem of a body of water in addition to water sample analysis

practiced for many years because it reflects the long term quality situation independent of the current inputs (Adeyemo *et al.*, 2008).

Sediment deposited on the banks and flood plains of a river is often mineral-rich and makes excellent farmland. The fertile floodplains of the Nile in Egypt and of the Mississippi river in the United States have flooding rivers to thank for their excellent soils. On the negative side, when rivers flood, they leave behind many tons of wet, sticky, heavy and smelly mud-not something you would want in your basement.

Knowing the contaminant levels of an areas sediments prior to dredging can save large amounts of time and money. Engineers would not need to test sediments as they were dredged in order to know which sediments could be ocean-dumped and which sediments need decontamination. Visualization of sediment contaminant data is a powerful way to gain the knowledge necessary to dredge and dispose of sediments cost-effectively.

Sediment is also the major site for organic matter decomposition which is largely carried out by bacteria. Important macro-nutrients such as nitrogen and phosphorous are continuously being interchanged between sediment and overlying water (Abowei and Sikoki, 2005).

Sediment quality is closely linked to the water quality. Many water-borne pollutant and nutrient species are predominately associated with particulate matter that can settle and become sediment. Fine-grained silt or clay sediments have the potential to adsorb or otherwise sequester greater quantities of pollutant species than sand-sized sediments because of their higher surface area. Because fine-grained sediments tend to accumulate behind dams, dam removal options must consider the quality of the exposed sediments. Moreover, dissolved oxygen (DO) is usually rapidly depleted (within millimeters or mm to a few centimeters or cm) below the sediment-water interface of fine-grained sediments resulting in significant sediment oxygen demand (SOD) which helps to depress dissolved oxygen (DO) concentrations in the overlying water column. The resulting anoxic conditions can also drive the development of steep chemical gradients for various pollutant and nutrient species with the result that sediment-water exchange can constitute a significant component of nutrient or pollutant budgets for a water body.

Sediment can act as sinks of multiple chemicals that accumulate over time, making risk assessment and sustainable management difficult and complex. The assessment of sediment quality should therefore be carried out through tiered decision-making frameworks in sequential

steps of increasing complexity and cost. Therefore, the development of tools to link chemical concentrations of contaminants to the potential for observing toxicity is of great interest, since these tools can be very useful in initial assessment steps for an efficient allocation of limited resources; e.g., they can serve to identify uncontaminated sediment with low probability of toxicity, in which further testing would not be necessary, or to identify sediment that are highly likely to be toxic and would require attention in subsequent management steps (Alvarez *et al.*, 2008).

Both point and nonpoint sources contribute to the nutrient and sediment pollution of the Bay. In contrast to point source pollution, which originates from a specific locale, nonpoint source pollution does not arise from one particular identifiable source. Nonpoint source pollution can enter a water body with overland flow, air pollution, and groundwater. Examples of nonpoint sources for nitrogen include agricultural application of commercial fertilizers, runoff from feedlots and urban areas, leachate from failing septic systems and atmospheric deposition. Wastewater and storm water discharges and sanitary and combined sewer overflows are examples of point sources for nitrogen. Common sources of phosphorus include weathering of soils and rocks, runoff from agricultural land and municipal wastewater discharges (Darrell *et al.*, 1998).

2.3. Soil quality

Soil is derived from the Latin word “Solum” which means earthly material in which plant growth takes place. Soil is a natural body consisting of layers (soil horizons) of mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, physical, chemical, and mineralogical characteristics. It is composed of particles of broken rock that have been altered by chemical and environmental processes that include weathering and erosion. Soil is essential for survival of the living world, especially for human population. Soil is a dynamic medium made up of minerals, organic matter, water, air and living creatures including bacteria and earthworms. It was formed and is forever changing due to physical factors; the parent material, time, the climate and the organisms present (Bajpai, 1994).

Excess nutrients especially phosphates, sulfates and nitrates are classified as pollutants in waste water. Large tonnage of phosphate enters rivers and lakes through super phosphate fertilizer

washed from soil and from chemicals used to improve the performance of detergents (Abowei and Sikoki, 2005).

Soil type influences nutrient losses and subsequent nutrient transport to water bodies by influencing the availability of nutrients to transportation. Particle size, mineral composition and amount of organic matter all impact the movement of nutrients through the soil and into surface runoff and groundwater. For example, smaller particle size results in a greater affinity for water runoff and groundwater. For example, smaller particle size results in a greater affinity for water and nutrient binding, with sandy soils presenting a greater vulnerability to nutrient loss compared to silty or clay soils. Mineral composition changes the nutrient binding characteristics of the soil as well, depending on whether elements present in the soil are positively or negatively charged, and if they readily form compounds with phosphorus, nitrogen, or carbon, or are prone to oxidation and chemical breakdown. The elements present in the soil (silicates, metals, salts, etc.).

Solid wastes are unwanted materials thrown away in solid form, arising from the normal community activity. It includes garbage i.e. kitchen and food wastes, rubbish materials like paper, rag, glass bottles, metallic cans, plastics, fibers, residues from home fuels, street sweeping, building debris, rubbles and abandoned vehicles. Urban solid waste is also called as municipal waste or garbage or trash (Sharma, 2001).

Excessive pollution results in change of soil environment and also decreases the fertility of soil. Industrial pollutants change the soil fertility (Sastry *et. al.*, 2001).

To evaluate the soil quality it is essential to compare the laboratory data with the standard value. A standard soil quality nutrient value chart is given below.

Table 2.2 The table shows the soil quality evaluation consideration of nutrients value.

Element	unit	Low	Medium	High
Nitrogen	ppm	<75	76-150	151-300
Phosphorus	ppm	<12	13-25	26-75
Sulfur	ppm	<12	13-25	26-75
Iron	ppm	<20	21-40	41-200
Calcium	%	<0.004	0.0042-0.008	0.0082-0.036
Magnesium	%	<0.00097	0.00098-0.0024	0.0025-0.011

Potassium	ppm	<78.2	78.2-156.4	160.3-586.5
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(Source: land and soil utilization guide, 2003)

Methodology reveals the entire process that will be followed for the completion of the study successfully. It helps to organize and conduct the study. The following methodological activities have been undertaken to complete the research work.

3.1. Location of the study area

Study areas were selected according to the objectives of the study. The Mayur river bed is uplifted by dumping of municipal waste and by the accumulation of sewage sludge that impaired its natural flow and now it's turned into a habitat of aquatic weed. So, it is urgent need to excavate and revive the river. Due to this fact, Mayurriver was selected as the study area to conform how much it will affect the land beside when the excavated sediment will be shifted on it. Study area and sampling points of Mayurriver are shown by below figure.

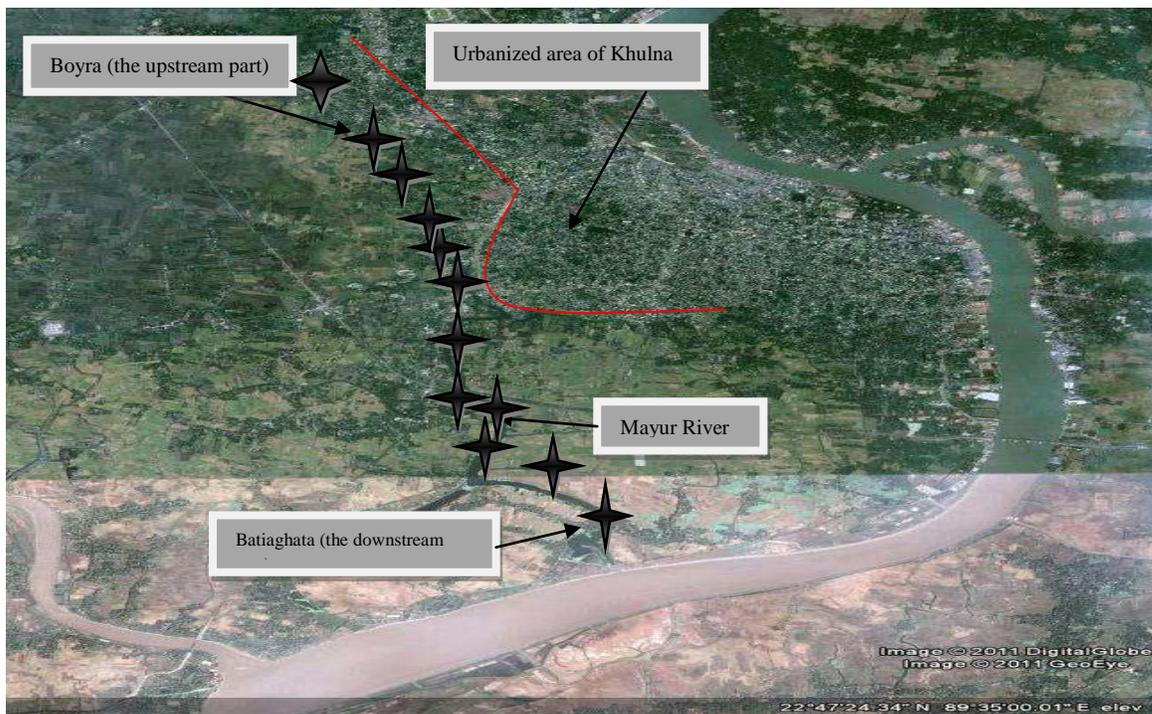


Fig. 1. The figure shows the sampling points at the Mayurriver.

3.2. Sampling point

The purposive sampling technique was followed where the particular units were selected for constituting a sample on the basis that the small mass that they so selected out of huge on were typical or representative of the whole.

A total of 12 sampling points were selected with a distance of at least one kilometer between the two successive points. Black star signs on the fig.1 show the study points. The samples were taken from the following specific locations.

Table 3.1The following table shows the coordinates of sampling point with area location.

Sample No	Station's Name	Latitude (N)	Longitude (E)	Elevation(m)
S1	Hamid nagar Sluice gate	22°50'00.0''	89°31'05.6''	3
S2	ChotoBoyraSosanghat	22°49'35.1''	89°31'46.5''	3
S3	Opposite KMC	22°49'21.1''	89°31'53.9''	1
S4	Bamboo bridge, Sonadanga	22°48'55.2''	89°32'10.07''	1.9
S5	Khaderkhal	22°48'32.0''	89°32'13.9''	4.7
S6	Gollamari	22°47'59.6''	89°32'26.4''	6.4
S7	Buromoulovidorga bridge	22°47'47.6''	89°32'34.7''	1.8
S8	MohammadnogorBiswaroad bridge	22°47'8.6''	89°32'19.5''	9
S9	Sachibuniawapdakheyaghat	22°46'38.5''	89°32'28.9''	9
S10	PutimariKheyaghat	22°46'17.3''	89°32'34.05''	9
S11	PutimariTalghat	22°45'54.2''	89°33'06.0''	4
S12	Alutola Bridge	22°45'26.6''	89°33'04.03''	5

3.3. Sampling procedure of water, sediment and soil

Water is a dynamic system and hence its characteristic quality changes with time and place. Water samples were collected from selected locations encompassing the entire Khulna town catchment area. Precautions were taken while handling the collected samples to ensure its integrity. Plastic bottle containers were used for collecting and storing the samples in the laboratory. The following procedure was followed while sampling.

- Before being filled with the sample, the container was first rinsed with the sample.
- The samples were collected by directly immersing the container in the water, and it was closed properly using appropriate stoppers.

Water samples were collected at regular intervals to identify their characteristics and the changes in their quality. A total of 12 composite water samples (6 in the upstream and 6 in the downstream) were collected from various locations encompassing the entire catchment area. Precautions were taken while handling the collected samples to ensure its integrity. Composite water samplings were completed from river water representing pre-monsoon season to evaluate the chemical composition. Water sample were collected from 50 cm depth of the Mayurriver.

The sediment beneath the water bodies is usually collected by using spade. In this study, composite sediment samples were collected in polyethylene and immediately transported to the laboratory for further physico-chemical analysis. The sediment sampling sites were as like composite water sampling sites of Mayurriver. They were shade dried and stored. The dried sediments were ground using hammer and sieved through a 2mm mesh sieve.

Soils are highly heterogeneous; hence it has to be analyzed for various physico- chemical. This also would help in assessing the amount of nutrients or amendments required for a particular soil to increase its productivity. Soil sampling is a technique by which a true representative sample of a given area is collected. A one-time sampling of soil representative of the entire catchment area was undertaken and analyzed using standard methods. The soil samples were collected from twelve selected sampling point at Mayurriver.

Composite soil samples were collected using spades from 3 feet distance from the bank of the river. Samples were collected in thick quality polyethylene bags and immediately transported to

the laboratory. They were shade dried and stored. The dried soils were ground using hammer and sieved through a 2mm mesh sieve.

3.4. Chemical analysis

The main objective of chemical analysis is to assess the quality of water, sediment and soil of Mayur river catchment area of Khulna town. The chemical parameters which were analyzed as pH, electrical conductivity (EC), available nitrogen, available phosphorus, available potassium, available sulfur, calcium, magnesium, iron, chloride, bicarbonate, carbonate, Total Dissolve Solids (TDS) and Total Suspended Solids (TSS).

Table 3.2The table shows the analyzing chemical parameters of water, sediment and soil and its method of analysis.

Chemical parameters	Method of analysis (Instrument)
pH	Electrometric (Hanna, pH 211, Portugal)
Electrical conductivity(EC)	Electrometric (Hanna, EC 214, Portugal)
Available nitrogen	Colorimetric
Available phosphorus	Molybdophosphoric blue color
Available potassium	Flame Emission Spectroscopic (Jenway, PFP7, Japan)
Available sulfur	Turbidimetric
Calcium	Titrimetric
Magnesium	Titrimetric
Iron	Colorimetric
Chloride	Titrimetric
Bicarbonate	Titrimetric
Carbonate	Titrimetric
Total Dissolve Solids(TDS)	Evaporating

Total Suspended Solids(TSS)	Gravimetric
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3.5. Determination of chemical parameters of water, sediment and soil

pH: pH determined electrochemically with the help of glass electrode pH meter as suggested by Jackson (1973).

Electrical conductivity (EC): The electrical conductivity of the soil was measured at a soil: water ratio of 1:2.5 by the help of EC meter (USDA, 2004).

Determination of available Nitrogen: Available nitrogen of the soils was determined by colorimetric method as suggested by Baethgen and Alley (1989).

Determination of available Phosphorus: Available Phosphorus was extracted from the soil with 0.5M NaHCO₃ (Olsen's Method) at pH 8.5 and Molybdophosphoric blue colour of analysis was employed for determination. (Jackson, 1967).

Determination of available Potassium: The available K was determined from NH₄OAc. (pH 7.0) extract as described by Jackson (1967). The extract was analyzed for available K by a flame analyzer at 589 nm (Jackson, 1967).

Determination of available Sulfur: After extraction of soil with 500 ppm of P from Ca-phosphate, the concentration will be determined by turbidity method as described by Hunt (1980).

Determination of available Ca and Mg: The available Ca²⁺ and Mg²⁺ were determined from NH₄OAc. (pH 7.0) extract as described by Jackson (1967). The contents of Ca²⁺ and Mg²⁺ were measured by titrimetric method as mentioned by Ramesh and Anbu (1996).

Determination of available Fe²⁺ and Fe³⁺: Available Fe²⁺ and Fe³⁺ were determined from NH₄OAc. (pH 3.0) extract as described by Jackson (1967). The contents of Fe²⁺ and Fe³⁺ were measured by colorimetric method.

Chloride (Cl): Chloride (Cl⁻) was determined by the titrimetric method as described by Jackson (1973).

Carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-): Carbonate and bicarbonate contents of the water samples were determined by titrimetric method as mentioned by Jackson (1973).

Total Dissolved Solids (TDS): Total dissolved solids (TDS) were measured by simply evaporating water sample as suggested by Ramesh and Anbu (1996).

Total Suspended Solids (TSS): Total suspended solids (TSS) were measured by suspended constituent's separation by filtration and after drying. The weight of the suspended materials is determined of water sample as suggested by Ramesh and Anbu (1996).

4.1. Water, sediment and soil quality

Mayur River's water, sediment and soil samples laboratory analysis data are presented under the categorized graph. Their results are also discussed in the following section.

4.1.1. pH: Overall pH condition of the river can be shown by a graphical presentation where the pH analyzed data of water, sediment and soil were plotted in the graph.

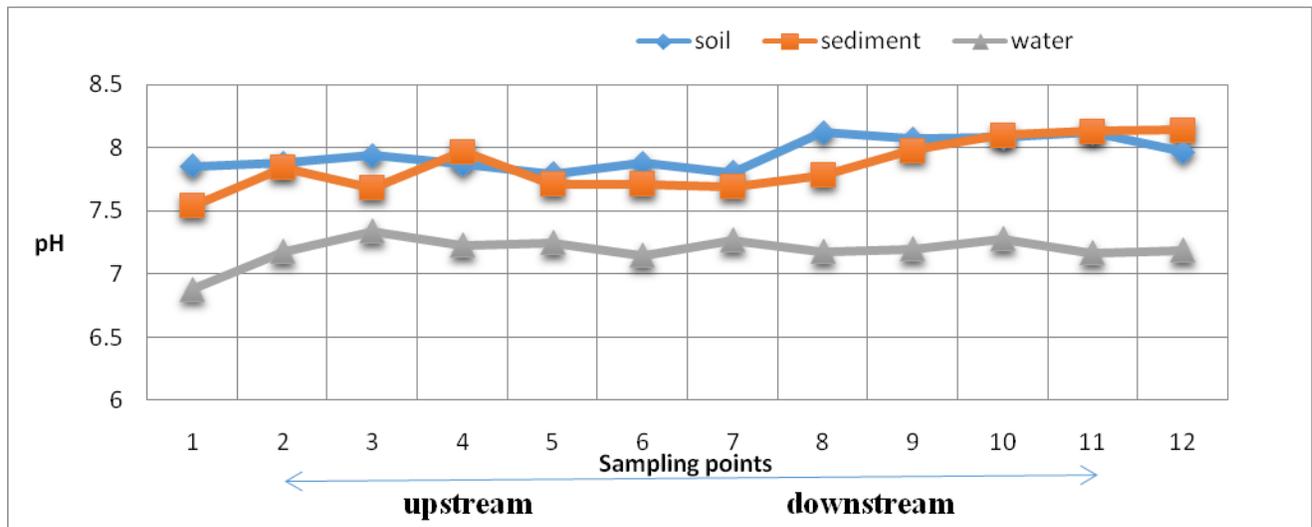


Fig. 2. The graph shows pH fluctuation of water, sediment and soil at twelve sampling points of Mayur river.

From the Fig.2, it is clear that the pH of the river water fluctuates regularly in narrow range. Lowest pH (6.88) has found at the top upstream sampling point 1 and highest pH (7.34) has tested at sampling point 3. Sediment pH values at downstream sites are greater than upstream sites. Upstream sediment samplings areas give ups and downs pH values. pH of sediment has increased from sampling point 7 and reached maximum at last sampling location of downstream. Soil pH curve at upstream points is in little bit zigzag motion. It reaches high at sampling point 8 from sampling point 7 and decreases again. Sediment sample pH has increased at sampling point 12 but soil pH has decreased at that point.

4.1.2. Electrical conductivity (EC): Overall EC condition of the river at the sampling areas can be shown by a graphical presentation where the EC analyzed data of water, sediment and soil were plotted in the graph.

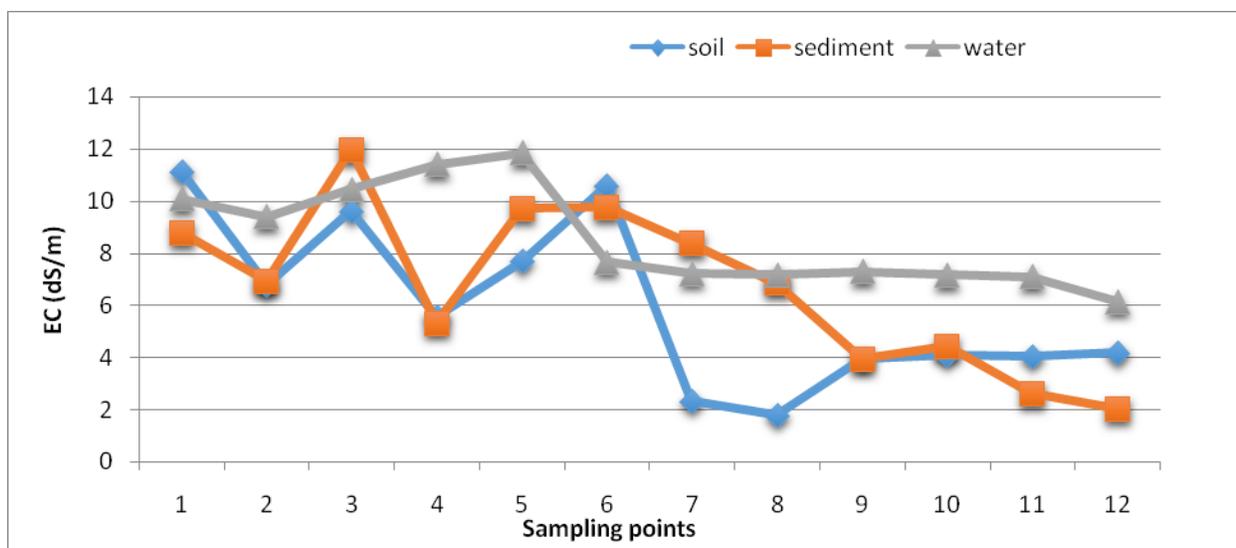


Fig. 3. The graph shows the EC values of water, sediment and soil at twelve sampling points of Mayur river.

The Fig. 3. represents that EC value in water has increased from sampling point 2 and reached maximum 1.67dS/m at sampling point 5, then it has decreased quickly. Downstream sampling site 12 gives the minimum EC (0.77 dS/m) of water among the total sampling point. In case of sediments there has found a wide range of variation in EC. The sampling point 3 shows the highest sediment EC (11.96 dS/m). EC value has decreased from sampling point 6 to sampling point 9. Final point of the downstream shows the lowest pH of sediment. It has also observe that, soil EC curve presents a zigzag form at upstream side and it shows a static relation from sampling point 9 to 12. Maximum EC (11.13 dS/m) of soil has found at the top sampling point 1 where it is minimum at sampling point 8.

4.1.3. Nitrogen content

It is clear from the Fig. 4. that nitrogen concentration in water samples is very low. Sampling point 3 represents the maximum nitrogen concentration (23.887 ppm) and sampling point 12 shows the minimum concentration (0.979 ppm) of nitrogen. Almost same nitrogen concentration in water sample has tested at the sampling points 1, 8, 10 and 11. Highest nitrogen concentration (386.762 ppm) of sediment has found at the sampling point 3 where the lowest concentration (112.98 ppm) has found at sampling site 12. Nitrogen concentration of soil samples has decreased gradually from sampling point 2 again this value has increased and reached maximum at sampling point 9. However, sampling point 6 shows the lowest soil nitrogen contents (46.058 ppm).

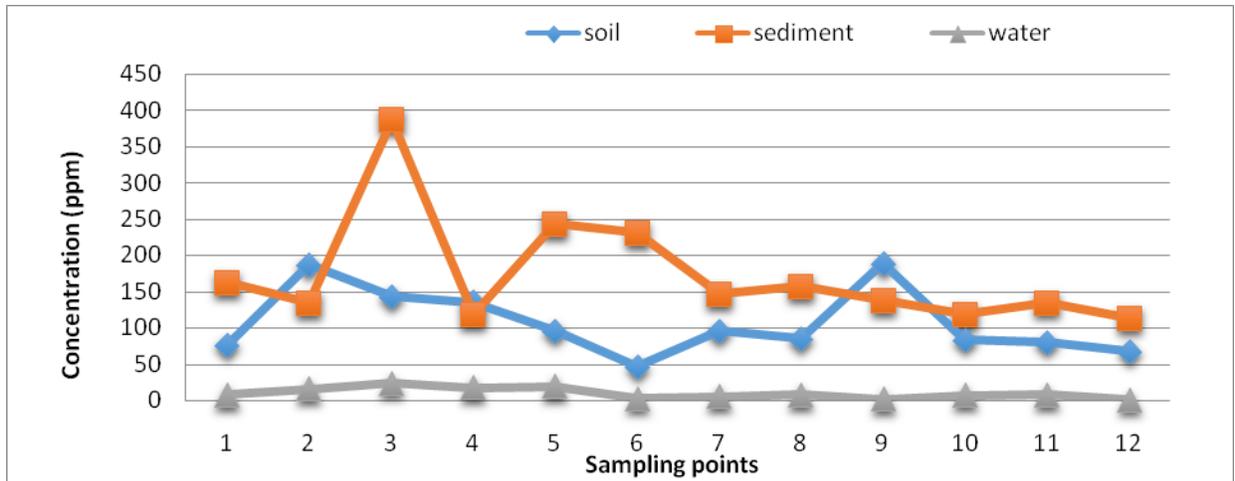


Fig. 4. The graph shows the concentration of nitrogen in water, sediment and soil at twelve sampling points of Mayur river.

4.1.4. Phosphorus content

Below mentioned Fig. 5, represents lower phosphorus concentration in water at the total twelve sampling area of Mayur river where sampling points 1, 2 and 8 to 12 had less than 0 ppm of N. Oppositely, sampling points 3 to 7 showed more than 1 ppm of P of water. In the favor of sediment, the phosphorus ion concentration maintains an increase and decrease relationship at the overall sampling sites. Minimum Phosphorus concentration has found at sampling point 8. In case of soil, phosphorus concentration fluctuation curve at the upstream area is different than downstream. Sampling point 2 shows the maximum amount (29.368 ppm) of phosphorus of soil.

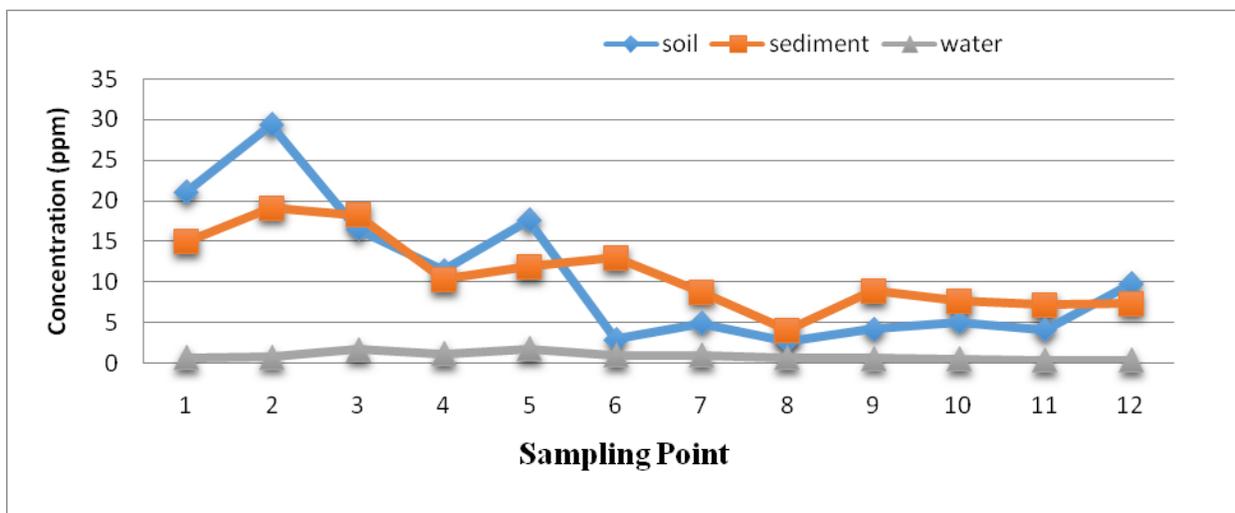


Fig. 5. The line diagram shows the concentration of phosphorus in water, sediment and soil at twelve sampling points.

4.1.5 Potassium content

Fig. 6. shows that potassium concentration in water has increased from sampling point 2 and reached maximum at sampling point 5. Almost same potassium concentration level has found at the downstream of Mayur river as sampling point 8, 9, 10 and 11. There had minor potassium concentration difference between sampling point 1 and 2. Moreover, minimum amount of nitrogen has tested at the last sampling site 12 of the river. In the account of sediment samples; potassium concentration is high at the more river area. Maximum potassium level has found at two sampling point of 5 and 8.

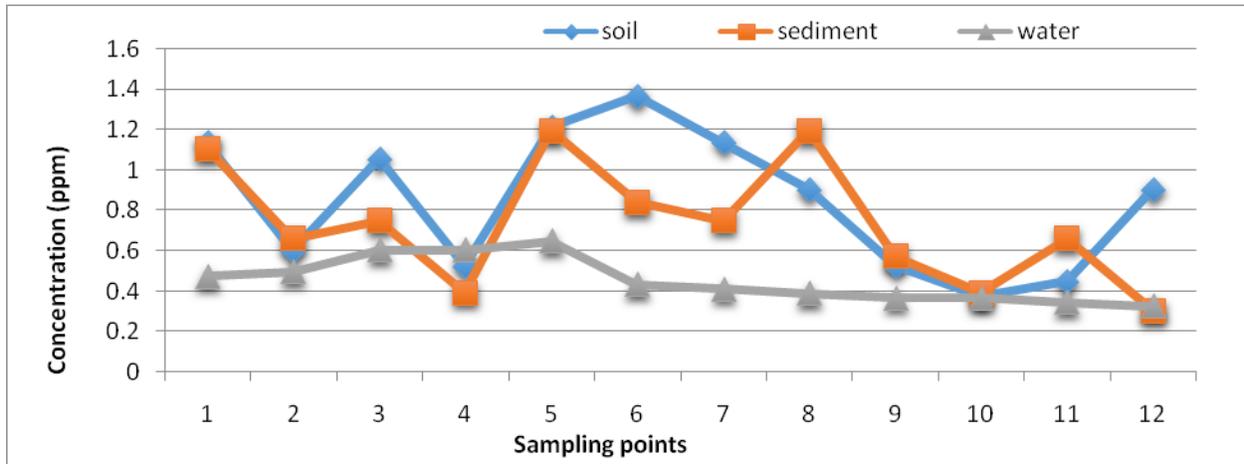


Fig.6. The graph shows the concentration of potassium in water, sediment and soil at twelve sampling points of Mayur river.

Sampling point 1 represents the second maximum concentration (0.105 ppm) of potassium of sediment. To assess the potassium concentration of soil, there has a great change among the sampling points. Highest concentration (1.364 ppm) has obtained at sampling point 6. As the concentration curve looks upward movement from sampling point 4 and it gets downward from sampling point 6 and reached lowest (0.368 ppm) at sampling point 10. Again it takes upward turn.

4.1.6 Sulfur content

Fig. 7. shows that the Sulfur concentration in water is almost same in every sampling area. So, they throw a static relationship of sulfur content among the twelve sampling points of water. Sulfur concentration in composite sediment samples fluctuate highly at upstream area. Maximum value (0.346 ppm) and minimum value (0.008 ppm) has found at sampling point 3 and sampling point 12, respectively which located at two different poles. In soil samples, sulfur concentration curve represents an alternate decrease

and increase relationship through the total sampling sites. Downstream sampling points show less sulfur content soil.

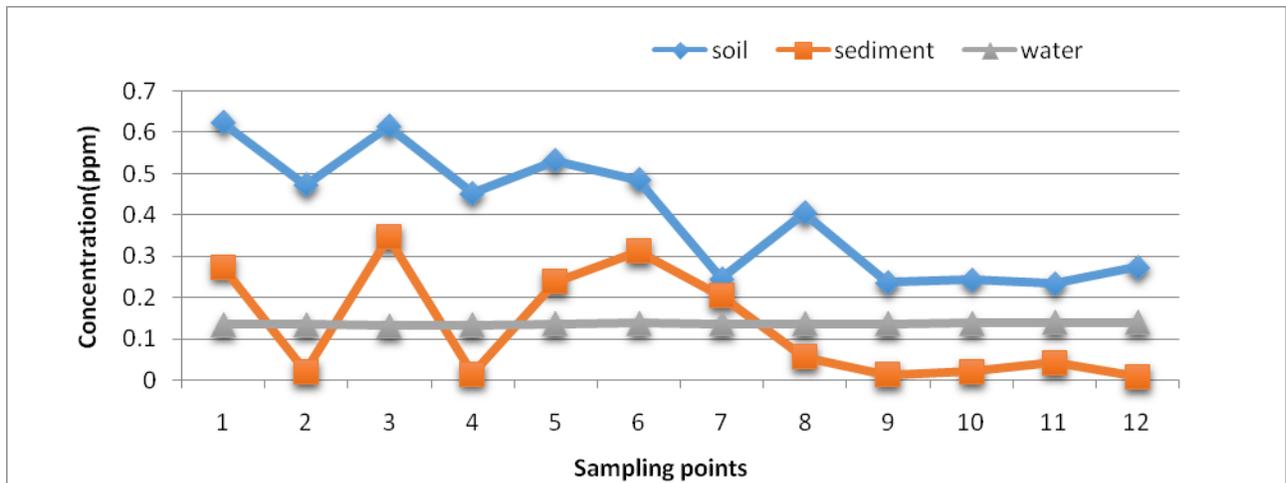


Fig. 7. The graph represents the concentration of sulfur in water, sediment and soil at twelve sampling points of Mayur river.

4.1.7 Calcium content

It is clear from the Fig. 8 that, almost an equilibrium relation in case of calcium concentration is presence between water, sediment and soil samples among the sampling points. Calcium content Graph about water shows a gradual decreasing concentration from sampling point 7 to 10. Although a change is clear at sampling point 4, where water and soil calcium concentration has increased with comparison of previous sampling point but has not occur the same incident for sediment sample. It is a little bit static.

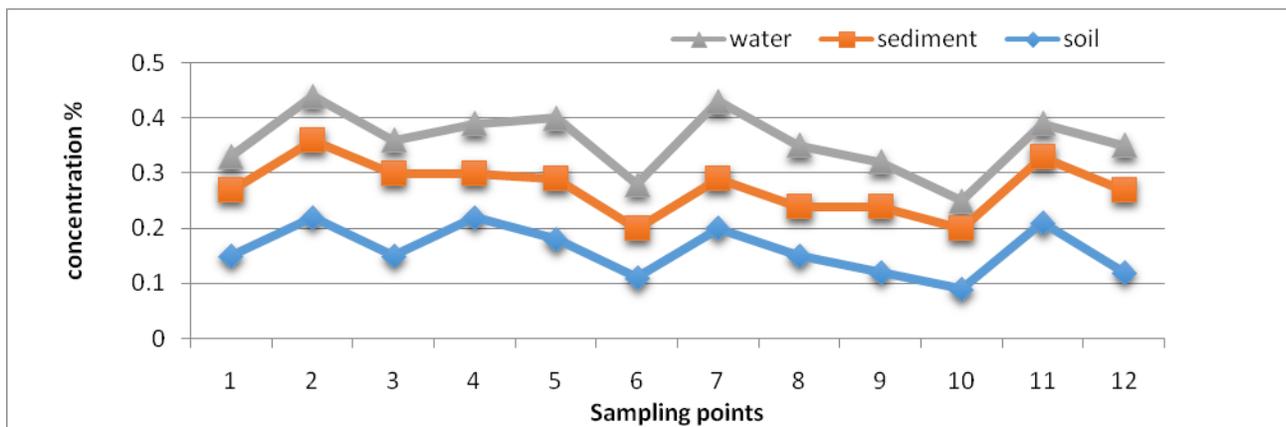


Fig. 8. The line diagram shows the concentration of calcium in water, sediment and soil at twelve sampling points of Mayur river.

4.1.8. Magnesium content: Overall Magnesium content at the sampling areas of the river can be shown by a graphical presentation where the analyzed data of water, sediment and soil were plotted in the graph.

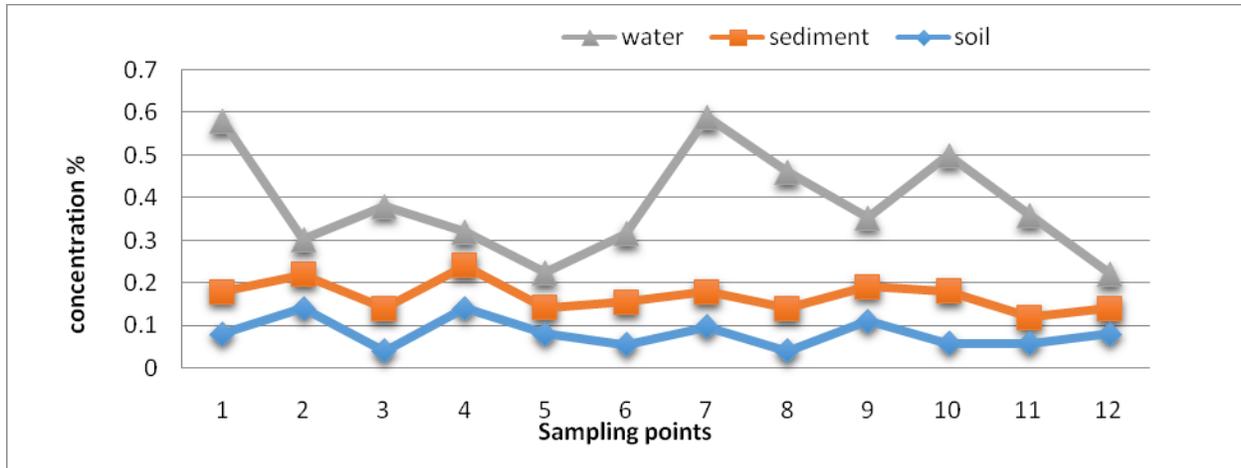


Fig. 9. The line diagram shows the concentration of magnesium in water, sediment and soil at twelve sampling points.

From the above figure we can see that there is an equilibrium state flow between sediment and soil samples. Sampling point 4 shows the highest magnesium concentration of sediment and soil. There exists an irregular pattern of change of the concentration in water. Maximum value 0.41 % and minimum value 0.079 % in water has found at the sampling point 7 and 5, respectively.

4.1.9. Iron content: Overall iron content at the sampling areas of the river can be shown by a graphical presentation where the analyzed data of water, sediment and soil were plotted in the graph.

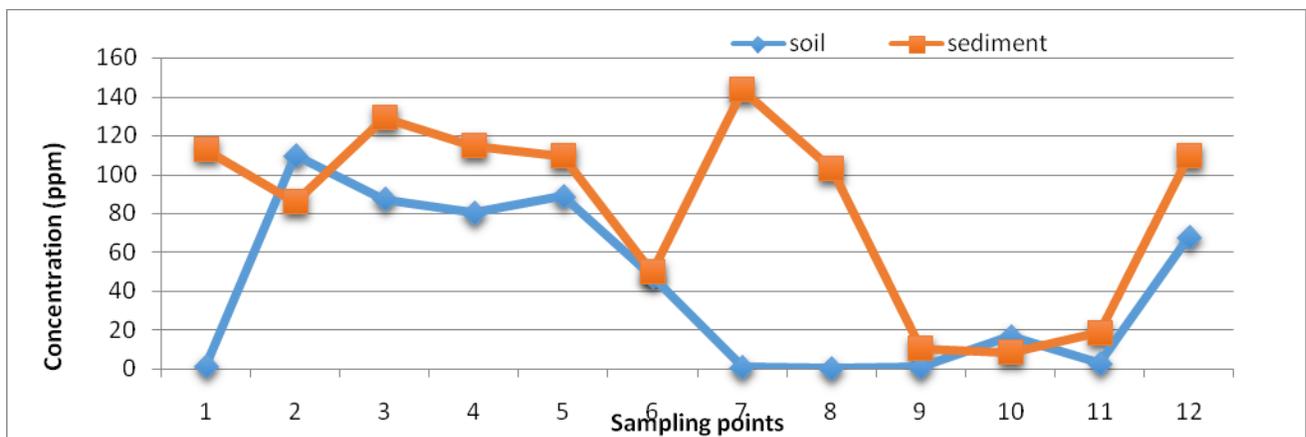


Fig. 10. The graph represents the concentration of iron in sediment and soil at twelve sampling points.

From the Fig. 10 it can be said that sampling point of 7 shows the maximum iron concentration (143.785 ppm) in sediment sample, although here iron concentration in soil is low as 0.983 ppm. On the other hand, sampling point 10 shows the minimum iron concentration (8.64 ppm) of sediment and sampling point 8 represents the minimum soil iron concentration (0.223 ppm). Iron concentration in sediment is very much uniform at the total area while its concentration in soil at upstream is greater than downstream.

4.1.10. Chloride content: Overall chloride content at the sampling areas of the river can be shown by a graphical presentation where the analyzed data of water, sediment and soil were plotted in the graph.

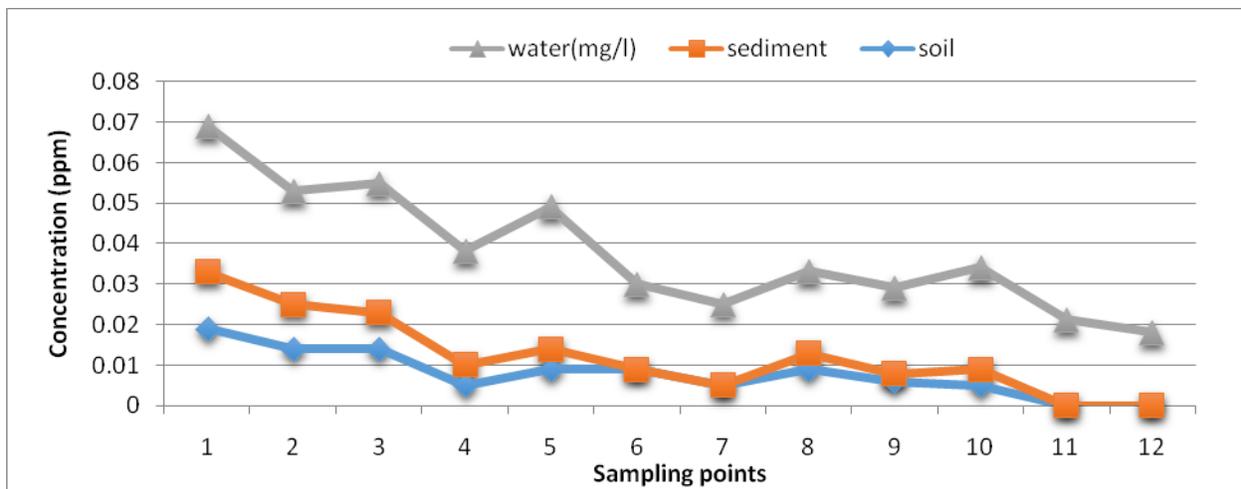


Fig.11. The line graph shows the fluctuation of chloride concentration values of water, sediment and soil at twelve sampling points.

In case of chloride ion concentration an equilibrium relation between water, sediment and soil of Mayur River become distinct which is cleared from the line graph Fig. 11. The highest value of chloride in water (0.036%), sediment (0.014%) and soil (0.019%) lies at the top sampling point of upstream location. Chloride concentration in water, sediment and soil at upstream is high than downstream.

4.1.11. Bicarbonate (HCO_3^-) content

From the graph Fig. 12, it is clear that bicarbonate ion concentration in water sample at every sampling point is higher than sediment and soil samples. And bicarbonate concentration (0.067%) in water declares the maximum at two sampling points 3 and 4. After this sampling point, amount of bicarbonate in water decreases drastically and again fluctuate slowly. In sediment samples, bicarbonate ion concentration fluctuates highly at some upstream points with comparison of downstream points. At the sampling points of 4 and 8, this rate as 0.006% and 0.019% respectively for sediment, is equal with soil bicarbonate

concentration values of those mentioned points. In case of soil, bicarbonate concentration curve shows an alternate decrease and increase relationship through the total sampling area.

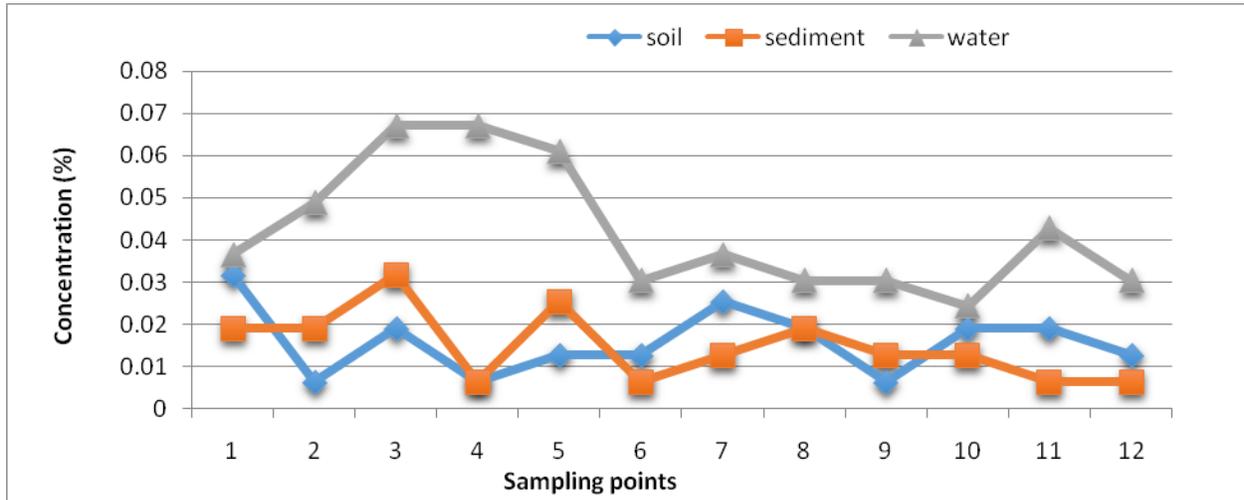


Fig. 12. The graph represents the concentration of bicarbonate in water, sediment and soil at twelve sampling points.

4.1.12. Total Dissolved Solids (TDS) of water samples

From the graph Fig.13, it can be said that, the TDS values of water samples at upstream points are high than the downstream points. Some points of the upstream of the river show the static TDS condition while there is an alternate increase and decrease state are seen at downstream TDS curve represents the static value from sampling point 3 to 5.

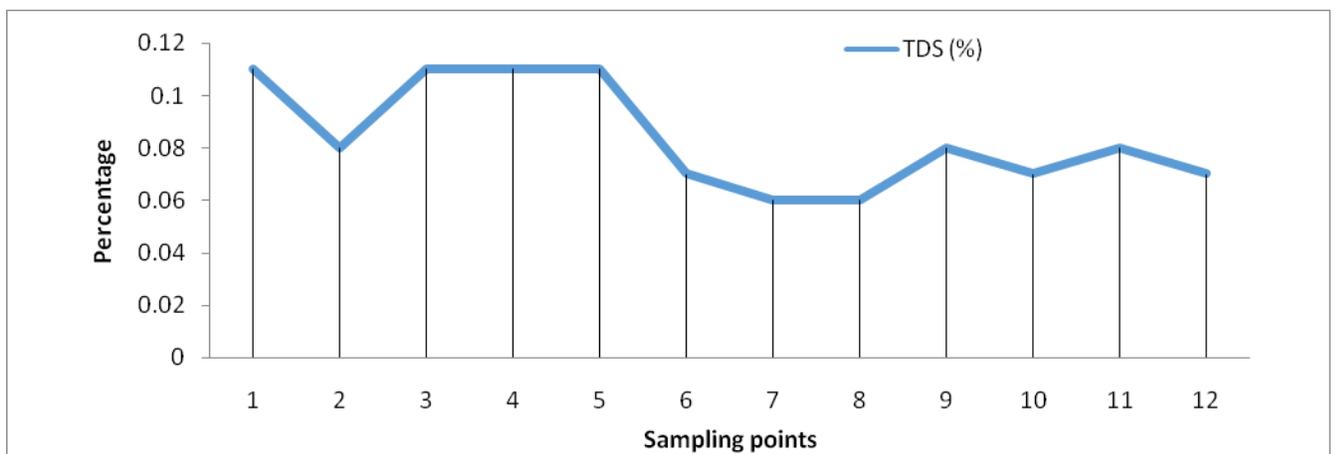


Fig. 13. The graph shows the changes of Total Dissolved Solids (TDS) of water at twelve sampling points of Mayurriver.

4.1.13.Total Suspended Solids (TSS) of water samples:Overall TSS content at the sampling areas of the river can be shown by a graphical presentation where the analyzed data of water, sediment and soil were plotted in the graph.

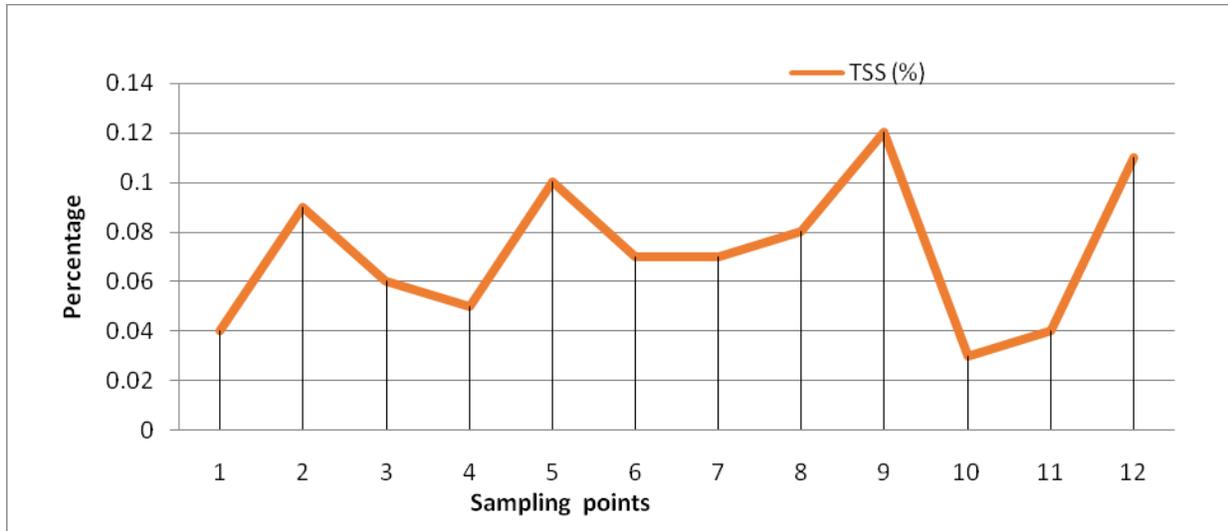


Fig.14. The graph represents the changes of Total suspended Solids (TSS) value of water at twelve sampling points.

The TSS Fig. 14 shows an alternate increase and decrease curve of water samples at the total sampling area. Downstream water samples TSS values fluctuate highly than the upstream values. Sampling point 9 at the downstream has the highest TSS amount (0.12%). At the top upstream area, composite water sampling point 1 represents the lowest TSS value as 0.04% which is close to minimum value of 0.03% which lies at the sampling point 10.

4.2. Comparison with standard value

Laboratory analysis data of water, sediment and soil samples has comprised with standard value given by FAO and SRDI. It has observed that most of the Mayur River water chemical parameters analyzed values fall in the standard limit range where NO_3^{2-} and Mg^{2+} contents value is out of range. Remarks “Yes” in the following tables represents that nutrients content in the sample fall in the standard limit range while “No” represents the below of standard limit range. Extreme, high, medium and low show the various level of concentration in the water, sediment and soil samples of the Mayur river with the standard value of agriculture purpose.

Water samples remark is given at the table 4.1. water quality of the mayur river at the sampling sites are shown by the remarkation of nutrients constituent.

Table 4.1 The table represents the remarks of sampling point about water of Mayur River.

Sediment remarks have shown in the table 4.2. Sediment pH at every point stays within standard

Sampling point	pH	NO ₃ ²⁻	PO ₄ ³⁻	K ⁺	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Fe ²⁺
S1	Yes	High	Medium	Low	Low	Extreme	Extreme	High
S2	Yes	Medium	Medium	Low	Low	Extreme	Extreme	High
S3	Yes	Extreme	Medium	Low	Low	Extreme	Extreme	High
S4	Yes	Medium	Low	Low	Low	Extreme	Extreme	High
S5	Yes	High	Low	Low	Low	Extreme	Extreme	High
S6	Yes	High	Medium	Low	Low	Extreme	Extreme	High
S7	Yes	Medium	Low	Low	Low	Extreme	Extreme	High
S8	Yes	High	Low	Low	Low	Extreme	Extreme	High
S9	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S10	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S11	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S12	Yes	Medium	Low	Low	Low	Extreme	Extreme	High

range. NO₃⁻ and PO₄³⁻ show different content rate at different sampling points. Downstream sites of the river show low PO₄³⁻ content. SO₄²⁻ and K⁺ concentrations are low at entire sampling zone where in case of Ca²⁺ and Mg²⁺, they are in extreme amount. Iron concentration in sediment is high at the upstream sites.

Table 4.2 The table represents the remarks of sampling point about sediment of Mayur river.

Sampling point	pH	EC	NO ₃ ²⁻	PO ₄ ³⁻	K ⁺	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ³⁻	TDS	TSS
S1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S2	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S3	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S4	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S5	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	dirty
S6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S8	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S9	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	dirty
S10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	cloudy
S12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	dirty

It has analyzed that Mayur river side soils carry almost same amount of nutrients like sediments. Remarks for soil samples have given at table 4.3.

Table 4.3The table represents the remarks of sampling point about soil of Mayur River.

Sampling point	pH	NO ₃ ²⁻	PO ₄ ³⁻	K ⁺	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Fe ²⁺
S1	Yes	Medium	Medium	Low	Low	Extreme	Extreme	Low
S2	Yes	High	High	Low	Low	Extreme	Extreme	High
S3	Yes	Medium	Medium	Low	Low	Extreme	Extreme	High
S4	Yes	Medium	Low	Low	Low	Extreme	Extreme	High
S5	Yes	Medium	Medium	Low	Low	Extreme	Extreme	High
S6	Yes	Low	Low	Low	Low	Extreme	Extreme	High
S7	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S8	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S9	Yes	High	Low	Low	Low	Extreme	Extreme	Low
S10	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S11	Yes	Medium	Low	Low	Low	Extreme	Extreme	Low
S12	Yes	Low	Low	Low	Low	Extreme	Extreme	High

5.1. Summary and Conclusion

Various chemical parameters such as pH, EC, NO_3^- , PO_4^{3-} , K^+ , SO_4^{2-} , Fe^{2+} , Cl^- , Ca^{2+} , Mg^{2+} , CO_3^{2-} , HCO_3^- , TDS and TSS were analyzed to assess the water, sediment and soil quality of Mayur River. Laboratory analyzed data were compared with the standard value. Water, sediment and soil samples point remarks tables describe the samples quality. pH and EC show positive remarks and other most important nutrients (such as NO_3^- , PO_4^{3-} , SO_4^{2-} , K^+ , Ca^{2+} , Cl^- , HCO_3^-) contents are in available concentration in water for irrigation purpose. Mg^{2+} content in water shows negative results. Most of the sampling sites show cloudy appearance while other sampling points water are dirty in the favor of TDS remarks. pH of sediment and soil shows positive remarks with the consideration comparison with standard value. NO_3^- and PO_4^{3-} contents of sediment and soil samples at different points are remarked differently where K^+ and SO_4^{2-} show low in amount at every sampling point for sediment and soil of Mayur River. Ca^{2+} and Mg^{2+} nutrients are found in extreme concentration. However, unpleasant odor and brackish colour of the Mayur river water represent bad water quality. Comparison with the standard result, Nutrients value in water show good in concentration although soil and sediment's micro and macro nutrient are rich in different amount.

After all the analyzed result, it is clear that the water, sediment and soil quality of Mayur river is roughly suitable for agriculture but it is most essential to know the presence of heavy metals amount for give suggestion on suitability of agriculture. There was lack of analysis of heavy metal for equipments unavailability and economic solvency which retarded this kind of experiment in present research work.

Finally, further research should be carried out to find out the heavy metal pollution for assessing the suitability of water, sediment and soil quality of Mayur river for using in agricultural purpose or other land filling activity. In the meantime, strict enforcement of domestic and municipal wastewater discharge management are vital to protect the water resource and sediment quality to improve the Mayur river.

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