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A Study on Physico-Chemical Analysis of Wetlands Soil and Surface Water in Parvati Arga, Gonda District, Uttar Pradesh

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KEYWORDS

wetland, soil, water testing, physico-chemical testing, Parvati, Arga

ABSTRACT:

Introduction: Wetlands are complex ecosystems that play vital roles, including flood control, water purification, nutrient retention, and supporting biodiversity. However, they are highly threatened by human activities such as agricultural runoff, industrial effluents, urbanization, and land-use changes. The Parvati Arga wetland in Uttar Pradesh, a Ramsar site, faces similar threats from eutrophication, agricultural practices, and infrastructural development. Wetlands globally are experiencing rapid degradation, with many lost or significantly altered, undermining their crucial ecosystem services.

Materials and Method: The study employed a field-based observational design to assess the environmental status of the Parvati Arga wetland in Uttar Pradesh, focusing on soil and water quality. Soil and water samples were collected from stratified sites using GPS coordinates, with seasonal sampling during summer, monsoon, and winter. Soil tests included pH, nitrogen, phosphorus, potassium, and salinity, while water tests assessed turbidity, hardness, dissolved oxygen, and nutrients. Data were analyzed using statistical methods to assess fertility, nutrient availability, and water quality, comparing results to BIS and WHO standards for ecological management.

Results and Observations: The study showed that soil of Arga Tal has a pH of 6.68, moderate moisture content (38.35%), and low nitrogen (0.043%) and organic carbon levels, indicating a need for amendments. The soil's electrical conductivity is 257 µS/cm, and potassium content is 36.8 mg/kg. Parvati soil, with a higher pH of 7.74, shows more moisture (49.56%), and a higher electrical conductivity of 1587 µS/cm. Nitrogen content is 0.43%, and potassium is 54.2 mg/kg. Arga's water turbidity is 56.1 NTU with a pH of 7.91, while Parvati's water has turbidity above 100 NTU and a pH of 7.7, indicating pollution that requires treatment.

Conclusion: The study found that Arga soil has favorable pH, moisture, and non-saline properties but suffers from nitrogen, organic carbon, and sulphur deficiencies. Parvati soil, with better potassium and calcium, faces salinity and compaction issues. Arga's water quality is good, while Parvati's requires treatment due to high turbidity and pollution. Both areas need targeted improvements for better agricultural productivity and water quality.

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1. INTRODUCTION

Wetlands constitute one of the complicated ecosystems that inhabit the boundary between land and water. Among these ecological and hydrological processes, they play a lot of roles in the ecosystem. Such functions comprise flood control, water purification, retention of sediment and nutrients, dry season grazing, agriculture, micro-climate, recreation, and cultural values, as well as supplying water to domestic and livestock. Wetlands are considered to be the most productive of all the ecosystems on earth the contrary, they are also the most threatened habitats [1, 2].

The physico-chemical properties of wetland soils are very crucial in defining the general ecological condition of these habitats. The parameters of soil pH, electrical conductivity, the content of organic carbon, nutrient availability, and cation exchange capacity affect the development of plants, microbial activity, and water quality. The changes in these soil qualities are usually due to agricultural run-offs, industrial effluents, urbanization, and Altera ion of land-use that cause eutrophication, biodiversity loss, and decline in wetland ecosystems [3, 4].

The rapid degradation of wetlands in India has been caused by encroachment, deforestation of the catchment areas, uncontrolled dumping of wastes, and unsustainable agricultural activities. Indian wetlands are experiencing comparable ecological problems to other key wetlands like the Ropar Wetland in Punjab and the freshwater systems in Ethiopia [5, 6].

Figure 1: Exact Location of the place where the study has been done in Arga Tal

Figure 2: Exact Location of the place where the study has been done in Parvati Tal

One such ecologically and socio-economically important wetland system is called Parvati and Arga, and it is found in Uttar Pradesh. The Parvati Arga wetland in the Tarai region is recognized as the habitat of several endangered species. The wetland is a freshwater oxbow lake in the Tarabganj tehsil in the Gonda district of Uttar Pradesh and occupies a land area of 1084.84 hectares, and is at an elevation of approximately 93 meters. Gulriha Nala links these wetlands with the Terhi river. Some of them are Kondar Lake, which is one of the biggest oxbow lakes with a territory of 237.6 hectares. They are geomorphologically part of the paleochannels of the Ghaghara River that have abandoned a series of small streams along the way southwards. Other notable wetlands that are located in the area include Urva tal, Upadhia tal, Garela tal, etc. Hot summers, moderate

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winters are experienced here with the temperature ranging between 4°C during the winter and 48°C during the summer, and the average rainfall of 1240 mm. The wetlands offer a diverse ecosystem and sustain massive flora and fauna. In 2022, Parvati Arga wetland (bird sanctuary), a biodiversity-rich and heterogeneous wetland in the Gonda district of Uttar Pradesh, was declared a Ramsar site. There are many migratory birds, including ferruginous duck (Aythya nyroca), Gadwall (Anas Strepera), common Pochard (Aythya ferina), and 64 species of fauna of seven different families and 35 species of flora of seven different families also recorded here (Ramsar Convention, 2019). Nonetheless, there is a severe threat to the wetland from the land use dynamics. The eutrophication and shrinkages are caused by the infrastructural development, intensive farming near the wetland, use of fertilizers and insecticides [5].

Wetlands are an important natural resource that can provide ecosystem benefits on local and regional levels. Their unique characteristics make them include global biogeochemical and hydrological cycles despite their scattered nature. This is accompanied by a continued degradation of the number and quality of wetlands on the Earth. A good part of the wetlands on the earth, between 30 to 90 percent, have already been lost or, in any case, changed considerably in several countries worldwide. This destruction and degradation of the wetlands culminates in the lack of access to their important ecosystem services to people. Wetland degradation incorporates a scope of processes that undermine the well-being, functionality, and vitality of the wetland ecosystem [7, 8].

2. MATERIALS AND METHOD

Research Design

The present study was considered to assess the environmental status of Parvati Arga Wetland, Uttar Pradesh, through an integrated assessment of soil and water quality parameters. Systematic surveys, field measurements, and laboratory analyses were all combined in a field-based observational investigation design. The design allowed for the identification of spatiotemporal differences in the wetland's ecological condition, with a focus on physico-chemical characteristics that affect the sustainability and health of the wetland. Sampling sites were carefully selected to capture the diversity of the wetland environment. In order to guarantee reproducibility and spatial accuracy, the sites were resolute using Global Positioning System coordinates and comprised open water zones, marshy vegetation areas, and both inflow and outflow points. This stratified site selection helped in covering diverse ecological niches, thereby providing a complete picture of the wetland's environmental quality. To temporal variability, seasonal sampling was directed during summer, monsoon, and winter. This method was modified from previous wetland monitoring frameworks, where seasonal dynamics are considered serious for interpreting ecological processes. Seasonal changes in temperature, rainfall, and hydrology directly influence soil nutrient cycling, water chemistry, and biological productivity, making their inclusion in the study design essential. The first component focused on soil survey and analysis, which was expected to regulate soil fertility status, nutrient reserves, and the extent of anthropogenic influences on soil health within the wetland catchment. The second component involved a water survey and analysis, emphasising the assessment of physico-chemical properties of wetland water to assess pollution load, ecological balance, and conformity with established environmental quality standards. By participating in these two dimensions, the detective accepted a multidimensional design that enabled an all-inclusive assessment of the ecological

Journal of Chemical Health Risks
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status of the wetland. This method not only facilitated the identification of spatial and seasonal differences but also provided a dependable baseline for controlling conservation methods and informing long-term management involvement for the maintainable preservation of the wetland ecosystem.

2.1 Soil Survey, Testing and Analysis

Soil sampling was shown using a transect-based survey method, with profile points fixed along gradients of land use and topography surrounding the wetland. Composite soil samples were collected using augers, air-dried, ground, and separated 2 mm mesh before laboratory testing. The soil samples collected from the Parvati Arga Wetland catchment were subjected to detailed physico-chemical analysis to determine their fertility status and nutrient dynamics. Soil texture was assessed using the hydrometer method, and the textural class was categorised according to the USDA textural triangle. Soil pH was measured in a 1:2.5 soil-to-water suspension using a glass electrode pH meter, while organic carbon satisfied was estimated by the Walkley and Black wet digestion method, with organic matter afterwards calculated by multiplying OC values by the standard conversion factor of 1.724. Total nitrogen was analysed through the Kjeldahl digestion method, whereas available phosphorus was determined by Olsen’s method employing sodium bicarbonate extraction. Available potassium levels were measured with a flame photometer. To assess soil salinity, the electrical conductivity of a 1:5 soil–water extract was recorded. Positive ion exchange capacity was determined following Chapman’s method (1965), which indicates the soil’s nutrient retention capacity. Finally, calcium carbonate content was quantified by titration with sodium hydroxide after acid digestion. Together, understanding of soil quality, nutrient availability, and possible anthropogenic impacts within the wetland, these parameters provide a complete ecosystem

2.3 Water Survey, Testing and Analysis

The physicochemical properties and seasonal variability in several locations within the Parvati Arga Wetland were assessed through analysis of the water samples. To measure parameters that change quickly on-site, including conductivity, dissolved oxygen, free carbon dioxide, pH, air temperature, water temperature, and total dissolved solids confirm accuracy, a transportable water analysis kit was used. Standard titrimetric methods, such as alkalinity, salinity, total hardness, calcium hardness, magnesium rigidity, and chlorides, were used in the lab to resolve other chemical parameters. A nephelometric turbidity were used to estimate nutrient-related indicators like nitrates, nitrites, phosphates, and sulphates meter was used to measure turbidity, and spectrophotometric methods. In addition, silicates were measured in order to assess the wetland ecosystem's nutrient cycling. A complete status was made possible by the inclusion of both physical and chemical parameters, understanding of the wetland's ecological balance, pollution load, and water quality. These ecological and possible analyses also made it possible to assess the suitability of wetland water for residential uses by comparing it to BIS and WHO water quality standards.

3. Calculation and Analysis

The data obtained were scientifically processed through standard procedures of calculation and statistical interpretation to generate meaningful into the ecological condition of the Parvati Arga Wetland from soil and water analyses. For soil parameters, values of organic carbon were changed into organic matter using the conventional factor (OC × 1.724), while nutrient availability classes were resolved by comparing

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

measured values of nitrogen, phosphorus, potassium, and other chemical properties against established fertility rating scales. Soil salinity was expressed regarding electrical conductivity, and the positive ion exchange capacity values were taken to assess nutrient retention capacity and soil fertility potential. For water quality, descriptive statistics such as mean, standard deviation, range, and seasonal variation were calculated for each parameter to identify longitudinal and temporal instabilities. Physico-chemical values were also compared with BIS and WHO permissible limits to assess compliance with water quality standards. A Water Quality Index was derived by assigning appropriate weights to individual parameters and aggregating them into a single score, which facilitated the categorisation of water into excellent, good, poor, or unsuitable classes. Regular differences in soil and water parameters were, in addition, examined using analysis of variance to determine whether dissimilarities across summer, monsoon, and winter seasons were significant differences

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3.1 RESULTS AND OBSERVATIONS

Both Table 1 and Table 2 describe two wetlands that form part of the Parvati–Arga Bird Sanctuary and share strikingly similar characteristics, yet their scale and ecological weight differ. Arga Tal covers an area of approximately 191.39 hectares (around 1.91 km²), while Parvati Tal is far larger, spanning about 502.43 hectares (5.02 km²). This difference in size alone implies distinct ecological capacities: Parvati Tal can support a broader range of hydrological and biological processes, while Arga Tal, though smaller, may act as a more sensitive microhabitat within the sanctuary.

Geographically, the two regions lie at identical coordinates—26°56′09″N and 82°09′45″E—and sit at elevations ranging between 93 to 120 meters above sea level. Both share the same geomorphic origin as oxbow lakes formed by meandering rivers and are primarily rain-fed. Their hydrological regimes are seasonal, with water levels fluctuating depending on monsoonal inflows. These parallels mean that both wetlands are highly dependent on

monsoon strength and vulnerable to changing rainfall patterns, but the larger expanse of Parvati Tal may buffer it more effectively against short-term variations compared to the smaller Arga Tal. Soil composition in both areas consists of alluvial silt-clay, which allows for nutrient retention and supports dense vegetation, critical for sustaining migratory and resident bird species. Climatically, both fall under the humid subtropical, monsoon-influenced zone (Köppen Cwa), which ensures hot summers, distinct wet seasons, and cool winters. These conditions favor a dynamic wetland ecology but also expose them equally to risks of drought or flooding extremes. Conservation status is shared as well, with both being officially recognized under the Ramsar designation (IN2416), underscoring their international ecological significance. In comparing them, the key differentiator is clearly scale. Parvati Tal, more than twice the size of Arga Tal, likely serves as the primary ecological anchor of the sanctuary, offering broader habitats and supporting larger flocks of waterfowl and waders. Arga Tal, smaller and possibly more shallow, may instead provide niche breeding grounds or feeding sites where water concentration and vegetation density are higher. Thus, while the two wetlands mirror each other in geography, climate, and classification, their differing sizes give them complementary roles in maintaining the sanctuary's overall ecological balance.

Table 1: Geographical Parameters in Arga Tal

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

Parameter	Value / Description
Area	~191.39 ha (≈1.91 km²)
Coordinates (approx.)	26.953625°, 82.174701°
Elevation	~93–120 m above sea level
Geomorphic origin	Oxbow lake, rain-fed
Climate type	Humid subtropical, monsoon-influenced (Köppen Cwa)
Hydrology	Seasonal, rain-fed shallow wetland
Soil type	Alluvial silt-clay
Conservation status	Part of Parvati–Arga Bird Sanctuary, Ramsar Site (IN2416)

Table 2: Physico-Chemical Properties of Soil obtained from Arga Site (Mohanpur, Gonda, U.P.)

Parameter	Value / Description
Area	~502.43 ha (≈5.02 km²)
Coordinates (approx.)	26.939752°, 82.122753°
Elevation	~93–120 m above sea level
Geomorphic origin	Oxbow lake, rain-fed
Climate type	Humid subtropical, monsoon-influenced (Köppen Cwa)
Hydrology	Seasonal, rain-fed shallow wetland
Soil type	Alluvial silt-clay
Conservation status	Part of Parvati–Arga Bird Sanctuary, Ramsar Site (IN2416)

The physico-chemical profile of the Arga soil provides an important insight into its fertility status and agricultural suitability. The pH of 6.68 indicates that the soil is slightly acidic to near neutral, which is generally favorable for most crops, as the availability of essential nutrients remains optimal in this range. The electrical conductivity is 257 µS/cm, signifying that the soil is non-saline. Such low conductivity ensures that soluble salts will not interfere with plant growth, making it suitable for a wide range of crops without salinity-related stress. Moisture content is relatively high at 38.35%, which suggests good water retention capacity. This is advantageous for sustaining crops, particularly in areas with irregular rainfall, though excessive moisture may sometimes hinder aeration. The total nitrogen content is very low at 0.043%, reflecting poor nitrogen fertility. Nitrogen deficiency can severely limit vegetative growth, leading to stunted plants and reduced yields. The absence of total organic carbon further corroborates this finding, as organic matter is the principal source of soil nitrogen and plays a pivotal role in improving soil structure, microbial activity, and nutrient cycling. Hence, organic amendments such as farmyard manure, compost, or green manuring are highly recommended to restore fertility. Among the exchangeable cations, sodium is present at 29.3 mg/kg, which is within safe limits, and does not pose sodicity hazards. Potassium is measured at 36.8 mg/kg, which is low to moderate. Potassium is critical for plant metabolism, stress tolerance, and quality parameters of grains and fruits; therefore, supplementation through potash fertilizers may be needed. Total phosphorus is recorded at 17.36 mg/kg, a moderate value that indicates adequate availability for

Table 3: Chemical Properties of surface water obtained from Arga Site

Name of Test	Test Result	Units	Method of Test
Turbidity	56.1	NTU	IS:3025 (Part 10) 1984
pH value	7.91	-	IS:3025 (Part 11) 2022
Total Dissolved Solids	176	mg/l	IS:3025 (Part 16) 2023
Total Hardness as $CaCO_3$	121.62	mg/l	IS:3025 (Part 21) 2009
Calcium as Ca^{2+}	10.98	mg/l	IS:3025 (Part 40) 1991
Magnesium as Mg^{2+}	22.88	mg/l	IS:3025 (Part 46) 1994
Total Alkalinity as $CaCO_3$	154	mg/l	IS:3025 (Part 23) 1986
Chloride as Cl^{-}	8.72	mg/l	IS:3025 (Part 32) 1988
Nitrate as NO_3^{-}	BLQ (LOQ=1.0)	mg/l	IS:3025 (Part 34) 1988
Sulphate as SO_4^{2-}	BLQ (LOQ=1.0)	mg/l	IS:3025 (Part 24) 2022

The soil sample shows a slightly alkaline pH of 7.74, which is generally suitable for a wide range of plants but may limit the availability of certain micronutrients that prefer more acidic conditions. The electrical conductivity is fairly high at 1587 µS/cm, indicating that the soil could have a moderate level of soluble salts, which might affect plant growth, especially for salt-sensitive species.

With a moisture content of 49.56%, the soil retains a good amount of water, making it suitable for crops that require moderate to high moisture. However, this could also lead to drainage issues if the soil is compacted, especially with the bulk density of 2.48 g/cm³, which is on the higher end and suggests possible compaction. This can impede root growth and reduce water infiltration, potentially affecting the overall health of the soil. The nitrogen content is measured at 0.43%, which is a typical level, but not particularly high, indicating that the soil might need additional nitrogen inputs for high-demand crops. Similarly, the total organic carbon content is not present (NP), which points to a potential lack of organic matter, crucial for improving soil structure, fertility, and microbial activity. Without organic carbon, The water sample shows some concerning characteristics, particularly its turbidity, which is reported as greater than 100 NTU. This indicates that the water is heavily polluted with suspended particles, making it unsuitable for immediate use without filtration or other treatment methods to improve clarity and remove contaminants. The pH level, at 7.70, falls comfortably within neutral territory, suggesting that the water is not overly acidic or alkaline, which is generally a positive sign for both human consumption and for the environment.

The total dissolved solids, measured at 249 mg/l, indicate a moderate concentration of dissolved substances in the water. While not alarmingly high, this suggests a certain level of mineral content that could influence the water's taste or its suitability for use in sensitive applications, like industrial processes. The hardness, reported at 188.31 mg/l, is relatively high, implying that the water may lead to scaling in pipes, appliances, and machinery if not treated. This is primarily due to the presence of calcium and magnesium, both of which are contributing 43.94 mg/l each. Alkalinity is reported at 193.60 mg/l, which shows a notable buffering capacity in the water. High alkalinity can affect the water's ability to balance pH changes, and while this level is not excessively high, it could lead to issues with water chemistry, especially in industrial or agricultural contexts. Chloride content, at 38.70 mg/l, is within a reasonable range but could start to affect the taste or corrosiveness of the water if it were significantly higher. The absence of measurable nitrate levels (BLQ) is a good sign, indicating that the sample is not contaminated with nitrogen compounds that can be harmful in high concentrations. Finally, the sulphate concentration at 93.16 mg/l is on the higher side but still within tolerable limits, potentially influencing taste and contributing to water's hardness The surface water sample from Parvati Tal appears to meet basic criteria in several respects (pH, nitrate levels), the high turbidity, hardness, and sulphate content highlight areas where treatment could be necessary to make the water more suitable for drinking or other uses.

Table 5: Chemical Properties of surface water obtained from Parvati Site

S. No.	Name of Test	Test Result	Units	Method of Test
1	Turbidity	>100	NTU	IS:3025 (Part 10
2	pH value	7.7	-	IS:3025 (Part 1
3	Total Dissolved Solids	249	mg/l	IS:3025 (Part 16
4	Total Hardness as $CaCO_3$	188.31	mg/l	IS:3025 (Part 2
5	Calcium as Ca^{2+}	43.94	mg/l	IS:3025 (Part 40
6	Magnesium as Mg^{2+}	43.94	mg/l	IS:3025 (Part 46
7	Total Alkalinity as $CaCO_3$	193.6	mg/l	IS:3025 (Part 23
8	Chloride as Cl^-	38.7	mg/l	IS:3025 (Part 32
9	Nitrate as NO_3^-	BLQ	mg/l	IS:3025 (Part 34

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

Sulphate as SO_4^{2-}	93.16	mg/l	IS:3025 (Part 24) 1982

soil may struggle with maintaining its long-term productivity. Nutrient levels like sodium (37.6 mg/kg) and potassium (54.2 mg/kg) are within a healthy range, supporting plant growth. Potassium, in particular, is vital for root development and stress resistance. Phosphorus is at 28.46 mg/kg, which is a moderate amount, sufficient for most crops but could potentially be limiting for plants with high phosphorus demands. Calcium is found at 26.07 meq/100g, contributing to strong cell walls and plant health. The sulphate content is 0.28 mg/kg, which is low but still within acceptable limits for plant nutrition.

While the soil has a decent nutrient profile, it suffers from some issues like high electrical conductivity and lack of organic matter, which. **Comparison of Physico-chemical properties of soil from Arga and Parvati**

The pH of the Arga soil is 6.68, indicating that it is slightly acidic to near neutral, which is typically ideal for most crops as nutrient availability is balanced. On the other hand, the Parvati soil has a pH of 7.74, which is mildly alkaline. While this pH is still within the acceptable range for many plants, it may hinder the availability of certain micronutrients that thrive in more acidic conditions. Electrical conductivity is another area of contrast. Arga soil's electrical conductivity, at 257 µS/cm, suggests it is non-saline, posing no risks to plant growth related to soluble salts. In stark contrast, Parvati soil has a much higher electrical conductivity of 1587 µS/cm, which indicates the presence of moderate salinity that may limit the types of plants that can thrive without stress.

Moisture content plays an important role in soil health and plant growth, and here the difference is quite significant. Arga soil contains 38.35% moisture, while Parvati soil holds a higher moisture content of 49.56%. This suggests that Parvati soil retains more water, which could be beneficial for crops that require regular moisture. However, this higher moisture also raises concerns about potential drainage issues. Bulk density, which reflects soil compaction, is another point of distinction. Arga soil has an unusually high bulk density of 3.55 g/cm³, which might suggest compaction or measurement errors, severely limiting root penetration and aeration. Parvati soil, though also compacted with a bulk density of 2.48 g/cm³, is less dense than Arga's, yet still poses challenges for root growth and water infiltration.

In terms of nutrient availability, Arga soil shows significant deficiencies. The nitrogen content is very low (0.043%), and the absence of organic carbon means there is little in the way of nutrient cycling, leading to reduced soil fertility. These issues highlight the need for organic amendments to improve soil health. In contrast, Parvati soil has a more typical nitrogen content of 0.43%, though this too may not be sufficient for crops with high nitrogen demands. However, like Arga, Parvati soil also lacks organic carbon, which is essential for enhancing soil structure, fertility, and microbial activity.

Phosphorus in Arga soil (17.36 mg/kg) is moderate, and while it is sufficient for most crops, it needs careful management to avoid fixation in the soil. Parvati soil shows a higher phosphorus content of 28.46 mg/kg, which is again moderate but could better support plants with higher phosphorus needs. In terms of potassium, Arga soil measures 36.8 mg/kg, which is considered low to moderate and suggests a need for supplementation through potash fertilizers. Parvati soil, with a potassium level of 54.2 mg/kg, has a healthier

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

range of this essential nutrient. Calcium in Arga soil (6.73 meq/100g) is within sufficient levels, supporting soil structure and stability, whereas Parvati soil, with a much higher calcium content of 26.07 meq/100g, provides stronger structural support for plants and their root systems.

The sulphate content in both soils is low, with Arga soil having a negligible amount (0.014 mg/kg) and Parvati soil measuring slightly higher at 0.28 mg/kg. While both soils may benefit from sulphur supplementation, the levels in both are still within acceptable ranges for plant nutrition.

Comparison of chemical properties of surface water from Arga and Parvati

The chemical analysis of surface water from Arga and Parvati also reveals key differences. Arga's surface water has a turbidity of 56.1 NTU, which is quite high and indicates significant suspended particles that may affect both its aesthetic quality and safety. The water's pH of 7.91 is slightly alkaline, but it falls within the acceptable range for drinking water. The total dissolved solids (TDS) in Arga water, at 176 mg/l, is moderate and typical of surface water sources, while its hardness of 121.62 mg/l places it in the moderately hard category, which may affect the taste and cause minor scaling in pipes. The calcium and magnesium levels are both within safe drinking water limits, contributing to the water's hardness, and the alkalinity (154 mg/l) offers good buffering capacity. Low levels of chloride (8.72 mg/l) and the absence of detectable nitrate and sulfate are encouraging, indicating good overall water quality.

In contrast, the surface water from Parvati is much more concerning. The turbidity is greater than 100 NTU, a sign of heavy pollution, which makes the water unsafe for immediate consumption without filtration. The pH of 7.7 is neutral, but the water's hardness (188.31 mg/l) is notably higher than Arga's, suggesting potential issues with scaling in pipes and appliances. Calcium and magnesium levels are quite high at 43.94 mg/l each, contributing to this elevated hardness. Total dissolved solids in Parvati water are higher as well, at 249 mg/l, indicating a greater presence of dissolved minerals that could affect water quality. Alkalinity is also higher at 193.6 mg/l, which while providing some buffering capacity, could interfere with certain water chemistry requirements. The chloride content at 38.7 mg/l is within an acceptable range, but the higher sulfate concentration of 93.16 mg/l could influence taste and contribute to the overall hardness of the water.

While both sites have surface waters with acceptable pH levels, Arga's water is far cleaner and of better quality, free from significant contamination, while Parvati's water shows clear signs of pollution and requires more extensive treatment to be suitable for use.

1. DISCUSSION

A study determined the algal abundance and diversity and gave an overall ecological description of the wetlands in the eastern Hararge Oromia regional state, Ethiopia. Three wetlands were acquired, which can be found in the Eastern Hararghe zone: namely Haramaya, Adele, and Teneke. Three points on the wetland shore, the middle, and the wetland edge, where anthropogenic effect is thought to be high, were taken as a source of data, respectively. They concluded that the anthropogenic pressure, including agricultural activities and garbage dumping activities, worsened the water content and quality of biodiversity of these areas [9]. The soil at Parvati Arga demonstrated a slightly alkaline pH of 7.74, which is generally favorable for a wide range of plant species. However, this pH may limit the availability of certain micronutrients, which typically

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

thrive in more acidic conditions. The electrical conductivity (EC) was measured at 1587 µS/cm, indicating moderate salinity, which could potentially restrict the growth of salt-sensitive plants. This is a crucial finding, as salinity levels can affect the biodiversity of wetland plants, limiting the ecological diversity that the wetland can support. Furthermore, the moisture content of 49.56% suggests that the soil has a good capacity to retain water, which is beneficial for supporting plant growth, particularly during dry periods. However, the higher moisture content also raises concerns about potential drainage issues, particularly in the compacted soil areas, which have a bulk density of 2.48 g/cm³. This compactness could hinder root penetration and water infiltration, affecting soil aeration and root health.

A research study was conducted on the wetland degradation of Itu Local Government Area based on remote sensing and ground-truthing methods. Wetland degradation environmental issues were observed to comprise loss of biodiversity, ecosystem services, hydrological changes, decrease in carbon sequestration, climate feedbacks, erosion impact, and cultural implications. The study highlights the importance of holistic conservation policies for reducing the extensive effects of wetland degradation [10]. The physico-chemical characteristics of water and soil in Lalbandh, a freshwater wetland of West Bengal, Birbhum District, were studied. The water and soil samples taken at the wetland during the pre-monsoon, monsoon, and post-monsoon periods (2001-2003) were used, allowing for the study of up to 10 and 8 significant parameters, respectively. It was found that there was a seasonal variation in water and soil properties. The nutritional difference in the physico-chemical properties may be due to a multi-dimensional interaction between primary producers, consumers, and decomposers with the physical environment made up of soil, water, air, and the climatic factors [11]. The water quality in Parvati Arga also presents some challenges. The turbidity levels in the surface water of Parvati Tal were significantly high, exceeding 100 NTU, which points to substantial suspended particles in the water. High turbidity can reduce light penetration, thus impairing photosynthesis in aquatic plants and affecting the health of aquatic organisms. This is a critical concern for the wetland's ecological balance. In contrast, the water in Arga Tal, with a turbidity level of 56.1 NTU, while still elevated, shows less contamination. The higher turbidity in Parvati Tal suggests that the wetland is more impacted by anthropogenic activities, including agricultural runoff and possibly urban waste inputs. The pH of 7.7 in Parvati Tal's water is within the acceptable range for drinking water, yet it indicates a slight alkalinity. This could potentially affect nutrient availability and water chemistry, especially in agricultural and industrial applications. The water's hardness, measured at 188.31 mg/l as $CaCO_3$, is on the higher side, suggesting that the water could cause scaling in pipes and appliances. The elevated levels of calcium (43.94 mg/l) and magnesium (43.94 mg/l) contribute to this hardness. While these minerals are essential for aquatic life and human health, excessive hardness could interfere with water use in certain industries and daily life. Anthropogenic activities like building of dams, river management projects, and indirectly through changes and disturbances in the landscape of the watersheds of specific effluent discharges and deforestation, all of which were a growing danger to the environmental integrity of freshwater systems globally. To reach the monthly and seasonal changes of the "Ropar Weland", research on several physicochemical parameters was conducted. The highest value of all the parameters, but

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

the DO and the free CO2, was recorded during the summer and monsoon season, whereas the lowest value was recorded during the winter season. Free CO2 and the minimum value of DO during the summer season are attributed to the high temperature, as temperature is inversely related to DO. The other parameters, like phosphate, sulphate, magnesium, calcium, etc., were heavily varied on a seasonal basis and are subject to acceptable levels [12]. Our findings also show that seasonal sampling at Parvati Arga resulted in varying water quality, particularly in turbidity levels, with higher values recorded in Parvati Tal. This is in contrast to Ropar, where turbidity did not exceed the permissible limit, underlining the unique challenges faced by Parvati Arga in terms of water pollution, likely due to local agricultural and urban runoff

Urban wetlands of Bamenda municipality are very crucial in the production of vegetables, yet the inconsistency in the physico-chemical characteristics of soils is of great concern. On twenty-one surface soil samples, it was determined that the physico-chemical properties of the soil were in the framework of the study of the fertility condition of the soils, their variability and limitations, and sufficient data on the planning of sustainable land management. The soils in the units of management were grouped into six major components, which included base status; organic matter, weathering, acidity, sodium (Na) dispersal, and neo-synthesis that explained 96.24% of the variations observed. To have good management of the soils, the municipality should have individual management units [13]. Our findings in Parvati Arga Wetlands reinforce this notion, as we observed significant soil compaction and deficiencies in key nutrients, such as nitrogen and sulfur, that could be exacerbated by nearby urbanization. These findings highlight the importance of tailored land management and conservation strategies in maintaining the ecological balance of wetlands like Parvati Arga Wetlands, where the interplay between natural and anthropogenic factors is more complex.

The physico-chemical parameters of water and soil were measured in the Bhimsen Pokhari wetland of Jhapa district, located in eastern Nepal. Six sampling sites were sampled and analysed in triplicate for the samples on the soil. Finally, the central area of the wetland can be the most appropriate location to support the growth and development of the aquatic flora and fauna and microorganisms activities because of the presence of a greater amount of dissolved oxygen and soil organic matter [14]. Anthropogenic activities on the physico-chemical properties of the sediment of Hokersar wetland were conducted in summer, spring, and autumn seasons. The Inlet site recorded the highest Fe, Mn, Cu, and Zn values, and the lowest values were recorded at the outlet site. In addition, the trace elements were found to be found in increased concentration during the summer season compared to the autumn. This is perhaps because of the high rate of erosion of massive amounts of waste in the Wetland [15].

2. CONCLUSION

The study concluded that the Arga soil shows favorable pH, moisture, and non-saline properties, it suffers from critical nitrogen, organic carbon, and sulphur deficiencies, requiring organic amendments and fertilizer supplementation. The Parvati soil, though better in potassium and calcium, faces issues of high salinity and compaction. Arga's surface water is of generally good quality, whereas Parvati's water requires significant treatment due to high turbidity and pollution. Both areas require targeted improvements to optimize agricultural productivity and water quality. Further research could focus on the long-term impacts of organic amendments and nutrient management on soil fertility, particularly addressing nitrogen and carbon deficiencies in Arga soil. For Parvati, efforts could be directed at mitigating salinity, improving water retention, and reducing compaction through organic and mechanical methods. Additionally, advanced water treatment technologies could be explored for Parvati's polluted water, aiming for safer, more efficient purification processes. Continued monitoring and field trials will be essential to refine these practices and ensure the environmental sustainability and agricultural productivity of both sites.

REFERENCES

1. Akhter, S., & Brraich, O.S. (2020). Physico - Chemical Analysis of Fresh Water of Ropar Wetland (Ramsar Site), India. *Current World Environment, 15*, 117-126.
2. Abate, S. G., & Anteneh, M. B. (2024). Assessment of agricultural land suitability for cereal crops based on the analysis of soil physico-chemical characteristics. *Environmental Systems Research*, *13*(1), 1-25.
3. Kaur, N., & Brraich, O. S. (2021). Impact of industrial effluents on physico-chemical parameters of water and fatty acid profile of fish, Labeo rohita (Hamilton), collected from the Ramsar sites of Punjab, India. *Environmental Science and Pollution Research International*, *29*(8), 11534.
4. Argaw Ambelu & Seblework Mekonen & Azeb G/Silassie & Asgdom Malu & Kaliyaperumal Karunamoorthi. 2012. Physicochemical and Biological Characteristics of Two Ethiopian Wetlands. *Society of Wetland Scientists* 2013
5. Verma, Shivam & Sanyal, Srabani & Kushwaha, Prashant. (2024). Landuse Dynamics of Parvati-Arga Ramsar Wetland and Its Environs in Gonda District, Uttar Pradesh. 10.13140/RG.2.2.14995.90405.
6. Brook Lemma (1995): seasonal limnological studies on Lake Alemaya: a tropical African lake, Ethiopia. Archiv für Hydrobiologie/Suppl. 107 (2): 263 - 285.
7. Bognetteau E,Wood P, Afework H, Legesse T (2003)Wetlands and food security in South-West Ethiopia: an economic, ecological and institutional analysis for sustainability. EWNRA, Addis Ababa
8. Kratzer EB, Batzer DP (2007) Spatial and temporal variation in aquatic macroinvertebrates in the Okefenokee swamp, Georgia, USA. Wetlands 27(1):127–140 Wetlands
9. Abebe, Semu. (2019). Physico-chemical parameters and algal composition of wetlands in Eastern Hararghe Oromia regional state, Ethiopia. 7. 49-57.
10. Ivo, Henry & Etim, Ndifreke. (2023). Environmental Perspectives on Wetland Degradation in Itu LGA, Nigeria. 10.13140/RG.2.2.15198.20802.
11. Palit, D., & Mukherjee, A. (2010). Characterization of Physico-chemical properties of water and soil in Lalbandha fresh water wetland in Birbhum District West Bengal. *Ecol. Envir. and Cons*, *15*(4), 239-245.
12. Akhter, S., & Brraich, O. S. (2020). Physico-chemical analysis of fresh water of Ropar

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

wetland (Ramsar site), India. *Current World Environment*, *15*(1), 117.

13. ASONGWE, G. A., YERIMA, B. P., & TENING, A. S. (2016). Spatial variability of selected physico-chemical properties of soils under vegetable cultivation in urban and peri-urban wetland gardens of Bamenda municipality, Cameroon. *African Journal of Agricultural Research*, *11*(2), 74-86.
14. Bhattarai, K. P., Shrestha, P. K., & Koirala, O. (2017). Physico-chemical properties of water and soil of Bhimsen Pokhari Wetland, Jhapa District, Eastern Nepal. *Nepal J. Biosci*, *7*, 72-76.
15. Bano, H., Malik, S., Rather, R. A., Bhat, J. I., Islam, S., Bhat, T. A., & Bhat, M. A. (2022). Impact of anthropogenic activities on physico-chemical properties of sediment of Hokersar wetland: a protected wildlife reserve (Ramsar Site No. 1570) of Kashmir Himalaya. *Bangladesh Journal of Botany*, *51*(1), 83-92.

Table 4: Chemical Properties of surface water obtained from Arga Site

Parameter	**Test Result**	**Units**	**Method of Test**
pH Value	**6.68**	**—**	**IS: 2720 (Part 26) 1987**
Electrical Conductivity	**257**	**µS/cm**	**IS 14767:2000**
Moisture	**38.35**	**%**	**IS: 2720 (Part 2) 1973**
Total Nitrogen (as N)	**0.043**	**%**	**IS 14684:1999**
Total Organic Carbon	**NP**	**%**	**IS: 2720 (Part 22) 1972**
Sodium	**29.3**	**mg/kg**	**IS 9497:1980**
Potassium	**36.8**	**mg/kg**	**IS 9497:1980**
Total Phosphorus	**17.36**	**mg/kg**	**Manual Soil Testing India: 2011**
Calcium	**6.73**	**meq/100g**	**Manual Soil Testing India: 2011**
Sulphate	**0.014**	**mg/**	**Manual Soil Testing India: 2011**

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 2513-2528 | ISSN:2251-6727

Bulk Density	**3.55**	**kgg/cm³**	**IS: 2720 (Part 28) 1974**

The water sample presents several key findings based on its chemical composition. The turbidity level of 56.1 NTU is notably high, indicating a significant presence of suspended particles in the water, which may impair both its aesthetic quality and safety, depending on the nature of these particles. Ideally, water should have turbidity below 5 NTU for drinking purposes, so this result suggests the need for some form of filtration or treatment.

The pH value of 7.91 is within the acceptable range for drinking water, indicating that the water is slightly alkaline. This is generally a good sign, as water with a pH between 6.5 and 8.5 is stable and does not present any immediate issues for consumption. However, it does imply a slight buffering effect which can help manage any minor pH fluctuations. Total Dissolved Solids (TDS) are recorded at 176 mg/l, which is within the standard range for drinking water (100–500 mg/l). This suggests that the water contains a moderate amount of dissolved substances, typical for surface water sources. While this level is not high enough to raise concerns about salinity or overall water quality, it indicates the presence of various minerals in the water. Total hardness is measured at 121.62 mg/l as $CaCO_3$. This places the water in the category of moderately hard water. Though not excessively high, this level could lead to minor scaling in pipes or appliances over time, and it might also affect the taste, giving the water a "hard" sensation. However, this hardness is not harmful and is consistent with typical natural water sources. Calcium levels are 10.98 mg/l, which is within a reasonable range for drinking water. Calcium is an essential mineral, and its presence in this concentration is beneficial to health. Magnesium, another important mineral, is measured at 22.88 mg/l, contributing to the water's hardness and overall mineral content. Both calcium and magnesium are within acceptable ranges for water quality. Total alkalinity is recorded at 154.0 mg/l as $CaCO_3$, which is indicative of a water sample that can buffer against pH changes, providing stability. This is a desirable characteristic, as it helps prevent rapid shifts in pH that could lead to corrosion or discomfort during consumption. Chloride levels are 8.72 mg/l, which is relatively low, suggesting that the water is not overly saline. Chloride levels above 250 mg/l can result in a salty taste, but this result indicates the water is free from excessive salinity. The nitrate and sulfate concentrations are both reported as below the limit of quantification (BLQ), meaning that their levels are so low they couldn’t be measured with the given method (1 mg/l). Nitrates

Journal of Chemical Health Risks
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and sulfates at elevated levels can be harmful, particularly for infants (nitrates), and can also affect taste (sulfates), so these results are a positive sign of good water quality. Hence, the water sample has a few notable aspects, such as elevated turbidity and moderate hardness, but the chemical composition overall falls within safe and acceptable ranges for drinking water. The low concentrations of nitrates and sulfates are reassuring, and the calcium, magnesium, and chloride levels are typical of natural water sources