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# An Ecological Health Assessment of River Lohit by Bioindicator

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**Abstract:**
A study was conducted on the riverine health of the lower reaches (approximately 36.10 km in length) of the transboundary river Lohit, which spans approximately 460 km within Arunachal Pradesh, India, for two years, from 2020 to 2022. The observations recorded seasonal variations in its physicochemical profile, and macroinvertebrates richness, which serves as a bioindicator. A total of 22 physicochemical parameters were examined and grouped into two categories for the convenience of statistical analysis. These parameters displayed seasonal fluctuations but remained within the optimal range. It also recorded richness of macroinvertebrates falling under the phyla Arthropoda and Mollusca, revealed 13 orders, 35 families, and 38 species. The statistical analysis of correlation and Principal Component Analysis of macro-invertebrates, with observed physiochemical parameter elucidate the strong complex inter-relationships. It highlighted a multifaceted pattern in the variables characterized by opposing influences. The Heat map documented a uniform distribution of parameters and macroinvertebrates except in Ephemeroptera and Trichoptera in all four sampling sites throughout the study period. The study shows a complex but stable ecosystem during the study.
**Key words:** Riverine ecology, macroinvertebrates, Bioindicator, Water parameter, Aquatic health

## 1. Introduction

Water, the most vital resource for all forms of life, also harbors diverse flora and fauna that enrich the surrounding ecosystem. Transboundary rivers often traverse highly variable environments, further contributing to their unique and diverse biota. Therefore, monitoring and maintaining water quality in aquatic systems of transboundary river systems hold critical significance. Water is a universal solvent, capable of dissolving more substances than any other liquid without undergoing any chemical changes. This property sometimes makes it challenging to assess its degraded condition solely by observing its physical state.

Since time immemorial, human civilizations have originated, evolved, and thrived around water sources, while simultaneously contributing to their pollution. Running waters are among the most threatened ecosystems globally (Allan and Flecker, 1993). Human activities on land, in the air, and at sea have adversely affected water due to increasing industrialization, urbanization, and rapid development, all of which have profound effects on aquatic ecosystems. These changes lead to widespread modifications of the physical habitat and, consequently, alterations in biotic communities and ecological functioning (Principle et al., 2007). Therefore, the restoration of rivers or streams necessitates a comprehensive understanding of the structure and function of stream corridor ecosystems, as well as the physical, chemical, and biological processes that shape them (Hu et al., 2007).

Indeed, the monitoring of river systems plays a crucial role in comprehending the natural or anthropogenic impact on the ecosystems through which they flow. While modern technology and advanced systems provide transparent information, their use can still be costly and inconvenient during various phases of monitoring studies. Nature, on the other hand, offers indicators of environmental health through its diverse species of flora and fauna, commonly referred to as bioindicators. These bioindicators are readily available for easy and convenient observation and inference.

Bioindicators encompass species or groups of species whose functions, populations, or statuses can reveal the qualitative condition of the environment. Among bioindicators, macroinvertebrates, particularly benthic organisms, are widely utilized to assess the health of aquatic ecosystems (Rosenberg and Resh, 1996). They can detect changes in biochemical, physiological, or behavioral aspects and assess the quality of flowing waters, potentially indicating issues within their ecosystem. There exists an intricate interrelationship between macroinvertebrates and water quality, as these organisms serve as potential indicators of water quality (Sharma and Rawat, 2009). Such organisms have specific requirements concerning physical and chemical conditions. Any alterations in their presence/absence, numbers, morphology, physiology, or behavior may suggest that the physical and/or chemical conditions exceed their preferred thresholds (Rosenberg and Resh, 1996). The presence of numerous families of highly tolerant organisms typically indicates poor water quality (Hynes, 1962).

The present study focuses on assessing the riverine health of the transboundary river Lohit, which originates in Eastern Tibet as the Zayul Chu, then flows through China into India. In India, it converges with two other transboundary rivers, the Dihang and Dibang, and together they form the Brahmaputra River in Assam. The Lohit River journeys through mountainous regions and courses through Arunachal Pradesh before entering the plains of Assam. Throughout its course, it hosts a diverse array of aquatic macroinvertebrate species. The present study aims to conduct both qualitative and quantitative assessments of these aquatic macroinvertebrate communities and results from this study is expected to significantly contribute valuable baseline data to the aquatic fauna database and provide insights into the suitability of water quality, thereby offering insights into the overall riverine health status.

## 2. Materials and Methods

### 2.1 Study area

The study area, which spans approximately 36.10 kilometers in length along the Lohit River, is divided into four distinct sampling stations located within the Alubari region. Here are the specific coordinates and altitudes for each of sampling stations:

1. **Station 1 (S1)**: Latitude 27° 50' 22" N, Longitude 96° 00' 47" E, altitude 156 meters.
2. **Station 2 (S2)**: Latitude 27° 51' 09" N, Longitude 96° 01' 30" E, altitude 156 meters.
3. **Station 3 (S3)**: Latitude 27° 46' 41" N, Longitude 95° 40' 35" E, altitude 131 meters.
4. **Station 4 (S4)**: Latitude 27° 46' 44" N, Longitude 95° 40' 30" E, altitude 131 meters.

These distinct stations serve as strategic points for the research conducted along the Lohit River.

### 2.2 Sampling and chemical analyses

Samples were collected at different times of the year, corresponding to the seasons: pre-monsoon (March-May), monsoon (June-August), post-monsoon (September-November), and winter (December-February). Aquatic macro-invertebrates were gathered from various sampling stations, carefully preserved in 70% alcohol, sealed in polythene bags, and transported to the laboratory. The identification of these collected aquatic macro-invertebrates was carried out based on their morphological characteristics, following the methods described by Pennak (1989) and Edmondson (1974), supplemented with information available in online databases such as the India Biodiversity Portal (https://indiabiodiversity.org/document/show/628).

At each sampling station, water samples were collected from the middle of the river and stored in clean sampling bottles. Various water quality parameters were measured, including water temperature using a Mercury Thermometer, dissolved oxygen concentration using Winkler's modified method (APHA 1989), free carbon dioxide content following Welch (1952), turbidity assessed using the Nephelometric method, and pH measured with a Digital pH meter (Aqua Merck: HANNA). Additionally, a TDS (Total Dissolved Solids) meter was employed. The recorded parameter values were then compared with the optimum range specified by the World Health Organization (WHO, 2008) for drinking water quality. Any observed deviations from these specified ranges were used to evaluate the current quality of the water.

### 2.3. Data analysis

Physico-chemical and macroinvertebrates data were analyzed using statistical analysis tool-pack in MS-Excel. In addition, Correlogram (relationship amongst water properties and macroinvertebrates) using corrplot package in R, Heatmap (variations in physico-chemical properties of water and macroinvertebrates across 4 sampling stations) and principal component analysis (PCA) using ggplot package in R (ver. 4.2.1) were performed (R Core Team, 2023). The R-code used in the present study are provided in supplementary (Supplementary 1).

## 3. Results

### 3.1 Physico-chemical properties of Lohit River

Throughout the study period, the water exhibited a clear to slightly turbid appearance, particularly during the monsoon season. No objectionable odors were detected during the entire study duration. Notably, there were no detectable levels of pollutant indicator chemicals such as residual free chlorine, nitrates, phenolic compounds, or mineral oil throughout the study period (Table 1).

**Table 1:** Observed mean Physio-Chemical properties of Group-I profile of Lohit River in Pre-monsoon, Monsoon, Post-Monsoon and Winter Season from 2020-2022

| Sl. No. | Parameters | Station -1 | Station -2 | Station -3 | Station -4 |
|---|---|---|---|---|---|
| 1 | Appearance | Clear | Clear | Clear | Slightly turbid |
| 2 | Odour | Unobjectionable | Unobjectionable | Unobjectionable | Unobjectionable |
| 3 | Residual free Chlorine mg/l | absent | absent | absent | absent |
| 4 | Nitrates(as NO3) mg/l | absent | absent | absent | absent |
| 5 | Phenolic Compounds (as C6H5OH) | absent | absent | absent | absent |
| 6 | Mineral Oil, mg/l | absent | absent | absent | absent |

**Table 2:** Observed mean Physio-Chemical Parameter Group-II profile of Lohit River in Pre-monsoon, Monsoon, Post-Monsoon and Winter Season from 2020-2022 with optimum range respectively (WHO,2008)

| SL. NO. | PARAMETERS | Optimum Range | Station -1 | | Station -2 | | Station -3 | | Station -4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation |
| 1 | Air Temperature $^0$C | N/A | 24.63 | ± 5.04 | 24.25 | ± 4.80 | 26.12 | ± 5.11 | 25.63 | ± 5.37 |
| 2 | Water Temperature $^0$C | N/A | 22.00 | ± 4.95 | 22.25 | ±4.06 | 23.37 | ±4.98 | 23.25 | ± 4.95 |
| 3 | pH | 6.5-8.5 | 7.03 | ±0.24 | 7.15 | ± 0.18 | 7.33 | ±0.33 | 7.33 | ± 0.44 |
| 4 | DO mg/l | 5-9.5 | 6.48 | ±0.88 | 6.62 | ± 0.92 | 6.51 | ±0.67 | 6.40 | ± 0.76 |
| 5 | Turbidity | 5(Max) | 0.65 | ±0.76 | 0.7 | ± 0.8 | 1.35 | ± 1.50 | 1.31 | ±1.44 |
| 6 | Free Carbon Di-Oxide | 22(Max) | 3.51 | ±0.83 | 3.61 | ± 0.75 | 3.83 | ± 1.02 | 3.95 | ±0.79 |
| 7 | Total Hardness (CaCo3) mg/l | 200(Max) | 95.00 | ±39.65 | 96.75 | ± 40.07 | 104.87 | ± 48.29 | 106.75 | ±47.88 |
| 8 | Iron | 0.30(Max) | 0.19 | ±0.25 | 0.195 | ± 0.25 | 0.27 | ± 0.26 | 0.27 | ±0.27 |
| 9 | Chloride (as Cl)mg/l | 250(Max) | 4.49 | ±1.62 | 4.63 | ± 1.91 | 4.31 | ± 1.19 | 4.13 | ± 0.98 |
| 10 | Fluoride(as F)mg/l | 1.0(Max) | 0.03 | ± 0.04 | 0.03 | ± 0.04 | 0.07 | ± 0.07 | 0.07 | ± 0.07 |
| 11 | TDS mg/l | 500(Max) | 103.50 | ±37.42 | 101.62 | ± 35.97 | 114.75 | ±48.89 | 111.50 | ± 39.41 |
| 12 | Calcium mg/l | 75(Max) | 34.13 | ±9.67 | 38.37 | ± 13.22 | 39.96 | ±14.28 | 40.68 | ±10.51 |
| 13 | Magnesium mg/l | 30(Max) | 17.88 | ±4.12 | 17.22 | ± 4.24 | 18.29 | ±4.42 | 19.20 | ±4.31 |
| 14 | Manganese mg/ml | 0.10(Max) | 0.10 | ± 0.04 | 0.09 | ± 0.02 | 0.09 | ±0.02 | 0.09 | ±0.04 |
| 15 | Sulphate(as SO4) mg/l | 200(Max) | 11.21 | ± 2.10 | 10.81 | ± 1.45 | 7.63 | ± 5.18 | 8.36 | ±5.53 |
| 16 | Alkalinity (as CaCO3) mg/l | 200(Max) | 96.5 | ± 50.13 | 103.87 | ± 51.95 | 103.75 | ± 46.20 | 102.87 | ±50.87 |

The observed Physico-chemical parameters with their standard deviation of the study area with their comparison to (WHO, 2018) optimum range is summarized in Table 2. Temperature displayed an increasing trend toward the monsoon season, with water temperatures ranging from 22.0°C ± 4.95 to 23.3°C ± 4.98 and air temperatures from 24.6°C ± 5.04 to 26.1°C ± 5.11. pH levels fluctuated between 7.33 ± 0.24 and 7.33 ± 0.44 with the highest values occurring during the winter and the lowest during the monsoon and post-monsoon seasons. Dissolved oxygen (DO) was at its minimum during the monsoon and peaked in winter across all sampling stations, with a mean range of 6.40 ± 0.76 to 6.62 ± 0.92. Turbidity varied from 1.19 ± 0.39 to 2.00 ± 0.88 NTUs (Nephelometric Turbidity Units), with the highest values observed at S3 during the monsoon. Free $CO_2$ ranged from 3.51 ± 0.83 to 3.95 ± 0.79 mg/l, with maximum values in the pre-monsoon season and minimum values during the monsoon. Total hardness ranged from 95.0 ± 39.6 mg/l to 106 ± 47.8 mg/l . TDS and alkalinity ranged between 101 ± 35.9 mg/l to 114 ± 48.8 mg/l and 96.5 ± 50.1 to 103 ± 51.9 mg/l, respectively, with the highest alkalinity during monsoon and the lowest in pre-monsoon at different sampling stations. Additionally, no objectionable odors were noted, and pollutant indicator chemicals were absent throughout the study period. (Table 2).

In addition to the previously mentioned parameters, the study also assessed other water quality indicators, with their respective minimum and maximum readings falling within the recommended WHO (2008) optimum range for drinking water quality. The mean value with SD of these parameters include iron (0.13 ± 0.08 mg/l to 0.21 ± 0.14 mg/l), chloride (4.13 ± 0.93 mg/l to 4.64 ± 1.91 mg/l), fluoride (0.21 ± 0.08 mg/l to 0.24 ± 0.09 mg/l), calcium (34.13 ± 9.67 mg/l to 40.68 ± 10.51 mg/l), magnesium (17.88 ± 4.12 mg/l to 19.20 ± 4.31 mg/l), manganese (0.09 ± 0.02 mg/l to 0.10 ± 0.04 mg/l), and sulphates (7.64 ± 5.18 mg/l to 11.21 ± 2.10 mg/l). These findings demonstrated that these parameters remained within the acceptable range for drinking water quality throughout the study period, further indicating the suitability of the water for consumption and ecological health.

### 3.2 Macroinvertebrate Faunal diversity of Lohit River

The study uncovered a diverse array of aquatic macroinvertebrates, totaling 38 species, encompassing 35 families and 13 orders, representing two phyla, namely Arthropoda and Mollusca (Table 3). Within the Arthropoda phylum, six families were attributed to the order Ephemeroptera, six to Trichoptera, three to Placoptera, three to Hemiptera, five to Coleoptera, two to Odonata, one to Megaloptera, four to Diptera, and one to Crustacea. Additionally, the study identified gastropods from the Hygrophila family, as well as Architanioglossa and Unionoida families, within the Mollusca phylum. These findings underscore the remarkable diversity of aquatic macroinvertebrates inhabiting the study area, contributing valuable insights into the local aquatic ecosystem's richness and complexity.

**Table 3:** Distribution of macroinvertebrate fauna at four stations of Lohit river pre-monsoon, monsoon, post-monsoon and winter Season from 2020-2022

| PHYLUM | ORDER | FAMILY | MACROINVERTEBRATE SPECIES | SAMPLE STATIONS (S1, S2, S3 & S4) |
|---|---|---|---|---|
| ARTHROPODA | EPHEMEROPTERA | Baetidae | *Baetis sp.* | S1, S2, S3 & S4 |
| | | Ephemerellidae | *Ephemerella sp.* | S1, S2, S3 & S4 |
| | | Ecdyonuridae | *Ecdyonurus sp.* | S1, S2, S3 & S4 |
| | | Leptophlebidae | *Leptophlebia sp.* | S1, S2, & S4 |
| | | Caenidae | *Caenis sp.* | S3 |
| | | Heptagenidae | *Rithrogena sp.* | S1, S2, S3 & S4 |
| | TRICHOPTERA | Glossosomatidae | *Glossosomatidae sp.* | S1, S2, S3 & S4 |
| | | Hydropsychidae | *Hydropsyche sp.* | S1, S2, S3 & S4 |
| | | Leptoceridae | *Leptocerus sp.* | S2 & S4 |
| | | Psychomyiidae | *Psychomyiidae sp.* | S1, S2, S3 & S4 |
| | | Hydroptilidae | *Ochrotrichia sp.* | S1, S2, S3 & S4 |
| | | Molannidae | *Molannidae sp.* | S1, S2 |
| | PLECOPTERA | Parlidae | *Perla sp.* | S1, S2, S3 & S4 |

| | | | | |
|---|---|---|---|---|
| | | Nemouridae | *Nemouridae sp.* | S1, S2, S3 & S4 |
| | | Pelteoperlidae | *Pelteoperlidae sp.* | S1 & S2 |
| | COELEOPTERA | Elmidae | | S3 & S4 |
| | | Psephenidae | *Psephenus sp.* | S2, S3 & S4 |
| | | Dysticidae | *Dysticus sp.* | S1, S3 & S4 |
| | | Gyrinidae | *Gyrinidae sp.* | S1, S3 & S4 |
| | | Hydrophilidae | *Hydrophilus indicus* | S1, S2 & S4 |
| | DIPTERA | Chironmide | *Chironomus sp.* | S3 & S4 |
| | | | *Ablabesmgia sp.* | S2, S3 & S4 |
| | | Tipulidae | *Antocha saxicola* | S3 |
| | | Simulidae | *Simulium sp.* | S1 |
| | | Tabanidae | *Tabanidae sp.* | , S3 & S4 |
| | ODONATA | Aeshnidae | *Nasiaseschna sp.* | S1, S2, S3 & S4 |
| | | Gomphidae | *Gomphidae sp.* | S1, S2, S3 & S4 |
| | MEGALOPTERA | Corydalidae | *Corydalidae sp.* | S1 |
| | HEMIPTERA | Nepidae | *Ranatra filiformis* | S1, S2, S3 & S4 |
| | | Corixidae | *Sigira sp.* | S1 & S2 |
| | | Mesovelidae | *Mesovelidae sp.* | , S2& S4 |
| | CRUSTACEA | Palaemonidae | *Macrobrachium choprai* | S1, S2, S3 & S4 |
| | | | *Macrobrachium s assamense* | S1, S3 & S4 |
| | | | *Macrobrachium sp.* | S1, S2, S3 & S4 |
| **MOLLUSCA** | SORBEOCONCHEA | Pachychilidae | *Brotia costula* | S1, S2, S3 & S4 |
| | HYGROPHILA | Planorbidae | *Indoplanoris exustus* | S1, S2, & S3 |
| | ARCHITANGLOSSA | Ampullaridae | *Pila globosa* | S1, & S3 |
| | UNIONOIDA | Unionidae | *Lamellidens marginalis* | S1, S2, S3 & S4 |

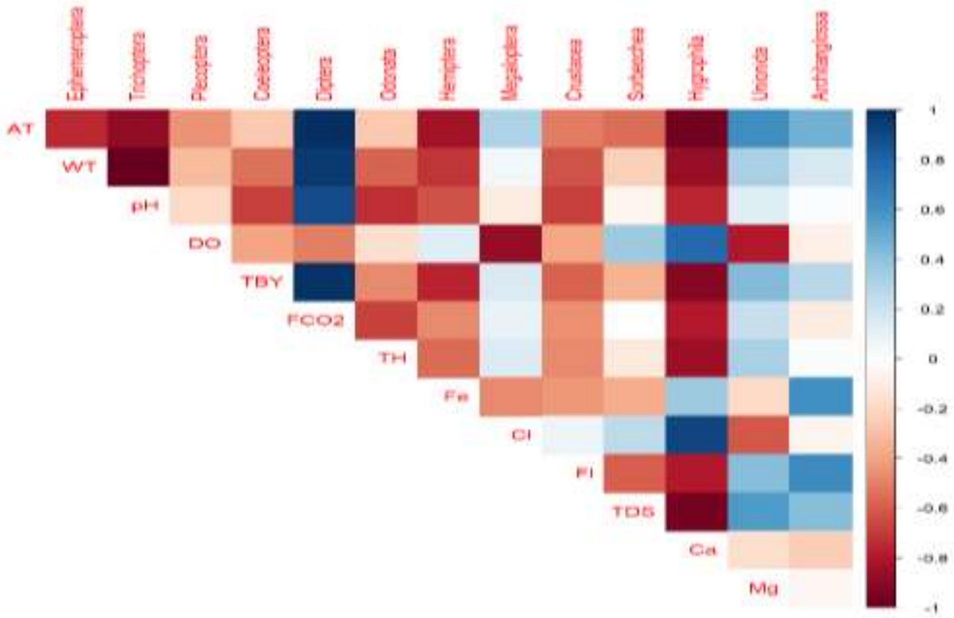


**Figure 1:** Correlation of macroinvertebrates with respect to physiochemical parameters

### 3.3 Correlation and Heatmap between physicochemical parameters and macroinvertebrates

The present study showed significant correlations in the abundance of observed orders of macroinvertebrate to different observed water quality parameters (Figure 1 & Supplementary 2). Among all macroinvertebrates Diptera, Megaloptera, Urionida and architenglossa shows strong positive relation to all observed parameters except negative correlation to Dissolved Oxygen. The order Hygrophila shows strong positive relation to DO, Fe and Chlorine whereas strongly negative correlation to others observed parameters.

The observed heatmap of macroinvertebrate shows uniform distribution in all four sampling sites except orders Ephemeroptera and Trichoptera (Figure 2). all the observed physiochemical parameters show uniform readings in all four sampling sites during study period.

**Figure 2:** Heatmap of macroinvertebrates abundance and physicochemical parameters

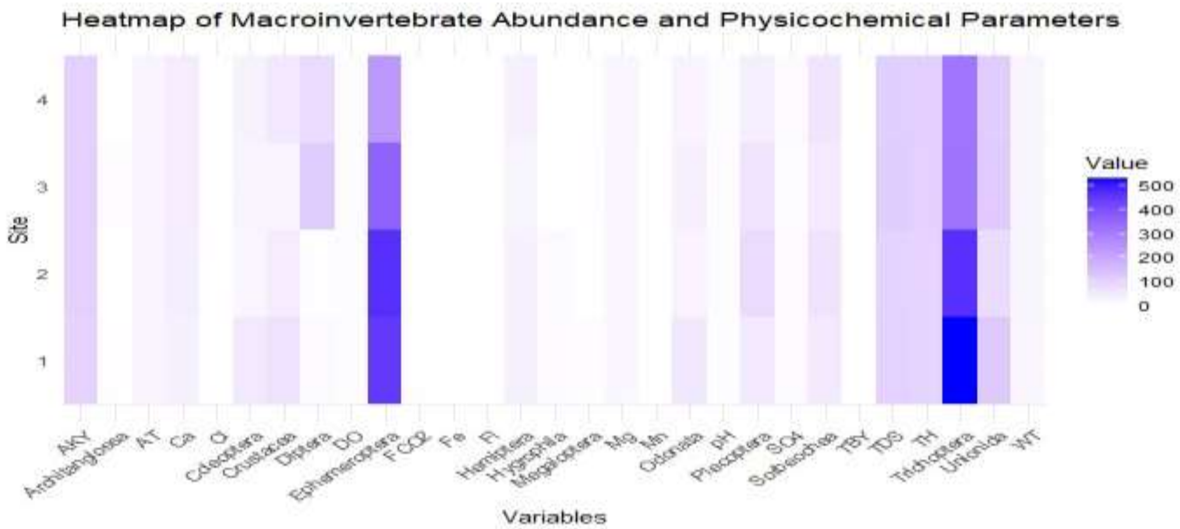
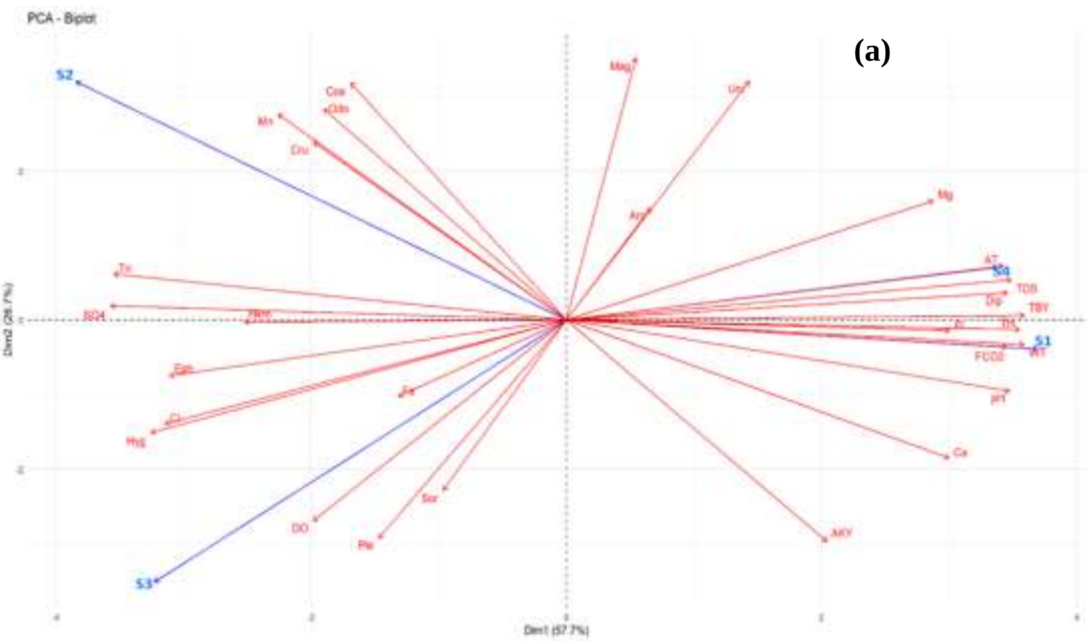



**Figure 3.** Biplot (**a**) and scree (**b**) plot (PC1 & PC2) and B) of macroinvertebrate taxa and Environmental water physico-chemical properties




**(b)**

**Table 4**. Principal Component Analysis (PCA) of macroinvertebrate taxa and Environmental water physico-chemical properties

| | Variables | PC1 | PC2 | PC3 | PC4 |
|---|---|---|---|---|---|
| **Macroinvertebrates** | Ephemeroptera | -0.211 | -0.075 | -0.217 | -0.708 |
| | Trichoptera | -0.240 | 0.061 | -0.029 | 0.617 |
| | Plecoptera | -0.100 | -0.292 | -0.196 | -0.082 |
| | Coeleoptera | -0.115 | 0.317 | -0.013 | -0.071 |
| | Diptera | 0.234 | 0.037 | -0.125 | 0.000 |
| | Odonata | -0.129 | 0.282 | -0.152 | -0.042 |
| | Hemiptera | -0.171 | -0.003 | 0.335 | 0.021 |
| | Megaloptera | 0.037 | 0.351 | 0.075 | 0.010 |
| | Crustacea | -0.134 | 0.238 | 0.240 | -0.103 |
| | Sorbeochea | -0.065 | -0.228 | 0.341 | -0.134 |
| | Hygrophila | -0.221 | -0.151 | 0.048 | 0.022 |
| | Unionida | 0.097 | 0.319 | -0.108 | -0.117 |
| | Architanglossa | 0.045 | 0.150 | -0.418 | 0.073 |
| **Water Physico-chemical properties** | Air temperature | 0.232 | 0.072 | -0.113 | 0.022 |
| | Water temperature | 0.243 | -0.033 | -0.015 | -0.002 |
| | pH | 0.236 | -0.095 | 0.021 | 0.040 |
| | Dissolved oxygen | -0.134 | -0.269 | -0.175 | 0.174 |
| | Turbidity | 0.243 | 0.006 | -0.046 | 0.001 |
| | Free $CO_2$ | 0.234 | -0.036 | 0.127 | -0.012 |
| | Total hardness | 0.241 | -0.013 | 0.080 | -0.061 |
| | Fe | -0.089 | -0.102 | -0.416 | 0.063 |
| | Cl | -0.213 | -0.139 | -0.142 | -0.042 |
| | Fl | 0.204 | -0.014 | -0.260 | 0.027 |
| | Total dissolved solids | 0.236 | 0.054 | -0.098 | -0.022 |
| | Ca | 0.203 | -0.185 | 0.099 | 0.005 |
| | Mg | 0.195 | 0.160 | 0.192 | -0.061 |
| | Mn | -0.153 | 0.275 | -0.068 | 0.064 |
| | $SO_4$ | -0.242 | 0.019 | 0.060 | -0.027 |
| | Alkalinity | 0.138 | -0.296 | 0.023 | 0.056 |

*The values highlighted in red colour indicates the strong (positive or negative) loadings on PCs*

### 3.4 Principal Component Analysis (PCA)

Principal Component Analysis (PCA) results (**Table 4** and **Figure 3**) showed that macroinvertebrate groups *viz*., ephemeroptera, trichoptera, plecoptera, coeleoptera, odonata, hemiptera, crustacea, sorbeochea, hygrophila, and water physico-chemical properties *viz*., dissolved oxygen, Cl, Mn, $SO_4$ had strong negative loadings on the PC1, while diptera, unionida, air temperature, water temperature, pH, turbidity, free $CO_2$, total hardness, FL, TDS, Ca, Mg and alkalinity had strong positive loadings. Similarly, on the PC2, coeleoptera, megaloptera, odonata, crustacea, unionida and architanglossa, Mg and Mn had strong positive loadings while plecoptera, sorbeochea, hygrophila, Architanglossa, dissolved oxygen, Fe, Cl and alkalinity had strong negative loadings on the PC2. Overall, PCA elucidate the complex inter-relationships between the macroinvertebrate taxon and water physico-chemical properties. Further, it highlighted a general trend where one group of factors exhibited negative relationships, while another group displayed positive relationships and thus suggested a multifaceted pattern in the variables characterized by opposing influences.

## 5. Discussion

The water quality assessment in the Lohit River involved an extensive examination of various physicochemical parameters, with significant variations observed across different seasons. Notably, water temperature exhibited a declining trend from the monsoon to winter at all sampling stations (Table 2), following the seasonal pattern of ambient temperature fluctuations. pH levels ranged between 6.5 (during the monsoon) and 7.9 (during winter), crucially influencing biological productivity and regulating various biological processes and biochemical reactions (Table 2). Dissolved oxygen levels fluctuated between 5.2 mg/l (monsoon) and 7.9 mg/l (winter), playing a vital role in supporting aquatic life and ecosystem balance. Turbidity, which greatly influences aquatic organism distribution, peaked at 3.3 NTU during the monsoon but was significantly lower during winter (Table 2).

In addition to physicochemical assessments, the study also focused on aquatic macroinvertebrates as bioindicators of water quality. A total of 38 species from 35 families and 13 orders, representing two phyla (Arthropoda and Mollusca), were identified during the study period (Table 3). The highest diversity of macroinvertebrates was observed during the pre-monsoon season, with 25 species from ten orders. In the monsoon season, 16 species from eight orders and 14 families were recorded. Post-monsoon recorded 22 species from 13 orders and 21 families, while the winter season had 19 species from ten orders and 18 families (Table 3). The study noted lower macroinvertebrate population densities during the monsoon, possibly due to heavy rainfall and high-water current, with maximum diversity observed in the pre-monsoon period. Which is similar to the findings of Kumar and Khan (2013) in Pondicherry mangroves, India. These findings underscore the importance of understanding the ecological dynamics and water quality indicators in the Lohit River ecosystem.

Macroinvertebrates are frequently employed in biomonitoring due to their sensitivity to pollution and their ability to integrate the effects of environmental stressors over both short-term and long-term periods. The populations of benthic macroinvertebrates in streams and rivers serve as valuable indicators for assessing the overall health of these aquatic ecosystems. Biological assessments and criteria derived from these assessments can serve as the foundation for management programs aimed at restoring and maintaining the chemical, physical, and biological integrity of freshwater systems. Living organisms provide valuable insights into their surrounding conditions and can be instrumental in evaluating the cumulative effects of physical, chemical, and biological impacts on ecosystems (Karr and Chu 1999). Different taxa of macroinvertebrates exhibit distinct habitat preferences and pollution tolerances. The absence of sensitive species and the presence of tolerant ones can be indicative of water quality conditions (Kripa et al. 2013).

## 5. Conclusion:

The findings of the present study indicate that the water quality of the Lohit River is in a very good to excellent condition. The physicochemical characteristics of the river in the study area revealed the absence of harmful chemical contamination, with all observed parameter values falling within permissible limits. However, it is essential to emphasize the need for in-depth and long-term studies in this area, which could potentially lead to the discovery of new species and the development of new ecological concepts. Therefore, there is a pressing requirement for effective management, awareness initiatives, and interventions to mitigate anthropogenic activities and prevent further degradation of this dynamic freshwater ecosystem. Such measures are crucial for the preservation and sustainable management of the Lohit River and its surrounding environment.

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