***Original Research Article***

# Fish assemblage with respect to physiochemical characteristics along Barak River, India

## Abstract

This study investigated the fish population, environmental characteristics, microhabitats, and soil erosion along the Barak River in Manipur and Assam. The survey covered 18 sites spanning from Maram in Senapati district, Manipur, to Badarpur in Karimganj district, Assam. The assessment involved analysing six physico-chemical parameters and collecting fish specimens, focusing on human activities affecting different sections of the river. The environmental conditions varied significantly between two distinct geographical regions: the hilly area in Manipur and the plains in Assam. The river exhibited narrowness, shallow depths, rapid flow, and a substrate composed of stones and gravel in the hilly region of Manipur. Conversely, in the plains of Assam, the river was wider, slower flowing, deeper, and featured a substrate consisting of silt and clay. Bank erosion and river meandering were prevalent in the plains, which were densely populated and extensively cultivated. The survey documented a total of 35 fish species from 15 families and 7 orders. Interestingly, the distribution pattern indicated an absence of certain fish species in one region that were present in the other. The highest species diversity was recorded in Namtiram, Tamenglong district, Manipur, for the hilly stretch, and Srikona, Cachar district, Assam, for the plains. Surprisingly, the study noted that physicochemical parameters had minimal influence on fish distribution; instead, it appeared that habitat and other environmental factors played a more significant role in regulating the presence of fish species.

**Keywords**: Assam, Environmental impact, Ichthyofaunal diversity, Manipur, North-eastern India

## Introduction

The biodiversity of freshwater ecosystems is a crucial part of our planet's ecological balance, exhibiting higher species richness compared to terrestrial and marine environments [1]. Despite covering only a minute fraction of Earth's surface (0.8%) and water resources (0.01%), freshwater sustains 6% of all known species. This ecosystem hosts diverse animal orders, contributing significantly to vertebrate (25%) and invertebrate diversity. Rivers, complex in their makeup with distinct habitats, varying climatic zones, landscapes, and biogeographical regions, are among the most productive and valuable freshwater ecosystems on Earth [2, 3].

Northeast India is part of the Indo-Burma biodiversity hotspot, recognized globally among 25 such hotspots. This region, classified as the 10th biogeographic region in India, encompasses over one-third of the country's total biodiversity [4]. The Barak River, a major river in Northeast India, traverses six states (Meghalaya, Manipur, Mizoram, Assam, Tripura, and Nagaland) before continuing its course into Bangladesh. This river basin spans across parts of India, Bangladesh, and Myanmar. Originating from the Manipur hills in Senapati district at an elevation of 2331 meters, the river flows through the Nagaland-Manipur border, meandering into Assam. The Barak River extends approximately 464 km from its source to its division at the India-Bangladesh border. The primary transboundary tributaries from India include the Jiri,

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Dhaleshwari (Tlawng), Longai, Madhura, Sonai (Tuirial), Rukni, and Katakhal. The river's regime comprises two distinctive sections in India: the hilly catchment and the alluvial plain known as the "Barak Valley." In India, the Barak River basin covers an area of 41,723.12 sq.km, accounting for nearly 1.38% of the country's total geographical area. This entire basin falls within the Eastern Himalayan region of the Agro Climatic Zone, characterized by a Hot Subhumid to Humid ecoregion with alluvial and red and lateritic soils. Forests predominantly cover a significant portion of this basin, with agriculture being the primary income source for the population. The population growth rate in the Barak Valley was recorded at 17.93% according to the Census of India 2011. Over recent decades, urbanization and infrastructural developments have been ongoing, often leading to threats such as overexploitation, water pollution, habitat destruction, and degradation, endangering freshwater biodiversity [5]. Thus, preserving freshwater habitats and their associated fauna has become an increasing priority.

The aquatic ecosystem's vitality hinges on the interaction between living organisms and their physical and chemical surroundings, including the habitat, nutrients, oxygen, and temperature. Fishes, known for their sensitivity to pollution, are valuable indicators of water quality in aquatic ecosystems [6]. The unique physical and chemical environments of various places, influenced by factors like seasons and human activities, shape fish communities, reflecting environmental distinctions. Fish assemblages typically comprise species occupying different trophic levels, offering insight into overall stream quality. Despite this, there's a scarcity of studies examining fish species assemblages, their habitat requirements, and mapping in the streams of Northeast India. Works by Kar [7, 8] have initiated investigations into macro and micro-habitat aspects in North-East Indian water bodies.

The freshwater resources of India have been extensively utilized for economic purposes, including irrigation, urban-industrial water supply, hydroelectric power, and waste disposal. However, the exponential rise in human population and consequent demands for water and its resources have led to the loss of stream habitat and a decline in aquatic organisms, notably fisheries resources. The primary threats to freshwater fishes stem from habitat modification, pollution, overexploitation, and the introduction of non-native species, resulting in their global decline [9]. Hence, this study aims to scrutinize the influence of environmental conditions on the Ichthyofaunal diversity of the Barak River.

**Material and methods**

The survey of the Barak River covered 18 sites, extending from Maram in the Senapati district of Manipur to Badarpur in the Karimganj district of Assam, as indicated in Figure 1. Specific details regarding the locations and their geographical coordinates can be found in Table 1. ~~All these locations underwent recording of physicochemical and environmental parameters, while fauna collection was conducted only at certain designated sites.~~ Notably, in the Assam region, where existing literature indicated higher pollution levels, ~~a comprehensive physicochemical analysis was extensively performed.~~ Each site's geographical coordinates were meticulously recorded using GPS technology. The survey took place between November and March from 2021 to 2022, a period chosen specifically when the river flow remained in its natural state without any influence from rain or floods. Selection of sampling sites was based on the presence of anthropogenic activities, such as towns or cities situated along the riverbank or nearby developmental projects, factors known to potentially impact the river's ecological balance and diversity of fauna.

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Field-based physicochemical analysis was conducted using a multi-parameter kit consisting of Hanna Multiparameter waterproof- HI98194 and Hanna Digital pH/Conductivity/TDS Meter 0 - 14.00 pH HI98129. A comprehensive assessment of six physicochemical parameters, namely temperature, pressure, pH, dissolved oxygen (DO), total dissolved solids (TDS), and conductivity, was performed at every sampling site. Samples were gathered in triplicate from three sub-sites within each study site for the purpose of physicochemical analysis, and the averages of these measurements were duly recorded.

At each study location, habitat inventory parameters were directly documented in the field. Using GPS, the geographical coordinates and altitude above mean sea level (m.s.l.) were recorded. Various aspects such as terrain type, microhabitat characteristics, substrate composition, vegetation cover, indications of erosion, and riparian land use were thoroughly examined and documented at each sampling site along the Barak River.

Fish sampling at study sites involved covering a 500-meter stretch at specific locations detailed in Table 1. Local community members were engaged in the process of netting and collecting fish. Selection of fish sampling sites primarily considered areas influenced by human activities to assess their impact on fish diversity in the environment. Initially, fish specimens were preserved using concentrated Formaldehyde directly in the field. Subsequently, these specimens were transferred to the laboratory, where they were preserved in 10% formalin and stored in sealed plastic bottles. In the laboratory, the specimens were identified by following standard literature, notably, Day [10, 11], Misra [12], Roberts [13], Rainboth [14], Sen [15, 16, 17], Talwar and Jhingran [18], Jayaram [19, 20, 21], Nath and Dey [22], Kar [7, 8, 23], Kar et al [24, 25], Kar and Khynriam [26], Menon [27].

**Results**

Physico-chemical properties were measured in triplicate manner at each survey points. In total six physicochemical properties were analysed, such as TDS, DO, pH, etc. as depicted in Figure 2. Temperature as well as pressure was increased from Manipur hilly stretch of river towards Cacher plain of Assam (Figure 2a, b). pH remained constant throughout our stretch of river except slight increase in plains in Assam. In general, pH in the range of 6.5 to 8 is considered as safe for fish growth and reproduction and the pH of river Barak was in the safer range (Figure 2c). There was no constant variation in DO, yet the value of DO of in plains of Assam was higher as compared to hilly stretch of Manipur (Figure 2d). There was no clear trend in variation of conductivity and TDS was found, however, their value relatively decreased from hill to plains (Figure 2e, f). Furthermore, conductivity and TDS variation follow the utmost similar pattern, which suggests their dependency on each other.

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The physicochemical parameters measured showed a mean value of temperature ..., DO.. (Figure 2)

Environmental variables such as terrain, vegetation, signs of erosion, etc. were studied at each sampling site. River Barak was geographically divided into two distinct regions i. e. Upland (hilly terrain of Manipur) and Lowland (Cacher plain of Assam) as displayed in Figure 3. The terrain was valley in Manipur region from Senapati to Jirimukh, whereas open land in Assam region plain from Fulertal to Badarpur. In the plain region of the river, the valley segment was alluvial, while in hilly regions of the river, the valley segment was colluvial. The substrate type was dominated by boulders, gravels and cobbles with frequently occurring quite large number of boulders and some bed rocks while fine sand in upland, whereas silt and clay in lowland region. Pools, riffles and runs were generally found to dominate the micro-habitat type with frequent occurrence of trench pools. The vegetation type was generally deciduous trees with

**Commented [D6]:** Already presented in materials and method some amount of shrubs and grasses. Moreover, the river Barak was generally wider in plains as compared to hills area. Signs of erosion had been predominantly visible in all the studied segments of the river. Soil erosion was common in plains, mainly due to bank erosion. Revier meandering was sever in Cachar plain of Assam, which causes flood problems in this region. As compared to hill, human population around river in plain was much larger, where river was used for transportation, fishing as well as cultivation. In the present study, it was also revealed that the anthropogenic activities which may cause perturbations in ichthyofaunal distribution were habitat destruction by construction of roads and bridges, the big amount of extraction of sand and stones from the river bed, indiscriminate fishing, point and non-point pollution due to sewage discharge and agriculture, and erosion of banks due to river meandering (Figure 4).

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In total 173 examples of fishes were examined and 35 species belonging to 15 family and 7 order has been identified and the list of the same is given below. Cypriniformes and Siluriformes were the most dominant order and more than 75% species belong to these orders. Cyprinidae and Bagridae were the most dominant family which account approx. 40% of identified species. The details of species distribution of identified samples are given in Table 2. The survey area can be distinctly divided into two geographic zone; Hilly (Maram to Sibilong) and Plains (Fulertal to Badarpur). Jakuradhar and Jirimukh were also hilly in nature but these areas can be considered as interface between hill and plains. Clear distinction in fish diversity can be found in between river stretch of Manipur hills to Assam plains. Fishes found in hilly region were relatively small as compared to plains where water pool like structures were common. Mostly fishes found in upper stretch of river were sheltered beneath the stones of river bed. In plains fishes were easily found at places where encroachment or disturbance, such as use of motor boat, agricultural use of river bank, use of water harvesting pump, sand mining, etc. was limited. Srikona in Cachar plains of Assam and Namtiram in hilly stretch of Manipur was rich in species diversity. It can be seen from table that species features in plains were absent in hilly stretch and vice versa. Fishes found in hills of Manipur were small in size and low in abundance as compared to plains in Assam.

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## Discussion

Physicochemical characteristics of stream play an important role on biodiversity [28]. Temperature and pressure were increased from hilly region of Manipur to plains of Assam. This was attributed to the elevation as elevation decrease from origin to mouth of the river. The pH of a water body is very important in determination of the water quality since it affects other chemical reactions such as solubility and toxicity of metals. Acidic water can accelerate the release of metals from rocks or sediments in the stream. Changes in the pH are very important as fish cannot survive in very acidic or basic water [29]. In general, pH in the range of 6.5 to 8 is considered as safe for fish growth and reproduction. pH of river Barak falls in safe range and remained constant thorough out stretch of river except slight increase in Plains in Assam. This might be the mineralization of river due to weathering of rocks, which results in increase in minerals in river. DO is remarkably significant in determining the water quality criteria of an aquatic system. DO values usually remain lower in a system having high rates of respiration and organic decomposition as compared to those systems, where the rate of photosynthesis is high [30]. DO levels between 5-6 ppm is required for optimal health of fishes. DO value of river Barak is optimal for fishes at most sampling site except in hilly stretch of Manipur. There was no constant variation in DO, yet the value of DO of in plains of Assam was higher as compared to hilly stretch of Manipur. In general, DO enters water through the air or as a plant by-product, such as photosynthesis. From the air, oxygen can slowly diffuse across the water's surface from the surrounding atmosphere. Since, the atmospheric pressure was low in hilly stretch of river Barak in Manipur, therefore it might be one reason for low DO as compared to plains where atmospheric pressure was slightly high. Furthermore, most photosynthesis takes place at the surface by shallow water plants and algae, a large portion of the process takes place underwater by seaweed, sub-surface algae and phytoplankton. This might be another reason for high DO value of river in plains as compared to hill as depth of river in plain was much larger as compared to hills as per observation [30]. This might be the reason why fishes in hills of Manipur were smaller and low in abundance as compared to plains of Assam where DO value was high. However, no clear trend in variation of conductivity and TDS was found throughout the river stretch. TDS may be influenced by changes in pH which can affect the solubility of the suspended matter. Similarly, conductivity of water is proportional to its dissolved mineral matter content. Therefore, conductivity varies directly with the temperature and pH. In conclusion, physicochemical characteristics of river Barak was optimal from hill to plains for fish growth and survival. Since, there was no significant variation in physicochemical parameters of river from hill to plains which can drastically affect the species distribution. Hence, impact of physicochemical parameters on faunal diversity can be neglected in present study.

The distinct distribution of fishes in different geographic region i. e. Manipur hills and Cachar plains of Assam suggest that habitat played an important role in their distribution. As can be seen from Table 2, species found in hilly area of Manipur were not recorded from plains of Assam and vice versa. Freshwater rivers, habitats are classified as upland and lowland. These two types of habitats are very different, and usually support very different populations of fish [31]. Upland habitats in mountainous areas are cold, clear, rocky and fast flowing rivers. This kind of environment supports fish species with limited temperature tolerances, high oxygen needs, strong swimming ability and specialized reproductive strategies to prevent eggs or larvae being swept away. In contrast, Lowland habitats are warm, coloured water due to sediment and organic matter and slow flowing rivers, which encourages fish species with broad temperature and low oxygen levels tolerances. Therefore, the habitats of river Barak can also be classified as upland and lowland [31]. Upland habitats were in mountainous areas, mainly in Manipur region from Senapati to Jirimukh, having cold weather, clear water, rocky substrate, and fast flowing rivers. Lowland habitats were plain, mainly in Assam region from Fulertal to Badarpur, having warm weather, coloured water, silty substrate, and slow flowing rivers. Therefore, this geographic difference has significant effect on species distribution. Furthermore, the river ecosystem was maintained in hilly stretch of Manipur, where threats to its biodiversity was insignificant. At some places roads were running parallel to the river, such as NH37 which may cause some concern. As compared to Manipur hills, plains of Assam were highly populated and river encroachment was visible. Agriculture, transportation, water consumption for city and towns, plastic and sewage discharge etc. was very common in plains of Assam, which is the cause of concern for biodiversity of river in future.

## Conclusions

River Barak was surveyed from Maram, Senapati district of Manipur to Badarpur, Karimganj district of Assam for making inventory of fish fauna, physcio-chemical characteristics and other environmental parameters, such as microhabitat, soil erosion, land use pattern etc. Several physico-chemical parameters were analysed, such as DO, pH, etc, which were found suitable for the growth and breeding of fishes across the river. River was geographically divided into two distinct regions, Upland (hilly region in Manipur) and Lowland (plains in Assam). River was narrow, fast flowing and low in depth in hilly stretch of Manipur, whereas wider, slow flowing and high in depth in plains of Assam as per observation. The river bed was composed of stone and gravel and river bank was covered with hanging trees in upland of Manipur. Contrary to this, river bed was composed of mainly silt and clay and bank were covered with grass and trees in lowland of Assam. River meandering and bank erosion was very common in plains. River valley in plain of Assam was highly populated and cultivated. In total, 35 species were recorded from the study sites. It was found that fishes found in plains were often not recorded from hilly region of river and vice-versa. Maximum species were recorded form Namtiram, Tamenglong district in Manipur and Srikona, Cachar district of Assam. The dependency of species distribution on physcio-chemical parameters was neglected, as there were no significant changes in these parameters of river from head to mouth. It was suggested that species distribution was mainly regulated by habitat and other environmental factors, as river was geographically divided into two distinct regions.

**Consent to participate**

Not Applicable

**Ethics approval**

Consent was obtained from the Zoological Survey of India, Sunderban Regional Centre, Canning, India for conducting a survey to collect, preserve & identify faunal specimens for better knowledge of the diversity, as well as preparation of the ichthyofaunal catalogue.

**Specimens Deposition**

The specimens used for the study are deposited in the National Zoological Collection of Zoological Survey of India, Sunderban Regional Centre, Canning 743329, India.



**References**

1. Dudgeon D, Arthington AH, Gessner MO, Kawabata ZI, Knowler DJ, Lévêque C, Sullivan CA. Freshwater biodiversity: importance, threats, status and conservation challenges. Biological Reviews. 2006;81:163-182.
2. Hitt NP, Bonneau LK, Jayachandran KV, Marchetti MP. Freshwater Ecosystems and Biodiversity. Lessons in Conservation. 2015;5:5-16.
3. Wetzel RG. Freshwater Ecosystems. In: Likens GE. Encyclopedia of Inland Waters. Elsevier. 2001;pp 75-87.
4. Jain A, Das A. North-East India: A Unique Biodiversity Paradise Unexplored or Lost?. International Journal of Scientific and Research Publications. 2022;12(4):112-119.
5. Roy S, Gupta A. Water quality assessment of river barak and tributaries in Assam, India. Pollution Research. 2011;30(4):453-456.
6. Chovanec A, Hofer R, Schiemer F. Fish as bioindicators, Bioindicators. In: Markert BA, Breure AM, Zechmeister HG (eds). Bioindicators and Biomonitors. Elsevier Science. 2003;639-676.

7. Kar D. Fundamentals of Limnology and Aquaculture Biotechnology. Daya Publishing House, New Delhi. 2007.
8. Kar D. Wetlands and Lakes of the World. Springer, London. 2013.
9. De Silva SS, Abery NW, Nguyen TTT. Endemic freshwater finfish of Asia: distribution and conservation status, Diversity and Distributions. Diversity and Distributions. 2007;13:172-184
10. Day F. On some new fishes of India. The Journal of the Linnean Society of London. 1873;11:524-530.
11. Day F. The Fishes of India: being a natural history of fishes known to inhabit the Seas and Freshwaters of India, Burma and Ceylon, London. Williams Dowson and Sons. 1878.
12. Misra KS. Teleostomi: Cypriniformes; Siluri. In: The fauna of India and the adjacent countries, Pisces. Government of India Press, Faridabad. 1976.
13. Roberts TR. The freshwater fishes of Western Borneo (Kalimantan Barat, Indonesia). Memoirs of California Academy of Sciences. 1989;14:1-210.
14. Rainboth WJ. Fishes of the Cambodian Mekong. FAO species identification field guide for fishery purposes. FAO, Rome. 1996.
15. Sen N. Studies on the Systematics, Distribution and Ecology of the Ichthyofauna of Meghalaya and their bearing on the Fish and Fisheries of the State. PhD Thesis, University of Gauhati (Assam). 1982.
16. Sen N. Occurrence, Distribution and Status of Diversified Fish Fauna of North-East India. In: Ponniah AG, Sarkar UK (eds). Fish Diversity of North-East India. National Bureau of Fish Genetic Resources, ICAR (Lucknow). 2000;pp 31-48.
17. Sen TK. The Fish Fauna of Assam and the Neighbouring Northeastern States of India. Records of Zoological Survey of India. 1985;Occasional Paper No 64:1-216.
18. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries, Volume 2. A.A. Balkema, Rotterdam. 1991.
19. Jayaram KC. The freshwater fishes of the Indian region. Narendra Publishing House, New Delhi. 2010.
20. Jayaram KC. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka - a handbook. Zoological Survey of India, Calcutta. 1981.
21. Jayaram KC. The freshwater fishes of the Indian region. Narendra Publishing House, Delhi. 1999.
22. Nath P, Dey SC. Fish and fisheries of North Eastern India Vol-I, Arunachal Pradesh. Narendra Publishing House, Delhi. 1997.
23. Kar D. Fishes of Barak drainage, Mizoram and Tripura. In: Kumar A, Bohra C, Singh LK (eds). Environment, Pollution and Management. APHA Publishing Corporation, New Delhi. 2023;203-211.
24. Kar D, Laskar BA, Nath D. Tor sp. (Mahseer fish) in river Mat in Mizoram. Aquaculture. 2002;3(2):229-234.
25. Kar D, Nagarathna AV, Ramachandra TV, Dey SC. Fish diversity and conservation aspects in an aquatic ecosystem in Northeastern India. Zoos' Print Journal. 2006;21(7):2308-2315.
26. Kar D, Khynriam D. Fishes in the Upstream Rheophilic Stretch of River Barak at Karong. Sustainability in Environment. 2022;7(3):77-96.

27. Menon AGK. Check List-Fresh Water Fishes of India. Record of Zoological Survey of India, Miscellaneous Publication. 1999;Occasion Paper No 175;1-366.
28. Md Rawi CS, Al-Shami SA, Madrus MR, Ahmad AH. Biological and ecological diversity of aquatic macroinvertebrates in response to hydrological and physicochemical parameters in tropical forest streams of Gunung Tebu, Malaysia: implications for ecohydrological assessment. Ecohydrology. 2014;7(2):496-507.
29. Chea R, Lek S, Ngor P, Grenouillet G. Large-scale patterns of fish diversity and assemblage structure in the longest tropical river in Asia. Ecology of Freshwater Fish. 2017;26(4):575-585.
30. Hossain MS, Das NG, Sarker S, Rahaman MZ. Fish diversity and habitat relationship with environmental variables at Meghna river estuary, Bangladesh. The Egyptian Journal of Aquatic Research. 2012;38(3):213-226.
31. Jusik S, Szoszkiewicz K, Kupiec JM, Lewin I, Samecka-Cymerman A. Development of comprehensive river typology based on macrophytes in the mountain-lowland gradient of different Central European ecoregions. Hydrobiologia. 2015;745:241-262.

**Table 1.** Details of the survey localities

| Locality | District | State | Elevation (In mtr) | Latitude | Longitude |
|---|---|---|---|---|---|
| **Site.1**- Koide Biisho, Maram | Senapati | Manipur | 1091 | 25.39704° N | 94.14275 ° E |
| **Site.2**- Kathikho, Karong | Senapati | Manipur | 1000 | 25.30683 ° N | 94.04366 ° E |
| **Site.3**- Namtiram, Tousem | Tamenglong | Manipur | 168 | 24.76001° N | 93.34765 ° E |
| **Site.4**-Sibilong bridhe NH37, Tousem | Tamenglong | Manipur | 103 | 25.06063° N | 93.47139 ° E |
| **Site.5**- Jakuradhor Part -1, Jiribam | Imphal East | Manipur | 10 | 24.613529° N | 93.084944 ° E |
| **Site.6**- Jirimukh, Jiribam | Imphal East | Manipur | 23 | 24.71206° N | 93.07725 ° E |
| **Site.7**- Fulertal, Lakhipur | Cachar | Assam | 18 | 24.78930° N | 93.02091 ° E |
| **Site-8**- Annapurna ghat, Silchar | Cachar | Assam | 5 | 24.83211° N | 92.79332 ° E |
| **Site-9**- Kanakpur ferry ghat, Silchar | Cachar | Assam | 11 | 24.80737 ° N | 92.81874 ° E |
| **Site-10 -** Sonabarighat Part-1, Sonai | Cachar | Assam | 12 | 24.76041 ° N | 92.83640° E |
| **Site-11-** Chandrapur Part-3, Lakhipur | Cachar | Assam | 29 | 24.80717 ° N | 92.93084 ° E |
| **Site-12-** Doyal Ferry ghat, Gobindapur Part-1 Lakhipur | Cachar | Assam | 4 | 24.75668 ° N | 92.91148 ° E |
| **Site-13-** Pachgram ghat, Algapur | Hailakandi | Assam | 1 | 24.86897° N | 92.59911 ° E |
| **Site-14-** Katakhal ghat, Hailakandi tehsil | Hailakandi | Assam | 5 | 24.82872° N | 92.63719 ° E |

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|---|---|---|---|---|---|
| **Site-15**- Srikona ghat, Salchapra | Cachar | Assam | 5 | 24.83592° N | 92.69855 ° E |
| **Site-16**- Ranighat, Bhairab Nagar | Cachar | Assam | 4 | 24.916197° N | 92.725766° E |
| **Site-17**- Masimpur, Silchar | Cachar | Assam | 5 | 24.867675° N | 92.768537 ° E |
| **Site.18**-Srigouri ghat, Badarpur | Karimganj | Assam | 2 | 24.86742 ° N | 92.52140 ° E |

**Table 2.** Species classification and its distribution at selected sampling sites

| SPECIES | L1 | L2 | L3 | L4 | L5 | L6 | L7 | L10 | L15 |
|---|---|---|---|---|---|---|---|---|---|
| Actinopteri | | | | | | | | | |
| Siluriformes | | | | | | | | | |
| Ailiidae Bleeker 1858 | | | | | | | | | |
| *Eutropiichthys murius* (Hamilton, 1822) | - | - | - | - | - | - | - | + | + |
| *Silonia silondia* (Hamilton, 1822) | - | - | - | - | - | - | + | - | + |
| Bagridae Bleeker 1858 | | | | | | | | | |
| *Hemibagrus menoda* (Hamilton, 1822) | - | - | + | - | - | - | - | + | - |
| *Mystus cavasius* (Hamilton, 1822) | - | - | + | - | - | - | - | - | + |
| *Mystus tengara* (Hamilton, 1822) | - | - | - | - | - | - | - | - | + |
| *Mystus gulio* (Hamilton, 1822) | - | - | - | - | - | - | - | - | + |
| *Sperata seenghala* (Sykes, 1839) | - | - | - | - | - | - | - | - | + |
| Ritidae Bleeker 1862 | | | | | | | | | |
| *Rita rita* (Hamilton, 1822) | - | - | - | - | - | + | - | + | + |
| Sisoridae Bleeker 1858 | | | | | | | | | |
| *Gagata cenia* (Hamilton, 1822) | - | - | - | - | - | - | + | - | - |
| *Glyptothorax clavatus* Rameshori & Vishwanath, 2014 | - | - | + | + | - | - | - | - | - |
| Siluridae Rafinesque 1815 | | | | | | | | | |
| *Ompok bimaculatus* (Bloch, 1794) | - | - | - | - | - | - | - | - | + |
| *Ompok pabda* (Hamilton, 1822) | - | - | - | - | - | - | - | - | + |
| Cypriniformes | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Botiidae Berg 1940 | | | | | | | | | |
| *Botia dario* (Hamilton, 1822) | - | - | - | - | + | - | + | - | - |
| Cobitidae Swainson 1838 | | | | | | | | | |
| *Lepidocephalichthys guntea* (Hamilton, 1822) | + | - | + | + | - | - | - | - | - |
| Cyprinidae Rafinesque 1815 | | | | | | | | | |
| *Garra annandalei* Hora, 1921 | - | - | - | + | - | + | - | - | - |
| *Labeo rohita* (Hamilton, 1822) | - | - | - | + | - | - | - | - | - |
| *Pethia ticto* (Hamilton, 1822) | - | - | + | - | - | - | - | - | - |
| *Puntius sophore* (Hamilton, 1822) | - | + | + | - | - | - | + | - | - |
| Danionidae Bleeker 1863 | | | | | | | | | |
| *Amblypharyngodon mola* (Hamilton, 1822) | - | - | - | - | - | - | + | - | - |
| *Barilius vagra* (Hamilton, 1822) | - | - | - | - | + | + | + | - | - |
| *Barilius bendelisis* (Hamilton, 1822) | - | - | + | - | - | - | - | - | - |
| *Chela cachius* (Hamilton, 1822) | - | - | - | - | + | - | - | - | - |
| *Opsarius bendelisis* (Hamilton, 1822) | - | + | - | - | + | - | - | - | - |
| *Rasbora daniconius* (Hamilton, 1822) | - | - | + | - | - | - | + | - | - |
| Nemacheilidae Regan 1911 | | | | | | | | | |
| *Schistura ferruginea* Lokeshwor & Vishwanath, 2013 | + | - | - | - | - | - | - | - | - |
| *Schistura minuta* Vishwanath & Shanta Kumar 2006 | - | + | - | - | - | - | - | - | - |
| *Schistura sikmaiensis* (Hora, 1921) | - | - | + | - | - | - | - | - | - |
| Anabantiformes | | | | | | | | | |
| Channidae Fowler 1934 | | | | | | | | | |
| *Channa gachua* (Hamilton, 1822) | - | - | + | - | - | - | - | - | - |
| *Channa melanostigma* Geetakumari & Vishwanath, 2011 | + | - | - | - | - | - | - | - | - |
| *Channa punctata* (Bloch, 1793) | + | - | - | + | - | - | - | - | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gobiiformes | | | | | | | | | |
| Gobiidae Cuvier 1816 | | | | | | | | | |
| *Glossogobius giuris* (Hamilton, 1822) | - | - | | | - | - | + | - | - |
| Synbranchiformes | | | | | | | | | |
| Mastacembelidae Swainson 1839 | | | | | | | | | |
| *Mastacembelidae Swainson 1839* | | | | | | | | | |
| *Macrognathus aculeatus* (Bloch, 1786) | - | - | + | - | - | - | - | - | - |
| *Mastacembelus armatus* (Lacepède, 1800) | - | - | - | - | + | | | + | |
| Cichliformes | | | | | | | | | |
| Ambassidae Klunzinger 1870 | | | | | | | | | |
| *Chanda nama* (Hamilton, 1822) | - | - | - | - | + | - | - | - | - |
| *Acanthuriformes* | | | | | | | | | |
| *Sciaenidae Cuvier 1829* | | | | | | | | | |
| *Johnius coitor* (Hamilton-Buchanan, 1822) | - | - | - | - | - | - | - | - | + |

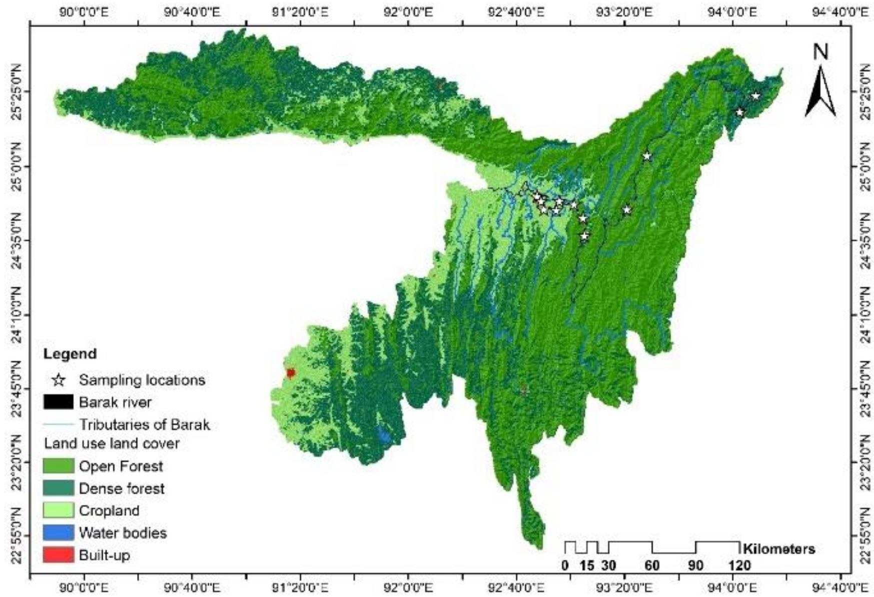


**Figure 1.** Study area map of river Barak.

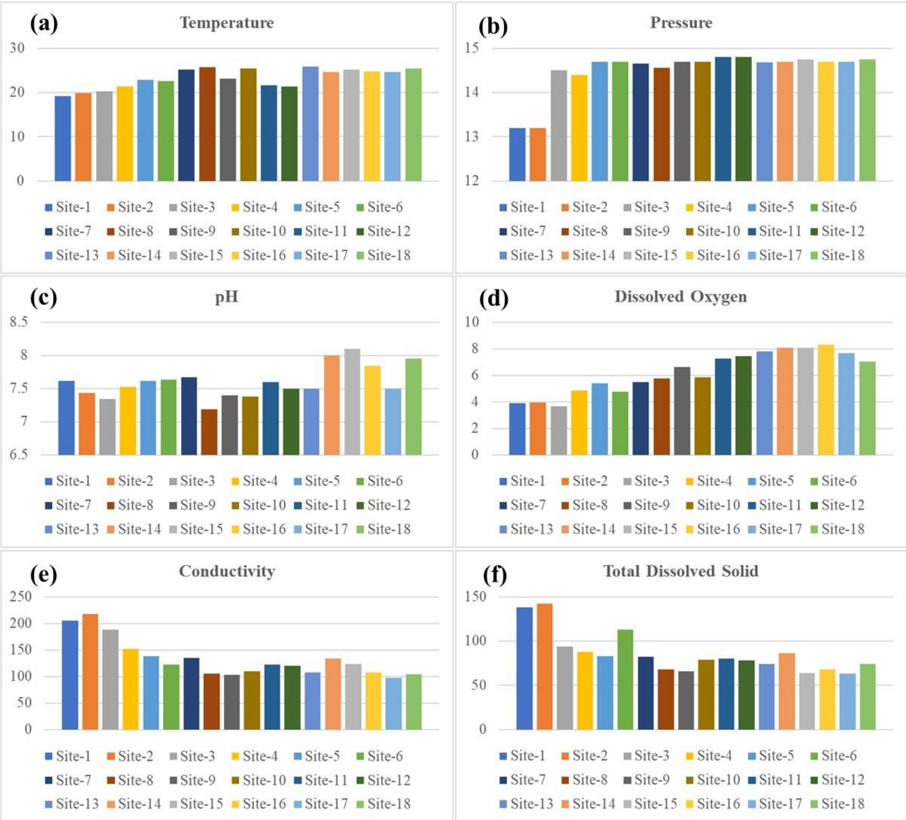


**Figure 2. (a)** Temperature (°C), **(b)** Pressure (psi), **(c)** pH, **(d)** DO ($mgL^{-1}$), **(e)** conductivity (µs/cm) and **(f)** TDS ($mgL^{-1}$) variations at different selected sites of river Barak.

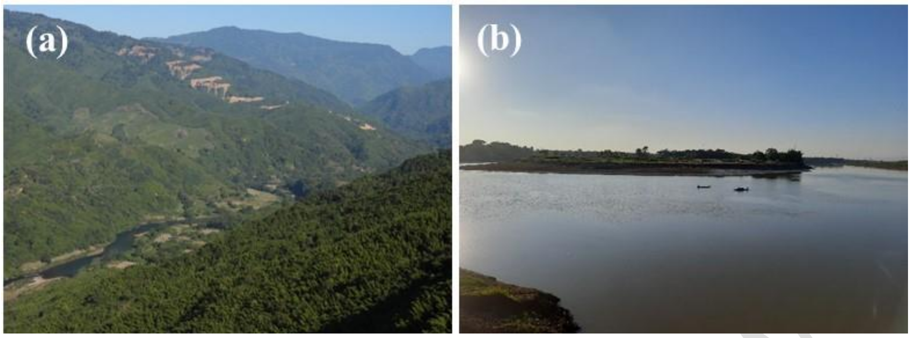


**Figure 3.** Habitat of river Barak at **(a)** Namlalong, Tamenglong district of Manipur and **(b)** Srikona, Cachar district of Assam.

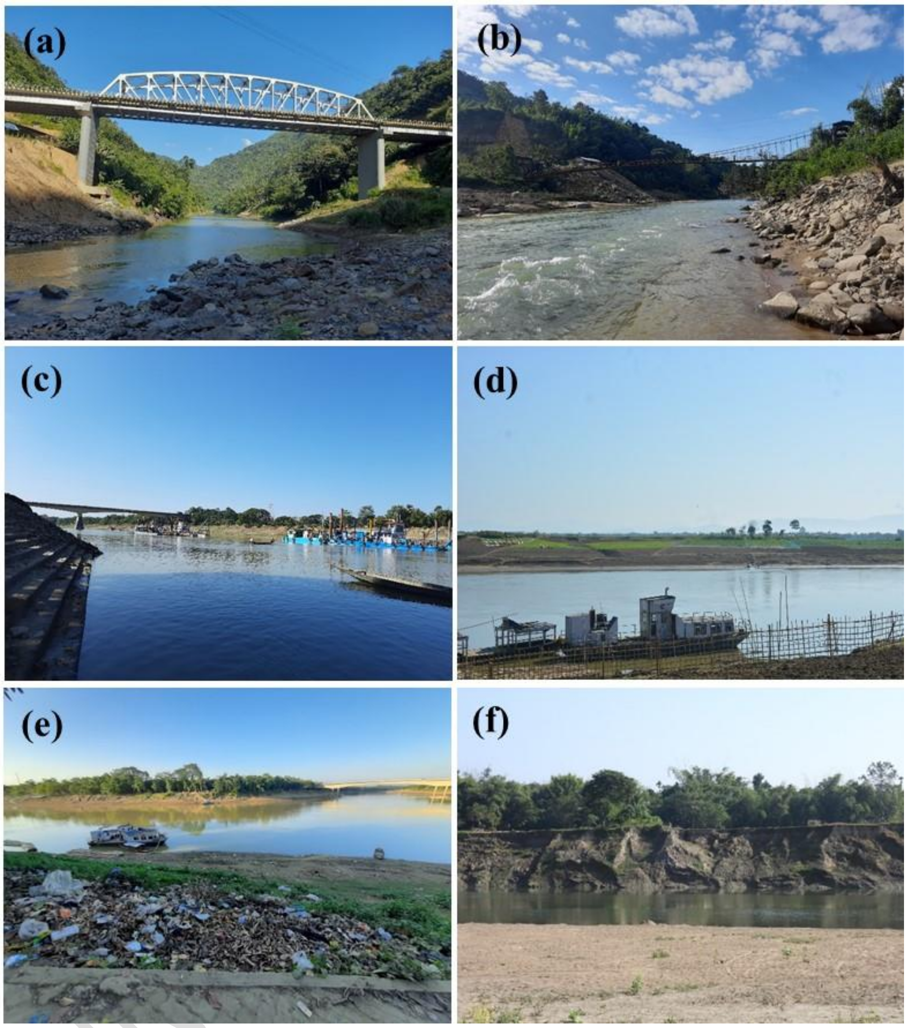


**Figure 4.** **(a)** Newly constructed bridge over river Barak near Sibilong in Tamenglong district of Manipur, **(b)** Construction of new bridge over river Barak near Namtiram village in Tamenglong district of Manipur, **(c)** Sand mining in river Barak at Badarpur area of Assam, **(d)** Use of river bank for agriculture and transportation in Cachar plains of Assam, **(e)** Plastic pollution near river Barak at Annapurna ghat, Silchar and **(f)** Soil erosion in river Barak at Gobindapur area of Cachar, Assam.