Training for Master Trainers

Capacitating Biodiversity Management Committees to

Document, Manage and Monitor Aquatic Ecosystems

An Extension to the "Package of Modules and Methods for Trainers. Training for Biodiversity Management Committees – A Curriculum" with Special Focus on How to Document, Manage and Monitor Aquatic Ecosystems

1st Edition

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Responsible
Patricia Dorn, Project Manager, NERAQ Project, GIZ

Authors
Nobinraja M, Ravikanth G, Ishan Agrawal, Savinuo Kikhi, Ranjeet Sahani

(These authors contributed equally to this work).

Page Layout & illustrations
ASPIRE Design

Photo credits/sources
Dr Ravikanth / Ms. Savinuo Kikhi / Mrs Usha Dewani Das

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BACKGROUND

Photo: Usha Dewani Das

Why another toolkit?

This toolkit is an extension to the exiting Training Manual "Training – Biodiversity Management Committees. Package of Modules and Methods for Trainers" which can be downloaded via following link.

This toolkit works as a detailed extension into Module 5 "Peoples Biodiversity Registers" (PBR) with a 5 step process on how to document a PBR. Also, this toolkit provides key methods on how to document traditional knowledge to ensure that Traditional Knowledge (TK) is documented.

This toolkit goes beyond the legal framework of the Biodiversity D Act. It provides ideas, examples and methods on how local communities (via the BMC structure) as custodians of their own resources can document, manage and monitor their (aquatic) resources.

Who should use this toolkit?

This toolkit is designed to empower master trainers working i.e. for government training institutions, State Biodiversity Boards and Practitioners supporting the capacity development of Biodiversity Management Committees (BMCs) and the documentation of Peoples Biodiversity Register (PBR). The toolkit engages them in the vital task of safeguarding our aquatic ecosystems. By providing clear guidelines and steps on how to document, manage and monitor aquatic ecosystems, this toolkit aims to build local capacity for effective environmental management. Master trainers will gain the skills needed to accurately monitor aquatic health, identify potential threats, and implement timely interventions.

This toolkit is designed to actively involve local community members and collaborate with nearby colleges or universities. It encourages a sense of responsibility for the health of river ecosystems, promoting participation from local communities, schools, colleges, and universities. This provides an opportunity for locals and researchers to contribute to meaningful data collection and analysis. Overall, the manual will serve as a bridge between scientific and community involvement, creating a synergistic effort for effective conservation and management.

The toolkit aims to strengthen Indigenous people and local communities (IPLC) to document, manage and monitor their valuable (aquatic) biological resources to

Keep their important status of being the custodians of their own resources.

Protect their resources, community land and local knowledge from external exploitation or misuse of external private companies, public interests and/or research outcomes.

Document their indigenous and local knowledge and practices four their next generation and to reinforce sustainable management practices.

Why focus on Aquatic Ecosystems?

India is one of the mega biodiversity centres in the world and houses two of the world's thirty-four biodiversity hotspots, located in the North Eastern Region (NER), namely, the Indo Burma Biodiversity hotspot and the Himalayas. The region has abundant species of flora and fauna, in particular an extraordinary **aquatic biodiversity**. Aquatic resources serve as significant sources for food, income security and shape cultural identity for considerable parts of the local population in NER. Despite the importance of aquatic ecosystems sustaining crucial aspects for humans' survival, there are often neglected.

Population growth, climate change impacts, invasive alien species, increased usage intensity resulting in pollution and unsustainable activities such as destructive fishing methods, domestic activities like bathing, washing vehicles, and garbage disposal near rivers, sand mining, quarrying and logging are increasingly threatening aquatic habitats in India's Northeastern Himalayan region. Conflicting interests and lack of integrated approaches among the various stakeholders further lead to unsustainable management practices.

Capacitating communities to document, manage and monitor aquatic ecosystems is therefore crucial to comprehend threats, identify pollutants, prevent further damage and strengthen the conservation efforts and sustainable management practices on the ground.

Photo: Usha Dewani Das

Acknowledgements

We are sincerely grateful to the various contributors bringing together government agencies, research and civil society organisations to write the first edition of this toolkit. We are indebted to the Nagaland State Biodiversity Board (NSBB) for sharing their in-depth field experience in documentation and preparation of Peoples Biodiversity Registers on Aquatic Resources in Nagaland. Special mention to Mr. Supongnukshi IFS, Member Secretary, NSBB; Ms. Savinuo Kikhi, NSBB; and Dr. Rajindra K. Puri, Director, Centre for Biocultural Diversity, University of Kent at Canterbury, UK, for their continuous support to strengthen documentation of bioresources. We warmly acknowledge the support of Mr. Ishan Agrawal, Senior Consultant Common Ground, and his dedicated work on common pool resource management. Common ground is a collective of 23 NGOs in India, dedicated to bring large scale impact in favour of better governance of natural resources with a "commons" approach. Common Ground is also part of the Alliance of Freshwater Ecosystems. We are grateful to Dr Ranjeet Sahani on behalf of the Foundation for Ecological Security (FES) for sharing his work on the Community Score Card. FES is committed to strengthening, reviving, or restoring, where necessary, the process of ecological succession and the conservation of land, forest and water resources in the country. We also thank Dr. Ravikanth (Senior Fellow) & Nobin Raja (Consultant) of Ashoka Trust for Research in Ecology and the Environment (ATREE) for their valuable input and experience of the monitoring part of this toolkit. Dr Ravikanth expanded the scope of his expertise to include assessment of ecosystem services and the promotion of biodiversity and ensure nutritional security through sustainable harnessing of bioresources. Mr. Nobin Raja is currently advocating interdisciplinary solutions for sustainable community use of aquatic resources for ATREE's project.

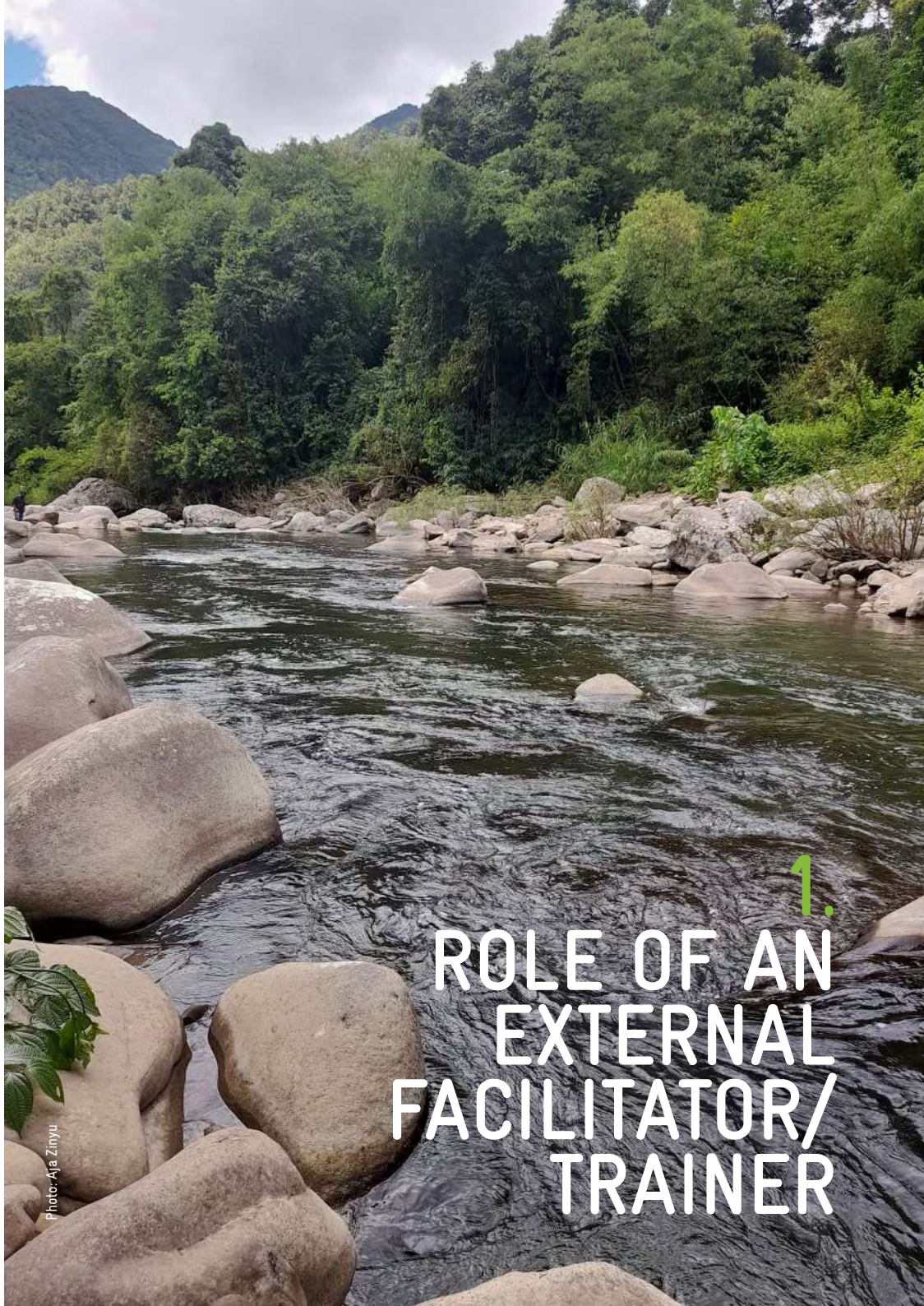


Photo: Aja Zinyu

1. ROLE OF AN EXTERNAL FACILITATOR/ TRAINER

Any organization (Government or non-government), involved in working with communities for better conservation and management of aquatic resources may have to perform following actions

1 Building awareness and mapping perceptions

Village council meetings with some external facilitation once or twice can help surface the issues related to aquatic resources. If not, some tools may be used to bring the issues to surface.

Community scorecard can be a good tool for communities and local government bodies for building the awareness for resources. It helps communities assess the status of freshwater resources and different ecosystem services received from them, noting the trends and identifying key issues if any. (Annexure-Community Scorecard Tool Process and Pilot Findings)

Sharing of data collected through methodologies described above with village councils and communities may also help in surfacing issues around aquatic resources.

2 Facilitating multi-stakeholder dialogue for planning

Resource management would need better dialogue between multiple actors and stakeholders. Facilitating such a process that helps different actors listen to the views of others can be useful for better, more equitable and ecologically sound management of resources. A guided process for collective planning for conservation will improve trust among stakeholders. The process may include-

a. Collectively developing the vision and hierarchy of goals for conservation
b. SMART Target setting for conservation
c. Developing a monitoring plan for long term for conservation targets.

3 Bringing inputs for citizen science, and noting down indigenous knowledge for management

External facilitators may support local communities by packaging monitoring tools as citizen science pilots, involving youth and technology for better conservation outcomes. This may include trainings for monitoring, tech for checking ecosystem health, catchment protection, presentation of data to communities etc.

4 Fostering cross-learning

Identifying champions of conservation within the community that may contribute peer to peer learning which is faster and more efficient. Exposure visits, designing learning processes for communities can be an important contribution of external facilitators.

5 Raising resources and bring better coalition of Government departments with communities

6 Sharing larger picture about the basin or range of hills or watershed or any locally relevant landscape unit to which village's conservation effort is contributing.

Supporting periodic landscape level dialogues for building consciousness of conservation efforts, impacts and issues that extend beyond a village level.

Cautions for external facilitators

1. As external facilitators, one should avoid taking decisions on behalf of local communities
2. Conservation credit should always belong to villages and village leaders,
3. Engage with those who participate less like women, landless and other such disadvantageous groups.

2. HOW TO DOCUMENT AQUATIC RESOURCES

Photo: Kenneth Pala

In this section the toolkit highlights the documentation of aquatic resources, its fauna and flora via the Peoples Biodiversity Registers (PBRs) – a species/resources focused documentation. For the documentation of Aquatic Ecosystem Services, please refer to section "Monitoring of Freshwater Ecosystem Services".

Given the technicality and the exhaustive nature of the PBR documentation it is quite difficult to document all the bio resources with limited manpower, resources and time. Often the BMCs require the help of the SBB for technical support during the documentation process. The technical team from Nagaland State Biodiversity Board (NSBB) has thus come up with their own way to do the PBR documentation. The **five** key steps adopted by the Nagaland State Biodiversity Board are listed below.

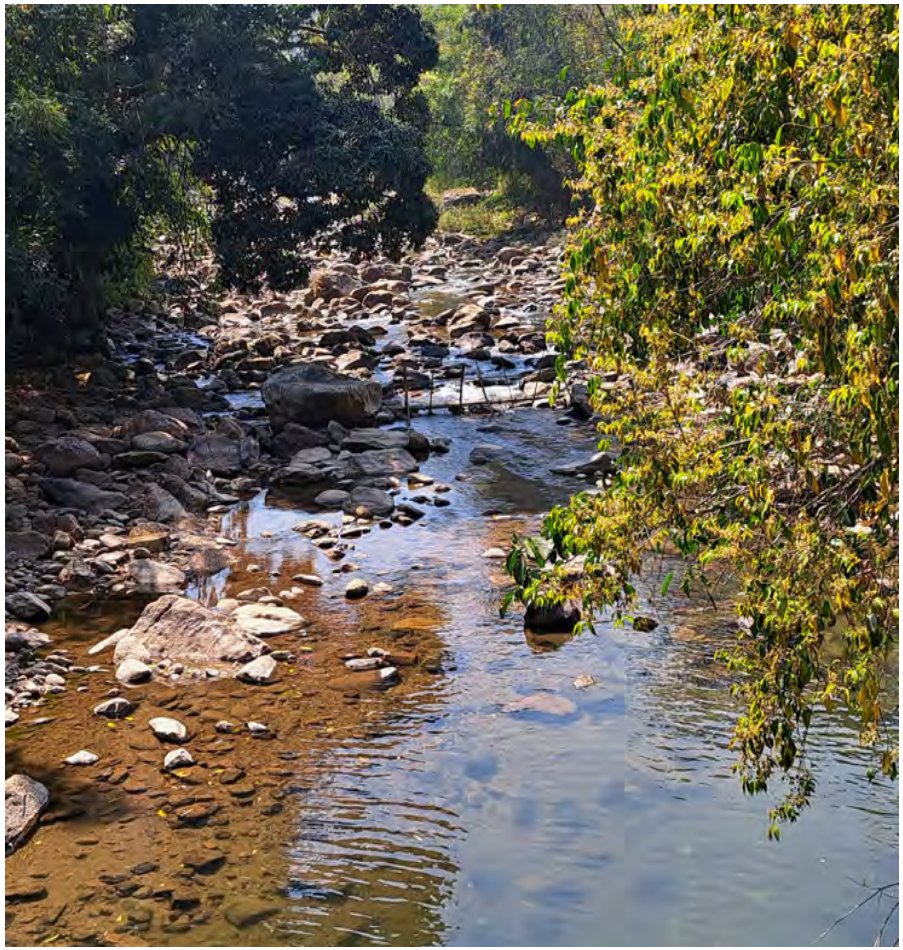
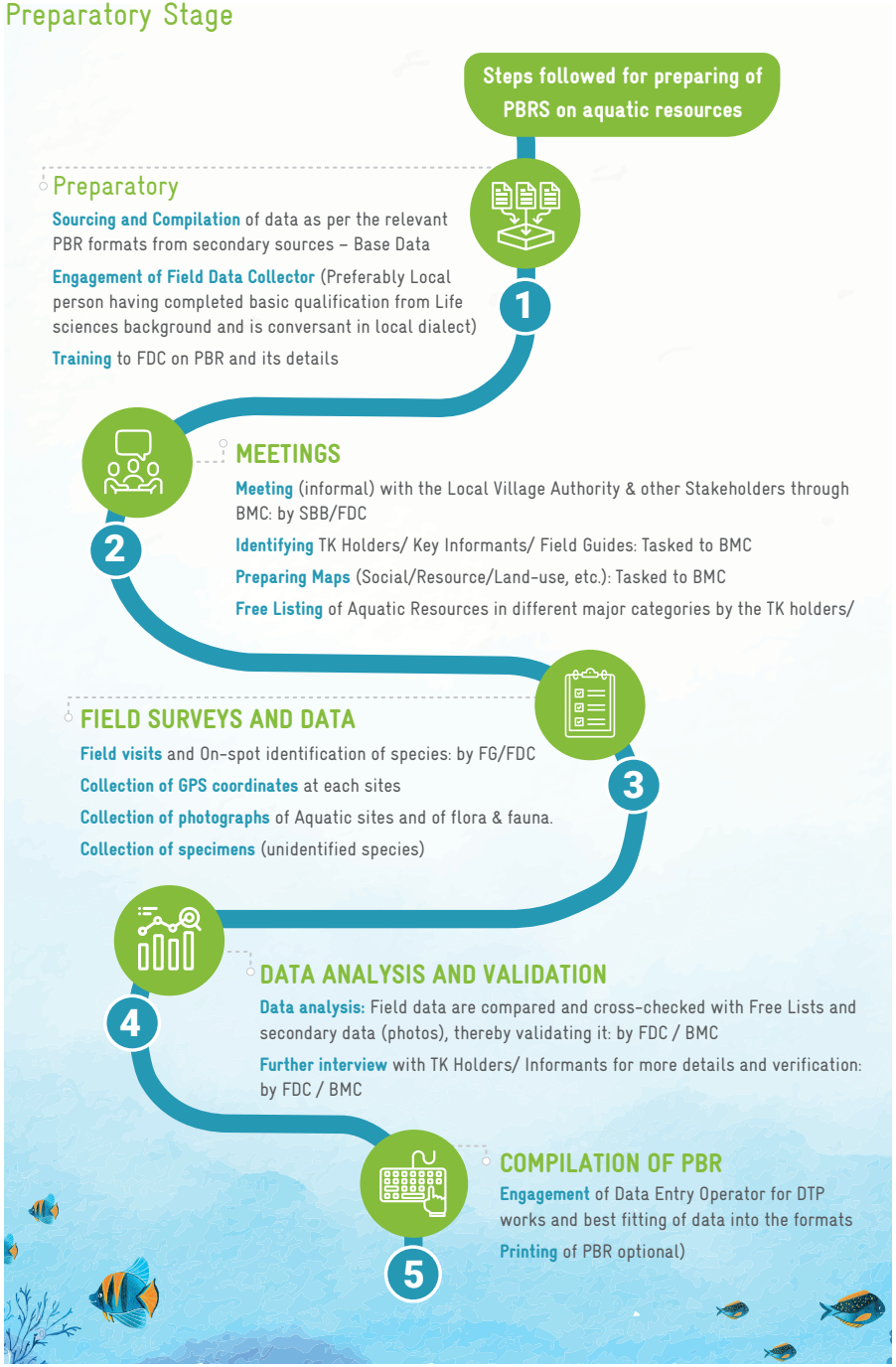


Photo: Patricia Dorn

Preparatory Stage



Sourcing and Compilation of data as per the relevant PBR formats from secondary sources. This involves the preparation of checklist/ Base PBR and is done with collection & compilation of data of an area/ region from available secondary data sources like Government Departments/ NGOs/ Journals/ Publications/ internet sources.

PBR FORMATS RELATING TO AQUATIC ECOSYSTEMS

The Aquatic Ecosystem and its Biodiversity of an area can be documented using the formats prescribed by the National Biodiversity Authority (NBA) for documentation of People's Biodiversity Registers (PBRs). The formats can be found below:

Format 9: Waterscape

Format 16: Culture Fisheries

Format 20: Aquatic Biodiversity

Format 21: Wild Aquatic Plant Species of Importance and

Format 28: Wild Animals (Mammals, Birds, Reptiles, Amphibian, Insects, others

9. WATERSCAPE

Waterscape element type	Sub- type	Features and Approx area	Ownership	General flora	General fauna	User groups	Management practices	General uses	Associated TK	Other details	Community accessed

16. Culture Fisheries

Fish Type	Local Name	Scientific Name	Common Name	Variety Features	Waterscape (Pond/ Bheri/talao)	Local status		Uses	Associated TK	Commercial rearing	Community/ Knowledge Holder
						Past	Present				

20. Aquatic Biodoiversity

Local Name	Scientific Name	Variety	Features	Habitat	Local status		Uses	Associated TK	Other details	Community/ Knowledge Holder
					Past	Present				

21. Wild Aquatic Plant Species of Importance

Local Name	Scientific Name	Variety Importance	Trends

28. Wild Animals (Amphibians, Bees, Birds, Butterflies, Dragonflies, Insects, Mammals, Reptiles and Spiders)

Animal Type	Local Name	Scientific Name	Habitat	Description	Season when seen	Local Status		Uses (if any)	Associated TK	Mode of Hunting, Collecting (If any)	Other details	Community/ Knowledge Holder
						Past	Present					

- **Engagement of Field Data Collector (*Preferably Local person having completed basic qualification from Life sciences background and is conversant in local dialect*):** At least 2 suitable local students or scholars per village preferably from Life Science background are identified and engaged as FDC for collection of PBR data in the field. Since the FDCs are local scholars, it is assumed they are conversant with the local dialect & their people which makes it easier for data collection. Ideally, one FDC would be male, the other female.

- **Training to FDC on PBR and its details:** The selected FDCs are called for a one-day training. This training is conducted by the technical staffs of NSBB. And it involves: - highlights of BD Act & Rules; roles of SBB, BMC and importance of PBR.
  - distribution of copies of PBR formats (both hard & soft copy)
  - 10 to 15 mins to familiarize them with the PBR formats.
  - detailed explanation of each PBR formats
  - briefed on how to set-up meeting through BMCs with the village authorities and other stakeholders.
  - briefed on collection of free lists and preparation of maps which may include details on the resource, social and land-use aspects of the village.
  - briefed on field surveys, collection of plant or animal specimens
  - briefed on facilitating focus groups to discuss collected data
  - Q & A session
  - summarizing the steps of PBR preparation by FDCs
  - the FDCs are handed the base PBRs (soft and hard copy) of the villages where assigned.

Photos: Nagaland State Biodiversity Board

1. **Meetings: (informal) with the Local Village Authority & other Stakeholders through BMC: *by SBB/FDC***
   - Prior to field work, the NSBB team organize an informal meeting with the BMC & other village stakeholders to highlight them on the roles of BMC, concept of PBR & its importance.
   - Each PBR format and the kind of data required to be documented are explained in detail with distribution of a copy of PBR formats.

Photos: Nagaland State Biodiversity Board

(This kind of informal meeting is necessary to build rapport with the local people so that they understand the importance of the documentation and ensuring cooperation)

Identifying TK Holders/ Key Informants/ Field Guides: Tasked to BMC:

The BMC members are asked to identify suitable informants/ TK holders in their village.

- The BMCs are also tasked to identify local Field Guides with good knowledge of the area/ terrain to assist the FDCs during field work.
- It's important that BMCs identify both men and women, old and young, to participate.

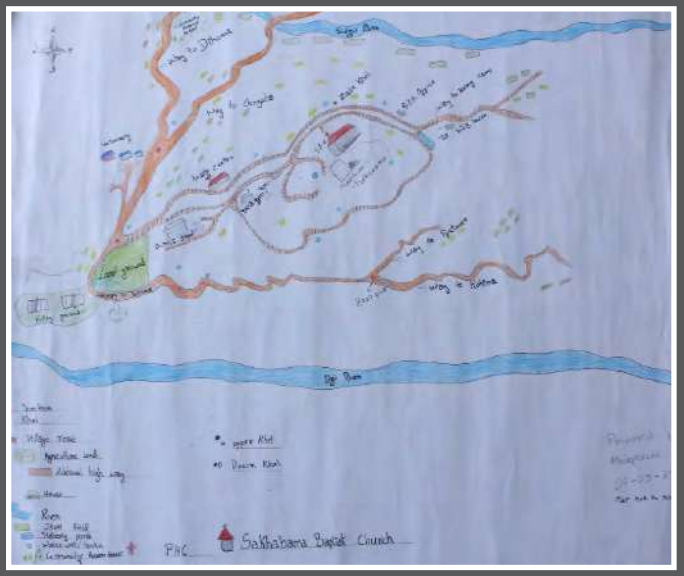
For detailed information on how to document traditional knowledge, please have a look the "Methods Manual – How to document Traditional Knowledge for Aquatic Resources in North East India"

Photos: Nagaland State Biodiversity Board

Preparing Community Maps (Social/Resource/Land-use, etc.): These maps may be prepared together by the FDCs, informants, TK holders and BMC members. Make sure there are groups of men, women and youth present, and that they produce their own maps. The social maps will include features like settlement area, health Centres, schools, churches, community hall, local ground, roads, market area, resting shed, khels /clans and other important landmarks. The land-use maps will include the locations and local names of land types such as forest, fields, jhumland, paddy fields, wells, water tanks, rivers and fisheries, Resource maps indicate location of important natural resources, such as those freelisted by key informants. Location of problematic areas/resources can also be mapped. These maps will be integrated as one map and incorporated into the PBR.

Photos: Nagaland State Biodiversity Board

Integrated social and resource Map



Resource Map

Social Map

Free Listing of Biological Resources in different major categories by the TK holders/ Key informants/ BMC. These includes free listing of agro-crops, domesticated fruit trees, timber trees, ornamental plants, wild vegetables and fruits, medicinal plants, wild animals and birds, aquatic animals and insects, aquatic plants, agriculture land race, rivers, and streams. The Key informants (including men and women, and youth) are given few days to prepare the free lists of major categories of bioresources; after completing the free lists, they are handed over to the FDCs. –

Photos: Nagaland State Biodiversity Board

- → FDCs work with focus group to compile freelists, establishing consistency in spelling and identifying synonyms, and validating a final list for each domain.
- → Ask focus group members to provide: meaning of names, uses (if any), any stories, or interesting facts that should be noted (recent decline or increase in abundance)

3. **Field Surveys and data collection:** At least 2 FDCs are assigned per village for gathering information in the village area. Steps involved in field surveys with local FDCs and Local Field Guides are as follows: -
   - ▶ At least 3 areas which are considered as having good biodiversity are identified by the Local Field Guides, making use of community prepared maps
   - ▶ For Aquatic Resources, the GPS co-ordinates of all available aquatic sites both natural (River/ Streams /Ponds /springs /brine springs) and man-made (tanks/ wells/ponds) are recorded with the help of GPS instrument (mobile phones in case there is no GPS instrument).
   - ▶ on reaching the survey sites, the Local Field guides will help in on-the-spot identification of biodiversity as much as possible, providing local names and uses when known.
   - ▶ in cases when unknown species are spotted, one or two samples are collected and taken to informants or TK holders for identification.
   - ▶ photographs of all recorded bioresources are taken.

- ▶ Gathering supplementary information: - The raw data including photographs, information and collected samples are shown to BMC members/informants for getting supplementary information as per PBR formats. Compiled freelists may also be discussed in this context. Further the informants/ TK holders are interviewed to get specific/ more information., such as meaning of names, uses, practices, stories, etc.
- ▶ Submission of raw PBR data to NSBB: The FDC will compile and fit the data into respective PBR formats and submit to the technical team in NSBB office.

Photos: Nagaland State Biodiversity Board

4. **Data analysis and validation**

Data analysis: After all the above steps are completed, the NSBB will check the data and further compilation/correction (if any) are done for each PBR formats. Then, the NSBB team will call a meeting with the BMC and TK holders for review and validation of the accuracy of collected data.

Field data are compared and cross-checked with Free Lists and secondary data (photos), thereby validating it: by FDC / BMC / Key Informants.

Further **interviews** with TK Holders/ Informants for more details and verification is done by FDC and BMCs as required.

Validation by Technical Support Group (TSG): The TSG will further authenticate and validate the PBR by listing local names of flora, fauna, TK

associated with flora and fauna. The TSG members may include subject matter specialist such as botanist, zoologist, taxonomist, agronomist, wildlife expert, etc.

Photos: Nagaland State Biodiversity Board

5. Compilation of PBR

Engagement of Data Entry Operator (DEO): Depending on the workload, one or more DEO may be engaged for DTP works and best fitting of data into the formats.

Printing of PBR (optional): After validating the PBR the Technical assistants of NSBB will ensure proper arrangement, fitting of data, rectify errors and then send for printing one copy of PBR.

Photo: Usha Dewani Das

3. HOW TO MANAGE AQUATIC ECOSYSTEMS

Aquatic ecosystems need to be managed in coordination with several actors and stakeholders with communities being the central actor in the management. The local village councils can play an important role in restoring or conserving freshwater ecosystems if they develop the institutional capacities required for doing so. Management issues are usually latent. They need to come to surface so that the local Government bodies may take action around them. Village councils/Gram sabhas can provide platform for discussion on management. Especially, in most North eastern states, natural resource management at village level comes under purview of local village institutions.

Following 8 principles of commons management (Elinor Ostrom's design principles) can be followed by village institutions for better management of aquatic resources. Following table suggests how these rules can be implemented.

8 PRINCIPLES OF COMMONS MANAGEMENT

1 **Define who has rights to appropriate resources and the boundaries of the resource itself**

Local Governments may note different users of aquatic resources; identify and demarcate catchments as part of the boundary of resource, especially springsheds.

2 **Rules governing the use of common goods should be adapted to local conditions and needs.**

Local Governments should adapt to local needs for developing rules for conservation. For instance, use of freshwater or extraction of fish may be developed on the basis of seasonal use pattern, time of breeding of different freshwater organisms.

3 **Collective choice: Allow most resource appropriators to participate in decision-making.**

Management committees can be formed for aquatic resources with representation of users/resource appropriators of all kinds. His includes farmers, fisherfolk, women, and other users as

4 **Effective monitoring: Monitors should be part of or accountable to the appropriators.**

Monitoring through citizen science efforts can be responsible to local government and help the local government in informed decision making.

5 **Graduated sanctions: The severity of sanctions should depend on the frequency or character of violations.**

A list of nature of violations may be prepared and rules for sanctions against violators may be developed as per the severity of violation as well as keeping in mind the vulnerability of the violator (single women or landless). Graduated sanctions are generally developed through collective thinking on a case-to-case basis and institutional memory of the village institution and not through a formal code. However, a basic level of graduated sanction may be codified.

6 **Accessible conflict resolution: Provide low-cost and accessible means for dispute resolution.**

Depending upon the resource users, conflict resolution should be in hands of local Government. If the resource boundaries extend beyond a village, there needs to be platforms between multiple villages for resolving conflicts. However, formal conflict resolution mechanisms are expensive and are often not reached out.

7 **Nested responsibility: Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system.**

Customary institutions in Meghalaya and Nagaland already have a nested structure, building an inter-connected system.

8 **Minimal recognition of rights to organize: Groups should have the authority to conduct their own affairs.**

This is already present in most North Eastern states where traditional and customary rights of communities have been secured by constitution. Village communities can take decisions on their own in most aspects of management.

Management functions

Management functions are of primarily two kinds-

1. Regulatory function

a. Regulating use and sharing of aquatic resources among users equitably while ensuring environmental requirements and sustenance of biodiversity.

b. Conserving aquatic and other biodiversity by bringing overuse under regulation, securing breeding and spawning grounds for ecologically important species.

c. Avoiding and managing pollution in water bodies.

d. Controlling commercial use like commercial fisheries and other aquaculture activities, tourism based on water bodies.

e. Catchment protection and treatment for better water conservation

f. Removal of encroachments on water bodies.

g. Addressing cross-sectoral issues related aquatic resource conservation like terrestrial biodiversity, regulating irrigation for agriculture and regulating use of chemicals in agriculture and other commercial activities to avoid leaching of chemicals in water bodies.

2. Restoration functions

This includes physical action for better restoration outcomes.

a. Investment and implementation of habitat restoration activities, ground water recharge support, water conservation

b. periodic cleaning of water bodies, removal of invasive species, and other such activities.

c. Restoration of riparian zones, riparian forests.

3. Awareness and Monitoring functions

a. Awareness drives about cleaning of water bodies,

b. Creating interconnectedness in land and aquatic resources management, especially in riparian zones.

c. Citizen science and involvement of youth for data collection through citizen science.

4. Fund raising for management

a. Seek resources from different Government programs or other resources for conservation and management activities.

b. Setting ecosystem service payment mechanisms or any other form of incentive mechanisms for regular funding of conservation efforts and building stewardship and encouraging youth for conservation.

c. Using local taxes and levees for upkeep of water bodies.

Undertaking these functions may be supported by development of a management plan for aquatic resources. Depending upon local situations, communities may chose to develop a simple or complex management plan. It is advisable to see management plan as a live document and need for communities to engage with management plan periodically for review. A Community conservation plan has been shared as annexure for Dikhu conservation zone in Nagaland.

Photo: Usha Dewani Das

4. HOW TO MONITOR AQUATIC ECOSYSTEMS

Photo: Patricia Dorn

This toolkit presents two different approaches to monitoring:

- Monitoring of Aquatic Ecosystem Services via the Community-Score Card
- River Monitoring via Citizen Science

But why to monitor in the first place? Detecting early signs of pollution, invasive species, and other environmental stressors are key proactive measures to maintain the delicate balance of aquatic ecosystems and adapting to various challenges. By equipping communities with the knowledge and tools necessary for effective river monitoring, we pave the way for sustainable management practices that will benefit current and future generations.

Monitoring and maintaining water quality is vital for various purposes, from local usage to supporting aquatic life. Pollution from domestic and agricultural sources adversely affects river quality. Regular monitoring is essential for effective pollution control and water resource management, aiding in the rejuvenation of depleted aquatic resources. These efforts align with United Nations goals for clean water, health, and biodiversity. Long-term monitoring systems are crucial for the early detection of pollution incidents, preventing harm to aquatic life, and ensuring the well-being of communities. Long-term water quality monitoring with local community involvement, as seen in citizen science initiatives, is essential for preserving biodiversity.

Consistent river monitoring is also vital for managing the threat of invasive alien species (IAS). Regular assessments of river ecosystems can identify any introduction of non-native species that could harm the local environment. Monitoring provides an early warning system, enabling prompt responses to potential invasions. This proactive approach helps prevent the establishment and spread of IAS, safeguarding native biodiversity. Effective management strategies can be developed to protect the delicate balance of river ecosystems from the risks posed by invasive alien species.

Effective river monitoring is essential for understanding and safeguarding the health of our aquatic ecosystems. This toolkit is designed to guide users through the critical aspects of river monitoring, offering clear instructions on where, what, how, and when to monitor. By strategically selecting monitoring sites, measuring key parameters, and employing appropriate sampling methods, we can obtain comprehensive data on river health. Safety measures and ethical considerations are integral to the monitoring process, ensuring that data collection does not harm the environment or the individuals involved. Involving local communities and volunteers fosters a sense of responsibility and encourages widespread participation. This collaborative approach not only enhances data collection and analysis but also strengthens community engagement in river conservation efforts.

4.1 Monitoring of Aquatic Ecosystem Services via the Community-Score Card

Photo: Patricia Dorn

The **Community Score Card** (CSC) is a participatory, community-based monitoring and evaluation tool that enables citizens to assess the quality of public services such as health centres, schools, public transport, water, waste disposal systems and so on (Post et al., 2014). The citizen could assess the health of their ecosystems and changes brought out by external forces and that understanding could be used to improve the ecosystems. This could be the best tool to capture people's perceptions and attitudes about their ecosystems and will provide insights into the functioning of the ecosystem at a large scale. Diverse stakeholders and communities are directly and indirectly dependent on freshwater ecosystems and how they perceive a change in various ecosystem services provided by the aquatic ecosystem is very important to design systematic conservation planning for freshwater ecosystems.

WHAT ARE FRESHWATER ECOSYSTEM SERVICES?

Ecosystems are the functional spatial unit which represents the gross total of all living beings and their physical environment. There are three basic components of an ecosystem. The energy, biotic and abiotic components. The functional aspect in terms of the exchange of energy among all these components is crucial.

Freshwater Ecosystems: The river is a source of freshwater and is an ecosystem in itself which affects the environment. The river freshwater ecosystem gives us different services, for example, drinking water, water for irrigation, and habitat for aquatic organisms.[6]

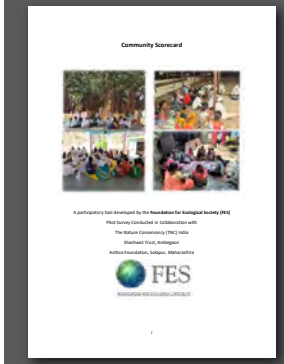
Ecosystem Services are defined as the benefits that people obtain from ecosystems and the direct and indirect contributions of ecosystems to human well-being. Freshwater Ecosystems provide us with ecosystem services such as provisioning, regulation maintenance and culture.

1) **Provisioning Services:** Drinking water, water for irrigation, water for bathing and cleaning, hydroelectricity generation, fishery, waterways and boating etc.
2) **Regulation and Maintenance:** Purification of water (The flowing river cleans up the pollution from the water and helps mix the dissolved oxygen), air quality regulation (The moisture of river water captures the dust and pollution), checking land erosion, flood control, soil formation, carbon sequestration etc.
3) **Cultural Services:** Entertainment such as water sports, and swimming, aesthetic and beauty appreciation such as fishing, spiritual services such as religious rituals, and birth and death ceremonies and symbolic appreciation and biodiversity.

WHY DO WE WANT TO DO COMMUNITY SCORE CARD RANKING OF FRESHWATER ECOSYSTEM SERVICES?

1. Community perceptions for understanding the ecosystem status
2. To improve the visibility and understanding of freshwater ecosystems among the communities and major stakeholders.
3. To bring the knowledge on freshwater ecosystem services together through consolidation to further enhance the awareness of the communities.
4. To bridge the indigenous knowledge and scientific knowledge to collate the information.
5. Use of community indicators to understand the system better. (Vision of the communities for UBB)

Please download here the complete questionnaire of the Community Score Card here.


Community Scorecard

FES

4.2 River Monitoring via Citizen Science

Monitoring should encompass a range of various parameter to provide a comprehensive picture of river health:

Photo: Shaikhom Inaotombi

PHYSICAL AND CHEMICAL PARAMETERS

Understanding physical and chemical parameters is crucial for assessing river health and managing ecosystems effectively. Water temperature influences aquatic organisms' metabolic rates, while flow rate affects sediment transport and habitat structure. Turbidity indicates suspended solids, impacting light penetration and photosynthesis. pH levels maintain aquatic life balance, and dissolved oxygen is vital for fish and other organisms' survival. High nutrient levels, such as nitrates and phosphates, can lead to eutrophication, causing excessive algae growth and oxygen depletion. Heavy metals indicate industrial pollution, posing toxicity risks. Salinity is important in estuarine regions, where freshwater meets seawater, affecting species distribution. Monitoring these parameters is essential for river health, providing baseline data and ensuring rivers maintain ecological balance. It also enables early detection of changes or threats, allowing timely interventions to protect and sustain the health of river systems, promoting biodiversity and supporting sustainable development goals.

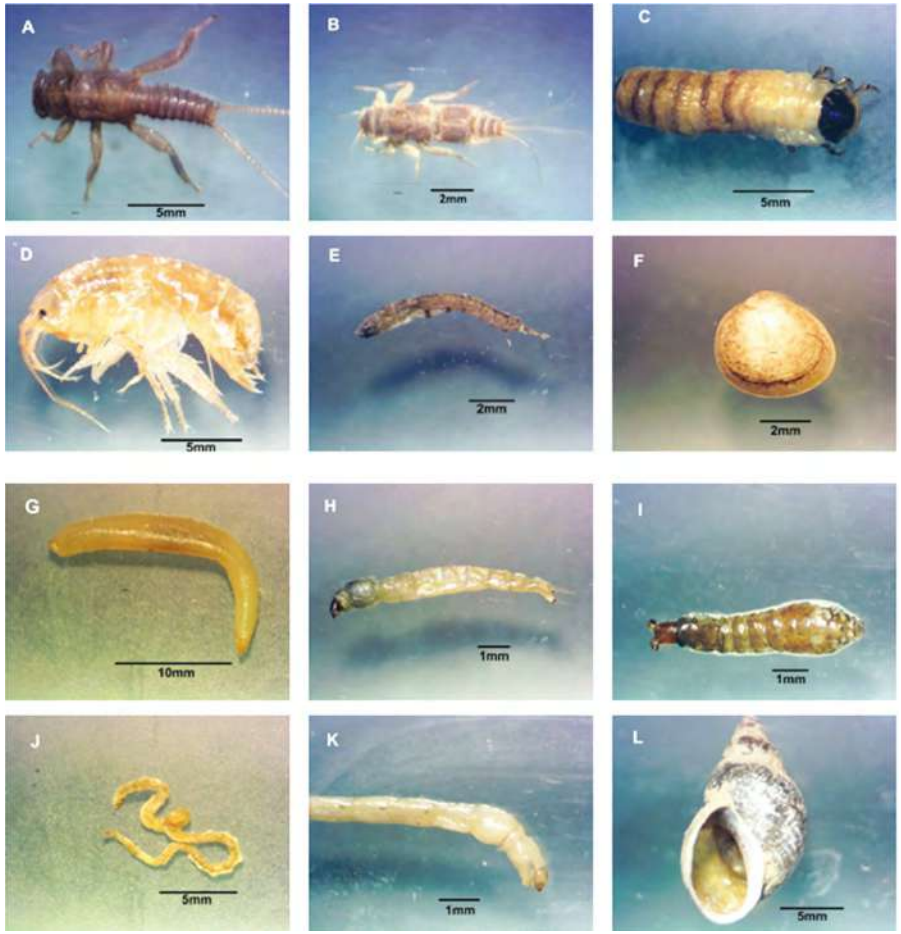
S.no	Parameter	Description
1	Water Temperature	Affects the metabolic rates of aquatic organisms.
2	Flow Rate	Influences sediment transport and habitat structure.
3	Turbidity	Indicates the presence of suspended solids.
4	pH Levels	Essential for maintaining aquatic life balance.
5	Dissolved Oxygen	Critical for the survival of fish and other aquatic organisms.
6	Nutrient Levels (Nitrates and Phosphates)	High levels can lead to eutrophication.
7	Heavy Metals	Indicates industrial pollution.
8	Salinity	Important in estuarine regions.

Biological Parameters

Biodiversity within a river ecosystem refers to the richness and variety of species present, serving as a crucial indicator of overall ecosystem health. A diverse range of species reflects a balanced and resilient environment capable of supporting various life forms. Additionally, the presence of indicator species, such as periphyton, benthic macro-invertebrates and fish, offers valuable insights into the health of the ecosystem. These species are particularly sensitive to environmental changes, making them reliable indicators of water quality and habitat conditions. Monitoring for invasive alien species is also essential to maintain ecosystem balance. Invasive alien species, if left unchecked, can disrupt the natural balance of the ecosystem, outcompeting native species and altering habitat dynamics. By actively monitoring and managing invasive species, we can help preserve the integrity and stability of river ecosystems for future generations.

S.no	Parameter	Description	How We Monitor
1	Biodiversity	Refers to the richness and variety of species present, indicating overall ecosystem health. E.g. Fishes	Counting and identifying different species of plants, animals, and microorganisms present in the river ecosystem.
2	Indicator Species	Species like periphyton (mixture of algae, cyanobacteria, heterotrophic microbes, and detritus) and benthic macro-invertebrates (Figure 2) offer valuable insights into ecosystem health.	Observing the presence and abundance of specific species known to be sensitive to environmental changes, indicating water quality and habitat conditions.
3	Invasive Alien Species	Non-native species that can disrupt the natural balance of the ecosystem, outcompeting native species and altering habitat dynamics.	Regularly monitoring for the presence of non-native species and taking measures to prevent their spread, such as early detection and removal efforts.

Figure 2: Some common stream benthic macroinvertebrates as bioindicators: (A) Stonefly nymph, (B) Mayfly nymph and (C) Caddisfly larva (most sensitive); (D) Scud, (E) Cranefly larva and (F) Clam (semi-sensitive); (G) Leech, (H) Midge larva, (I) Blackfly larva (semi-tolerant); (J) Aquatic worm, (K) Blood midge larva, (L) Pouch snail (Very tolerant).



(Source: Mir, Z.A., Arafat, M.Y. and Bakhtiyar, Y., 2021. Benthic Macroinvertebrates as Bioindicators of Water Quality in Freshwater Bodies. In Freshwater Pollution and Aquatic Ecosystems (pp. 165-184). Apple Academic Press)

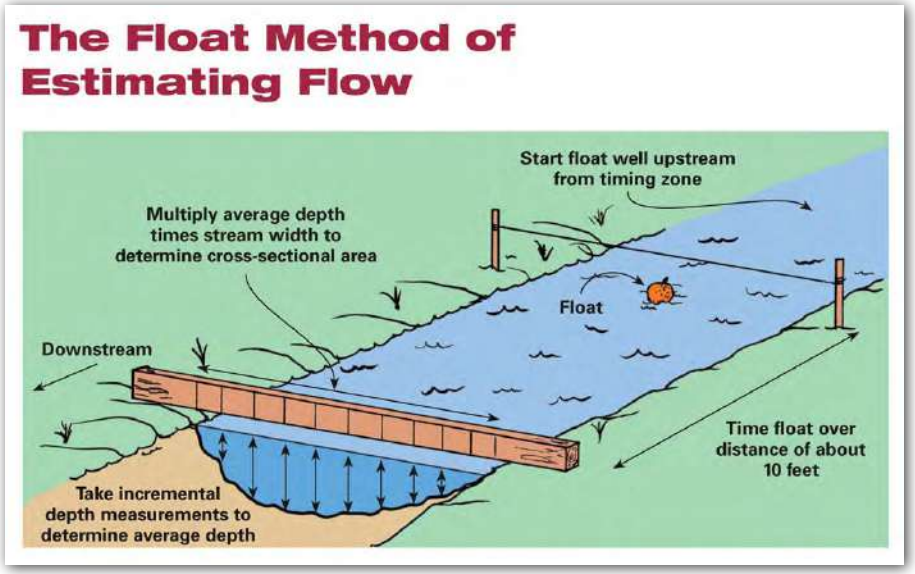
HOW TO MONITOR

To monitor the physical and chemical parameters of river ecosystems effectively, follow the protocols below with pictures:

Water Temperature / pH / Electrical conductivity/ TDS: Use the provided digital multi-parameter water quality meter to measure these values. Immerse the probe into the river at different depths and record the readings.

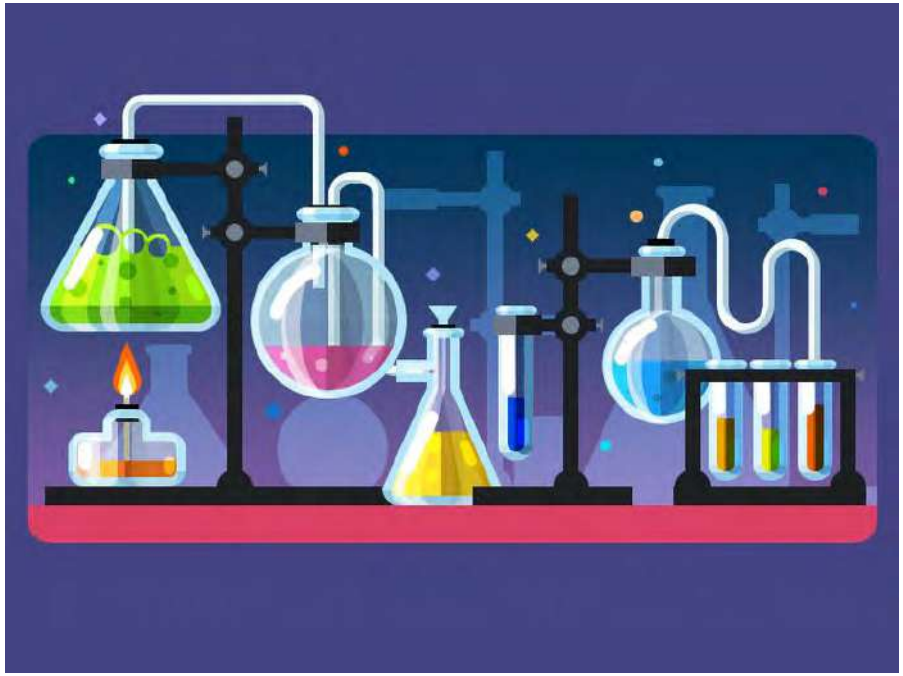
(Source: Hanna Instruments. Combo pH/ Conductivity/TDS Tester – Low Range HI98129. Retrieved June 3, 2024, from https://hannainst.in/product/combo-ph-conductivity-tds-tester-low-range-hi98129/)

Flow Rate: Employ the orange/rubber ball floatation method. Select a straight section of the river, measure a known distance along the bank, and release an orange (or any buoyant object) upstream. Record the time it takes for the orange to travel the measured distance. Repeat this process several times to obtain an average flow rate.



(Source: Floating Method" Polarpedia. Retrieved June 3, 2024, from https://polarpedia.eu/en/floating-method/)

Dissolved Oxygen (DO) / Nutrient Levels (Nitrates and Phosphates) / Heavy metals: Approach local colleges or universities for assistance, as measuring DO often require specialized equipment. Collect water samples according to standard procedures and have them analyzed in a laboratory, following strict contamination prevention protocols. By following these protocols and collaborating with educational institutions for more complex analyses, you can ensure comprehensive monitoring of river health, contributing valuable data for conservation and management efforts.



(Pinterest. Retrieved June 3, 2024, from https://www.pinterest.com/pin/699535754609385753/)

Where and when to monitor

Parameter	Where to Monitor	Time of Day	Frequency	Season
Water Temperature / pH / EC / TDS	Upstream, downstream, midstream points, even at diverse habitats	Mid-Morning	Weekly	Year-round, focus on pre and post monsoon / summer and winter, after significant events like rainstorms or discharges
Flow Rate	Upstream, downstream, midstream points	Mid-Morning	Monthly, after major rainfall events	Year-round, more frequent during rainy season
Dissolved Oxygen (DO)	Upstream, downstream, midstream points	Early morning and late afternoon	Weekly or bi-weekly	Year-round, focus on warmer months
Nutrient Levels (Nitrates and Phosphates)	Upstream, downstream, midstream points and near agricultural runoff points	Mid-morning	Monthly, bi-weekly during agricultural runoff periods	Agriculture seasons (winter and summer), after major rainfall
Heavy Metals	Upstream, downstream, midstream points and near agricultural runoff points	Mid-morning	Quarterly and after significant rainfall	Year-round

Useful References

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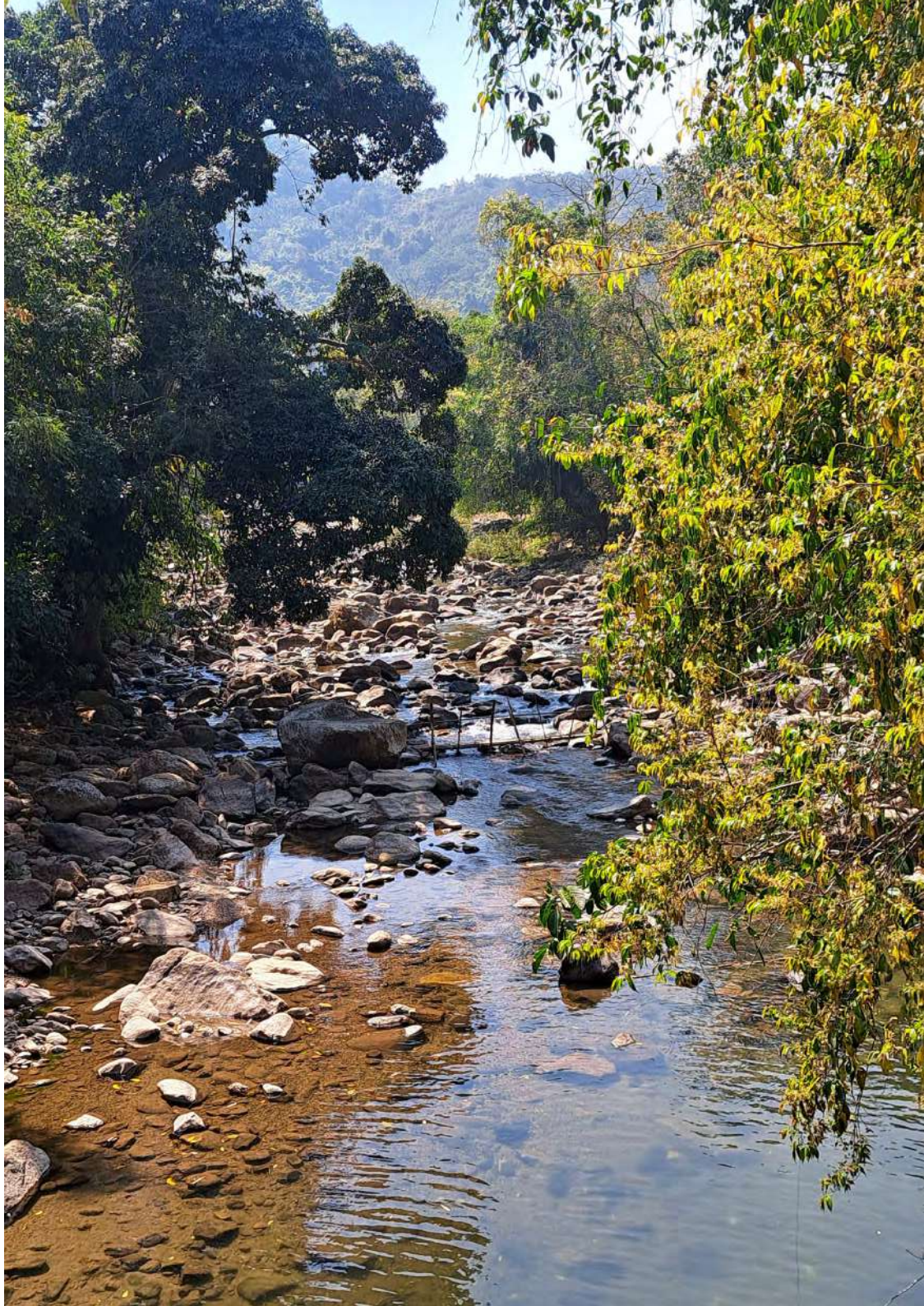
Your feedback to this booklet is highly appreciated. Kindly send it to
patricia.dorn@giz.de



Registered Offices:
Bonn and Eschborn, Germany
Friedrich-Ebert-Allee 32 + 36
53113 Bonn, Germany
Dag-Hammarskjold-Weg 1-5
65760 Eschborn, Germany
Email: info@giz.de

3rd Floor, A-2/18, Safdarjung Enclave
New Delhi-110029, India
Tel: +91 11 4949 5353
Fax: +91 11 4949 5391
Email: biodiv.india@giz.de