THE ENVIRONMENT MANAGEMENT

A Quarterly E- Magazine on Environment and SustainableDevelopment

पर्यावरणो रक्षति रक्षितः

(for private circulation only)

Vol.: VI | April - June 2020 | Issue: 2

Current Issue: Biodiversity Conservation and Management

CONTENTS

From Director's Desk

Diversity in all living things enriches our lives, but more importantly, biodiversity is essential to life on earth. About 8 million species of plants, animals, fungi, bacteria, viruses thrive in terrestrial and aquatic ecosystems of this biosphere. From purification of water to improvement of soil fertility, biodiversity performs multitude of functions on the earth that ensures in unlimited supply of services like food, medicine, clean water, recreation, knowledge up gradation etc. for human being. Different micro-organisms to macro organisms efficiently perform complimentary and supplementary functions of ecosystems together in the ecosystems and improve the resource availability and efficiency without causing any negative impact viz. pollution. Recently, it has been recorded that the loss of biodiversity is 1000 times more and about 1 million species are facing the threat of extinction. Furthermore, the current corona pandemic is also linked to the biodiversity loss besides anthropogenic activities. It means that a direct impact of biodiversity loss, epidemics and pandemics will be on human race. Before the situation goes beyond control, it is our duty to define biodiversity conservation from a new perspective.

The parties to the UNs Convention of Biodiversity adopted a ten year strategic plan of 2011- 2020 for Biodiversity Conservation and are Sustainable Management in October, 2011 through goal oriented 20 Aichi Biodiversity targets by involving policy planners, people and industries. The valuation of natural capital was emphasized in it by mainstreaming industries in biodiversity conservation. The World Environment Day 2020 is also focused on the theme 'Biodiversity' which is a step towards encouraging the people worldwide to save and protect the biodiversity and environment from different challenges world is facing today. The current issue of 'The Environment Management' is commemorating 'The World Environment Day 2020' with an objective to cover different aspects of biodiversity conservation and management for better lives of us and you.

Dr. Seema Mishra

Conservation of Biodiversity by Institutional Responsibility: Tools for Municipality and Business

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Biodiversity is the diversity within species, between species and of ecosystems. It is variability among living organisms from all sources. India is one of the 17 mega diverse countries in the world and enriched with different ecosystems viz. forest, desert, coastal, wetlands, grasslands etc. It is home to 7.6% of all mammalian, 12.6% of all avian, 6.2% of all reptilian, 4.4% of all amphibian, 11.7% of all fish, and 6.0% of all flowering plant species.Different ecosystem services and functions ofbiodiversity provide significant environmental, economic and social benefits to human being.Biodiversity is a complex and multifaceted resource that enters every realm of human endeavor: politics, economics, social, environmental, culture and religion: past, present and future.

Recently, it has been recorded that the loss of biodiversity is 1000 times more and about 1 million species are facing the threat of extinction. Furthermore, the current corona pandemic is also linked to the biodiversity loss besides anthropogenic activities. It means that a direct impact of biodiversity loss, epidemics and pandemics will be on human race. To address the policy and governance issues of biodiversity conservation, lot of initiatives have been taken at global, regional and national level by mainstreaming it in business and municipality operations. The article addresses the approaches for the conservation of biodiversity through municipal corporations and businesses.

Policy Frameworks for Biodiversity Conservation

The Convention of Biodiversity (CBD) was adopted in 1992 in Earth Summit that has given a momentum for the conservation of biodiversity and environment management at global, regional and national level. The CBD has designated National Biodiversity Strategy and Action Plan (NBSAP) as a tool for mainstreaming biodiversity conservation in national strategy through policy framework as a decision making system. India is a party to CBD from 1993 and it has enacted the Biological Diversity Act (BDA) in 2002 with focus on conservation, sustainable utilization and equitable sharing of biodiversity among different stakeholders. The act has promoted the conservation of biodiversity in decentralized manner by establishing National Biological Authority at national level, State Biodiversity Authority in different states and Biological Management Committees at local levels- panchayats, municipalities and corporations. Taking note of all these, the Government brought out a comprehensive National Environment Policy (NEP) in 2006 which did not abrogate sector specific policies, but provided the much needed synergy and coherence for sustainable development in all the policies. It emphasized that sustainable development policy and action profile should be such that the poor and the vulnerable derive livelihoods and quality of life from the fact of conservation of biodiversity and not its deterioration, and called for the mainstreaming of biodiversity in planning and development in all sectors.Our country

is regularly releasing NBSAP containing latest stock of biodiversity and actions performed under different goals of Aichi Biodiversity targets from 2011- 2020. The Sustainable Development Goals (SDGs) in 2015 set out an ambitious plan for addressing the range of societal challenges at global level wherein biodiversity and ecosystem services are integrated in many goals. Furthermore, biodiversity is interlinked with climate change policy framework, water, agriculture, wasteland development, environment management etc.

Integration is neither a one-off undertaking nor quick fix, but a continuing and long term process. It requires a holistic approach encompassing knowledge development (awareness raising and data generation); policy and institutional changes (changing the political and economic management mindset); a technical process (identification of indicators, analysis, clear priority setting, and implementation mechanisms); involvement and engagement of broad range of actors/stakeholders) across sectors and at all hierarchal levels (local, subnational and national); and dedicated leadership to guide, coordinate and manage the necessary links and processes.

Conservation of Biodiversity through Institutional Responsibility

Institutions are the systems that support humans in performing their activities as per their interest, knowledge and skill sets. They are integrated with formal values (compliance, regulations, policy etc.), informal values (codes of conducts, vision and mission) and their enforcement. Institutional responsibility in biodiversity conservation is promoted globally through different policies, schemes etc. and it has a profound effect in successfully preserving local biodiversity for long term. The institutional biodiversity initiatives can be through municipal corporations or industries by involving educational institutes and local NGOs. Different institutions require different set of agenda for integrating biodiversity conservation in their system. Some of the institutional sectors are described below:

i. Integration of Biodiversity Conservation in Municipal Corporation through City Biodiversity Index

The City Biodiversity Index (CBI), also known as the Singapore Index on Cities Biodiversity (SI) is a tool designed to allow cities to monitor and evaluate their progress and performance related to conserving and enhancing biodiversity and ecosystem services The idea for the CBI was proposed in 2008 and the development of CBI has been led by the Secretariat of the CBD, in collaboration with the Global Partnership on Local and Sub-national Action for Biodiversity, the Government of Singapore, and partners from academic institutions, international organizations and civil societies. The CBI indicators are broad and designed to meet three important criteria:

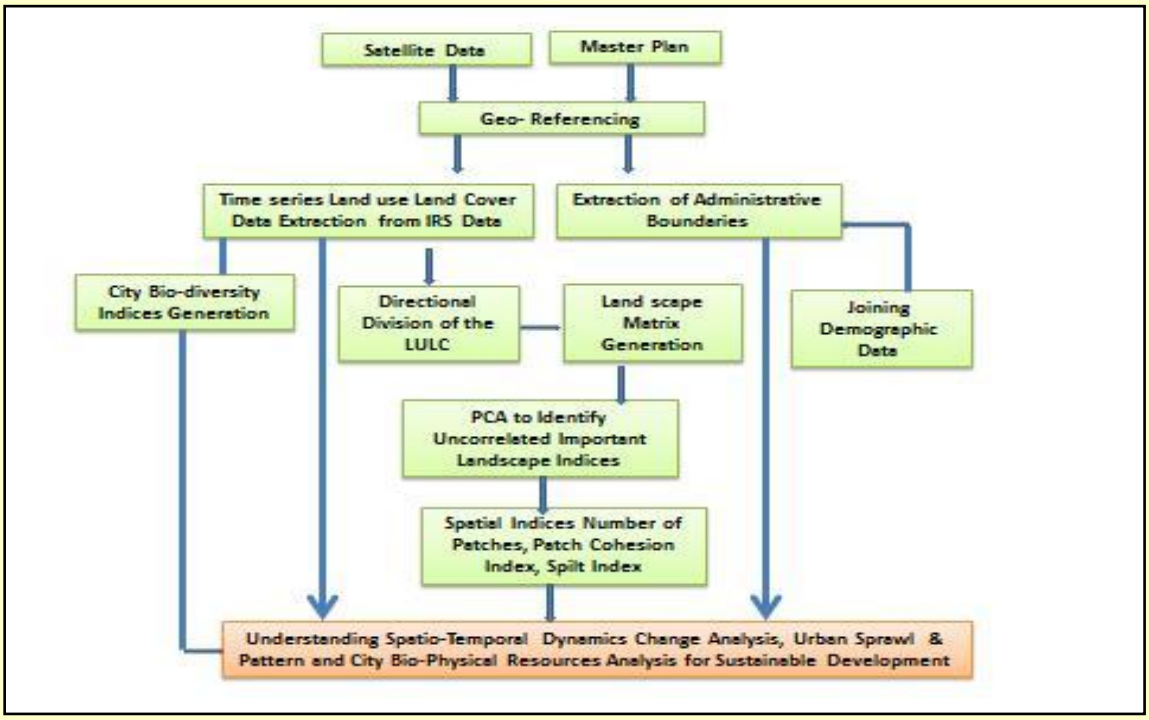
(1) to be a comprehensive tool for assessing not only biodiversity, but also ecosystem services, governance and management;

(2) to be a self-assessment tool, as it is not intended for comparisons between cities; and

(3) to be a simple but yet scientifically credible tool.

The list of indicators of CBI is listed below:

1. Proportion of natural areas 2. Connectivity measures or ecological networks to counter fragmentation 3. Native biodiversity in built-up areas (bird species) 4–8. Change in number of native species (4. vascular plants, 5. birds, 6. butterflies, 7. and 8. optional) 9. Proportion of protected natural areas 10. Proportion of invasive alien species 11 Regulation of quantity of water	12. Climate regulation: carbon storage and cooling effect of vegetation 13–14. Recreational and educational services 15. Budget allocated to biodiversity 16. Number of biodiversity projects implemented annually 17. Rules, regulations and policy – existence of local biodiversity strategy and action plans 18–19. Institutional capacity 20–21. Participation and partnership 22–23. Education and awareness



Layout of procedure for conducting CBI studies in Municipal CorporationsSource:http://www.spaenvis.nic.in/index1.aspx?lid=3072&mid=1&langid=1&linkid=579

For each indicator, the CBI manual proposed a scoring of 0–4 points, where 0 corresponds to poor performance and 4 points corresponds to excellent performance. Points can be summed to provide an overall score of the city's biodiversity performance. The indicators 1-10 cover 40 points, 11-14 covers 16 points and 15-23 cover 36 points.

So, the maximum score is 92 points. Greater Hyderabad Municipal Corporation (GHMC) released its "Greater Hyderabad Biodiversity Index" in the international event "CBD CoP-11" and become the first Indian city to have City Biodiversity Index. Now, several cities in India have developed their biodiversity index.

This indicator based tool can be used for multiple purposes of city development activities mentioned below which are exhaustive but not limited to the:
- Use for identification of weaker areas of policy intervention at city level for sustainable development
- Use for identification of the specific areas of SD to be encouraged, promoted and supported.
- Use for intercity comparison of sustainable development activities

The availability of authentic data and proper demarcation of city boundary are some of the limitations in this study but through consistent planning and data collection these issues can be sorted out. The inclusion of CBI in smart cities may further support in addressing the city sustainability issues.

ii. Biodiversity Conservation through Business Initiatives

Biodiversity is a fundamental component of long-term business survival. Businesses rely on genes, species, and ecosystem services as critical inputs into their production processes and depend on healthy ecosystems to treat and dissipate waste, maintain soiland water quality and help control the air composition. For example, paper industry relies on the short rotation tree species from getting good quality of pulp, as a resource to ensure high quality of wood.

At the same time, business and industry can have major negative impacts on biodiversity resources. Yet, while the private sector is part of the problem, it is also part of the solution. The resources and influence of the private sector offer important opportunities for innovative and effective contributions to conservation.

The CBD has emphasized the role of industries driven initiatives in biodiversity conservation. In COP 12 of UN CBD in Hyderabad, India Business and Biodiversity Initiative (IBBI) was planned as a national platform of businesses and its stakeholders for dialogue sharing and learning, ultimately leading to mainstreaming sustainable management of biological diversity in businesses. The Ministry of Environment, Forests and Climate Change (MoEFCC) launched the India Business and Biodiversity Initiative (IBBI) on the occasion of the International Day for Biological Diversity on 22nd May 2014 in New Delhi along with GIZ and Confederation of Indian Industries (CII). Presently, 30 Indian industries from diverse sectors viz. cement, power, steel, IT, chemical, motors, FMCG etc. including Tata group, Mahindra and Mahindra, ITC, Wipro etc. are part of IBBI. The main aim of this initiative is to advocate public policies supporting business and biodiversity interface at national and international level by documenting, showcasing and promoting good business practices nationally and globally.

India Biodiversity and Business Initiative Tools

Business member ship of IBBI was 30 in 2018 and representing from all major sectors of India, SMEs and one government undertaking company. Business members' signatory to 10 points IBBI Declaration has to submit biannual disclosure report to IBBI on the initiatives undertaken by members in last two years. In 2018 cycle 22 business has submitted their declaration report. The six companies also presented their biodiversity work in the annual report and integrated

report. The tools suggested by IBBI are as below:

i. Identification of linkages and dependency between business and nature:

The assessments of direct or indirect dependency of businesses on biodiversity helps in the identification of inter linkages across the businesses value chain. The industries like food processing, paper pulp directly depend on biodiversity for their operations while oil and gas industry depend indirectly on the biodiversity. Further, businesses have very severe or moderate impacts on the biodiversity. The oil and gas or mining sector may have high impact on biodiversity. So, on the basis of the type of dependency and impact on biodiversity, the businesses can prioritize their activities and plan for the management aspects.

iv. Risk Assessment

The loss of biodiversity leads to physical, financial, operational or regulatory risk for businesses. It is desirable that industries should map their dependency across the value chain and identify the risks and process for the management of biodiversity and associated services. The IBBI has developed a risk assessment matrix for the businesses.

ii. Natural Capital Indexing, Ecosystem Service Matrix and Valuation

The IBBI has developed a sector specific tool for the indexing and valuing the natural capital required in their operations. The natural capital drivers, such as biodiversity, land use, water requirement, greenhouse gas emissions, pollution and governance structure are used in the indexing to support industries in taking timely actions for mitigating risk related to biodiversity and climate change. Identification of site and operation specific ecosystem services matrix supports in internalization of action plan to mitigate the risks and develop nature based solutions for biodiversity conservation.

v. Reporting

The natural capital valuation is based on the Natural Capital Protocol that provides comprehensive details for the valuation of ecosystem services from biodiversity.

iii. Setting up of Targets and Goals

The next tool is the identification of operation specific goals and targets for their business as per the national and local policy leading to a sector wise best practices and case studies.

The last tool is the reporting or declaration of initiatives for biodiversity conservation and best practices as a case study. This report can be a part of annual report or integrated report.

Some Sector Wise Case Studies

i. Mahindra & Mahindra Ltd.,Igatpuri (M. S.)

Mahindra & Mahindra Ltd., Igatpuri is a manufacturing site for engines of utility vehicles. It requires very huge amount of water for its operations from Municipal Corporation from local dam. The downstream areas of dams are dependent on water flow for aquatic life, flora and fauna. During 2015, 2016 and 2017 due to heavy drought, the M&M was dependent on tankers for water supply. To address the risk the company has undertaken following mitigation measures from 2015 and it supported in increasing the business:

Mitigation measures	Business case
Training of employees on behavioral change	
Adaptation technologies that require less water	Reduction in water requirement in operations by 60% and from municipality by 75%
Greening of areas by micro irrigation.	
Construction of new check dams and storage of water in check dams.	0.42 crore reduction in water bills

The initiatives of M&M Igatpuri support in meeting the requirements under National

Biodiversity Target 2, by conservation of ecosystem services like fresh water and enhancing ground water table.

i. NTPC Ltd., Simhadri

NTPC Simhadri Super Thermal Power Station 2000 MW is located along the coast of Bay of Bengal near Pittavanipalem village in Vishakhapatnam (A.P.). The sweet water requirement for this project is drawn from the Yelleru canal. This coastline is breeding ground for Olive Ridley Turtles that is in vulnerable category (IUCN). The Olive Ridley Turtle conservation programme in Andhra Pradesh was started in 2010 with an objective to include the community as a major stakeholder. In 2015, NTPC, Simhadri signed a five year agreement with the Andhra Pradesh Forest Department to partner in the conservation efforts in 9 coastal districts. The conservation initiative covers 732 km of coastal area out of the total 972 km long coastline of Andhra Pradesh which was identified as a breeding area of the sea turtles. The interventions of NTPC, Simhadri have supported the forest department in aligning resources for this critical activity and resulted in an increasing trend in hatchlings released in the sea water. This case study is mainstreaming NBT 6 for conservation of protected areas.

Conclusion

The mainstreaming of biodiversity in institutions and business will definitely support in addressing the conservation issues of biodiversity and ecosystem services. The alignment of policy with local requirements will further establish linkages between government organizations, industries and civil societies that will help in generating effective tools for biodiversity conservation and management.

Importance of Biodiversity, Challenges and Opportunities for Sustainable Development

Dr. Archana Godbole
Applied Environmental Research Foundation (AERF), Pune (M. S.)

Since last couple of months, we are addressing the worst ever wakeup call by nature in the form of dangerous Corona virus affecting millions of people. It is different than the known natural disasters like earthquakes, volcanoes and tsunami that are regional, local, but this is pandemic, affecting humans at global level without sparing anyone and actually brought us all on the same level. The major precaution being talked and followed is social distancing. But did we ever think of distancing ourselves from nature and other species? Homo sapiens as species always wanted to control nature and environment and the technological advancement in last couple of decades helped reaching the peak of arrogance of Homo sapiens. Artificial intelligence, nano technology, explosion of information through internet and connectivity across the nations and regions is scary. But while achieving these advancements we all to a large extent ignored the power of nature and value of other species including viruses and microbes. With the advancement of biotechnology and deeper understanding of DNA, scientists across the globe are working on re originating extinct species like woolly mammoth from Siberia, Passenger pigeons from North America the list is long and the investments on such research are huge why not these are put to protection of nature and biodiversity, protection of habitats and to halt the further extinctions?

Valuing biodiversity and maintaining it for the future generations has been a part of many societies across the globe and some living traditions like sacred groves, sacred rivers and sacred mountains

still keep us linked to nature and biodiversity. However, the technology teaches us otherwise; that we can create forests, ecosystems and nature through few protected areas, excluding the communities from such wildernesses and creating forests through tree plantations. We want to complete our bucket list by crowding the known and unknown travel destinations, all the time looking for remote areas. In short it is the greed of humans that had modified,changed and or destroyed nature and ecosystems and obviously some day we have to price of this collective greed, which we are paying now.

Why biodiversity is important? We all are aware that biodiversity is important for our own survival as we need all the ecosystem services derived out of biodiversity. Now a day quite a lot is talked about bees and their importance for humans through extremely valuable service of pollination. Water, soil formation and carbon sequestration, food, medicines, fuels all we get because of biodiversity .But we have forgotten and ignored the value. Diversity and variations are the basis of evolution. Most of our food species have derived from the careful selection and cross breeding of species and subspecies to create best varieties, but then we have lost all the traditional knowledge of local agro-biodiversity and crops and when the diseases infest the GM crops or new biotechnology based varieties , we are again the losers. Are we going to learn any lessons from our bad karma of nature destruction?

We all must understand that why the new microbes reach humans faster ?there are no buffers in the form of wildernesses and host species that can take the brunt of virus like corona in a particular area, the travel industry and fast connecting word has posed another challenge . Food habits of some people and nations like China have crossed

all the boundaries . They have started breeding farms for animals like Pangolins and Civets to satisfy people's gastric preferences. Now we are trying to put the blame on these animals for spreading corona to humans. Bats are another such victims.

Deforestation is one of the major drivers of loss of biodiversity and contributor to climate change. It is destruction of range of habitats from forests to wetlands to deserts, sometimes it is hunting and killing, sometimes we destroy entire populations for our hobbies and there was absolutely no limit. The story of human hand and greed in destroying nature is very long. But where is the ray of hope? Yes we believe in hope and change. There are organizations, institutions and individuals working with all passion and commitment across the globe for saving species, habitats, actually we are trying to save ourselves. Through our work in north Western Ghats to protect forests and biodiversity we could test the new approaches and scaled up a few , have successfully established partnerships with communities , as we understand that the solutions to bring us back on track are difficult and cannot be achieved in isolation with just one or few organizations. Many stakeholders are required to resolve and sustain the efforts to reach the sustainable development goals.

At AERF we have started with participatory conservation of sacred forests since 1996 and could achieved it to some extent, but for last 10 years we have realized that the age old ideas of social fencing and intrinsic values will not protect these age old reference ecosystems. There was a need to link it to livelihoods and income generation; there was a need to build the strong institutions for transparency and accountability for the use and protection of natural resources at the village and panchayat level.

Sustainable development is a term that has been used over a period of time in the field of environment and unfortunately, we never understood the real meaning. We have many definitions right from Rachel Carson's to United Nation's; and many a times it is too simplified. But today's need is to have good practices that have thrived for long time, that have created win win both for natural resources and communities along with participation of more and more stakeholders .We also need to bring the attention of our corporate sector for meaningful partnerships and serious long term investment.

The use of biodiversity for human well being has been practiced over a long period of time in the human history. But now we need to work on how humans will get reconnected to biodiversity and nature, develop ways of sustainable lifestyles and limited use of natural resources.

Young generation has experienced the brunt of pandemic and it is for them to work seriously on these issues. If one has passion for nature, are committed to contribute to the process of change and ready to look at the careers beyond huge remunerations, sky is the limit for them. In CSR streams, in Human resource streams in education, in businesses there is a scope for the young generation. I am sure they will take this up seriously as the future of planet and biodiversity is their future.

Your Knowledge is Our Power

Anupam Singh Sisodia
Sustainability Outreach Officer
Leadership for Environment and Development (LEAD) – India

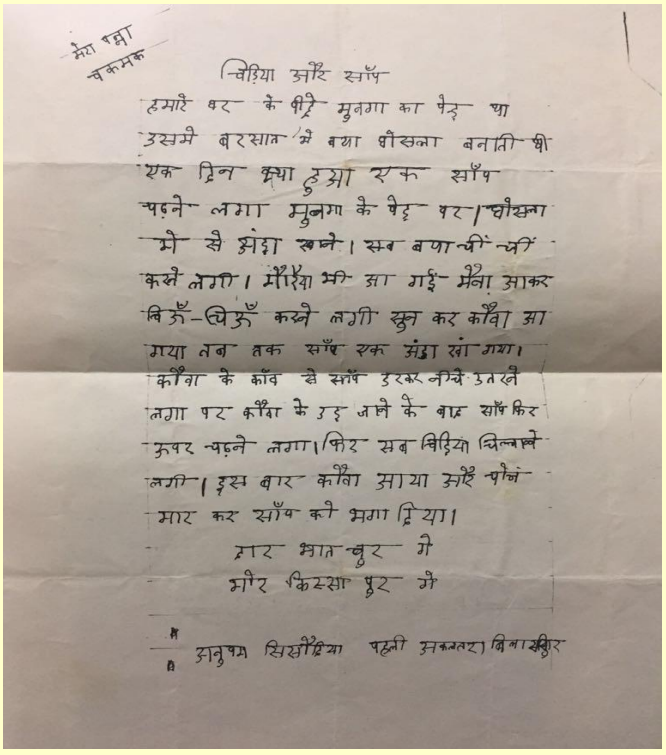
I am relatively more familiar with Chhattisgarh than other regions of the world. One, because it is my native place and two because most of my work revolves around Chhattisgarh region at the core. Thus, my experiences while being regional have a pan India context to them.

Today, we have added 22 new species of butterflies for Chhattisgarh, many of whose population was believed to be restricted to either Western Ghats or Himalayan region or both. In updating this human knowledge of distribution of these butterflies, Chhattisgarh has now been established to be a critical link in connecting two biodiversity hotspots of the world. A finding of a population of Small Cupid in Chhattisgarh has indicated an eastward extension to the global distribution of this species. In the current scenario of global warming, eastward extensions of South Asian fauna are very unusual, since most recent range extensions follow a trend of east to west extension of range.

Learn the Systems of Nature

The journey of consciously realizing the scientific World of biodiversity has been, in retrospect, an expected eventuality. As biology was the only subject dealing with life forms in school, I have come to realise that my understanding of biodiversity developed outside of books through real life observations. While I found the diagrams and charts in school books extremely tedious and uncomfortable to memorise, learning names and common behavior of life forms outside and beyond the school curriculum developed as more dominant nature.

My family's primary livelihood since generations comes from farming. I had the good fortune to be closer to the countryside, in farms adjoining forests where my grandparents worked. When your livelihood from generations is dependent on natural factors and you're moving around in the countryside, we tend to have greater interactions with non-human species and draw co-relations with abiotic and biotic factors responsible for their presence or absence at a given time. Guided by livelihood it becomes necessary to figure out how nature functions. By understanding the conditions supporting various life forms like birds, insects, mammals and so on, it culminates into an understanding of how a natural system functions as a whole. Consolidating these factors, it becomes a pool of knowledge which gets passed on to future generations for greater public good.


मेरा पहला चमत्कार

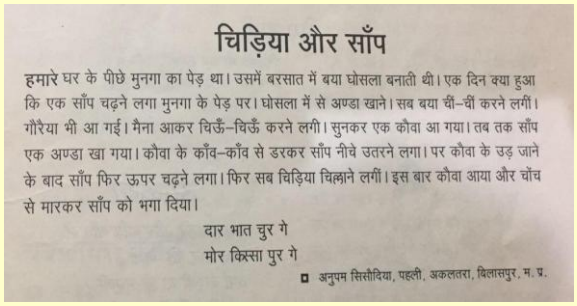
चिड़िया और साँप

हमारे घर के पीछे मुनगा का पेड़ था उसमे बरसात में बया घोसला बनाती थी एक दिन क्या हुआ एक साँप चढ़ने लगा मुनगा के पेड़ पर। चौकना मे से अंडा खाने। सब बया-चीं-चीं करने लगी। मौरिया भी आ गई मैना आकर चिऊँ-चिऊँ करने लगी खुश कर कौवा आ गया तब तक साँप एक अंडा खा गया। कौवा के काँव से साँप डरकर नीचे उतरने लगा पर कौवा के उड़ जाने के बाद साँप फिर ऊपर चढ़ने लगा। फिर सब चिड़िया चिल्लाने लगी। इस बार कौवा आया अपने पाँव मार कर साँप को भगा दिया।

दार भात चुर गे
मोर किस्सा पुर गे

अनुपम सिसौदिया पहली कक्षा बिलासपुर

First Scientific Note/ Observation



चिड़िया और साँप

हमारे घर के पीछे मुनगा का पेड़ था। उसमें बरसात में बया घोसला बनाती थी। एक दिन क्या हुआ कि एक साँप चढ़ने लगा मुनगा के पेड़ पर। घोसला में से अण्डा खाने। सब बया चीं-चीं करने लगीं। गौरैया भी आ गई। मैना आकर चिऊँ-चिऊँ करने लगी। सुनकर एक कौवा आ गया। तब तक साँप एक अण्डा खा गया। कौवा के काँव-काँव से डरकर साँप नीचे उतरने लगा। पर कौवा के उड़ जाने के बाद साँप फिर ऊपर चढ़ने लगा। फिर सब चिड़िया चिल्लाने लगीं। इस बार कौवा आया और चोंच से मारकर साँप को भगा दिया।

दार भात चुर गे
मोर किस्सा पुर गे

◘ अनुपम सिसौदिया, पहली, अकलतरा, बिलासपुर, म. प्र.

First Publication

Thus, for example we can say that the Pintails migrate to our region in winters and we expect to have Indian Pitta during the summers. This becomes a body of reliable facts, or rather what we understand today as science. I learned systems of nature in this context, and when there is a change in this system, for example if the Indian Pitta doesn't arrive in summers, we can quickly point it out and when the change is consistent or prolonged we are able to assign factors leading up to the change like loss of habitat, change in temperature, rainfall and so on. so that corrective measure can be taken.

Earn a Fortune

Moving along my undergraduate degree, B.A. (Program) in Economics taught me the distribution of scarce resources and its interaction with factors of production at the micro and macro level and my post graduate degree in Sustainable Development Practices gave me a managerial insight into how development rests on natural resources which is scarce.

As an employee of Leadership for Environment and Development (LEAD)- India since 2013, my nature of job involves working with the finest minds in our country. Various field assignments have taken me to the remotest corners of our country where I accumulated a fortune in my mentors.

I have been lucky to have mentors who have showed faith in me and never let me overlook my smallest of mistakes and have shown me the larger picture through otherwise neglected events. Mr. ParagRangnekar, from Goa, formally introduced me to butterflies in the forests of Nagaland. Our Director Bhawana encouraged me and created a space for me to pursue my interest in studying life forms. Casual bird watching trips with colleagues and their children has now been transformed into multiple nature walks for kids and people from all walks of life, where the range of participants is from age 6-60 years. Such nature walks became a basis for engagement of people with natural surroundings whose livelihoods are not dependent directly on natural factors, and for me a basis to

integrate educational institutions, industries and government departments in my activities.

During the above ongoing developments, I happened to meet Mr. Peter Smetacek, Founder Butterfly Research Center. It is through him I learned the finer nuances of life forms, including that of me as well and of course, butterflies.

Keystone to Contributing to Science

By talking about these experiences, I want to lay emphasis on that you have the responsibility of understanding what's going on around you in nature; by becoming people who we can ask and rely upon your regional, constantly monitored knowledge as reliable facts. It is your knowledge which would become our power in conservation of biodiversity as we cannot conserve till the time we know what exists, where it exists and how it exists. It is afterall transfer of this knowledge base which becomes the cornerstone of survival of any species or any civilization. If this knowledge base is corrupted, the civilization starts to go down.

Once you undertake the responsibility of and familiarise yourself with the subject, it naturally translates into identifying gaps in knowledge and ultimately filling those gaps.I could make new discoveries and add to the body of existing human knowledge by just becoming familiar with the biodiversity of my surroundings. It did not require huge equipments or laboratories, all it needed was a basic understanding of the subject which is the keystone to contributing to science. That is when your knowledge would understanding what's going around you in nature become our power. I would end by saying, we live in a tropical country which is a biologists dream, keep a watch of your surroundings. You are a part of a dynamic natural system, do not let marks, financial or educational background draw a boundary around what you can do. And lastly, engage more with people who you think are living their life well rather than making efforts to engage with people who the world thinks are successful.

R&D BASED PRODUCT DEVELOPMENT AND CONSULTANCY SERVICES AT SIES IIEM

- Mass production and commercialization of novel cultures of beneficial microorganisms having potential in N fixing, P solubilizing, Zn solubilizing, endophytes, AM Fungi, degraders of cellulosic materials and activated sludge process.
- Development of microbial products for improving climate change adaptation of crops and stress resistance.
- Extraction and commercialization of enzymes for pharma and food industry.
- Accreditation of lab from CPCB and NABL

Biodiversity Importance and Conservation

Dr. Sandeep Bhanot
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1. INTRODUCTION

(a) What is Bio-diversity?

The concept of biodiversity (synonymous with biological diversity) has been known to man ever since he began to minutely observe the living being around him. The term biological diversity was used by Robert E. Jenkins and Thomas Lovejoy in 1980. The word biodiversity itself may have been coined by W. G. Rosen in 1985. At about that time, as people became more aware of the extinction crisis, biodiversity emerged as a significant issue. It was given concrete expression in the World Resources Institute (WRI), World Bank (WB), International Union of Nature and Natural Resources (IUCN) and World Wide Fund for Nature (WWF) publications concerned with conservation of world's biological diversity. However, biodiversity did not become a familiar term to general public until the United Nations Conference on the Environmental and Development (UNCED) held at Rio de Janerio (Brazil) in 1992. The Conference laid immense stress on the biological diversity of our planet Earth and the need to preserve it for posterity. It defined the biodiversity: 'Biodiversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.' This is the single legally accepted definition of biodiversity adopted by the UN convention on Biological Diversity.

The most straight forward definition of biodiversity is the variation of life at all levels of biological organization. It includes diversity of forms right from the molecular unit to the individual organism, and then on to the population, community, ecosystem, landscape and biosphere levels. In the simplest sense, biodiversity may be defined as the sum total of species richness, i.e. the number of species of plants, animals and microorganisms occurring in a given region, country, continent or the entire globe. Broadly speaking, the term biodiversity includes genetic diversity, species diversity, ecosystem diversity and habit diversity.

(b) Types of bio-diversity

Genetic diversity (Diversity of genes within a species): Genetic diversity refers to the variation of genes among the population and the individuals of the same species. There are about 1.7 million known species of living forms on the earth. Each one stores an immense amount of genetic information. For example, the number of genes is ~35,000 in Homo sapiens.

Genetic diversity provides the raw materials for adaptation to changing environment and for the natural selection to act upon. If a species has more genetic variability, it can adapt better to the changed environment. The amount of genetic variation is the basis of the evolution of new life forms (speciation). It has a key role in the maintenance of biodiversity at species levels.

Species diversity (Diversity among species): It refers to the variety of species within a region, i.e. the number of species per unit area at the site (species richness). An estimated 1.7 million species have been described to date. Species are the primary focus of evolutionary mechanisms and therefore the origin and evolution of species are principle agents in maintenance of global biodiversity.

Ecosystem diversity (Diversity at the level of community/ecosystem): In an ecosystem there may exist different landforms, each of which supports different but specific vegetations. Ecosystem diversity in contrast to genetic and specific diversity is difficult to assess quantitatively since the boundaries of the communities, which constitute the various sub-ecosystems are elusive. Ecosystem diversity could best be understood if one studies the communities in various ecological niches within the given ecosystem; each ecosystem is associated with defined species complexes.

These complexes are related to composition and structure of the ecosystem.

Habitat diversity: It involves more than just the kind of communities and species- it depends on the spatial arrangement of habitats across a large area and on the fluxes of energy, nutrients, disturbances and organisms across the area.

Species diversity in natural habitats is a high in warm areas and decreases with increasing latitude and altitude. On land, diversity is higher in areas of higher rainfall and lower in drier areas. Tropical moist forests undoubtedly, are the richer areas. These comprise only 7% of the world surface area, but contain over 90% of all species.

In India we are endowed with a rich diversity of biogeographically distinct regions due to varying physical conditions and species groupings.

2. LITERATURE REVIEW: Dr. Graham Tucker (2005) in his study has found that corporate performance measurement systems developed so far are of limited direct relevance to corporate needs. This is primarily because of the difficulties associated with measuring biodiversity. Most systems that have been developed or recommended for biodiversity conservation performance measurements have focussed on indirect indicators that measure inputs, activities, processes or outputs, rather than impacts. Those that do suggest direct indicators of the state of biodiversity are very broad and ill-defined, and need to be refined and focussed on relevant project-specific issues.

Anke Fischer & Juliette C. Young (2007) in their study highlight that a better understanding of individuals' mental constructs of biodiversity, which are linked to their attitudes towards biodiversity management, is essential for the design of bio-diversity related policies that are supported by the public.

Alok Kumar Chandrakar (2009) in his paper overviews the biodiversity status of India, its importance, threats to it and various approaches for biodiversity conservation, action plan and current status have been discussed.

Roseli Pellens, Irene Garay and Philippe Grandcolas (2009) explained that the Brazilian Atlantic forest is a hotspot of biodiversity, characterized by its high species richness, level of endemism and danger of extinction. Their purpose were: 1) characterize the evolution of the forest fragmentation in this region, the present situation of its remnants, and the main strategies, conflicts and potentials for conservation; 2) evaluate the conservation value of the forest fragments based on a study of the community of a group of insects – the community of Blattaria; 3) integrate these information to propose guidelines to resolve potential conflicts based on positive and non-conflictual conservation recommendations.

Alexandar Ramadoss & Gopalsamy Poyyamoli (2011) explain that promoting students' commitment to protect local biodiversity is an important goal of education for sustainable development in India and elsewhere. The main focus of the biodiversity education was to create knowledge, interest and necessary skills to solve various biodiversity problems with reference to the local context. In order to develop the biodiversity consciousness among students, the action-oriented biodiversity education methods were identified in this study such as active classroom sessions, hands-onactivities, experiential education, and field exposures that are vital to achieve sustainable biodiversity knowledge and motivate to protect and conserve local biodiversity.

Chaurasia Girdhari L. &KumariVineeta (2015) in their review paper focus on the different types of biological diversity found on ecosystems and loss of biodiversity and species, richness of ecosystem and various causes of the loss of biological diversity due to anthropogenic as well as natural processes. They also mentioned the different tools and techniques for biodiversity databases creation, database management and interpretation for biodiversity conservation and management were studied.

In the paper by L.C. De & D.R. Singh (2015), region wise bio-diversities of different orchid species in India and its conservation through legislative measures, ex- situ and in- situ ways and bio-piracy of endangered species have been reviewed.

3. OBJECTIVES:

1. To understand the meaning and importance of bio-diversity

2. To understand different bio-diversity conservation methods

4. METHODOLOGY: The study is based on secondary research from various research papers

from the net which explain the meaning and the importance of bio-diversity and different methods used for its management and conservation.

5. FINDINGS FROM SECONDARY DATA

(a) The benefits of Biodiversity to mankind are:

1. Ecological role of biodiversity

All species provide some kind of function to an ecosystem. They can capture and store energy, produce organic material, decompose organic material, help to recycle water and nutrients throughout the ecosystem, control erosion or pests, fix atmospheric gases, and help regulate climate. These physiologically processes are important for ecosystem function and human survival.

A more diverse ecosystem is better able to withstand environmental stress and consequently is more productive. The loss of a species is thus likely to decrease the ability of the system to maintain itself or to recover from damage or disturbance. Just like a species with high genetic diversity, an ecosystem with high biodiversity may have a greater chance of adapting to environmental change. In other words, the more species comprising an ecosystem, the more stable the ecosystem is likely to be.

2. Economic role of biodiversity

For all humans, biodiversity is first a resource for daily life. One important part of biodiversity is crop diversity, which is also called agrobiodiversity.

Most people see biodiversity as a reservoir of resources to be drawn upon for the manufacture of food, pharmaceutical, and cosmetic products.

Some of the important economic commodities that biodiversity supplies to humankind are:

 Modern agriculture: Biodiversity is used as a source of material for breeding improved varieties, and as biopesticides, biofertilizers etc.

 Food: Crops, livestock, forestry and fish. Mangroves and coral reefs in coastal zone support fisheries.

 Medical drugs: Wild plant species have been used for medicinal purposes since before the beginning of recorded history. For example, quinine comes from the cinchona tree (used to treat malaria), digitalis from the foxglove plant (chronic heart trouble), and morphine from the poppy plant (pain relief). According to the National cancer Institute, over 70% of the promising anticancer drugs come from plants in the tropical rainforests. It is estimated that of the 2,50,000 known plants species, only 5,000 have been investigated for possible medical applications.

 Industry: Fibres are used for clothing, wood for shelter, energy and various other uses. Biodiversity may be a source of energy (such as biomass). Other industrial products are oils, fragrances, dyes paper, waxes, rubber, latexes, resins, poisons, and cork, which all can be derived from various plant species. Supplies from animal origin include wool, silk, fur, leather, lubricants and waxes. Animals may also be used as a mode of transport.

3.Aesthetic and cultural benefits

Biodiversity has great aesthetic value. Examples of aesthetic value include eco-tourism, bird watching, wildlife, gardening, etc. Eco-tourism is a source of economical wealth for many areas, such as many parks and forests, where wild nature and animals are a source of beauty and joy for many people. Biodiversity is also part of many cultural and religious beliefs. In many Indian villages and towns, plants like *Ocimum sanctum* (Tulsi), *Ficus religiosa* (Pipal), and *Prosopis cineraria* (Khejri) and various other trees are considered sacred and worshipped by the people. Several birds, animals and even snake have been considered sacred. Also, we recognize several animals as symbols of national and heritage.

4. Scientific role of biodiversity

Biodiversity is important because each species can give scientists some clue as to how the life evolved and will continue to evolve on Earth. In addition, biodiversity helps scientists understand how life functions and the role of each species in sustaining ecosystems.

From above it is clear that the survival and well-being of the present-day human population, depends on several substances obtained from plants and animals. The nutritional needs of mankind are also met by wild and domesticated animal and plant species. Indeed, the biodiversity in wild and domesticated form is the source for most of humanity's food, medicine, clothing and housing, much of the cultural diversity, and most of the intellectual and spiritual inspiration. It is, without

doubt, the very basis of man's being. It is believed that 1/4th of the known biodiversity, which might be useful to mankind in one way or the other, is in serious risk of extinction. This calls for an integrated approach for conserving global biodiversity.

(b) Threat to Biodiversity

The loss of biological diversity is a global crisis. There is hardly any region on the Earth that is not facing ecological catastrophes. Of the 1.7 million species known to inhibit the Earth (humans are just one of them), one third to one fourth is likely to extinct within the next few decades. Biological extinction has been a natural phenomenon in geological history. But the rate of extinction was perhaps one species every 1000 years. But man's intervention has speeded up extinction rates all the more. Between 1600 and 1500, the rate of extinction went up to one species every 10 years. It is estimated that about 50 species are being driven to extinction every year, bulk of them in tropical forest, due to human interference.

(c) Reasons for extinction of Biodiversity

1. Destruction of habitat: The natural habitat may be destroyed by man for his settlement, grazing grounds, agriculture, mining, industries, highway construction, drainage, dam building, etc. as a consequence of this, the species must adapt to the changes, move elsewhere or may succumb to predation, starvation or disease and eventually die. This is the most pervasive threat to birds, mammals and plants affecting 89% of all threatened birds, 83% of the threatened animals assessed. In our country, several rare butterfly species are facing extinction with the uncannily swift habitat destruction of the Western Ghats. Of the 370 butterfly species available in the Ghats, up to 70 are at the brink of extinction.

2. Hunting: From time immemorial, man has hunted for food. Commercially, wild animals are hunted for their products such as hide and skin, tusk, antlers, fur meat, pharmaceuticals, perfumes, cosmetics and decoration purposes. For example, in India, rhino is hunted for its horns, tigers for bones and skin, musk deer for musk (have medicinal value), elephant for ivory, gharial and crocodile for their skin, and jackal for thriving fur trade in Kashmir. One of the most publicized commercial hunts in that of whale. The whalebone or 'baleen' is used to make combs and other products. Poaching of the Indian tiger has been risen because of the increasing demand from pharmaceutical industries, which consume the bones of 100 tigers per year. Such huge demand has been met by poachers from India. Even the Project tiger Programme failed to check poaching and resultantly the tigers have been almost disappeared from Ranthambore and Keoladeo national parks. Smuggling of tiger bones and skins is a lucrative business. Hunting for sport is also a factor for loss of wild animals.

3. Over exploitation: This is one of the main causes of the loss of not only economic species but also biological like the insectivorous and primitive species needed for teaching or laboratory (like Nepenthes, Gnetum, Psilotum, etc.). Commercial exploitation of wild plants has invariably causes their overuse and eventual destruction. This has been true in case of Indian wild mango trees, which were turned into plywood as of the whales that were hunted for tallow. Faunal losses have been mainly because of over-exploitation. For instance, excessive harvesting of marine organisms such as fish, molluscs, sea cows and sea turtles has resulted in extinction of these animals.

4. Collection for zoo and research: Animals and plants are collected throughout the world for zoo and biological laboratories for study and research in science and medicine. For example, primates such as monkey and chimpanzees are sacrificed for research as they have anatomical, genetic and physiological similarities to human being.

5. Introduction of exotic species: Native species are subjected to competition for food and space due to competition for food and space due to introduction of exotic species. For example, introduction of goats and rabbits in the Pacific and Indian regions has resulted in destruction of habitats of several plants, birds and reptiles.

6. Control of pest and predators: Predator and pest control measures, generally kill predators that are a component of balanced ecosystem and may also indiscriminately poison non-target species.

7. Pollution: Pollution alters the natural habitat. Water pollution especially injurious to the biotic components of estuary and coastal ecosystem. Toxic wastes entering the water bodies disturb the food chain, and so to the aquatic ecosystems. Insecticides, pesticides, sulphur dioxide, nitrogen oxides, acid rain, ozone depletion and global

warming too, affect adversely the plant and animal species. The impact of coastal pollution is also very important, it is seen that coral reefs are being threatened by pollution from industrialization along the coast, oil transport and offshore mining. Noise pollution is also the cause of wildlife extinction. According to a study Arctic whales are seen on the verge of extinction as a result of increasing noise of ships, particularly ice breakers and tankers.

8. Deforestation: One of the main causes for the loss of wildlife is population explosion and the resultant deforestation. Deforestation mainly results from population settlement, shifting cultivation, development projects, demand for fuel wood, demand of wood as a raw material for many industries such as paper and pulp, match, veneer and plywood, furniture etc. In the Country, the current rate of deforestation is 13,000 sq. km annually. If this rate of deforestation continues, one can imagine the ultimate fate of our forest and biological richness. It is presumed that in coming years, the global loss of biodiversity from deforestation alone would be 100 species every day.

9. Other factors: Other ecological factors that may also contribute to the extinction of wildlife are as follows:

i. Distribution range – The smaller the range of distribution, the greater the threat of extinction. ii. Degree of specialization – The more specialized an organism is, the more vulnerable it is to extinction.

iii. Position of the organism in the food chain – The higher the position of the organism is in food chain, the more susceptibility it becomes.

iv. Reproductive rate – Large organisms tend to produce fewer offspring at widely spaced intervals.

v. Outbreaks of diseases – it is also one of the major causes for the decline in wildlife species. vi. Loss of gene flow – The individuals of plant and animal life may decline to the significant levels as a result of loss of gene flow.

vii. Substitution – During the process of evolution an existing species may be replaced by ecologically another one.

In developing counties like India, the development policies and projects have rarely been sensitive to the need for biodiversity conservation, and that of the local communities. The government's failure to remove poverty and curb middle-class consumerism has led to conditions in which sensible natural resources management assumes low priority**.**

(d) BIODIVERSITY CONSERVATION METHODS

We must make every effort to preserve, conserve and manage biodiversity. Protected areas, from large wilderness reserves to small sites for particular species and reserves for controlled uses, will all be part of this process. Protected areas are legally established sites managed for conservation of biodiversity. Worldwide about 8,163 protected areas cover over 750 million hectares of marine and terrestrial ecosystems, amounting to 1.5 percent of Earth's surface.

India is the second most populous country, and therefore any plan attempting at conservation must consider socio-economic development as the mounting human pressure threatens the biotic resources of the country. Furthermore, ours is predominantly an agriculture country, and hence, policy makers should realize that conservation and sustainable utilization of biodiversity is the key to all developmental planning projects.

(e) ACTION PLAN

To conserve the biodiversity, the immediate task will be to devise and enforce time bound programme for saving plant and animal species as well as habitats of biological resources. Action plan for conservation, therefore, must be directed to:

 Inventorization of biological resources in different parts of the country including the island ecosystem;

 Conservation of biodiversity through a network of protected areas including National Parks, Wildlife Sanctuaries, Biosphere Reserves, Tiger Reserves, Marine Reserves, Gene Banks, Wetlands, Mangroves, Coral Reefs, etc.;

 Rehabilitation of rural poor/tribes displaced due to creation of protected areas; Conservation of micro-organisms which help in reclamation of wastelands and revival of biological potential of land;

 Protection and sustainable use of genetic resources/germplasm through appropriate laws and practices;

 Regular access to biological resources of the country with the purpose of securing equitable share in benefits arising out of the use of biological resources and associated knowledge relating to it;

 Control of over-exploitation through TRAFFIC, CITES and other agencies, and also through treaties/protocols//environmental protection laws at National/International level;

 Protection of domesticated plant and animal species in order to conserve indigenous genetic diversity;

 Maintenance of corridors between different nature reserves for the possible migration of species in response to climate, or any other disturbing factor;

 Support for protecting traditional skills and knowledge for conservation;

 Multiplication and breeding of threatened species through modern techniques of tissue culture and biotechnology;

 Discouragement of monoculture introduction; and

 Restriction on introduction of exotic species without adequate investigations.

During the last twenty years, plans for biodiversity conservation have been developed by the WRI (World Resources International) and the IUCN (International Union for Conservation of Nature and Natural Resources) with support from World Bank and other institution. Basically, the conservation plan should have a holistic approach and encompasses whole spectrum of biota and activities ranging from ecosystems at the macro level to DNA libraries at the molecular level. There are two approaches of biodiversity conservation namely in situ (on site) conservation which tries to protect the specie where they are, i.e., in their natural habitat and ex situ (off site) conservation which attempts to protect and preserve a species in place away from its natural habitat.

6. CONCLUSIONS

It is imperative that the phenomenon of biodiversity is very vast, complex and interdependent and there is no single over-arching effect of diversity on either productivity or stability. The realized effects will depend heavily on environmental context and the time scale over which the effects are studied. However, it has become obvious that biodiversity is indeed important for both managed and natural ecosystems, though the relative contributions of diversity and composition remain unclear. It is therefore necessary for legislators to understand the basic science in order to maintain diversity at its current levels. If current human growth and resource management patterns do not change, it is likely that we will lose many important species, and the ecosystems of the world may never recover. Human is only one more of natural creatures and should not be alien to the other life-forms. We have no moral right to destroy nature and other beings that dwell on earth. We should treat all animals and plants with compassion. Every individual can make a small and yet significant effort in the race to save our planet and conserve biodiversity.

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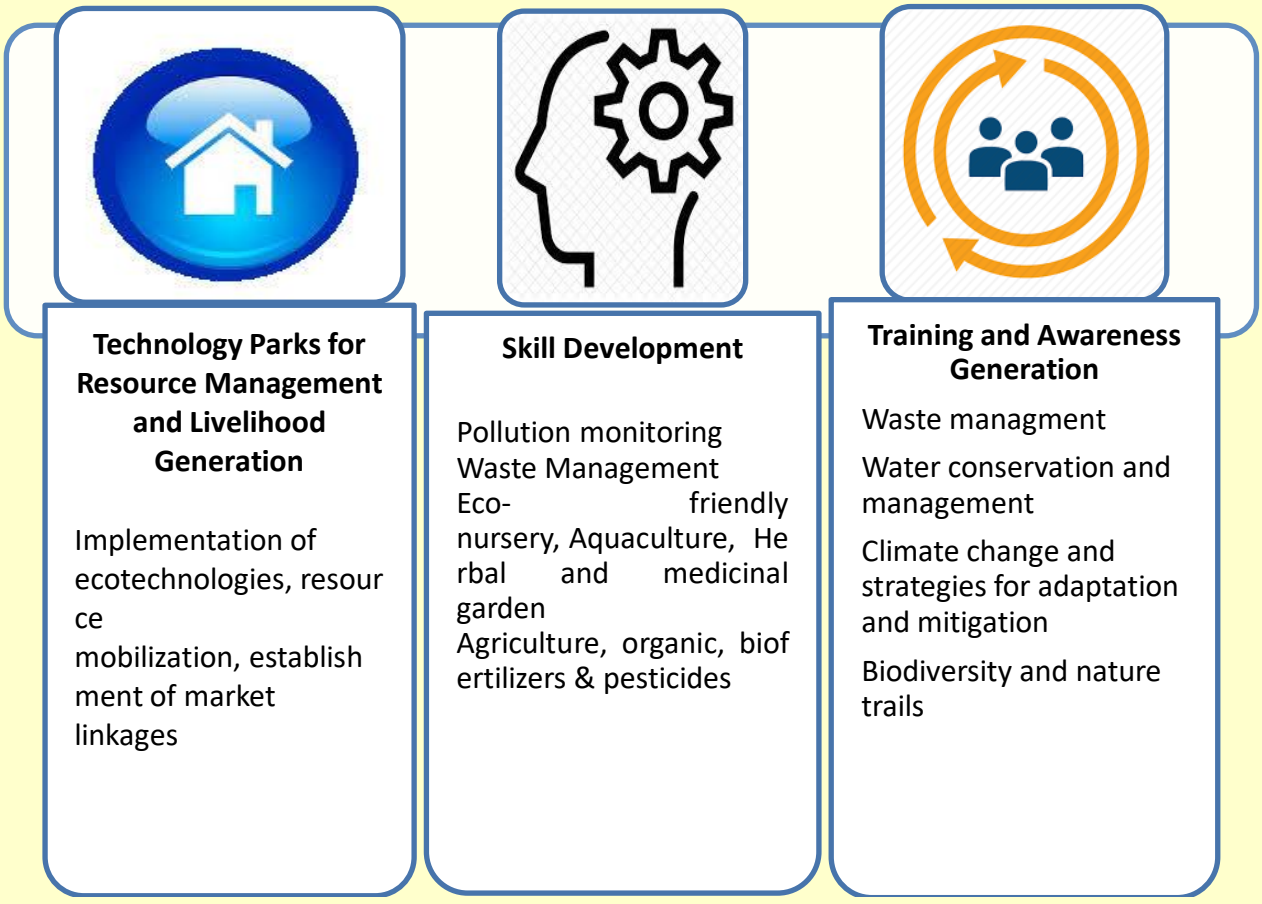
MAJOR AREAS COVERED UNDER OUTREACH ACTIVITIES AND COMMUNITY MOBILIZATION AT SIES IIEM



Microbial Biodiversity: Conservation and Management

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Biodiversity is one of the earth's greatest treasures and so the micro-oganisms. Microbial diversity includes algae, fungi, bacteria, archaea, protozoa and viruses Microbes are ubiquitous. They can exist in most inhospitable habitats with extremes of temperatures, pH, water and salt stress.

Microbes have a huge impact on our lives. They are crucial for nutrient cycling, food webs, energy flows, degradation of toxic materials antibiotics, fermented foods and industrial products including enzymes, biofertilizers and biofuels. They are the key players in climate change mitigation. Understanding their role in the environment is important for maintenance of our planet.

It is estimated that more than 1 trillion (10^{12}) species of microbes exist on this earth. Out of this only 1-5 % of the species are characterised. As far as the bacteria are concerned very few can be cultured in the laboratory. Thus, our knowledge of the species and their structure and function in the environment is poor. We need to explore various ecosystems to tap these resources.

Over the last few years, extinction of various organisms due to due to pollution, over industrialization increased human encroachments in deep areas in forests, introduction of predators and competitors has taken place. This has resulted in loss of balance in the ecosystem.

It is therefore necessary to preserve the biodiversity for sustainable development. There are various technologies to achieve this. These are classified as In – situ and ex-situ technologies.

For microorganisms, ex-situ technologies are very commonly used. These include culture collections, gene banks and repositories. The first microbial culture collection was established in France in 1890 by Prof. Frantisek Karl at the German University of Prague. Today we have 568 culture collections distributed in 68 countries throughout the world. These culture collections not only preserve and supply live cultures of bacteria but also provide identification services and preserve all the data of the known microorganisms. Some of the culture collections are specialized for prevention of industrially important cultures some for anaerobic cultures, pathogens, etc. Some examples include American Type Culture Collection, DSMZ (German Culture Collection), Microbial Culture Collection at IMTECH, Chandigadh, India and NCIM at NCL Pune. All these culture collections are registered inWorld Data Center for Microorganisms (WDCM).

The Ex situ technologies are expensive. The approximate cost of preservation of one culture is estimated as Euro10000.However, these technologies are successful in conserving microbes which are commercially important.

The in-situ preservation techniques are not so common for bacteria for various reasons. Although microorganisms are known to play critical role in ecosystem functioning, there are huge gaps in our understanding of the microbial

communities and relevance of microbial diversity in ecosystem functioning, particularly there is lack of adequate diversity assessment, no clear biogeographical patterns of distribution of microbial species, inability to link diversity to functioning and lack of knowledge on functional redundancy, resilience and resistance of microbial communities. However, it is well demonstrated that loss of microbial diversity in an ecosystem affects the productivity in terms of ecosystem services and multifunctionality of the ecosystem.

Various molecular, genomic, proteomic and metagenomic techniques have been developed in the recent years to assess the microbial diversity and its functioning in an ecosystem.

However, the present situation is grim. As far as the microbes are concerned, we don't know what to conserve and we also don't know what we have lost from various ecosystems. Perhaps this is the reason microbial diversity is yet to come on the forefront of biodiversity conservation policy and management.

Extensive studies especially on a long term basis are necessary for better understanding of microbial biodiversity, its ecosystem functioning, conservation and management.

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CSR – Contributing to Biodiversity Conservation in India

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India, the concept of corporate social responsibility, (CSR) has always been embedded in the tradition of philanthropy and has focused on education, health and religious activities. With introduction of Section 135 of Companies Act 2013, Government of India mandated CSR for large companies through a defined framework. India is one of the mega-biodiverse countries in the world, and requires significant resources (financial, capital, human and natural) guided by dedicated efforts to conserve and manage the broad spectrum of wildlife and biodiversity it holds. As per the India CSR Reporting Survey, the total CSR expenditure of the top N100 companies in India towards Environmental Sustainability Initiatives for the past two years is approximately INR 1200 Cr. And as per ***The Biodiversity Finance Initiative***, only 2-3% of India's total CSR funding goes towards biodiversity related activities. Several CSR supported conservation initiatives are being undertaken in India, both pre and post introduction of the CSR Act, a few noteworthy examples can be glanced here.

Save the Whale shark Initiative (SWI) was taken up by Tata Chemicals in 2004, in partnership with the Wildlife Trust of India and Gujarat State Forest Department. The initiative was undertaken for the conservation of the rare and endangered whale shark species, and involved studying the behaviour and migratory pattern of the species & creation of awareness regarding need for conservation of the species among the coastal communities of Saurashtra region. The initiative has successfully changed the perception of giant fish as just a source of meat, flesh and oil, to the 'daughter of Gujarat' which returns home from her in-laws to give birth to little ones.

Tata Consultancy Services led '***The Marine Turtle Conservation Programme'*** along with the coastal villages of Maharashtra. Through this project,113 nests and a large breeding population of endangered (female) Olive Ridley turtles were protected. This project resulted in successful translocation of 12,119 eggs of the species to hatchery, and a release of 6075 hatchlings into their natural habitats.

Tata Housing is engaged in tiger conservation across six landscapes of India, viz. Terai Arc, Sundarbans, Satpuda–Maikal, North Bank, Kaziranga KarbiAnglong and the Western Ghats and also associated with snow leopard conservation in Ladakh along with WWF as the implementation partner. The support in these initiatives involves training the forest staff and providing them with protective gear to curb poaching, provision of patrolling equipment of forest staff and awareness creation among the public about the vulnerable species.

The Muthoot Group – Human–elephant conflict management programme collaborated with Implementation partners for managing Human–Elephant Conflict and protecting elephant habitats across six India states. The company through its CSR funding is supporting development and training of anti-depredation squads across elephant attack-prone areas in these states, installation of low-cost solar fences in villages and electric fencing around agricultural fields, use of infrared sensors and alarms.

Rio Tinto and BNHS have partnered since 2014 with the aim to protect the Indian vulture population by setting-up a 'vulture safe zone' of about 32,000 sq. km around Bunder Diamond Project area in Madhya Pradesh. The project has adopted a multipronged approach in which apart from monitoring and tracking of vulture population, awareness among local people about vulture conservation was also raised.

Sony India has worked towards conservation of the Red Panda in Sikkim, West Bengal and Arunachal Pradesh. The project focused on estimating the population status and generating baseline data. Other objectives were study of ecology, habitat requirement and potential threats; development of mitigation measures to prevent and manage human wildlife conflicts, running sustainable livelihood

programmes for local communities of the region and others.

Godrej and Boyce set up the ***Marine Ecology Centre*** with an objective of marine diversity through research, education, raising awareness and regular monitoring. This Centre today supports several marine faunal species of fishes, crabs, prawns and molluscs. It is home to rich terrestrial fauna species, including birds, reptiles, spiders, mammals and over several different species of butterflies. The Centre is continuously engaged in running research projects on ecology and restoration of mangroves, and also works on increasing awareness among the community through education.

A conference on CSR & Biodiversity organized by the ***Maharashtra State Biodiversity Board and UNDP*** in 2019 to discuss opportunities for CSR Investment in priority areas of biodiversity conservation and management of Maharashtra indicates the scope for collaboration of various stakeholders in this direction.

Considering the relatively large and ever-increasing ecological footprint of companies both in rural and urban areas, it becomes more binding on them to contribute with a modest investment to overall prospects of biodiversity conservation. The CSR Act provides an excellent framework for engaging the corporates in identifying the conservation needs and fulfilling their responsibility towards nature. Also networking with external stakeholders is increasing, but still development of internal commitment for the CSR on biodiversity and ecosystems still remains challenging. Biodiversity is yet a difficult and exploratory subject for business to address through CSR, since it is intangible and holistic to catch in a single indicator. Though there are few concrete examples of corporate initiatives to conserve biodiversity; the dominant activity remains is networking with primary and secondary stakeholders. The future course for improving and enhancing the role of CSR towards biodiversity conservation will involve a mixture of approaches such as imposing through company level policies, networking with agencies working on development of standards & platforms, strategic partnerships with NGOs working on related projects and sponsoring nature organizations for their varied and complex requirements. Corporates through their CSR efforts can align with National Priorities and Government bodies such as ***National Biodiversity Authority*** and also towards NITI Aayog's efforts to track the nation's progress on through ***SDG India Index*** on SDGs – 1, 2,6, 7,11, 12,13,14,15 & 17.

Biodiversity Conservation and Management Aspects in India

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"Biodiversity is our most valuable but least appreciated resource." Yes, it is the bitter fact quoted by a great socio-biologist, Mr. Edward Wilson, who popularised the term, Biodiversity.

The global assessment report on biodiversity and ecosystem services by Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019) has indicated that the rate of global change in nature during past 50 years is unprecedented in human history. The drivers of change in nature have been changes in land use pattern, resource exploitation, climate change, pollution etc. It is also highlighted that about 1 million species today face threat of extinction[1]. Many may be extinct within decades if the intensity of drivers of loss of biodiversity is not reduced.

Biodiversity conservation has become a global concern today. There are two issues linked with rapid loss of biodiversity all over the globe, i.e. world-wide deforestation for various purposes beneficial to humans and global climate change. In addition to loss of biodiversity the ecosystem damage also has economic effect on humans. Nations with rich biodiversity reflect their good state of ecological health and also less economic dependence on other nations. Therefore although the biodiversity conservation is a global concern it is a goal of immense importance at national level.

Geographic regions with rich biodiversity are recognized as biodiversity hotspots.There are 34 identified biodiversity hotspots all over the world out of which India hosts four hotspots, namely, Western Ghats, North eastern Indo-Burma region, Himalaya and Sundaland (Nicobar Islands). India is home to over 45,000 plant species and 91,000 animal species (IUCN). Variety of ecosystems found in India such as forests, grasslands, wetlands, deserts, coastal ecosystem are result of country's diverse physiographic and climatic conditions.

India accounts for 7-8% of recorded species from the world with many endemic species of reptiles, amphibians and birds. 10% of recorded species are threatened. Many are endangered too. The causes for increasing loss of biodiversity in India are habitat loss, climate change, over exploitation, change in land use, introduction of alien species, hunting, rising pollution levels etc.

Large number of initiative have been taken up by Indian government at national and international level for conserving biodiversity. Some of the acts passed by Indian government for protection and conservation of biodiversity are Indian Forests Act (1927), Prevention of cruelty to animals (1960), Wildlife protection act (1972), Forest Conservation Act (1980), National Forest Policy (1988), Biological diversity act (2002), Wetland (Conservation and Management) Rules (2010) etc. National Biodiversity Authority was established in 2003 for implementing the Biological diversity act. Financial and technical assistance is extended to the State Governments under various centrally sponsored schemes for protecting and conserving wildlife such as Integrated Development of Wildlife Habitats, Project Tiger (1973) and Project Elephant (1992),Project Crocodile(1975), Conservation Project for Musk Deer (1974) etc.Also India is signatory to international conventions related to conservation and management of biodiversity such as Convention on Biological Diversity, Conservation of Migratory Species of Wild Animals, Convention on International Trade in Endangered Species of Wild Fauna and Flora. In India conservation of

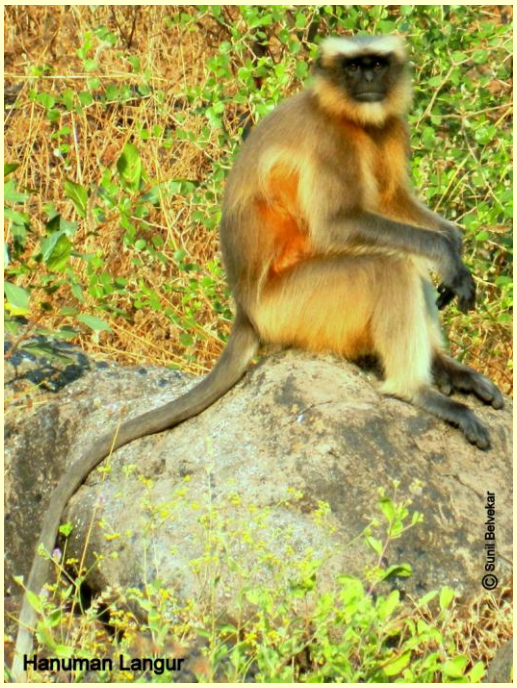
[1] Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2011), IPBES.

biodiversity has been part of tradition. Conservation and management efforts towards biodiversity are being practised traditionally and they reflect now in policies too.

Well, there are countless economic benefit from nature that humans are enjoying such as food, firewood, industrial products, construction material, fibres, medicinal products etc. Apart from these there are ecosystem services such as maintaining global temperature, natural air cleaning, pollination etc. Can we imagine cost of pollination without natural pollinators, Honey bees? Just can't imagine that, right? That's where biodiversity come into play. Now all this can be ensured to continue to be available for mankind only by conserving the ecosystems and thereby conserving the biodiversity. Also benefits of the biodiversity are required to be utilised in sustainable manner to avoid over exploitation.

There are two basic approaches of conservation namely, "*in situ*" and "*ex situ*". *In situ* conservation involves providing protection to species in their natural habitat. National parks, sanctuaries, biosphere reserves, reserved forests are means of *in situ* conservation. Whereas, *ex situ* conservation involves protecting species in artificial environment such as in a zoo, botanical garden, seedbank, gene bank, aquaria etc. *In situ* conservation is most advantageous approach as species survival is more in natural environment. There are 101 national parks, 553 wildlife sanctuaries, 86 conservation reserves, 163 community reserves in India[2], 25 marine protected areas and 106 island protected areas[3]. Different types of *ex situ* conservation have different purposes. Zoos aim for public education, conservation and animal research. Sanctuaries aim for protection of animals. Botanical gardens conserve plant species. Also they serve purpose of plant research, education and training. Seed banks play important role of source for planting in case particular species go extinct. However, *ex situ* conservation should be considered the last option.

After all balancing the country's development and livelihood needs of the growing population as well as controlling drivers of loss of biodiversity is a serious challenge. It is not enough to have laws and policies for conservation of biodiversity but it also needs resources to enforce them. Also, constant review and re-alignment of strategies at national level is required to conserve the biodiversity.



[2] National wildlife database (2020), WII
[3]Saravanan, K. R., K. Sivakumar and B.C. Choudhury (2011), Status of Marine and Coastal environments and developing a Marine Protected Area Network in India, WII.

The Need for Biodiversity Conservation and Forest Management

Anirban Sengupta
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We have been living in the era of modernization marked by the irrational growth of infrastructural development and an irreversible damage to our ecosystem. The last few decades, specifically 3, have seen the rise of concrete jungles around the world and shrinkage in the size and quality of our ecosystem. Resultant of it: higher pollution, natural catastrophe, imbalance in food chains, global warming, unprecedented and frequent natural disaster and severe public health issues.

The year 2020 marks the wrath of nature on its highly civilized human beings. From the global pandemic COVID, torrential unseasonal rains in Spain, Australian Bushfires to Cyclone Amphan, life on earth has been ravaged. Its high time we need to revisit our relationship with our ecosystem, build back better solutions for the ecosystem that sustains us. We need to revisit our biodiversity conservation efforts, reset the growing westernization of our food habits, focus on the people and culture to build stewardship with our environment. Building resilience, we can go a long way to build a "Better Tomorrow" by finding "our solutions in Nature".

As we transit from the "UN Decade of Biodiversity" to the "UN Decade of Ecosystem restoration", a look into the statistics provided by the Living Planet Report (WWF, 2018), we see a decline by 60% of the total population size of mammals, amphibians, birds, fish and reptiles in the last 40 years. According to reports (Mongabay, 2020) since 1978 over 750,000 square kilometers (289,000 square miles) of Amazon rainforest have been destroyed.WWF estimates that 27 per cent – more than a quarter – of the Amazon biome will be without trees by 2030 if the current rate of deforestation continues. As per the World Economic Forum Report 2020, "Although the world's 7.6 billion people represent just 0.01% ofall living creatures, humanity has already caused the loss of 83% of all wild mammals and half of plants". Putting a monetary estimate to the goods and services provided by ecosystems, the worth of biodiversity is at US$33 trillion per year—close to the GDP of the United States and China combined.

We need to find a convergence for the human andenvironment development agenda. 2020 stands as a critical year as the global leaders would review the realization of targets under Aichi Biodiversity, Convention on Biological diversity Targets, etc and build new targets for our ecosystem. But it is not just the responsibility of the governments alone, businesses, societies, people need to mobilize their actions beyond "mere compliance and reporting".

Sustainable Forest Management is impossible without the conservation of biological diversity in forest ecosystems. In addition to the establishment and functioning of protected areas (PA) and a network of protective forests to maintain biodiversity, it is necessary to ensurethe existence and species dispersal in the territories actively involved in forest management. An Inetgrative forest management system framework that maximizes the intersection between different forest management goals: production, protection and conservation based on high forest management standards with exclusive area for different ecosystem services needs to be demarcated. The need for monitoring yet remains crucial and there is a need for Biodiversity indicators to be used as a monitoring tool to assess the effects of forest biodiversity conservation policies. The Community based forest Management should be given more impetus and ecotourism development through community-based efforts are of high need and multiple success stories of

rehabilitating the ecosystem over the decades have surfaced. The efforts to provide livelihood to the forest users group needs to be strengthened to denounce them from deforestation and poaching. We need to amp up our efforts to ensure forest and biodiversity development. This need is highlighted in the upcoming UN Biodiversity Conference (COP 15)," Ecological Civilization: Building a Shared Future for All Life on Earth".

Thus, we need to join hands to save the biodiversity and forest resources, to sustain them we as a society will sustain ourselves. The very basis of our existence is at risk, and together we need to make amends for a vibrant, healthy and augmented ecosystem.

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Natural Versus Accelerated Rates of Biodiversity Loss

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The diversity of life on Earth has never been, and never will be, static. Natural forces can act to destroy habitat, species and individual organisms. Obvious examples include volcanic eruptions, floods, earthquakes, droughts, typhoons, storms etc. Previous mass extinction events have been associated with asteroid impact. Global biodiversity has fluctuated through geologic time as evolution has added new species and extinction has taken them away. Evolution and extinction are natural processes, the responses of populations of organisms to changes in their physical and biological environment. Change is and shall continue to remain, in a very real sense, a basic fact of life.

If change is the norm, why are we now concerned about the conservation of biodiversity? In the past, the environmental changes responsible for fluctuations in diversity occurred over relatively long periods of time. Over the years, many parts of the world have gradually become more arid, which has changed the nature of their constituent ecosystems. Even times of relatively rapid environmental change allow organisms the chance to adapt. Further, within a short period by geological standards, glaciers have frequently advanced and retreated, but at a rate gradual enough to allow organisms to migrate and evolve in response. Natural calamities have occasionally destroyed most or even all of one type of ecosystem and great numbers of organisms, but there were always refuges for some species and niches large or small in which evolutionary processes could continue.

The environmental changes affecting biodiversity today have a different origin, order, and magnitude than those recorded in geologic annals. Today, the rate and scale of environmental changes brought about by human activities have increased to the point where a great many species may not have sufficient time or space in which to migrate or adapt.

The current loss of biodiversity has several causes. The direct destruction, conversion, or degradation of ecosystems results in the loss of entire assemblages of species. Overexploitation, habitat disturbance, pollution, and the introduction of exotic species accelerate the loss of individual species within communities or ecosystems. More subtly, selective pressures arising directly and indirectly from human activities can result in the loss of genetic variability. Exploitation, habitat alteration, the presence of chemical toxins, or regional climate change may eliminate some genetically distinct parts of a population yet not cause extinction of the entire species. As genetic variability is lost, however, the species as a whole becomes more vulnerable to other factors, more susceptible to problems of inbreeding, and less adaptable to environmental change.

The most important single factor affecting the fate of biodiversity on Earth is the accelerated rate of habitat destruction, particularly in the tropical forests. When an area of forest is cut and the land is converted to intensified use, most of the species living in it cannot survive in the replacement system, be it an agricultural field, pasture, or plantation forest. When any habitat type is reduced to small patches, the organisms that depend on it are in greater danger of extinction as their populations are reduced in number, isolated, and subject to the highly altered impacts of sun, wind, water, soil conditions, other organisms, and human beings. These and other factors enter selectively into small patches of any habitat,

severely reducing the diversity of life in that locale.

Unlike these currently threatened species, or those whose fate is now part of the geologic record, human beings can decide not to choose extinction. We can change our behavior and stop the acceleration of environmental degradation and species loss, thereby safeguarding species, their habitats, and our own future options for their use and enjoyment. However, our understanding of the Earth's biological diversity has significant gaps. This lack of information hampers our ability to comprehend the magnitude of the loss of biodiversity, prevent further losses, and formulate sustainable alternatives to resource depletion.

Biodiversity studies suggest that numbers of organisms on the planet have declined by more than a half in the last 45 years. World Wildlife Fund (WWF) has recently released Living Planet Report 2018 along with Living Planet Index. The Living Planet Index (LPI) is an indicator of the state of global biodiversity and the health of our planet. It was first published in 1998. It tracks the population abundance of thousands of mammals, birds, fish, reptiles, and amphibians around the world. Key findings of Living Plant Report 2018 are given below:

1. Populations crashing (In the period of 1970-2014)
   - The main reasons for biodiversity decline continue to be the overexploitation of species, agriculture, and land conversion.
   - 60% Loss of vertebrates(animals with a backbone)
   - 80% decline in freshwater fauna population
   - 90% loss of wildlife in Latin America, which is the worst-hit region

2. Species disappearing
   - The index of extinction risk for five major groups - birds, mammals, amphibians, corals and an ancient family of plants called cycads shows an accelerating fall.
   - The current rate at which species are going extinct is 100 to 1,000 times greater than the natural rate of extinction

3. Boundaries breached
   - In 2009, scientists weighed the impact of humanity's expanding appetites on nine processes known as Earth systems within nature. Each has a critical threshold, the upper limit of a "safe operating space" for human species.
   - The critical threshold for climate change is global warming of 1.5 degree C.
   - So far, humans have clearly breached two of these planetary boundaries: species loss, and imbalances in Earth's natural cycles of nitrogen and phosphorous (mainly due to fertilizer use).
   - For two others, climate and land degradation, we have begun breaching critical threshold indicators. Ocean acidification and freshwater supply are not far behind. As for new chemical pollutants such as endocrine disruptors, heavy metals, and plastics are concerned, their full impact is yet to be assessed.

4. Forests shrinking
   - Nearly 20 percent of the Amazon rainforest, the world's largest, has disappeared in five decades. Tropical deforestation continues unabated, mainly to make way for soybeans, palm oil, and cattle.
   - Globally, between 2000 and 2014, the world lost 920,000 square kilometers of intact or "minimally disturbed" forest, an area roughly the size of Pakistan or France and Germany combined.

5. Oceans depleted
   - Plastic pollution has been detected in all major marine environments worldwide, from shorelines and surface waters down to the deepest parts of the ocean, including the bottom of the Mariana Trench.

- Freshwater habitats, such as lakes, rivers, and wetlands, are most threatened.
- These are strongly affected by a range of factors including habitat modification, fragmentation and destruction; invasive species; overfishing; pollution; disease; and climate change.
- Since 1950, humans have extracted six billion tonnes of fish, crustaceans, clams, squids and other edible sea creatures.
- Climate change and pollution have killed off half of the world's shallow-water coral reefs, which support more than a quarter of marine life.
- Coastal mangrove forests, which protect against storm surges made worse by rising seas, have also declined by up to half over the last 50 years.

Way Forward

1. With two key global policy processes underway – the setting of new post - 2020 targets for the Convention on Biological Diversity and the Sustainable Development Goals – there is currently a unique window of opportunity to reverse the trend.
2. At present, very few studies have been conducted globally on the influence of natural disasters on biodiversity. It is therefore necessary to undertake international action to discuss influence of disasters and to establish an international protocol for future precautionary approaches to minimize the influence of natural disasters on biodiversity.
3. Lessons can be learned from progress towards addressing other critical global issues, like climate change, and everyone – governments, business, finance, research, civil society, and individuals – has a part to play

OUR PARTNERS

Government

- Department of Science and Technology
- Board of Reserch in Nuclear Sciences
- Department of Biotechnology
- MOEFCC, CSIR, DRDO
- Maharashtra Pollution Control Board
- MCGM & NMMC

Non -Government

- MMR- Environment Improvement Society
- Ashoka Trust for Research in Ecology and Environment
- Indian Centre for Plastics in Environment
- Balwant Rai Mehta Panchayati Raj Kendra
- SEAL Ashram
- SOSVA

Industries

- BPCL
- Kukyo Camlin
- JSW
- RCF
- Mumbai Waste Management Ltd.
- Agrisearch India Pvt. Ltd.
- Diva Envitech Pvt. Ltd.

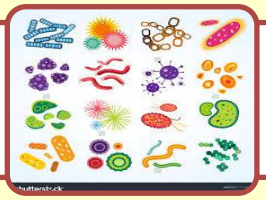
SPECIFIC AREAS OF EXPERTISE AT SIES IIEM IN INDUSTRIAL R&D AND CONSULTANCY

Environmental Pollution Monitoring, Assessment and Control

- Waste water treatment technologies
- Zero discharge
- analysis of samples
- Hazardous waste management
- Lab analysis services and desginig of lab

Ecology and Biodiversity

- Assessment of ecosystem services and biodiversity indexing
- Mapping of resources and modelling
- Eco restoration of resources



Microbial interventions in Environment Management

- Bioremediation and phytoremediation
- Mass production of Biofertilizers and biopesticides

Environment Management

Desigining of policies and plans as per agenda 2030 of Sustainable Development for industries and institutions

Climate change vulnerability assessment, identification of adaptation and mitigation technologies

CO_2 neutrality assessment in industries

Execution of CSR Initiatives

Defining of strategy, planning, implementation and execution of activities

Capacity building and skill development

Community mobilization for livelihood generation by developing theme based hubs

Other services

Survey and data analysis

Preperation of DPR, proposals, SOPs

Training Programmes, Customized events

Salient Technologies Transferred to Industries by SIES IIEM

Sr. No.	Areas of Consultancy	Major Deliverables
1.	Mass culturing of AM Fungi	Development of novel culture of AM fungi for mass application Development of lab for culturing of AM fungi and other biofertilizers
2.	Ethanol Production from Rice Industry Waste	Ethanol extraction from rice industry waste
3.	Treatment of leachate from Hazardous Waste	Low cost efficient technology for leachate treatment from hazardous waste management facility
4.	Disinfection of Ballast Water	Low cost disinfection techniques for ballast water
5.	Sewage Treatment / Recycling Plant	SBR model for the treatment of sewage waste
6.	CO_2 sequestration studies of afforestation projects	On site monitoring, data collection, interpretation and validation
7.	Water and energy auditing	Identification of potential losses and defining strategy for conservation
8.	Solid Waste Management	Characterization of waste, strategies for waste management and efficient technologies

SIES IIEM DEDICATED TO ENVIRONMENT MANAGEMENT THROUGH R & D AND OUTREACH ACTIVITIES

ABOUT SIES IIEM

- SIES IIEM was established in 1999. It has been contributing in the fields of R&D activities and Academics in the areas of Environment Management and Biotechnology.
- IIEM is recognized by Department of Scientific and Industrial Research for research activities and has successfully completed various research projects with funding from DST, BRNS, DBT, ICMR, MOEFCC, MMREIS and several other agencies.
- IIEM also conducts consultancy services, organizing seminars, workshop and providing community service through research and creating awareness.




INFRASTRUCTURE AND FACILITIES

State of Art Facilities to conduct R & D and consultancy in the areas of Environmental Science and Management. Laboratories are equipped with the advanced equipments (HPLC, AAS, GC, HVS etc.)

CONSULTANCY SERVICES

GREEN MANAGEMENT

Environmental Monitoring and Analysis

- Water, Soil, Air, Waste
- Eco-toxicity studies

Conservation of Resources and Biodiversity

- Eco restoration of Resources
- Biodiversity mapping and indexing

Waste Management

- Wastewater management for zero discharge
- Solid waste management
- Industrial sludge management
- E- waste management

Expertise in:

- Advanced oxidation processes
- Aerobic and anaerobic processes
- Bio- and phyto- remediation

EIA and Sustainability Solutions for Mitigation of Climate Change Vulnerability

GIS based Environmental Planning and Management

- Natural resource mapping
- Groundwater recharge study
- Site selection
- Database management

GREEN COMMUNICATION

Providing CSR Solutions for Environment and Society

- Environmental Education
- Training and Awareness programme
- Water audit and energy audit
- Carbon footprint mapping
- Capacity building
- R&D proposals and report writing
- Events – workshops, seminars and conferences

Areas of Research	Specific Areas
1. Total Water Management	1. Purification of drinking water by using low cost techniques. 2. Management of nitrite contaminated wastewater 3. Textile wastewater management. 4. Phytoremediation. 5. Oil spill management by biosurfactants. 6. Management of brine generated from water purification technologies. 7. Assessment and management of marine pollution
2. Solid Waste Management	1. Management of industrial waste. 2. Management of MSW and other solid wastes. 3. Management of agro- residue.
3. Applied Biotechnology	1. Utilization of biofertilizers and biopesticides in soil fertility management and agriculture. 2. Exploitation of beneficial microorganisms in remediation of heavy metals, oil pollution etc.
3. Management of Natural Resources	1. Pollution monitoring and management 2. Ecorestoration. 3. Studies on Climate Change. 4. Biodiversity Studies. 5. GIS & Remote Sensing

MAJOR FUNDING AGENCIES

- Ministry of Environment Forest and Climate Change
- Department of Science and Technology
- Department of Biotechnology
- Board of Research in Nuclear Sciences
- Indian Council of Medical Research
- Mumbai- Metropolitan Region- Environment Improvement Society

OUTREACH ACTIVITIES

Macrofauna and Microfauna of River and Its Significance in Environmental Management as Bio-indicator and How It Is Used in Urban Sustainability

Ankita Pawar
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Rivers, and aquatic ecosystems are the biological engines of the planet and are the basis for life and the livelihoods. Rivers are rich in the fresh water diversity. India is a mega diverse country with respect to freshwater fish species (650+ species). In freshwater fish diversity, India is eighth in the world and third in Asia."Nearly 50% of the aquatic plants of the world are recorded from the Indian subcontinent. There are hundreds of species of different group found in the river ecosystem such as invertebrates, arthropods (insects and crustaceans), fishes, amphibians, molluscs (snails and mussels).

Macrobenthos and microfauna are a key constituent of the marine environment. They play a vital role in ecosystems' ecological processes such as decomposition of organic matter, nutrient cycling, pollutant metabolism, dispersion and burial, translocation of material and in secondary production benthos are more sensitive towards any alteration occurring in their habitation whether natural or anthropogenic . For example, alteration in water temperature, dissolved oxygen, water flow and sediment content impart significant effects on composition and abundance of macro and micro fauna. Further modification in population densities on seasonal scales has been characteristic of variable patterns in reproduction, larval settlement and growth which are directly related to variations in temperature. Although these changes may be minor for the most of the places, yet the alteration in the distribution of macro and microfaunal grouping was relatively clear representing that the assessment of benthic fauna is an influential tool to distinguish even slight variation in environmental parameters. They are the major bioindicator of fresh water system. **Few examples of Macrofauana of India**

Hydrozoa - occurring in freshwater habitats of India with their status and distribution. In spite of immense ecological role, contributing a valuable source of potential Bio- medical compounds, very little work has been done towards study of this group of animals in India. More attention and exploration for these animals are needed along with taxonomical studies to understand species diversity and distribution of this diversified group. Only about 40 species of Hydrozoan cnidarians were reported from freshwater bodies of the world of which only 9 species were recorded from India.

Phylum porifera The poriferans, commonly known as sponges, are represented by over 219 freshwater species belong to 45 genera in six families globally. In India, 31 species of freshwater sponges belonging to 11 genera are represented by a single family Spongillidae (Soota, 1991), of which 11 species are endemic. Out of the 37 Oriental species, over 81% (31 species) are known to occur in India

Phylum nematomorpha An interesting group of nematode-like animals, commonly called as horsehair worms, whose free-living adults are found in freshwaters (with only 5 marine forms), but the larval forms are parasitic, mainly on arthropods. As many as 356 freshwater species are known

from the world (FAdA 2017), with only 20 species belonging to 5 genera being reported from India

Mollusca: gastropoda Freshwater molluscs play a pivotal role in the freshwater ecosystem. Globally, there are estimated 5,000 species of fresh water molluscs, of which 217 have been reported from India. In the present work, 150 species of gastropods belonging to 51 genera and of 16 families have been ascertained to occur in India.

Annelida: Oligochaeta The oligochaetes are elongate and segmented animals with no appendages belonging to Phylum Annelida. Oligochaetes generally comprise of 50% of the benthic macro-invertebrate communities in Indian lakes, rivers and streams, at least 10% of the benthic community in estuaries near-shore, coastal areas etc., and 40% terrestrial, freshwater and marine oligochaetes.

Arthropod: Crustacea group class Crustacea (822 species) has the share of 8.7% of all freshwater species. Crustaceans constitute a large group of the Arthropoda comprising crabs, lobsters, crayfish, shrimp, krill, barnacles, copepods, ostracods, etc. inhabiting a wide range of habitats, and are free-living, parasitic or sedentary organisms. There are over 73141 known species of crustaceans divided into a number of major groups. As per global estimate, 11,990 species of crustaceans are known from freshwater and about 822 species have been reported from Indian freshwater habitats. **Few examples of Microfauna of India Kingdom protista**Finlay and Esteban (1998) estimated about 2390 species of protozoans in freshwater habitats out of 36400 species known from the world. In India, 3510 species in 6 phyla have been reported, of which 52% are free-living and the rest parasitic species. According to the present estimate, about 1600 species of free living protozoans have been recorded from India including the estuarine species. A total of 106 species of ciliates belonging to 58 genera and 36 families are reported from the fresh water ecosystems of India.

Order Cyclopoida This order comprises 12 families, but only four of them, viz. Oithonidae Dana, Cyclopinidae Sars, Cyclopettide Martínez Arbizu, and Cyclopidae Rafinesque, are represented in inland waters of India. Of these, the members of Cyclopidae, much like those of Diaptomidae, are most widely and almost exclusively distributed in inland waters, and this family is also highly speciose with over 1,100 world species in about 60 genera. Also, it is an ecologically highly diversified and taxonomically difficult taxon, with species displaying planktonic, benthic, interstitial, and even parasitic adaptations. To date, **86 species in 20 genera** are known in India.

Class maxillipoda: Subclass Copepoda: the free-living inland water Copepoda is so far known only by about 200 species in 60 genera from India. The order Calanoida has 40 families. Truly freshwater Indian species are typically planktonic, and belong to the family diaptomidae. This family contains about 470 species in 61 genera in the world, and with 45 species in 13 genera in India. **Class branchiopoda:** The branchiopods include cladocerans or Water fleas, a group of small-sized, mostly microscopic branchiopods representing one of the most primitive groups of lower Crustacea. In all, 131 species of Cladocera are known from inland waters of India. Other than cladocerans, the remaining are known as large branchiopods or non-cladoceran branchiopods. Presently, 40 species of large branchiopods under 14 genera, 11 families and 4 orders are known to occur in India. **Macrofauna and micro fauna there role in Nitrogen cycle** They plays a positive role in nutrient dynamics and organic matter mineralization through particle reworking

and burrow ventilation. In particular, they commonly helps the creation of oxic zones in the sediment, which stimulate nitrification. It might also facilitate solute transport as a result of burrow ventilation, and secretion of labile organic substances on burrow linings. These series of factors may result in an increase in nitrogen removal as they all potentially enhance microbial denitrification. However, this enhancement is not always observed since it is strictly dependent on the bioturbation mode, which in turn depends on the morphology, physiology and ethology of macrofauna. Urban Sustainability -More than half of the world's population now live in urban areas when we talk about Urban Sustainability water plays an very important role. As the India is Mega diverse country and most of the biodiversity is present in Indian fresh waters. Sustaining urban rivers can helps us to sustain biodiversity in India. Mithiriver is the classic example of adverse impact of urbanisation on the rivers. theMithi River flows through the heart of Mumbai City, which is a Metro and a premier city of India. Once upon a time this river was Sweet in taste but now due to the disposal of untreated sewage and dumping of liquid & solid wastes it is the most polluted water body. The hills in the "Sanjay Gandhi National Park", which are at an altitude of 246 Meters above sea level, are the originating place of the River. Thereafter it merges with the overflows of Tulsi, Powai and Vihar lakes and travels downstream for around 18 Kms up to Mahim Bay. All the thickly populated areas like the residential and industrial complexes of Powai, Saki Naka, Kurla, Bandra- Kurla complex and Mahim lie on its path. In its initial stretches the river is narrow, but near the BandraKurla Complex it is at its widest. Further, it has a rather steep gradient in its initial stretches, and hence the water flows quite fast. However, on its second leg (say after Andheri), it course goes through a flat region. As a result of this, water and waste accumulate. Urban Sustainability can help us to sustain these rivers in metropolitan cities of India. To restore urban rivers it is important to monitor the quality of environmental components. Macrofauna and microfauna are important bioindicators of river systems. Bioindicators can be a measure, an index of measures, or a model that characterizes an ecosystem or one of its critical components. They are also a method of monitoring or detecting the negative impacts that industrial activity has on the river ecosystems. This information helps develop strategies that will prevent or lower such effects and make industry more sustainable. The role of bioindicators in sustainable development will help ensure that industry leaves the smallest footprint possible on the environment.

Biodiversity of Phytoplankton in River Ecosystem and It's Environmental Significance

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Introduction

What is phytoplankton? The word phytoplankton derived from Greek word phyto (plant) and plankton (made to wander or drifts) they are small microscopic autotrophic organism that live in watery environment they live both salty as well as freshwater environment.

Like all others plants phytoplankton also have chlorophyll to capture sunlight and they use photosynthesis to form into chemical energy. They consume carbon dioxide and release oxygen as a by-product. Because they need light for photosynthesis phytoplankton live near surface where enough sunlight are available for process of photosynthesis the thickness of this layer of the ocean- the euphotic zone- various depending on water clarity, but it most limited to the top zone 200-300 meters (600-900 feet).

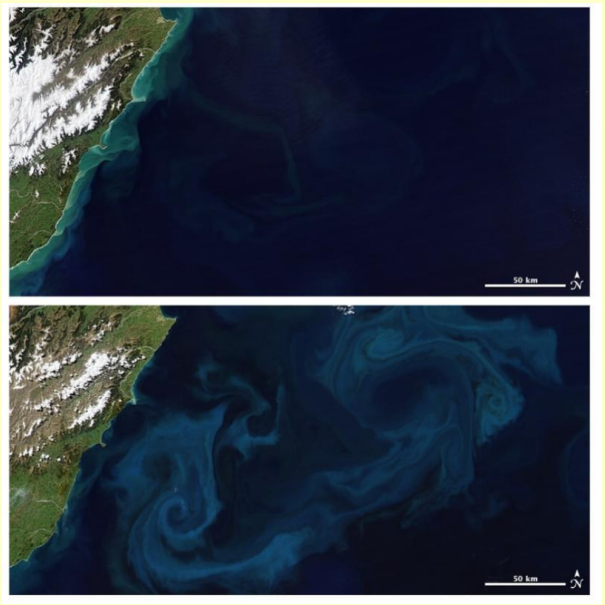
Types of phytoplankton

Phytoplankton have different types some phytoplankton are bacteria, some are protist and mostly they are single celled plants. Among the common kind of cyanobacteria, diatom, dinoflagellates, green algae and coccolithophore.

Phytoplankton comprise into to two very different kind of organism the large category include single cell algae knows as protists which is advanced eukaryotic cells similar to protozoa. These includes diatom and they found most abundantly near the coastal regions occasionally this organism form blooms.

Other type of phytoplankton are most primitive but more abundant than algae it is photosynthetic bacteria. They are tiny cells measuring about size of some only microns therefore they are undiscovered untill 1970_s scientists now knowns these bacteria are responsible for half of ocean's primary productivity. These groups include

cyanobacteria, which are believed to be the among oldest organism on Earth and the origin of photosynthetic organelles in plant cells known as chlorophyll.



(Phytoplankton can grow explosively over a few days or weeks. This pair of satellite images shows a bloom that formed east of New Zealand between October 11 and October 25, 2009.

phytoplankton in river ecosystem

There are numerous similarities between marine and freshwater phytoplankton. There are substantial differences in the proportions of phytoplankton species representing the major divisions of algae in marine and freshwater environments, and several important groups (classes and orders) are representative of one habitat or the other. The marine phytoplankton is dominated by numerous species of Chrysophyta (diatoms, coccolithophores, and silicoflagellates, Pyrhophyta (dinoflagellates). Several other groups of algae are at times either conspicuous or abundant, but they are represented by very few species. These include the Cyanophyta [cyanobacteria; e.g. very small-celled species of Synechococcus or large

bundles of Oscillatoria (Trichodesmium) filaments]. Another characteristic member of the marrine phytoplankton is Halosphaera (division Chlorophyta, class Prasinophyceae), which has spherical green cells.

Freshwater phytoplankton is well represented by species of most of the major divisions of algae that have a planktonic component. Therefore, a plankton sample from a lake may contain Cyanophyta, Chlorophyta, Chrysophyta, and Pyrrhophyta. Euglenophyta, which can usually be found in small ponds, are not common members of the freshwater phytoplankton. A large number of species of Chlorophyta and Cyanophyta are found in freshwater, but not in seawater. Coccolithophores, which are characteristic of marine plankton, are rarely observed in freshwaters. Marine and freshwater ecologists generally approach the study of phytoplankton.

Freshwater phytoplankton is the phytoplankton occurring in freshwater ecosystems. It can be distinguish between liminoplankton (lake phytoplankton), heleoplankton (phytoplankton in ponds), and potamoplankton (river phytoplankton). They differ in size as the environment around them changes. They are affected negatively by the change in salinity in the water

What types of freshwater phytoplankton are there?

The main groups of phytoplankton found in streams are the green algae (Chlorophyta), red algae (Rhodophyta), blue-green algae (Cyanobacteria) and diatoms (Bacillariophyta).

Green algae: Green algae often look like strands of green hair flowing in the current. Spirogyra is a common green alga. Under a microscope its chloroplasts are clearly seen as spirals.

Red algae: Red algae, such as *Audouinella*, uses a different part of the light spectrum it is able to grow in places where the other algae can't, so tends to be found in shaded places such as under rocks or banks.

Blue-greenalgae: The chlorophyll in the alga Cyanobacteria is not in chloroplasts but diffused throughout the cell. Pigments, other than chlorophyll, contribute to their coloration so cyanobacteria are not usually bright green. Nostoc is another cyanobacteria that is often conspicuous in streams. It looks like bubbles of firm jelly attached to the rocks. The 'bubbles' are masses of small chains of cells.

Diatoms: Mats of brown growth, fluffy masses or slimy layers on rocks are some of the ways diatoms appear to the naked eye. Gomphoneis forms thick, glistening, light-brownish mats on river substances and is often mistaken for didymo. However, didymo has much larger cells and grows in tougher, more fibrous mats.

Biodiversity of phytoplankton Species found in Indian rivers.

Bacillariophyceae (diatoms): This was the most dominant group among phytoplankton, being represented by 24 taxa where some species
like Didymosphenia, Gyrosigma, Nitzchia, Pinn ularia, Naviculalanceolata and N. radiosa,

Chlorophyceae (green algae): This was the second dominant group among phytoplankton after Bacillariophyceae and is comparatively more important so far its species richness and contribution to the total phytoplankton production is concerned.

Euglenophyceae: Euglenoids showed maximum development in autumn and minimum in winter.

Cyanophyceae (cyanobacteria): This group showed its maximum development in July at all the sites.

The River Ganga (2,525 km long) is the largest river basin in India, covering 26.2 percent of India's total geographical area. The plankton in a reservoir is an important biological indicator for evaluating the water quality of a reservoir. phytoplankton are important primary producers and the basis of the food chain in open water some species on the other hand can be harmful to human and other vertebrates by releasing toxic substances into the water. Phytoplankton studies and monitoring are useful for control of the physico-chemical and biological conditions of the water in any irrigation project.

The phytoplankton community of river Ganga during the present study was represented diatoms, green algae and blue green algae. In phytoplankton Diatoms were dominated and class Blue green algae was found least during study period.

Phytoplankton communities of the Ghorajan Beel, a floodplain lake of the **Brahmaputra** River basin, Assam. The qualitative and quantitative net plankton samples were examined with reference to variations in richness, community similarities,

species diversity, dominance and evenness of phytoplankton.

Total no. of 52 species of phytoplankton were recorded, dominated by Chlorophyta (22 species), followed by Bacillariophyta (18 species); their monthly richness ranged between 28-49 species.

Phytoplankton species found river Yamuna River Yamuna: Thirty five taxa contributed to the phytoplankton community river Yamuna belonging to Chlorophyceae (21), Bacillariophyceae (10), Cyanophyceae (3) and Dinophyceae (1). The percentage distribution of phytoplankton showed that Chlorophyceae was dominant at all the stations.

Phytoplankton of the Narmada River consisted mainly of green algae (Chlorophyceae) Diatoms (Bacillariophyceae) and the blue green algae (Myxophyceae). Diatoms (Bacillariophyceae) was represented by 7 genera where asMyxophyceae by 10 genera respectively. In Narmada river the temporal succession of phytoplankton groups is noticed as Chlorophyceae>Cyanophyceae>Bacillariphycease. The species composition, distribution, abundance of phytoplankton population is governed by various physico-chemical factors of the water body. The population of Plankton fluctuates in different seasons and months. of Phytoplankton of River Narmada Madhya Pradesh (India).

Phytoplankton study of River Jhelum.A total of 53 genera of phytoplankton belonging to Chlorophyceae (17), Bacillariophyceae (24), Cyanophyceae (09), Euglenophyceae (2) and Chrysophyceae (1).

Significance of phytoplankton freshwater ecosystem

Cyanobacteria are able to fix nitrogen from the atmosphere.

All organisms require large amounts of nitrogen for their metabolism and cyanobacteria play an important role in making atmospheric nitrogen available in nutrient cycles.

Algae help to 'purify' water by absorbing nutrients and heavy metals from streams and rivers.

Phytoplankton can be valuable indicators of environmental quality.

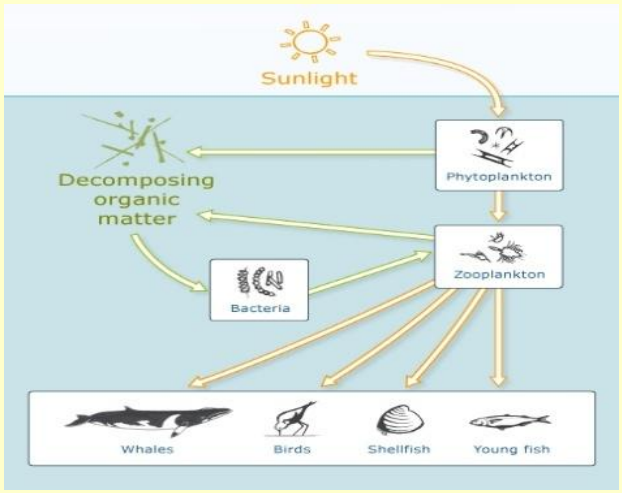
Many are sensitive to changes in pH, in nutrient levels or in temperature. Monitoring species abundance and composition can be useful to identify changes in water quality caused by changes in surrounding land use.

Phytoplankton as indicator of water Quality

phytoplankton, long have been used as indicators of water quality as some species flourish in highly eutrophic waters while others are very sensitive to organic and/or chemical waste.

<u>The food web:-</u>

Phytoplankton also form the base of virtually every aquatic food web in- short they make most of aquatic life possible they are primary producer feeding everything from microscopic animal like zooplanktons to multi tons whales. Small fishes and invertebrates also feed on



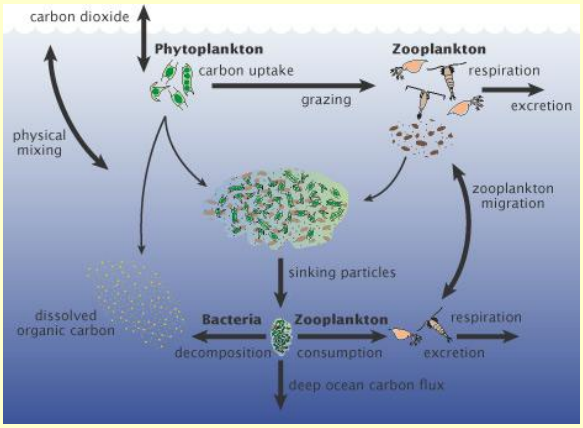
plankton and then this smaller animals eaten by bigger once.

Phytoplankton can also be the harbingers of death or disease certain species of phytoplankton produce powerful biotoxin, making them responsible for so-called "red tides" or harmful algal blooms. This toxins kill marine life and people who eat contaminated sea food.

(Red tides off the coasts of California. Red tides caused by toxic dinoflagellates blooms)

Climate and the carbon cycle

Through photosynthesis, phytoplankton consume carbon dioxide on a scale equivalent to forests and other plant present on land. Some of this carbon is carried to the deep ocean when phytoplankton die, and some is transferred to different layers of the ocean as phytoplankton are eaten by other creatures, which themselves reproduce, generate waste, and



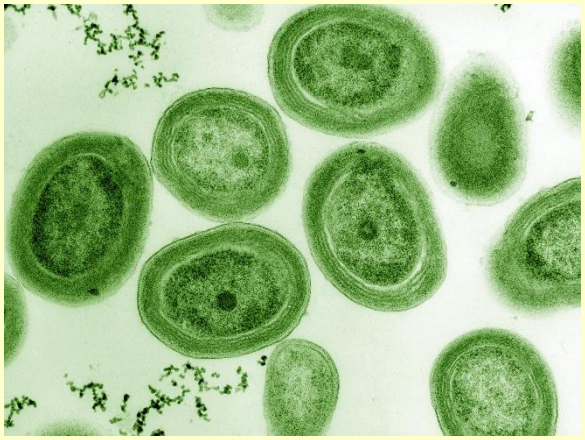
die.

Phytoplankton are responsible for most of the transfer of carbon dioxide from the atmosphere to the ocean. Carbon dioxide is consumed during photosynthesis, and the carbon is incorporated in the phytoplankton, just as carbon is stored in the wood and leaves of a tree. Most of the carbon is returned to near-surface waters when phytoplankton are eaten or decompose, but some falls into the ocean depths.

Photosynthetic bacteria are especially important in the nutrient-poor open ocean, where they scavenge and release scarce vitamins and other micronutrients that help sustain other marine life.

Phytoplankton as a source of oxygen

Where does the oxygen we breathe come from? rainforests are responsible for roughly one-third (28%) of the Earth's oxygen but most (70%) of the oxygen in the atmosphere is produced by marine plants. The remaining 2 percent of Earth's oxygen comes from other sources. The ocean produces oxygen through the plants (phytoplankton and algal plankton). These plants produce oxygen as a byproduct of photosynthesis, a process which converts carbon dioxide and sunlight into sugars the organism can use for energy. One type of phytoplankton, ***Prochlorococcus*** releases countless tons of oxygen into the atmosphere. It is so small that millions can fit in a drop of water. ***Prochlorococcus*** is most abundant photosynthetic organism on the planet.



Prochlorococcus

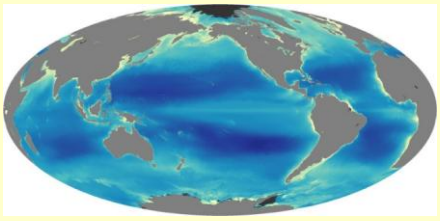
Global Patterns and Cycles

Differences from place to place

Phytoplanktons thrive along coastlines and continental shelves, along the equator in the Pacific and Atlantic Oceans, and in high-latitude areas. Winds play a strong role in the distribution of phytoplankton because they drive currents that cause deep water, loaded with nutrients, to be pulled up to the surface.

These upwelling zones, including one along the equator maintained by the convergence of the easterly trade winds, and others along the western coasts of several continents, are among the most productive ocean ecosystems. By contrast, phytoplankton are scarce in remote ocean gyres due to nutrient limitations.

Phytoplankton are most abundant (yellow, high chlorophyll) in high latitudes and in upwelling zones along the equator and near coastlines. They are scarce in remote oceans (dark blue),



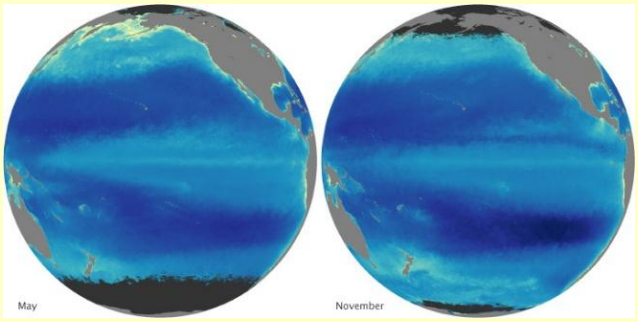
where nutrient levels are low. This map shows the average chlorophyll concentration in the global oceans from July 2002–May 2010.

Differences from season to season

Like plants on land, phytoplankton growth varies seasonally. In high latitudes, blooms peak in the spring and summer, when sunlight increases and the relentless mixing of the water by winter storms subsides. Recent research suggests the vigorous winter mixing sets the stage for explosive spring growth by bringing nutrients up from deeper waters into the sunlit layers at the surface and separating phytoplankton from their zooplankton predators.

In the subtropical oceans, by contrast, phytoplankton populations drop off in summer. As surface waters warm up through the summer, they become very buoyant. With warm, buoyant water on top and cold, dense water below, the water column doesn't mix easily. Phytoplankton use up the nutrients available, and growth falls off until winter storms kick-start mixing.

In lower-latitude areas, including the Arabian Sea and the waters around Indonesia, seasonal blooms are often linked to monsoon-related changes in winds. As the winds reverse



direction (offshore versus onshore), they alternately enhance or suppress upwelling, which changes nutrient concentrations. In the equatorial upwelling zone, there is very little seasonal change in phytoplankton productivity.

In spring and summer, phytoplankton bloom at high latitudes and decline in subtropical latitudes. These maps show average chlorophyll concentration in May 2003–2010 (left) and November 2002–2009 (right) in the Pacific Ocean.

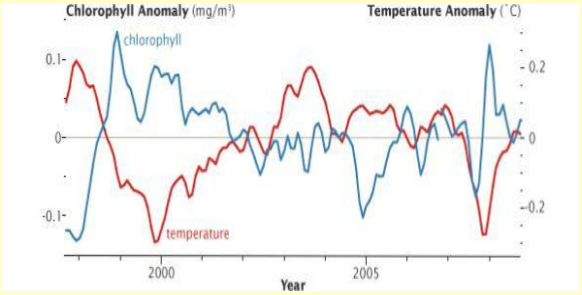
Long-term changes in phytoplankton

Productivity

Because phytoplankton are so crucial to ocean biology and climate, any change in their productivity could have a significant influence on biodiversity, fisheries and the human food supply, and the pace of global warming.

Many models of ocean chemistry and biology predict that as the ocean surface warms in response to increasing atmospheric greenhouse gases, phytoplankton productivity will decline.

Productivity is expected to drop because as the surface waters get warm.



About 70% of the ocean is permanently stratified into layers that don't mix well. Between late 1997 and mid-2008, satellites observed that warmer-than-average temperatures (red line) led to below-average chlorophyll concentrations (blue line) in these areas

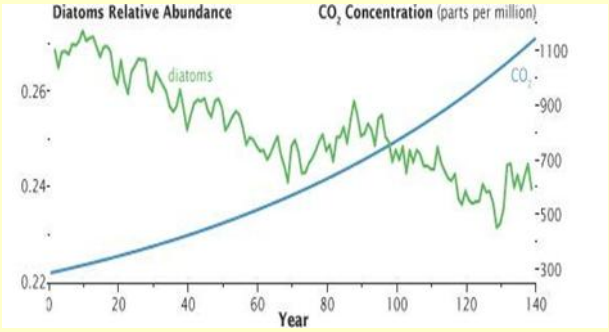
Species composition

Hundreds of thousands of species of phytoplankton live in Earth's oceans, each adapted to particular water conditions. Changes in water clarity, nutrient content, and salinity change the species that live in a given place.

Because larger plankton require more nutrients, they have a greater need for the vertical mixing of the water column that restocks depleted nutrients. As the ocean has warmed since the 1950s, it has become increasingly stratified, which cuts off nutrient recycling.

Continued warming due to the build up of carbon dioxide is predicted to reduce the amounts of larger phytoplankton such as diatoms), compared to smaller types, like cyanobacteria. Shifts in the relative abundance of larger versus smaller species of phytoplankton have been observed already in

places around the world, but whether it will change overall productivity remains uncertain.



As carbon dioxide concentrations (blue line) increase in the next century, oceans will become more stratified. As upwelling declines, populations of larger phytoplankton such as diatoms are predicted to decline.

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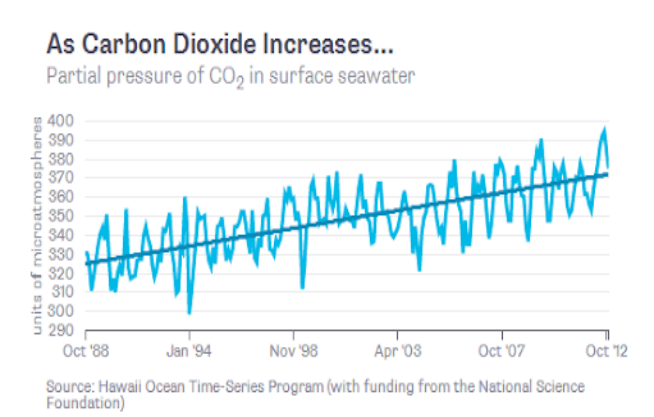
Ocean Acidification and Understanding Coral Bleaching

Shree Srishti Mahesh
APL, Perungudi, Chennai

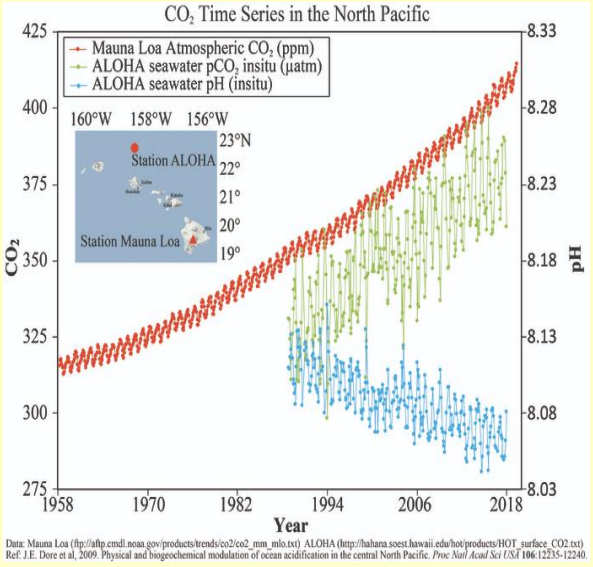
Anthropogenic greenhouse gases have a substantial impact on the earth and oceans alike. However, silent irreversible damages occurring beneath ocean surfaces which covers 2/3rd of the earth largely goes unnoticed. For layman, the GHG is more of an atmospheric pollution causing global warming and ice melting leading to increased sea levels. The carbon di-oxide do more than just trap heat beneath the troposphere. They are also responsible for the rise of temperature in the oceans as well as ocean acidification, threatening the delicate balance of species underwater.

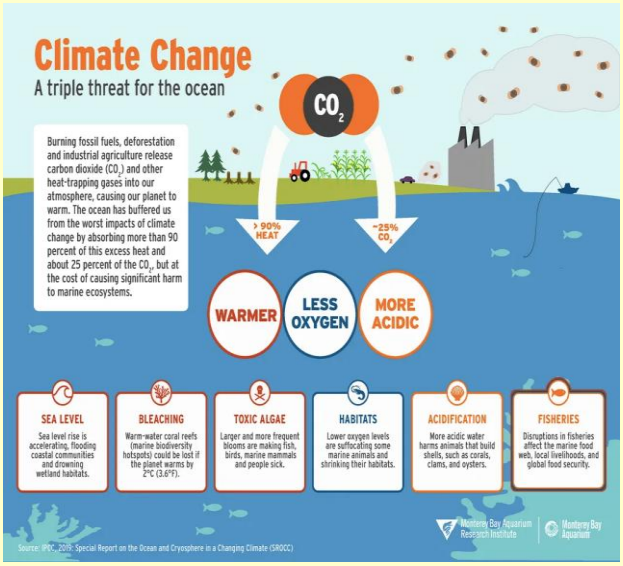
Ocean acidification: It is a process where the carbon dioxide in the atmosphere dissolves in the ocean water to form an acidic compound, carbonic acid. This results in the decrease of pH of the water and threatens existence of the fragile marine ecosystem. Organisms are very sensitive to pH variations; some experience a change in their hormones and chemical levels in an effort to adapt, some turn infertile while others perish.



The graph depicts how the concentration of carbon dioxide, measured in ppm, in the atmosphere has increased (measured here as partial pressure) which enhances the CO2 absorption in sea water. The increase of carbon dioxide results in decrease of sea water pH.

Being a log scale, a decrease of pH by 1 signifies a 10 fold increase in acidity. Considering the actual Sea water pH change from average of 8.25 to 8.14 since the beginning of industrial revolution , this corresponds to 30% increase in H+ ion concentration.





For example, in humans, arterial blood pH normally falls within the range 7.35–7.45. A drop of 0.1 pH units in human blood pH can result in rather profound health consequences, including seizures, heart

arrhythmia, or even coma (a process called acidosis). (Source :NOAA)

Ocean warming reduces dissolved oxygen and increasing CO2 absorption. The phenomenon along with decrease in pH , has major repercussions on marine ecosystem, like the loss of breeding ground for marine organisms, reduce fish counts, coral bleaching.

Understanding coral bleaching:
Coral reefs are an underwater ecosystem and have a mutual relationship with a type of algae calledzooxanthellae. The corals, having no chloroplast cell of their own, derive their nutrition from algae, which can photosynthesize. In return, the coral provides the algae with shelter. This is endosymbiotic relationship, where both the organisms are benefitted.

The decrease in pH of the ocean waters begins to cause a disturbance in the function of coral reefs. The skeleton of the reef reacts with the acid and dissolves, weakening the corals. This decalcification process also occurs in crustacean shells. The change in pH and temperature causes damage to the coral tissues, forcing the coral polyps to expel the algae out of the system. This causes the corals to turn grey-white, or to bleach. Without the algae which contribute to about 70% of the energy of coral, the coral reef cannot produce food and function on its own, so very soon it tends to die.

The Corals are home to 25% of the marine

species in the ocean. The loss of coral reef leads to a loss of biodiversity, endangerment of species, and increase in danger of floods.

Is Coral Bleaching Irreversible:
Luckily the corals can recover from bleaching. Corals can regain their algae if correct conditions are restored, and return to their bright colours and survive if we give them chance.
Though the bleaching can take place over a short span of time, it may take decades for coral reefs to recuperate to full life the bleaching event. If humans continue “business as usual” and keep burning fossil fuels releasing the GHGs, coral reefs will be under severe threat by the middle of the century. This would be irreversible tipping point for coral reefs as they would have no chance to recover.

HEALTHY CORAL
BLEACHED CORAL

United Nations through its SDGs has laid down the desired path to be followed to conserve the ecosystems at it only through collective effort of every nation and citizens that the goals can be achieved.

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- Last Date for the submission of application forms: 1st July 2020

Environment in News Headlines

Coronavirus pandemic: Tracking the global outbreak

Coronavirus is continuing its spread across the world, with about 6.9 million confirmed cases in 188 countries. More than 400,000 people have lost their lives.
The virus, which causes the respiratory infection Covid-19, was first detected in the city of Wuhan, China, in late 2019. It then spread quickly across the globe in the first months of 2020. The outbreak was declared a global pandemic by the World Health Organization (WHO) on 11 March. This is when an infectious disease is passing easily from person to person in many parts of the world at the same time.
The WHO has warned that the pandemic is a long way from being over and says people should be prepared for new outbreaks to build up very quickly - especially in areas where lockdowns are eased.

BBC News, June 7, 2020

India under worst locust attack in 27 years

Desert locust swarms have become the latest threat looming large on India amid the series of crises induced by the coronavirus pandemic. With several states in north India struggling to keep the large swarms of locusts at bay, the worst in 27 years, the government has moved to use advanced sprayers and drones to stop acres of crop from being damaged.
India Today, May 28, 2020

Global environmental changes are leading to shorter, younger trees

In a global study published in the 29 May 2020 issue of Science magazine, researchers including experts at the University of Birmingham, showed how rising temperatures and carbon dioxide have been altering the world's forests. These alterations are caused by increased stress and carbon dioxide fertilization and through increasing the frequency and severity of disturbances such as wildfire, drought, wind damage and other natural enemies. Combined with forest harvest, the Earth has witnessed a dramatic decrease in the age and stature of forests.
This study reviews mounting evidence that climate change is accelerating tree mortality, increasingly pushing the world's forests towards being both younger and shorter. This implies a reduction in their ability to store carbon and potentially large shifts in the mix of species that compose and inhabit these forests. This is likely to have big implications for the services those forest provide, such as mitigating climate change.

Science, May 29, 2020

Part of Navi Mumbai's Talawe Wetland turns into a gorgeous shade of pink!

After numerous pink flamingos painted the Talawe wetland pink with their surprising arrival in Navi Mumbai, a new phenomenon that has grabbed the limelight. Interestingly, a portion of Talawe wetland has become deep pink in colour, leaving the city-dwellers amazed. Researchers and microbiologists state that this pink colouration is the outcome of red algal bloom, that is multiplying in the saline water of Talawe wetland. The likely reason behind this occurrence is the rising heat, humidity and increased water evaporation along with salinity, thus, rendering pink colour to a portion of the wetland.

TOI, May 20, 2020

Forthcoming Events

E-School on River Management

Articles, photos etc. are invited for next issue (July-September, 2020) of the Newsletter on the theme "Sustainable Management of River Ecosystem"

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