

Vasundhara
Issue 9 | February 2022

THE

WATER PALETTE

EXCLUSIVE: INTERVIEW WITH
DR. RITESH KUMAR
*"Everybody matters for wetlands
conservation"*

Eco Club, TERISAS brings to you "The Water Palette", the ninth edition of Vasundhara magazine, curated to discuss essential aspects of the most productive and sensitive ecosystem on the terrestrial region of Earth 'The Wetlands', the formal knowledge of which is somewhat hidden in our curricula. The information in the magazine is for general use only and has been compiled from various research papers/articles/government databases. Some personal experiences and anecdotes have also been shared for which we extend our sincere gratitude to the contributors. The content is accurate to the best of our knowledge as of 5th February 2022. We apologize for any inadvertent errors that may exist.

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Editor's Note

Wetlands, one of the most productive and essential ecosystems on the terrestrial region of the earth are at substantial risk of deterioration. The impact of this is significant not only from an ecological perspective but also from the socio-economic point of view. As in most of the scenarios of degradation, human activities are at the root. Therefore, it is we humans who are required to take actions in favour of our mother earth (Vasundhara).

A critical issue in this regard is certainly unparalleled and that is about the education related to wetlands. Unlike other issues, there is little awareness of wetlands and their conservation practices. Even Ramsar Convention was the first convention aimed at global nature conservation and that was on wetlands. But education about the sensitivity and significance of wetlands have not yet been universal. The consequence is that most of the sensitive wetlands in the world are the victims of irresponsible and environmentally-unfriendly behaviour. Even most of the so-called environmentalists have little formal knowledge about wetlands and the ecosystem services they provide.

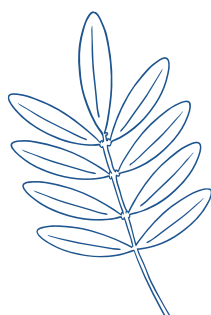
At Vasundhara, we realised this problem, and therefore, decided to work on the edition specifically dedicated to wetlands. We at Vasundhara believe that inculcation of sustainable behaviour needs a comprehensive approach towards knowledge transfer. Therefore, along with the information of the fundamentals, we collected on-field experiences of the experts and dependent local communities. Keeping in mind the diversity of our readers, the team Vasundhara has approached the theme holistically covering different legal, ecological, economic, business-related, and technological perspectives. Considering the importance of story-telling, we have also come up with the migratory bird story and the travelogue to let the readers visualize the significance of wetlands not only in aesthetic terms but by understanding socio-economic and biodiversity-related aspects as well. To foster the process of change, we have come up with a career guide enlisting the opportunities, through which the interested readers can be a part of the action towards environmental conservation and sustainability.

Lastly, I would thank all the participants involved in the preparation of the magazine including the interviewers, community representatives, our seniors and obviously the team members. All the work for this magazine was carried out in an online mode but the extensive discussions and meetings that were held to ensure harmony in the work would not let you realize so. The pandemic has also impacted the health of our team members but their dedication is what has led to the successful & timely preparation of this edition.

- Lovish Raheja

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WETLANDS:

Introduction, Evolution and Current Scenario

A Brief Overview

Wetlands are the unique landscape features of the earth wherever water meets land. The presence of water shapes the physical, biological, and chemical characteristics of the site. Although there are various definitions for classifying wetlands for legal purposes, they are primarily considered transition zones between upland and aquatic ecosystems and areas where groundwater reaches the surface.

The origin of wetlands dates back to the Ordovician period when the first terrestrial plants dependent on moist substrates began to colonize the land. Over the years, natural selection and evolution occurred, leading to the appearance of swamps and bogs in the Devonian period. Swamps dominated the Carboniferous period occupying vast regions of land, even extending their presence in the Mesozoic and Cenozoic eras. However, the current distribution of wetlands was majorly due to glaciation during the Pleistocene Epoch which created various types of landscapes for the distribution and characterization of wetlands. Wetlands exist in every country and all climatic zones. Not only do they have unique biodiversity and ecosystem, but they also make important contributions to people, wildlife, and the environment.

Classification: Six Main Types



Peatlands: They make up nearly half of the world's wetlands and are critical for water conservation and flood mitigation by absorbing heavy rainfall and releasing the water gradually. They also play an important role in carbon storage and are a natural habitat for a variety of endangered species.

Coasts and deltas: Wetlands along these regions are the connectors between marine, freshwater, and terrestrial ecosystems. They serve as important migration and breeding grounds, thus providing important sustenance to the local community.



Rivers and Lakes: They connect to major wetland systems and deltas and are critical in wetland formation in arid and semi-arid regions. Since these regions are characterized by seasonal rainfall, the wetlands retain the water for a long time during the dry season.



High Altitude Wetlands: They store water from rain and glacial melt, thus enriching both the quality and quantity of water. The ability to promote vegetation reduces soil erosion and creates a unique ecosystem.

Arctic Wetlands: They are the main ecosystem in the Arctic region and are very important towards global biodiversity and are the main source of livelihood for the local indigenous people.



Urban Wetlands: These are wetlands in cities or urban areas. They directly affect the surroundings and the microclimate of that region. Thus degradation of these wetlands can lead to several drastic effects and contribute to climate change.

EVOLUTION THROUGH AGES

Wetlands exhibit a rich cultural diversity throughout the evolution of humanity and civilizations. From sustaining the communities in the fertile floodplains of the Nile, Tigris, and Euphrates rivers to providing food for large populations in Asia, wetlands have played a major role throughout. They are directly related to the earliest evidence of rice cultivation by people living in Asia. It began in the broad belt of the Ganges plain and extended eastward into southern China. Archeological excavation in Chekiang Province, China, in 1973-74 found rice grains at least 7000 years old from cultivation in wetlands. In Mesoamerica, wetlands were primarily used for elevated agriculture and drained-field agriculture whose small remnants are used even today.

Wetlands are more beneficial to both the people and wildlife than any other ecosystem. There is an abundance of algae, plants, and invertebrates making up the lower strata of the food chain thus leading to a boost in the diversity of wildlife. Like rainforests and coral reefs, they have a very productive ecosystem. Different types of wetlands are home to several thousand plant species ranging from evergreen trees to mangroves. They are an important migration and breeding spot for a variety of birds as well as is home to several endangered species like Sumatran tiger, tadpole shrimp, European eel, water vole, etc. Wetlands are also a source of identity, spirituality, and economy for the indigenous peoples who have called it their home for many years. They serve as agriculture and hunting grounds, ceremonial and initiation sites, and also as traditional gathering places. The products derived from the resources such as food, fiber, tools, medicine, etc serve as a source of income and livelihood for the local community. The long-held cultural and traditional values of these indigenous peoples play an important role in the protection and conservation of the wetlands.

LEGAL PERSPECTIVES:

Ramsar Convention and other initiatives

Wetlands are important for several reasons, including the fact they are – rich in biological resources, highly productive, provide ecosystem services such as water storage, purification, flood mitigation, microclimate regulation, and various other functions too. Also, they provide a source of livelihood, food, and water to several communities.

Since the 1700s, the world has lost nearly, 87 percent of its natural wetlands. India too has lost nearly one-third of its wetlands due to rapid urbanization, agricultural expansion, and pollution. This highlights the fact that human activities have been liable for the displeasing state of wetlands, in the country, and across the world too.

Wetlands are extraordinarily diverse ecosystems, serving numerous purposes. Hence, an understanding was reached that there is a need to conserve them. This realization, by several countries across the globe, gave birth to the noted “Ramsar Convention”. The Ramsar Convention is an intergovernmental treaty that provides a framework for the ‘conservation and wise use of wetlands and their resources. The convention was adopted in 1971, in the Iranian city of Ramsar, hence the name. It was adopted with the goal of conserving wetlands, and promoting their wise use through national action, international cooperation, capacity building, policymaking, and technology transfer, to contribute to sustainable growth.

The initial call for a convention on wetlands, on a global scale came in 1962 during the MAR conference, which was concerned around the destruction of marshland and wetlands in Europe. Over the next eight years, a convention text was negotiated through a series of international conferences. The treaty was officially named “The Convention on Wetlands of International Importance”.

Australia was the first country that acceded to the convention and its Cobourg Peninsula was designated as the world’s first Ramsar site in 1974. The convention came into force in 1975 and UNESCO agreed to act as its depository. As of October 2021, there are 172 contracting parties to the convention and over 2000 designated sites across the world. The Convention was modified by the Paris Protocol in 1982 and the Regina Amendments of 1987. Montreux Record is a mechanism, launched in 1990, that contains a list of all the Ramsar sites that require urgent attention. World Wetlands Day was first celebrated in 1997, and since then, every year, it is celebrated on February 2 to mark the anniversary of the convention. The Ramsar Convention works closely with its International Organization Partners (IOPs), which are: Birdlife International, IUCN, International Water Management Institute, WWF, Wetlands International, and International Wildfowl and Wetlands Trust.

India became a party to the Convention in 1981, and Lake Chilika was declared the country’s first Ramsar site. Nearly 4.6% of India’s geographical area is covered by wetlands and 42 sites have been designated as Wetlands of International Importance (Ramsar Sites). Over the last few decades, our wetlands have suffered massive loss and destruction due to land reclamation, degradation through drainage, pollution, and hydrological alteration, which are all, primarily the result of the ever-expanding human civilization. Therefore, apart from being a party to the Ramsar Convention, several legislations have been enacted at the National level too. The Wetlands (Conservation and Management) Rules, 2017, by the MOEF&CC under the provisions of the Environment (Protection) Act, 1986 , provides a legal framework for the conservation and management of wetlands in India. The rules call for the establishment of a State Wetland Authority, composed of ministers, officials, and experts in each state. The guidelines also allow states to allocate staff and budgetary allocations for carrying out all activities and functions of the authorities smoothly.

The National Wetlands Committee was also established under the 2017 rules. It ensures supervision and regulation of all the state authorities, proper implementation of rules, acting as an advisor to the central government on conservation issues, developing policies for wise use, and collaborating with international agencies.

The National Plan for the Conservation of Aquatic Ecosystems (NPCA) was formulated in 2015. It is a centrally sponsored scheme, being implemented by the MOEF&CC. It focuses on holistic wetland conservation and other related aspects such as water quality, biodiversity, etc,

In addition, there are other laws, that indirectly promote wetlands protection. For example, the Wildlife Protection Act, 1972, the Forest Act, the Indian Fisheries Act,1857, the Exclusive Economic and other Marine Zones Act,1976, and various other such ordinances have been enacted by the Central Government as well as state governments, explicitly focusing on wetlands conservation as they coincide with the subject matter of the respective act. February 2, 2021, marked the 50th anniversary of the historic Ramsar Convention. To mark the occasion, a Centre for Wetland Conservation and Management (CWCM), was established in Chennai under the MOEF&CC. The centre will focus on research needs, knowledge gaps, and capacity building for effective management and wise use of wetlands in India.

However, despite several regulations, our wetlands are now under greater threat than ever before. The main reason for this is that the current regulations do not recognize the participation and importance of local communities in the process of conservation. Involvement and awareness of the local communities will be a driving force in governing and monitoring wetlands. Colossal efforts will be required in the direction of people’s participation, protection, innovation, and decision-making for building a climate-resilient future for the nation.



Wetlands are also known as Kidneys of the landscape due to their natural ability to clean the water, protect against floods, and recharge the underground aquifers.

Wetlands can be considered as biological supermarkets as they provide different types and huge volumes of food that attract many animal species.



Photo courtesy:
Ananya Pandey, MSc Economics

WHAT REALLY MATTERS!

with

Dr Ritesh Kumar



Dr Ritesh Kumar is Director, Wetlands International South Asia and has been a part of the organization for over two decades now. He has coordinated multidisciplinary projects on wetlands assessment, ecosystem services evaluation, sustainable livelihoods, disaster risk reduction and climate change adaptation. He has been a part of several policy-making processes related to wetlands in India and also advises several state governments on policy and management aspects of wetlands. He has been closely associated with the Ramsar Convention process, as an expert member of the Convention's Scientific and Technical Review Panel.

Q1. To begin with, we would like to get an idea about your journey. How did you come into this field and the position in which you are today? How has your organization succeeded in this journey?

I got introduced to wetlands during my masters' course in business economics through my professor, Dr Pushpam Kumar, who is now with UN Environment as the head of the Economics division. He was working on a project tasked with the economic valuation of Yamuna floodplains and I was a part of the research team that was working on the evaluation of the hydrological functions, especially the groundwater recharge. When we finished our masters' project on environmental economics where I worked on the economic valuation of Harike wetlands, I was recommended to Wetlands International by Pushpam, who used to advise this organization. I joined as the Junior Technical Officer, and my task was largely centred around bringing socio-economic dimensions into wetland management. Gradually as I started working on more projects, I realized that much of the work in the wetlands has been dominated by a few streams such as limnology or hydrology, but does not incorporate the wider social lens. What I consider much of the environmental challenge today, is not a problem of science, per se, but our inability to understand how and why people make decisions or opt for certain choices. It leads to a very technocratic construction of any conservation challenge. And it is assumed that if you get the science right, the problem will go away. However, in reality, the political and social choices associated with it are far more central to what we do. So the journey started and I started looking into the hydrology of the wetland systems, catchment planning and thereby I started working with various sectors- disaster reduction, water management, dealing with food production and trying to understand why they fail to internalize wetlands. Gradually I moved on to larger projects. Post the tsunami in 2004, a lot of money was being invested in coastal ecosystem restoration, several of which was being wasted as much of the effort was being put into mangroves forestation only and in settling the coastline. It was then that I travelled the entire coastline, which allowed me to understand how coastal communities believe in the ecosystem and how coastal wetlands are configured in their development storylines. And then I was able to create partnerships with different sectors.

Today we are talking about nature-based solutions but it was way back in 2004-05 that we started looking into investment into wetlands as long term nature-based solutions for disaster reduction. We are looking into the food sector and

how cropping systems would be aligned with wetland functioning. Thereby, generally, I also rose within my organization and got an opportunity to represent my organization at the RAMSAR Convention's scientific and technical review panel. Soon after that I received recognition and was able to introduce a resolution on wetlands and poverty reduction. I brought in several new dimensions to this area of thinking such as how wetland and poverty issues or health issues are connected, and we merged them into the mainstream thinking. For the last 10 years, I have been heading the organization. The work now spans across 14-15 states, we have several partners and a team of 20 young people who look forward to learning and building their careers with us. Yes, it has been a long journey, nearly 25 years with this organization. This was my first job- started with a basic internship- but now has become my own story.

There are certain things we are proud of- eg: integrated management- the government guidelines are far more systematic and integrated today. We were able to connect different sectors to wetland conservation. They are found under India's National Disaster Management Plans and several sectoral plans that talk about wetlands. We have been able to support the creation of the regulatory regime today. India has a very robust social structure- every state has a state wetland authority. We have been a part and parcel of this journey not to mention the RAMSAR sites which are playing an incredibly important role in increasing the information to the states and authorities which are designating wetlands. This has been a long satisfying journey, yet a lot needs to be done.

Q2. How effective has the Ramsar convention been in conserving wetlands?

Initially, the Ramsar convention began with a waterbird orientation. Wetland conservation began when hunters shooting ducks noticed a decrease in the number of ducks in the wetland and therefore hunting decreased. Concerned about where they would continue to shoot and where the game had gone, they began investing themselves that if we need more ducks, we need more wetlands, so where are these wetlands and what is happening to them, and then this entire chain reaction started from North America, Europe,



and down to developing and underdeveloped countries. So, to that end, the convention has provided that table, that conversation and negotiation space, and it has taken some fantastic conclusions on complicated matters like climate change, with some of those discussions being extremely far-reaching. However, for a variety of reasons, the convention's implementation has fallen short of our expectations. Conventions are also non-binding legal instruments, and national concerns always take precedence. So, we're committing to wise use within the convention. Here wise use implies that we keep wetlands in their natural state as much as possible, and we include their values into sectoral thinking. On the one hand, the convention has provided us with the opportunity to add new wetlands to the Ramsar list.

“ India has the largest wetlands network in South Asia, but their condition isn't always ideal due to a variety of factors including inadequate management and a lack of capacity. ”

As a result, there are a lot of challenges. We continue to designate Ramsar sites, but we put equal effort into ensuring that the promise of Ramsar sites, that their health would be maintained via wise usage, is achieved to a lesser extent for a variety of reasons. Now, if we look in our newspapers to see why wetlands are in the news today, we'll find issues like groundwater decline or wetlands decline, which is why we're having floods, so it's much closer to our climate and water security today, and thus the actions we take for water security, climate security, and food security will have consequences for wetlands, and unless these two goals are harmonized, we'll get complex solutions. More wetlands are needed now, and wetland authorities do exist. As a result, the voyage has been complicated. The Ramsar Convention deserves credit for drawing attention to wetlands, which are still a source of debate on a global and national basis. However, we fall short in one area: ensuring that the Ramsar Convention's obligations are kept in letter and spirit. We're making good progress, but there's still a lot of work to be done. We're fairly certain that we've lost almost 30% of our natural wetland regimes in the last 30 years, and we're generating new wetlands, such as aquaculture farms, salt pans, dams, reservoirs, and irrigation channels. Man-made wetlands do not replace the importance of natural wetlands, and this is a tendency that is not limited to India. The Ramsar Convention maintains the topic alive, but it is up to us to judge ourselves, monitor wetlands conditions, and guarantee that pledges are made by the convention's priorities.

Q3. A significant amount of money was released under the NPCA (National Plan for Conservation of Aquatic Ecosystems) last year, for the conservation of wetlands. Could you please shed some light on how that amount would be allocated further, and how effective, in your opinion, this might be?

Usually, NPCA's single year spending is close to 60-70 crores. It releases money primarily for designing and implementing integrated management plans. So the state governments can apply under the scheme, thus seeking funds for implementation of integrated management plans. The ministry also conducts capacity building courses, invests in inventories, etc. and the money is then spent on the priorities expressed by the state. However, for a country like India, wherein nearly 5% of our landmass is under wetlands, this amount of money is highly insufficient. So, an important issue is- Will we ever have sufficient funds for conserving the wetlands?

“Money itself is not going to deliver conservation. Conservation will be delivered by institutions that can secure actions at various levels and who can then monitor and adapt.”

So any investment that we make, at first, is an experiment. A certain amount of period needs to be given before we can revise our approach. Now, if we add all the money that has been spent by several ministries on programs related to wetlands, then the amount would come somewhere close to 1000 or 1500 crores in a year. However, this figure tells us only a limited part of the story. When we talk about the 'Water for All' mission of the Jal Shakti Mantralaya, we ask, where does water come from? We know that water is provided by nature, as rain settles down in rivers or wetlands. But again, if the wetlands are healthy, then only, the scheme could function well.

Under the Swachh Bharat Mission, all of the waste that is concentrated, where does it go? If we do not have a complete life cycle syncing around waste, then all of the waste would end up being released into the wetlands. So, on one hand, we are investing in concentrating all of the waste, and on the other, we might contaminate the wetlands. Thus, it is here that money matters, i.e., how we can converge wetland conservation with development sector thinking. Wetland conservation is not an isolated exercise. Why are wetlands degrading today? The primary

cause of that is pollution, as we know. So if we do not get the story on pollution right, or if we do not get our story on waste management right, conservation is not going to function. Hence, we need to ensure that the different sectors, which have projects affecting the wetlands, have their investment portfolios aligned with the entire functioning of wetlands. Otherwise, the process of conservation is not going to work well.

Q4. Despite having multiple wetlands, you highlighted in a webinar once, that Delhi still needs a Ramsar site declaration. What recommendations do you have for improving the list of requirements for wetlands designation?

The Kalindi floodplains, the Yamuna floodplains, and other possible Ramsar sites in Delhi all have enough features to qualify as a Ramsar classification. So, the problem does not lie with designation. What matters is, what we do after we've been assigned to secure, integrate, and administer the site. The Delhi Wetlands Authority is making steady progress; now we have a map of wetlands; basic data on over a thousand wetlands; the department of environment knows which agencies own wetlands, their programs and all of this is discussed in high-level meetings over wetlands with the chief secretary. In that sense, they are on the right track. The bigger issue, in my opinion, is to guarantee that the city, which is parched, does not eat up its wetlands by illegal colonies, unauthorized encroachment, or changing the catchment in such a manner that natural flows do not return to wetlands. When it comes to the list of criteria, the countries negotiate them. There are nine criteria in total, seven of which are related to biodiversity, one to ecosystem type and rarity, and one to culture. Adding criteria, may not result in more meaningful sites. There's always a debate over whether we can identify a wetland for its hydrological significance, and the present criteria are sufficient to offer you the cue, and we've already recognized rivers, reservoirs, and streams as Ramsar sites. So, the criterion will not limit the Delhi administration's effort towards redefining the Ramsar site, yet the criteria are the most contentious issue. We can name at least one Ramsar site from Delhi even if we stick to the existing criteria, like the Kalindi Kunj wetlands are so beautiful that they meet the requirements for Ramsar site designation. Similarly in the Yamuna Biodiversity Park, incredible restoration work being done provides another example.

Q5. We also have a piece lined up on "Ecotourism in Wetlands". Could you please suggest how this can be done sustainably, without causing any harm to the environment?

From what has been observed so far, pure tourism in wetlands, just for the sake of making them more attractive to tourists, is not recommended. The reason is that wetlands are very fragile, and they cannot accommodate human interference beyond a certain point. So we recommend only low scale, nature-based tourism, which benefits the local economy. One of the major reasons, why the local communities are usually hesitant in participating or securing the wetlands, is that they have no incentives. Suppose, they stop polluting the wetlands. Now, what do they get back? As a whole, the society benefits from groundwater recharge, mud irrigation, etc, but it is mainly the local communities that are paying the price of lost economic opportunities. How do we, then, balance the incentive structure? Well designed, well-meaning, nature conservation and nature interpretation programs, can give actual opportunities to the local communities, to participate, and thus be an active steward of nature.

As we have seen in the case of Chilika Lake, the Mangalajodi community used to poach birds, and they were then told that they could earn more by acting as eco-guides to the visitors. And as we can see today, Mangalajodi has found its place on the World Tourism map. So, eco-tourism, or nature-based tourism, needs to be designed, keeping in mind the interests of the local people, and it must also be regulated at certain levels. We also need to focus on the educational aspect. So nature education, participation in conservation, etc, are some of the core elements of good ecotourism projects that need to be taken into consideration.

Birds in Manalajodi

Photo source: Govt of Odisha website



Q6. What message would you like to convey to the young readers of Vasundhara?

Everybody matters for wetlands conservation. My biggest message is that the contribution of each portion of society is valuable for wetlands conservation.

“Every small action matters right from deciding not to keep our water taps open, which then leads to pollution of lesser water and then lesser discharge; to a property dealer deciding not to sell properties lying in eco-sensitive areas in the wetlands and to learning and talking more about wetlands, etc.”

Secondly, it is to be understood that wetlands conservation is not a technical subject worked on by ecologists, biologists or limnologists, indeed, all forms of sciences, learning systems and knowledge are relevant for wetland conservation today. We need more diverse knowledge systems today to handle wetlands conservation.

As a student, where do you study wetlands? You study economics, sociology but you don't study wetlands at all. So, if we don't have young students trained in wetlands, we cannot expect them to pick up wetland management as a career. These things need to change and School textbooks cover the minutest details of flowers, but the fact that hydrophytes are indicators of wetlands are not covered in these books. People know about forests or the water cycle but wetland is somewhere hidden.

If the younger generation does not read or talk about wetlands, we can't expect the future to be very robust.

“More young people should pick up careers in wetlands- economists, anthropologists, ecologists, political scientists; all these people can make substantial contributions to wetland conservation. We need more integrative sciences and knowledge systems to address wetlands challenges today because the present state of wetlands degradation is not just a science problem, it is more about how people interact and relate to wetlands.”

WETLANDS: INDIA

JAMMU AND KASHMIR: WULAR LAKE

Wular Lake is the 2nd largest fresh-water lake of Asia, situated on the foothills of Haramuk Mountain. It is spread in a total area of 200 square km covering almost 24 km in length while its breadth is 10 km.

RAJASTHAN: KEOLADEO NATIONAL PARK

It is a man-made and managed wetland and was notified as a bird sanctuary in 1956 and elevated to the status of a national park in 1982 in Bharatpur.

RAJASTHAN: SAMBHAR LAKE

Sambhar, India's largest inland salt lake has been designated as a Ramsar site because the wetland is a key wintering area for tens of thousands of pink flamingos and other birds that migrate from northern Asia and Siberia.

GUJARAT: NALSAROVAR BIRD SANCTUARY

Nalsarovar is a natural freshwater lake (a relict sea) that is the largest natural wetland in the Thar Desert.

KERALA BACKWATERS: VEMBANAD LAKE

It is a chain of salt water lagoons and lakes lying parallel to the Arabian Sea coast of Kerala. The network includes 5 huge lakes, 38 rivers and lagoons, extending virtually half the length of Kerala state.

HIMACHAL PRADESH: RENUKA

Smallest Ramsar site in India.

HIMACHAL PRADESH: CHANDRATAAL

This wetland supports the IUCN Red Listed Snow Leopard (VU).

UTTAR PRADESH: HAIDERPUR

The 47th Ramsar Site since December 2021, is a human-made wetland formed in 1984 and is located within the boundaries of Hastinapur Wildlife Sanctuary.

MANIPUR: LOKTAK LAKE

Loktak Lake is not only the largest freshwater lake in northeast India, it is also home to unique floating islands called "phumdis as well as Sangai, the dancing deer."

WEST BENGAL: SUNDERBANS

Locally known as Badabon, this is one of the richest biodiversity hotspots in India. This UNESCO World Heritage site is known for its mangroves, coastal forests that serve as a biological buffer between the land and sea. It is about 10,000 sq km across India and Bangladesh, of which 40% lies in India.

ODISHA: CHILIKA LAKE

Home to the peculiar Irrawady dolphins, Odisha's Chilika Lake is one of the first Ramsar Sites of India.

ODISHA: BHITARKANIKA MANGROVES

This site's Gahirmata beach is said to be the world's largest nesting ground of the Olive Ridley Turtles. It is also known to host a larger variety of the mangroves than the Sunderbans!



ODISHA:

AN ENTHRALLING ESCAPE

An account by Neha K.N.

Located in eastern India, Odisha also known as "Utkala" is a state with third largest population of the Scheduled Tribes in India. The state is home to several magnificent and beautiful wetlands, temples like Mukteshwar, Lingaraj temple complex, the renowned Puri Jagannatha and Konark Sun temple that I visited during my trip to Odisha in January 2020. Declared as India's first Wetland of International Importance under the Ramsar Convention in 1981, Chilika Lake, Asia's largest brackish water lagoon was a captivating experience for me. It spreads over Puri, Khurda and Ganjam districts of Odisha. It was nearly an hour's journey from Puri's Sterling Resort where we were residing to the Chilika Lake by road. The two places are approximately 40 km apart. On arriving at one of the boarding points, we bought tickets and hopped onto a boat that takes the tourists to the sea mouth where the waters drain into the Bay of Bengal. The boats are managed by the OTDC (Odisha Tourism Development Corporation) with the local fishermen and other stakeholders. The safety of the passengers is ensured by life jackets that have been made mandatory. It is nearly 2 hours before one gets to the mouth of the sea to spot the dolphins. It's all worth when one finally spots them, swim peacefully through the waters of the lake. It was a pleasure to see the dolphins. I immediately took out my camera and started filming them to capture and revisit the beautiful moment later. It felt cheerful to see the eagerness with which people waited to get a glimpse of the dolphins. Even while I penned my experience for the magazine,

I revisited the videos and it brings me tears of joy, as an individual who has always been fascinated and concerned about the wildlife. I later learned that tourism in recent years itself has become one of the major threats to the survival of the endangered Irrawaddy dolphins. The lake has several islands where the ferry rests briefly for the tourists to grab some refreshments and munch on the local cuisines. These islands are also an important site for the migratory birds that arrive by October and stay till March. Chilika Lake is known to be the largest wintering ground for migratory birds in the Indian sub-continent. We also got to see the red crabs that were shown by the fishermen.

I could see that a considerable number of locals, mainly the fisher-folks living on the islands and shores are dependent on the lake for their livelihood. Being a state that is highly prone to the fury of the frequent tropical cyclones, the ruins and remains of the devastating cyclone, Fani (2019) was evident en route to the lake. The best time to visit Chilika Lake is between the months of October to March, as one gets to witness flocks of migratory birds, flying in from all over the world. The pleasant burbling of water and the sight of the dolphins and birds enjoying peacefully in the calmness of the massive lake surroundings is going to stay with me forever. However, it is on us to protect these beautiful and fragile creatures if we are to ensure they survive and flourish in the years to come.

WETLANDS:

THE ECOSYSTEM AND CARBON BUDGET REGULATORS

Wetlands are the intersection of terrestrial and aquatic ecosystems. Hence, the value of wetland ecosystems services is higher as compared to terrestrial and aquatic ecosystems individually. The hydrological services include regulation of water quantity, groundwater recharge, flood regulation, erosion control, sediment transportation etc. The wetland ecosystems are one of the most productive habitats and are home to huge biodiversity. The environment of wetlands supports agriculture of some of the most important crops from food security perspectives such as rice, barley, wheat etc. They also serve as a buffer to the extremities of the climate. The coastal wetlands contribute to the reduction of intensities of waves, storm surges and tsunami in the coastal regions. Most of the ancient civilizations of the world have evolved around wetlands such as the Indus Valley Civilization along the Indus River, Egyptian Civilization along Tigris, Euphrates and Nile River etc. which highlights the significance of wetlands for livelihood and thus the sustenance. They work as a support system to accomplish a plethora of needs which eventually paves the way for the growth and development of human civilization.

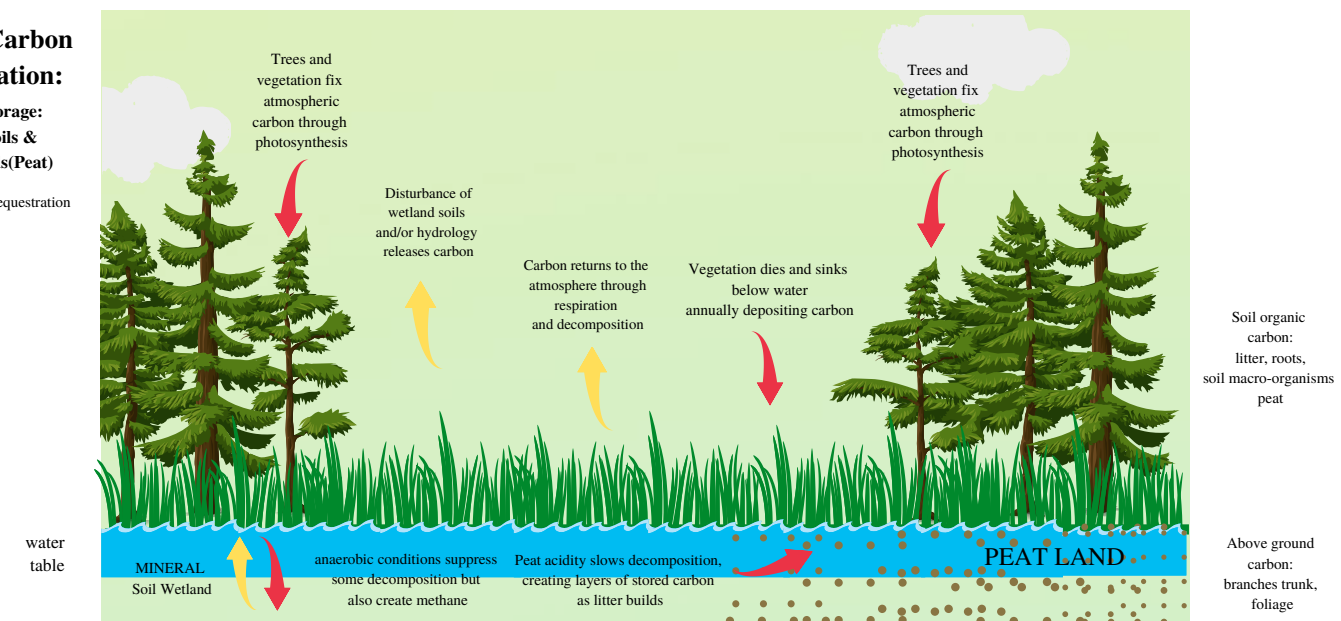
Another important function of wetlands is the regulation of the carbon budget and is the most

relevant discussion in recent times considering their carbon sequestration capacity. Wetlands usually have a dense distribution of vegetation resulting in a relatively higher amount of carbon fixation through plant photosynthesis. Further, since the soil of wetlands is usually anoxic i.e., it has limited oxygen availability due to which decomposition rate is relatively lesser and thus leads to lesser CO_2 emissions (however, in anoxic conditions, methane (CH_4) emission is another problem but that is negligible because of an extremely larger capacity of CO_2 sequestration). This results in soil having high organic matter content which supports healthy vegetation by adding nutritional value to the soil. With time the decayed vegetation also contributes to the organic content in the soil. Hence this is a reinforcing loop resulting in increased carbon sequestration (however, this loop has some limiting constraints that depend on the geomorphological features of the landform). According to a study by Mitsch et al. (2013), the wetlands sequester about 850Tg/year of net carbon (primarily considering the difference between the amount of CO_2 sequestration and CH_4 emissions) with an average capacity of 118 g C per square meter per year. Peatlands, which roughly form 3% of the total terrestrial landscape of the earth sequester about 30% of all land-based carbon.

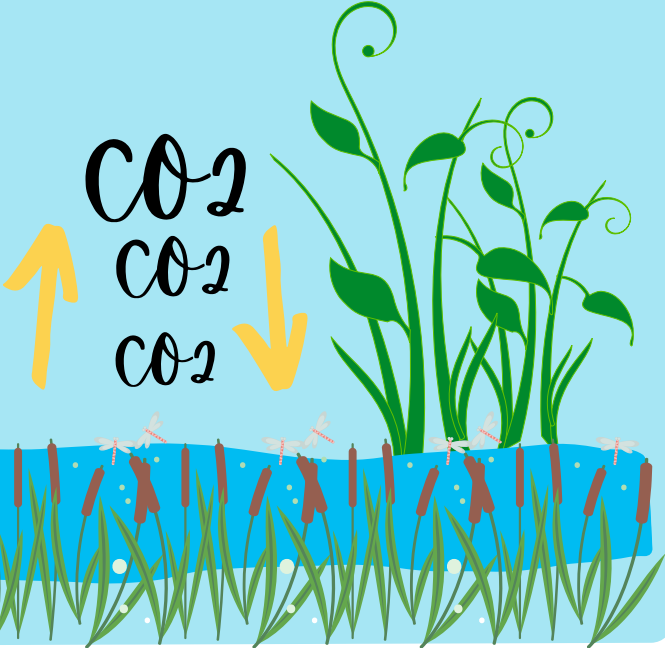
Wetland Carbon Sequestration:

Carbon Storage:
Mineral Soils &
Organic Soils (Peat)

increased carbon sequestration



CARBON SEQUESTRATION BY WETLANDS



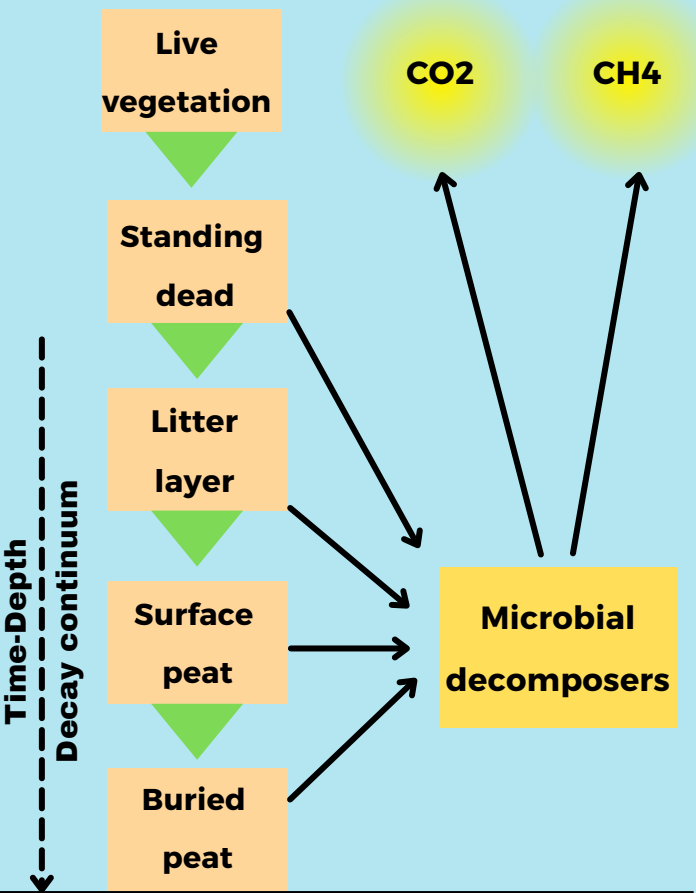
Carbon sequestration is the process by which atmospheric CO₂ is captured and stored long-term in natural or man-made sinks. Studies show that wetlands can store CO₂ for several thousand years to millennia. Carbon sequestration is primarily mediated by plants. During photosynthesis, plants take up atmospheric CO₂ into their tissues in the form of simple sugars, which are converted into complex substances such as lignin and cellulose and deposited in leaves, stems, and roots, and eventually in the soil (as soil organic carbon; SOC) when the plants die. It is known that most wetland plants use atmospheric CO₂ as their main C source. Because of their high rates of gross primary production compared to terrestrial plants, they have a high assimilative capacity for CO₂.

Wetlands can save a lot of government expenditure by storing carbon, because according to the data, the average emissions per person in India were 1.77 tonnes in 2020, compared to 0.93 tonnes in 2000. There are 2 approaches by which we can increase carbon sequestration by wetlands:

- 1) non-manipulative approach and
 - 2) manipulative approach.
- In the non-manipulative approach, the government needs to intervene to convert wetlands into protected areas and provide funds for wetland restoration. In addition, the studies have shown that creating wetlands or

artificial wetlands releases 15 percent less methane gas.

The manipulative approach involves altering the wetland components used to decompose organic matter and sequester carbon. This approach uses biotechnology to alter the



Time-depth continuum of organic matter decomposition and accretion in wetlands

characteristics of soil microbes so that they can sequester the maximum amount of CO₂. Manipulation of soil microbes and plants involves actions aimed at altering the genetic makeup and composition of microbial and plant communities. Proponents of this measure to improve carbon sequestration point out that wetland microbial communities are involved in organic matter decomposition, while vegetation contributes the organic matter.

Another technique is the use of biochar, a porous carbonaceous solid produced by thermochemical conversion of biomass in an oxygen-deficient atmosphere. The use of biochar C is traditionally practiced in terrestrial agriculture, where its application to the soil improves the chemical properties of the soil by increasing the pH level, the availability of plant nutrients and SOC and reducing the toxicity of aluminum.

The application of humic acid can also increase carbon sequestration. Studies have shown that soil samples to which humic acid from lignite or

compost was added retained 96.0% and 90.4% organic carbon, respectively, significantly more than the soil sample to which humic acid was not added (30.8%).

But we still lack data on how much carbon wetlands around the world have stored because there is no mapping and the complexity of wetlands is primarily due to the depth of a wetland, and no two wetlands are the same depth. The picture on the previous page shows how carbon storage in a wetland depends on time and depth.

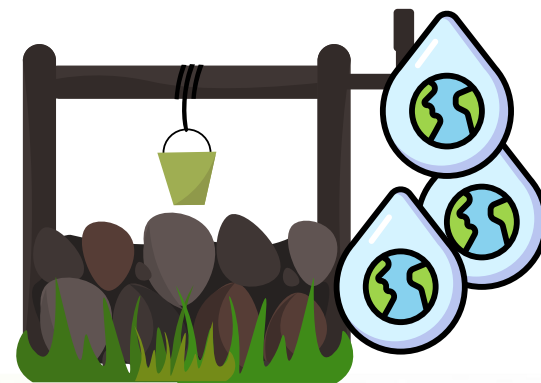
Wetlands are a vital ecosystem for mitigating climate change. They need to be preserved and research should be done on how we can preserve this ecosystem. Finally, the government and people need to understand the importance of this national heritage and its importance because we need to build ecosystems that are sustainable against climate change. And wetlands are an already built system that just needs to thrive if left untouched. The fight against climate change is real.



Photo courtesy: Ananya Pandey, MSc Economics

WETLANDS: HYDROLOGICAL FUNCTIONS AND SIGNIFICANCE

Wetlands are crucial features in the landscape that offer a wide range of services to the people, as well as the flora and fauna. Wetlands being the most productive ecosystem, the hydrological services they offer cannot be overlooked. The hydrological services include protecting and improving water quality, groundwater recharge, storing floodwaters, and maintaining surface water flow during dry periods. The best way to understand the role of wetlands through the analogy by Bucher et al. (1993) is that they act like a sponge that soaks in water during the wet season and releases it during the dry weather conditions.



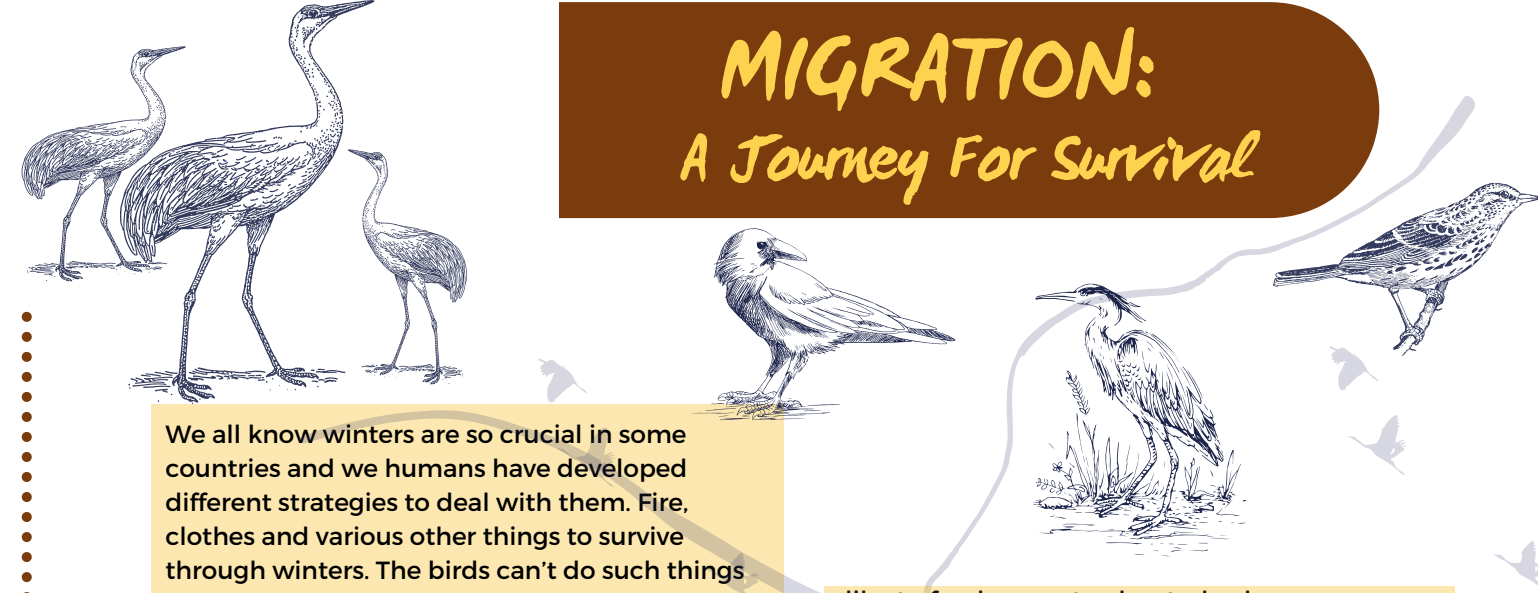
infiltration rate is related to the soil type that wetland has but above all the groundwater is recharged significantly with the presence of Wetlands in the landscape.

The water quality in the wetlands depends on the geographical location and the inflow and outflow of the water in the wetland, for instance, chemical concentrations are lower in wetlands that get water from precipitation and lose it through surface-water outflows and (or) seepage to groundwater. The vegetation in the wetlands prevents erosion by stabilizing sediments and absorbing and diffusing wave energy, it helps to prevent shoreline erosion (Hammer, 1992). The ability to control erosion aids in less deposition of sediments in the lower/downstream affecting the soil quality to support vegetation and agriculture.

Wetlands increase the holding capacity of these surface runoff water from buildings and pavements thereby enabling flood control and waterlogging situations. Considering the reality of Climate Change and the increase in global temperature the precipitations have become uncertain and extreme. High intensity of rainfall in a shorter duration when combined with increased concrete surfaces reduce the infiltration rate and increase the surface runoff. The wetlands play a vital role in recharging the ground aquifers and the groundwater. The

The wetlands have numerous significant services that they provide to the people, wildlife, animals. While designing a water management plan their role must be taken into consideration. Along with the rich biodiversity they also provide water for agriculture by recharging the aquifers and the groundwater recharge. Each wetland is unique and it offers different sets of hydrological functions owing to the geographical location, source of water, soil type, climate conditions, etc. and thus it needs to be planned and managed accordingly keeping into consideration all these factors.

MIGRATION: A Journey For Survival



We all know winters are so crucial in some countries and we humans have developed different strategies to deal with them. Fire, clothes and various other things to survive through winters. The birds can't do such things so they migrate to other places, where they can get favourable conditions to survive and complete their life cycle. During migration, birds move from areas of low or decreasing resources to areas of high or increasing resources. The two primary resources include food and nesting locations. Behind every migration, there is a story.

"No one wants to go away from their homes until it comes to their survival and we the ruddy Shelducks are known for our movement. Our journey towards the Asan wetland of Uttarakhand begins in October. Leaving behind our home we have to move to a new place to keep ourselves alive. Though it is our favourite winter destination, it bothers how much effort the movement requires. Siberia, our homeland, gets covered with snow during winters, making it difficult to find food. The distance between Siberia and our temporary home is approximately 3,700 km. During our journey, we get to see many beautiful and mesmerizing sites. We like it here at Asan, as the people of Asan are making efforts to make our stay more comfortable by doing things like preventing poaching, making several mudflats, etc. Along with us, other species of migratory birds also visit this place. There is quite a competition but thanks to adaptation that everyone has different requirements. This reduces the competition. We

like to feed on roots, shoots, buds, grasses, leaves, seeds, and stems. Others have different food preferences"

Apart from ruddy Shelducks, the wetlands in winters get filled with other migratory birds from all over the world. The regular visitors of this place include Red-crested Pochard, Eurasian Wigeons, Tufted Pochard, Great Cormorant, Bar-headed Goose, etc. Because of these visitors, the winters not only become alive and beautiful but also the different colours of these birds make the place much more appealing.

The migratory birds are an essential part of our country's environment, yet they are not given much importance. And, it can be rightly pointed out about human beings that they have a big role to play in the reduction of migratory birds species. These migratory birds visit our country every winter, making our winters more beautiful and pleasant.

We must give them the attention and love, they deserve. We should respect the birds' homes as much as we do with our homes. A home is important to everyone, whether it belongs to humans, animals or birds. Now the time has come for us to start valuing nature for making our lives worth living.



Photo courtesy:
Janhavi Bhujabal, MSc CSP

SITES AROUND THE SIDES



CAMARGUE

The Camargue is the largest wetland in France, and the second largest delta in the Mediterranean region after the Nile delta. With an area of 360 sq. miles it has been identified as an Important Bird Area by the BirdLife International. The brine ponds are few of the European habitats for the greater Flamingo. Camargue horses roaming the plains is a sight to behold.

VENETIAN LAGOON

The Venetian Lagoon is the largest wetland in the Mediterranean Basin. With an area of 212 sq. miles, it is an enclosed bay of the Adriatic Sea, in northern Italy. In terms of its complexity and richness, it can be compared to other areas already recognised by the international community, such as the Camargue, the Danube Delta, the Po Delta and the Gulf of Gabès.



DANUBE

A UNESCO World Heritage site, the Danube Delta is the second largest river delta in Europe that is best preserved. It is located mostly in Romania with a small part in Ukraine. The waters from the delta drain into the Black Sea. The total area of the delta is 1,994 square miles. The region supports rich flora and fauna; with a large variety of fish species and birds like Pelicans.



MESOPOTAMIAN MARSHLANDS

Declared as UNESCO Heritage site in 2016, the Mesopotamian Marshlands, a rare aquatic landscape in the desert, used to be the largest wetland ecosystem in Western Eurasia. Along with a political edge to it, draining of portions of the marshes began in the 1950s for agriculture and oil exploration as well, with around 10% of the original area left in recent years. Known as the Iraqi marshes, these are located in Southern Iraq and Southwestern Iran.



EVERGLADES

A Wetland Area of Global Importance, the Everglades is a tropical wetland in the U.S state of Florida. With an ecosystem found nowhere else, the National Park is an unparalleled landscape protecting several rare and endangered species. It is the largest contiguous mangrove forest in the western hemisphere.



THE SUDDS

A vast swamp in South Sudan, the Sudd is formed by a section of White Nile, one of the two main tributaries of the longest river on our planet, The Nile. The area of the swamp is highly variable with an average of 12,000 sq. miles that may extend to over 50,000 sq. miles in wet season. It was known as the historic habitat of the endangered painted hunting dog. It is a Ramsar Wetland of International Importance.



KAFUE FLATS

Located in Zambia, they include 2 National Parks: Lochinvar and Blue

Lagoon national parks. These are under IUCN category II protected areas. Floodplains, lagoons, ox-bow lakes form a part of the complex structure of the flats. The flats are an extremely important abode for the Wattled Crane (VU - IUCN) and Kafue lechwe, the endemic antelope.



SUNDERBANS

Formed by the confluence of the Ganges, Brahmaputra and Meghna rivers, the delta formed in Bay of Bengal in South Asian region consisting of Bangladesh and Indian state of West Bengal is the largest river delta in the world. The UNESCO World Heritage site known for its mangroves and coastal forests serves as a biological buffer between land and sea. This unique ecosystem is famous for the royal Bengal tiger, Gangetic dolphin, and estuarine crocodile.



WASUR

Forming a part of the largest wetland in Indonesia, the Wasur National Park is one of the least disturbed by humans. The high value of its biodiversity has led to the park being dubbed the "Serengeti of Papua". The area is under conservation by the World Wildlife Fund for Nature since 1991. Endemic Tree Kangaroos can be spotted here.



GURRUWILING

Curruwiling (Arafura Swamp) is the largest freshwater ecosystem in Arnhem Land and one of the largest contiguous paperbark swamps in Australia with an area of 270 sq. miles. It features numerous lagoons, floating mat communities, sinkholes, sandstone hills and springs. The area is of great cultural significance to the Ramingining community who use the swamp for fishing, hunting and gathering eggs of crocodiles and geese. The swamps are also managed by the community that relies on traditional land management practices.



PANTANAL

Meaning "abundance" in Portuguese, the Pantanal Wetlands in South America is the world's largest tropical wetland, covering an area of 70,000 square miles. Located mostly within the Brazilian state, it extends to portions of Bolivia and Paraguay and is home to a staggering variety of flora and fauna.



OKAVANGO

Located in Botswana, a South African country with approximately 70% of area under Kalahari Desert, Okavango delta, a UNESCO World Heritage site is home to approximately 260,000 mammals during the dry season.





Wetland's Economics and the Realm of Ecotourism

Why are wetlands considered an integral part of the Economy? To answer this let's, understand their connection. The Economy is a crucial aspect of human societies. Every society develops around its unique environment, and thus, its economy reflects the society's needs and cultural attributes.

Culture shapes the economy, and the economy helps human society thrive. The culture around wetlands is intricately intertwined with it. People depend on various ecosystem services like fishing, agriculture, and the diversity of flora and fauna provided by wetlands. That, in turn, builds up the economy of a wetland. Here is a table that shows the importance of inland fishing. Water from these wetlands can also be used for irrigation purposes on which most of the farmlands depend. Wetlands are natural Water Treatment Plants (WTP). An exquisite example of this is "The City of Joy"- Kolkata. The east Kolkata wetlands save millions of dollars for the city as it does not require a WTP because of its wetlands. This is why many environmental experts call Kolkata an Ecologically Subsidized City.

Year	Total (million tonne)	Marine Contribution (%)	In-land contribution (%)
2001-02	5.96	47.7	52.3
2002-03	6.20	48.2	51.8
2003-04	6.40	45.9	54.1
2004-05	6.30	44.1	55.9
2005-06	6.57	42.9	57.1
2006-07	6.87	44.1	55.9
2007-08	7.13	41.0	59.0
2008-09	7.62	39.1	60.9
2009-10	7.91	39.2	60.8
2010-11	8.29	38.8	61.2

Source: Ministry of Agriculture (2012)

Here comes the challenge; these sites are in danger mainly due to human activities. Unplanned urban expansion and industrialization alter the area's culture and destroy the whole ecosystem on which the place's economy depends. Now, for survival, the culture has to be preserved. And it can only be done through preservation by the indigenous communities of the wetlands who understand the rules of nature around the wetland.

If a wetland civilization thrives, tourism could be crucial to its long-term viability. A tourism model has to be incorporated where the indigenous people are represented, and their values are demonstrated in front of the world, where tourists are told about the significance of a wetland.

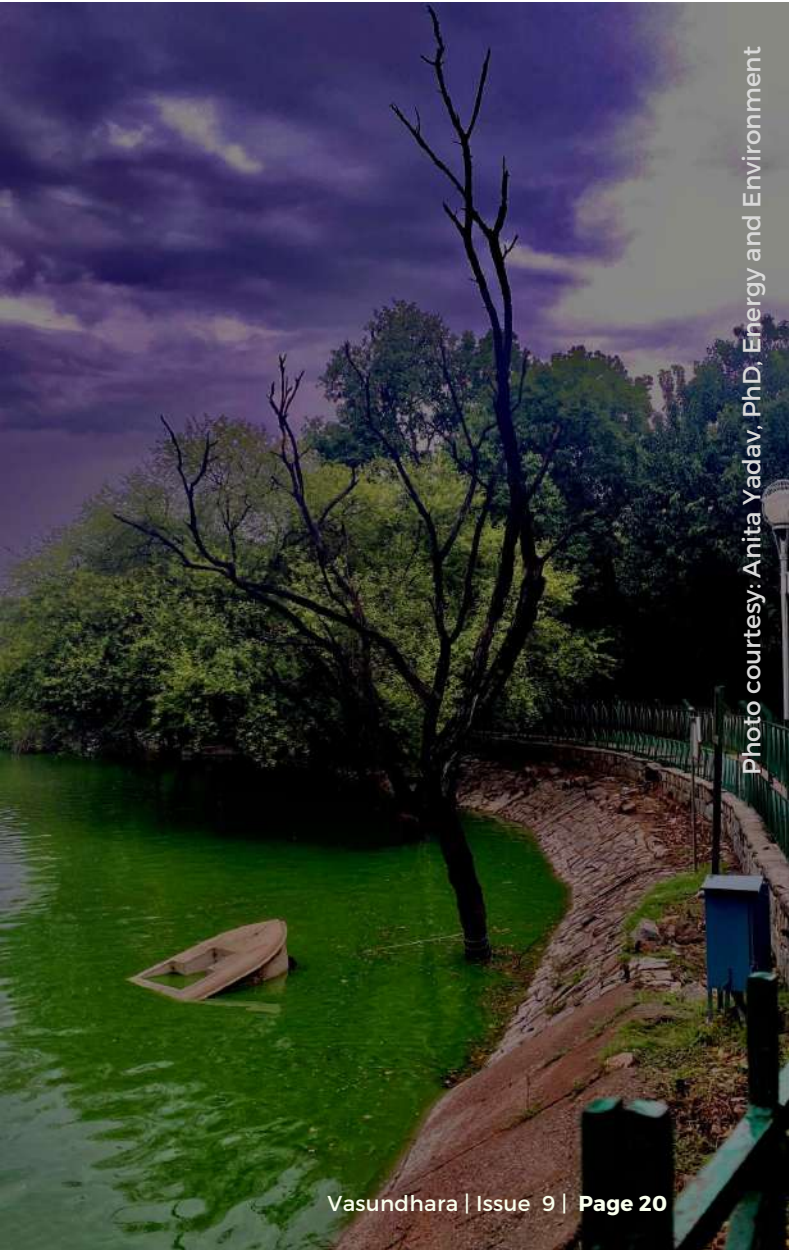
Governments should come up and introduce regulations to protect these wetlands to ensure that tourism supports and does not reduce the quality of life of the local community and to increase benefits from tourism to the local economy.

Tourism is a significant contributor to the world economy at nearly 10 percent. But environmental impact assessment has to be done to make it more sustainable. A book on the development of ecotourism in India by Singh, Sarvjeet (2009) describes ecotourism as "an entirely new approach in tourism that provides opportunities for visitors to experience powerful displays of nature and culture and to learn about the importance of biodiversity, conservation, and local cultures."

The Indian government should take up the case study of countries like Singapore, where the tourism model is based on educating people on the importance of the natural environment and making people aware of the impacts of the changing climate. As of now, the tourism sector is responsible for 235 million jobs all over the globe. India can take inspiration from the model of Singapore, as India has a high potential to showcase its flora and fauna-like wetlands, tap into the tourism industry and create jobs. As the Indian economy faces recession due to the ongoing pandemic and the increasing unemployment rate, tourism can be a major game-changer. Not just that, India needs to incorporate its young force into the tourism sector.

With the help of its new education policy, young minds are taught about the importance of natural heritage and its importance for sustainable infrastructure. The government should also develop initiatives to make the tourism sector an attractive career choice for the new generation and encourage entrepreneurs to create new startups.

According to World Travel and Tourism Council, India ranked 10th among 185 countries regarding travel & tourism's total contribution to GDP in 2019. During 2019, the contribution of travel & tourism to GDP was 6.8% of the total economy, i.e., Rs. 13,68,100 crore (US\$ 194.30 billion). The tourism sector can be a gold mine for the economy if we follow the trend. Sustainability is a new trend in the twenty-first century, and India must adapt to keep up. Because of our rich tradition, Indians have a natural affinity for sustainability. India must promote its cultural legacy and biodiversity to the rest of the world to attract millions of visitors worldwide to see the wonders of Incredible India.



Beyond Legends: Wetlands as a Way of Life

Significance of Wetlands since Time Immemorial

In the Siramaur district of Himachal Pradesh, there lies an elliptically shaped lake - RenukaWetland, fenced by two parallel steep hills directing east-west. It happens to be the largest lake in Himachal Pradesh, shaped in the form of a sleeping woman. One of the popular legends has it that the lake gained spiritual importance after Goddess Renuka, mother of Lord Parashurama, sacrificed her life to escape from falling prey to the brutal king Sahasrarjun.

Today, the sanctity of the wetland is maintained to honor the eternal Goddess Renuka, worshipping her in the temple dedicated in her name. Every year, a fair is held mainly in the cultural and festive spirit that brings the community together and engages with visitors by organizing folk dances and a culture-driven program. To honor her son, Lord Parashurama, who is believed to be an incarnation of Lord Vishnu, an immersive procession is carried out at Parashurama Tal, which involves placing his idols in handcrafted palanquins. Lush green alpine forests and scenic lakes make the program even more appealing and beautiful.

With values and benefits come threats too. High tourism pressure, siltation, pollution, catchment destruction, to name a few, pose a threat to the biodiversity and species that thrive in the freshwater lake and marshes of the wetland. Let's circle back to them in more detail.

Role of Wetlands in Human Civilization

Ancient literature has mentioned the emergence and sustenance of human civilization in the riverine system/wetlands and that many of the essential needs are met with their aid like water, production of protein, purification of water, flora and fauna, control of flood, recreation activities, etc.

Rural communities residing near such wetlands depend on them for their livelihood. The wetland cluster of Calcutta is an astounding example, which is home to 155 species of summer birds (data as of 2002) some of which are resident birds and the others, migratory. The migratory birds come from Siberia, East-Europe through the Trans-Asia migration route. These wetlands provide a fresh fish repository in the Calcutta market, employing thousands of rural people in the vicinity of 7,500 acres.

Loktak lake of Manipur stretches over an area of 26,600 acres, is a means of generating income for an average household through collecting aquatic plants (89.7%), fishing (69.7%), rearing livestock which is an age-old means of livelihood for the communities. Over 30 edible plant species make up for the preparation of their traditionally rich food. The Manipuri revere the lake as 'Loktak Ima' (Ima - Mother) as a gesture to pay their respects for the values and benefits provided by the wetland.

The Posing Threats

Like Loktak Lake and the Calcutta wetlands cluster, many other wetlands of India have gained international interest, which has invited threats that directly affect the lives of the rural communities dependent on the wetlands to earn their source of income, for the locally sourced food impacted by the degradation of the wetlands. For instance, the threats surmounting the Loktak wetlands are:

- The Hydropower project that involves unsustainable extraction of water
- Decaying vegetable matter on Phumdi (floating island)
- Fragmentation due to road construction
- Ithai barrage construction leading to water regime alteration
- Siltation
- Pollution

One of the notable losses to the population in terms of biodiversity loss was the disappearance of the migratory fishes from Chindwin-Irrawaddy, Myanmar, the main reason catering to the construction of the Ithai barrage that altered the natural hydrology of the region and blacked their pathways. Other endangered species include Manipur Brow Antlered Deer, Keeled Box Turtle, Sarus Crane, Amboina Box Turtle, King Cobra, Burmese Python, among others.

The lands that native communities once considered their own, since the time their

ancestors lived in, unhindered, untouched, came at the cost of their alienation in the name of progress. Loss of agricultural land to floods, the decline in the catching of fish, restrictions to access essential requirements, have not only threatened the native communities' sustainable livelihoods but have also given rise to conflicts with the management committees enacting these impositions.

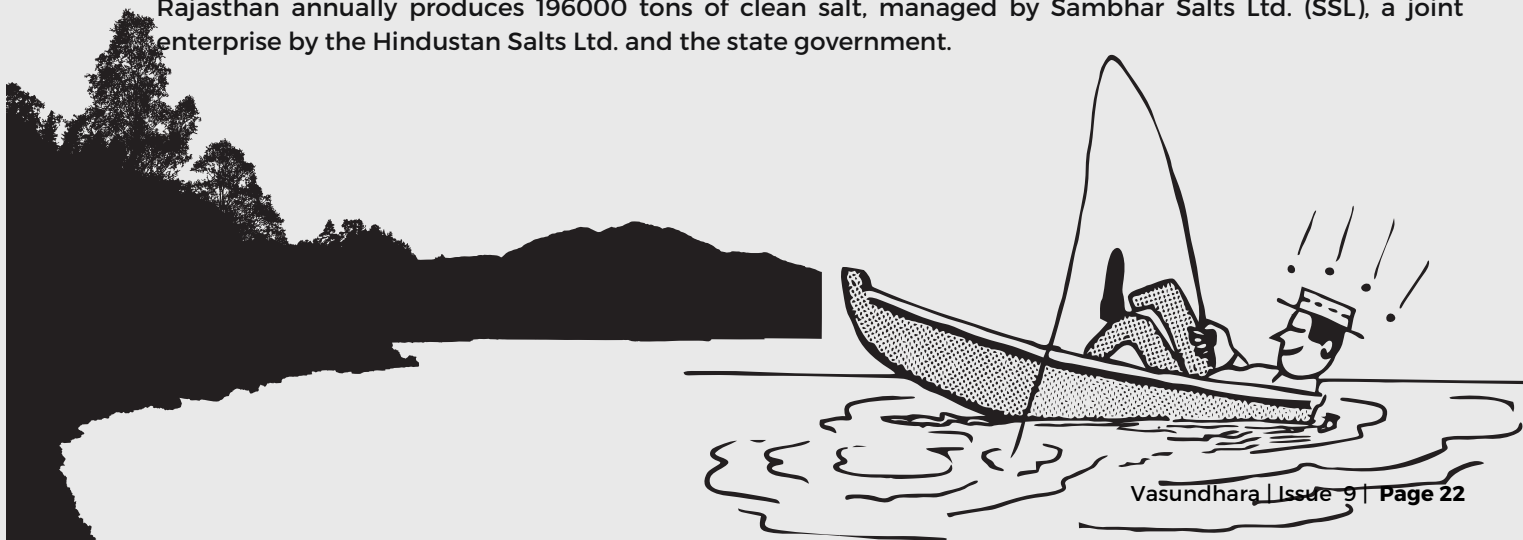
Aligning Economic Priorities with Social Values

It's only human to value the natural ecosystem and feel a connection, one that finds harmony in social functioning. Developing long-term strategies, one that finds a balance in maintaining the ecological and social values, while also having a benefit-sharing plan for the residing rural community can prove to be effective. Environment impact assessments carried out may not necessarily be in sync with the perception of the public. Hence, finding a middle-ground is imperative, one that adapts to the parameters of ecological conservation and is valued by both the people and the experts. While, over the years there have been wetland conservation initiatives led by experts, activists, communities, however, keeping in account social, geographical characteristics, that align with living conditions of the indigenous groups, their traditional knowledge, beliefs, life experiences, cumulatively will sustain their culture and livelihood for generations to witness and experience.



HISTORICAL FACT:

The origin of the Sambhar Lake in Rajasthan is dated to the 6th century, created by Goddess Shakambari, an incarnation of Goddess Durga. The mythology says, in the era of Mahabharata, a priest named Shukracharya, got his daughter, Devayani, married to the emperor of India, King Yayati. The Devayani temple not only exists to date but also, through excavations, many terracotta figurines, discs, stoneware were found, which are now preserved in the 'Albert Museum' of Jaipur. The Sambhar lake wetland in Rajasthan annually produces 196000 tons of clean salt, managed by Sambhar Salts Ltd. (SSL), a joint enterprise by the Hindustan Salts Ltd. and the state government.



PEOPLE OF THE WETLANDS

*There lives a small river inside me,
I breathe freely in its aura,
See here I stand for its existence
Just like it does for me*

It is often argued that people, working around natural resources are not aware enough to use the resources sustainably. The argument includes that these people do not understand the impacts of climate change, pollution, anthropogenic activities, etc. This argument remains incompetent as it is incomplete. Although these people don't understand the scientific jargon very well, they understand the changing dynamics of their workplaces much better than anybody else. The prejudices about people, living around the wetlands are no different. Just like our wetlands, these people have been suffering for the past multiple years. It is also true that there are multiple cases of negligence towards the wetlands, by the local communities. In such cases, we can observe that there is a lack of awareness or incentives. Some communities, after realizing the importance of wetlands, have also come up with local but effective solutions. Here, we bring to you, the ground-level information about the conditions of the wetlands of our country, directly from the "people of the wetlands", people, who have been standing for the existence of the wetlands for decades.

Umashankar Mandal, The 'Mangrove Man' of Sunderbans, Bengal

"Sunderbans has fertile land, to begin with. Agriculture and fishing are the main occupations of the local people. Every house has its own pond. Due to the frequency of cyclones and floods during the monsoon season, there is a decrease in the local agricultural land of the area. With the rise in sea level, saltwater is mixing with fresh water. This increases the alkalinity of the soil, thereby reducing the cultivable land area of the mangroves. Saltwater is pooling up inside the ponds, affecting the fish population. With the increased water level, the reduction of habitable land area for the native wildlife is also decreasing. The aftermath of cyclones/floods leads to frequent displacement/destruction of the homes of the villagers. Example: After Cyclone Amphan had washed away quite a majority of the mud houses, some of them still haven't been rebuilt. Planting more mangroves along the banks will protect the fertile soil against erosion. A group of people known as the Mangrove Army has been carrying out this task very successfully."

"We live in a mess and everybody around the city is responsible for this."

Boatmen of Uttar Pradesh

"We have immense respect for our wetland, as one, in our culture, we believe that this wetland is our mother and second, we live off it. Earlier people used to do fishing in our area, but now there is nobody, as there are no fish left in the water body. The water is so polluted, there is barely any organism living in there. There is very little income in our work but it is the only thing we can do. Mostly we take tourists on boat rides or we take people, who come here to perform cultural rituals. So many people visit the wetland, complain about the pollution, and then go on polluting it themselves. In our area, multiple cleaning drives have been happening for decades, but no fruitful results have come out."

V. Ashwini, Janitor, Tamil Nadu

The dumping hole, where we put our waste today was part of a chain of wetlands. I remember it being a beautiful place to sit beside during my evenings. I have a lot of memories - emotions attached to the wetland, but these things don't matter in our practical world. Since the city needed a dumping area and the wetland was drying, it was converted into one. The same has happened to a lot of wetlands. I, myself collect waste from approximately a hundred families and dump it in the pot-hole, which was once a beautiful lake. Sometimes our community gets blamed for this horrible condition, but it is not our waste, we are not producing this huge amount of waste. We live in a mess and everybody around the city is responsible for this.

Prakash Negi, Mule driver, Uttarakhand

"Although the amount of silt- sand produced by the streams has increased, the availability and approachability have decreased to a great extent. Earlier, whenever the water level of the wetlands decreased, we would go and collect the sand, which would be used for construction. Now, all along the boundaries of the wetlands, heavy construction has happened. So, we can't approach those areas, as they are private property. Two, the sand has no place to settle. This is a major reason behind floods. The wetlands do not have enough space to expand and then because of sand contamination the capacity of the wetlands to hold water is also reduced."

Farmers of Nava Kulyari, Chhattisgarh

"For a long time now, we've been witnessing this phenomenon, where the summers are so dry that the wetlands are left with very less water, leaving us with almost no water for agriculture. But, during the monsoons, the water levels rise so much that there are periods of massive floods. To deal with the dry summers we have built huge man-made ponds, but they are neither sufficient nor sustainable. The natural supply of water has to be maintained. Every year, a lot of property gets damaged because of floods. The soil is constantly losing its fertility. The number of bird species has also reduced. They are crucial for the pollination and seed dispersion of many plant species. We don't have any massive political agenda behind standing up for our wetlands, our motto is very simple. If these wetlands somehow disappear, we'll die."

"We don't have any massive political agenda behind standing up for our wetlands, our motto is very simple. If these wetlands somehow disappear, we'll die"

Fishermen of Kochi, Kerala

"There are barely any fishes left in our wetlands today. Every year, so many fishermen leave the state and migrate to other parts of the country in search of work. Many of us have started to do construction work as well. Fishing is not merely our job, it is our life, but what can we do when the fishes, left in the wetlands are not sufficient? The major reason behind this is overfishing. A few years ago we were introduced to the Chinese fishing nets, capable of catching hundreds of fish at once. Most fishermen shifted to these "more effective" nests. So, when fishes were not given enough time to breed and were constantly caught at a high rate, it is no wonder that soon the number reduced to nothing. Then, the pollution has also increased a lot. We have to understand that only if we respect our wetlands, we can live off these."

**Photo courtesy:
Ganeshdeekshith Siragam, MTech REEM**



CAPITALIZING WETLANDS: 'Private' Profit on 'Public' Costs

Photo Courtesy:
Anita Yadav, PhD Programme



C. Mohan, Farmer, Kerala

"In the past few years, the natural freshwater supply has reduced a lot. We grow paddy here, and paddy requires a lot of water to grow. When we constantly conserve water for a whole year, then two crops of paddy can be yielded in a year. Because natural supply has decreased, we have come up with our solution. We get large potholes dug and conserve fresh water in there (mostly rainwater). There is also the problem of saltwater contamination. Crops cannot grow in saltwater, it messes up with the pH of the soil. A proper freshwater supply has to be maintained. We cannot change the scenario all over the world, but we can manage our little worlds (our lands, our fields) and we have been doing it."

Vilas Saini, fisherman, Assam

"Although I don't earn very much through my job, it is kind of the only job I can do. I don't own any fields or major property. All I can do is fishing. Even during the non-fishing seasons (the government bans fishing during the breeding season), I prepare for the fishing season itself. In the past few years, the number of fish, here, in Bagjhan, Assam, has reduced drastically. This year the fishes are fifty percent less than the last year. The size of the fish is also constantly reducing. After the oil spill in May 2020, almost everything has been destroyed. Water has dried out throughout a stretch of 4 to 5 km. Then there are cases of overfishing and invasive fishing. Most of the fish species have vanished. The amount of silt- sand has also increased. More and more people are losing their fishing jobs, because of this."

Photo courtesy:
Janhavi Bhujabal, MSc CSP

In today's world, the wetlands have gained huge importance due to their role in mitigating pollution, support to plants and animals, role in water security and prevention of floods, soil erosion, etc. But despite their immense value, various social and economic pressures can drive decisions to damage them through pollution, destruction of habitat, land reclamation, and drainage. Although several laws remark conservation of wetlands, they are not yielding desired results. As a result, many firms like Kohler Co. target these natural ecosystems for building something as trivial as a golf course. Although the company estimated that the proposed project would create 227 jobs with a \$21 million annual economic impact on residents and businesses; the negative externalities far outweigh the positive impact resulting from the deal.

Another threat to wetlands is from the disposal of coal-ash. This black carbon contains harmful non-biodegradable metals such as lead, mercury, chromium, selenium, cadmium, and arsenic which can cause cancer, lung disease, and birth defects in humans. Once coal ash is dumped in the wetlands, the authorities are stuck in a catch-22 situation. Since leaving it there is shortsighted and dangerous, but the clean-up will require ample time and resources. Even though the clean-up of the Kingston spill took years and cost more than \$1 billion, it also led to an improvement in public health, an increase in local property values, increase in jobs, redevelopment opportunities, and healthy freshwater ecosystems. In many cases, the firms accused of coal ash spill also tried to foot the bill of cleanup on their customers. In particular, Duke Energy agreed to spend 8 to 9 billion dollars to excavate 31 coal ash ponds in North Carolina. Their spokesperson estimated that about 40% of this payment will be passed on to the region's retail customers.

The firms politicize this payment in order to fill their shareholders' pockets. In this case, the shareholders were expected to receive an approximate return of around \$200 million in the coming years.

The restoration of wetlands needs management of the ecosystem's needs with a holistic approach. It requires stringent laws to prevent land swapping for developmental activities. To illustrate, the New South Wales state government acquired two wetlands under their protected national park estate and the Hamilton Conservation Authority mandates developers to relocate the destroyed habitat. The authorities also need to involve local participation to conserve the habitat in the long run. For instance, the Nepl family in Northwest Iowa successfully revived the drained wetland by collaborating with the state's science laboratory. Due to limited land area available to crop producers, they had to drain wetlands to increase production. Currently, there is a lack of individual incentive to conserve wetlands. The revival and restoration programs should incorporate sustainable actions to protect biodiversity and support the livelihood of those people who depend on it. It is crucial to introduce policies for coal plants to successfully transition into the clean energy future. Over time, these actions will not only revive the lost ecosystems but also promote better economic growth in society.



Q1. We came across how you undertook a lot of research to come up with a Hydroponic technique for saving Bellandur Lake in Bangalore. Could you help us in understanding, how you came up with the technique, its implementation and impact?

Our team members come from different fields and have no formal training in wetland or environment conservation. But our first preference for saving the lake was to allow the lake to fill up with rainwater. However, we soon learnt that rainwater alone was not adequate as the civic administration - BBMP, connected the stormwater drains to inland pipes but unfortunately, the lake went completely dry by summer and was not filled up completely by monsoon. We witnessed this situation during the first 2-3 years. But if lakes go dry that way, along with the problem of water scarcity there is a risk of it turning into a wasteland with human activities. Since monsoon rain was not enough, we got BBMP to harvest water from new sources, which again turned out to be insufficient. So, we were looking at alternative water sources, and our second approach was to go with the treated sewage water.

I live in South City, that has a well-regulated Sewage Treatment Plant (STP) maintained by the owner's association. At that point, they had 8 lakh litre/day STP used in new blocks of the complex. We approached them to give us access to excess water, remaining after their usage. They asked us to get permission from BBMP, and they in turn asked us to get permission from the Pollution Control Board and we obtained the same.

Along with treating the lake with treated water from May 2015, we also researched how to purify the lake water. The simplest approach that struck us was - Hydroponics! The roots absorb the nutrients from the water and the plant grows. We wanted something quite simple that does not sink, and that would also be manageable in terms of cost. We used PVC pipes to build Artificial Floating Islands (AFI) and insert various kinds of plant seeds. We were quite enthusiastic about it. We also got water testing done by some volunteers from an engineering college. By June 2016, we had introduced 3 AFIs (Artificial Floating Islands) on the lake.

IN CONVERSATION WITH Usha Rajagopalan



Usha Rajagopalan, a woman who has worn many hats, is a renowned lake conservationist and a writer by profession. She is the chairperson of the Puttenahalli Neighbourhood Lake Improvement Trust (PNLIT), a not-for-profit charitable trust, involved in the restoration of the lake. She has been instrumental in reviving the Puttenahalli Lake in her South Bangalore neighbourhood, with the help of other committed citizens. She has been the recipient of several awards and recognitions for her extraordinary work in lake conservation. She also received the "Woman of Substance" award from Rotary Club, Bangalore, in 2014.

They were working well without sinking; the plants started growing well, which indicated the presence of pollutants in water, because something that is a nutrient for the plant, is also a pollutant for the water. Continued water testing helped us in measuring the progress; in a span of 6 months, water purification of the lake was becoming evident. With time, we introduced more floating islands. The real test came about when we decided to extend this model to the wetland in our vicinity. It is a constructed wetland where BBMP has introduced some plants as a part of a bio-filter system where the influx flows through these plants, gets purified, and fills up the lake with purified water. But we learnt that, without maintenance i.e., replacing and cleaning the plants timely, it became a wasteland. But once our AFIs started working, we

got BBMP to clean up all the trash dumped on the wetland location with an attempt to introduce an AFI on the wetland as well. The BBMP helped clean the wetland spot. We also introduced 'Agitation' to reduce duckweeds which covered the wetland. We went about diverting the treated water to the wetland from the lake, and in no time the duckweeds vanished. Once it was cleaned, we covered the wetland with AFIs along the periphery.

The parameters of tested water improved and the AFIs were a huge proof of the improvement in the condition of the lake. We could see the fish in the lakes and it was a beautiful feeling. We understood the importance of wetlands, the importance of maintaining them and how well the AFIs were working in doing so.

Q2. For metropolitan cities like Bangalore, how effective, do you believe are citizen-led initiatives in safeguarding their last few remaining lakes from encroachers?

Bangalore once had around 1000 lakes. It was called the 'City of lakes.' Today we have around 200 odd lakes. It is not that people have not been conscious about the fact that the lakes are disappearing, but whatever we are doing today is rooted in the attempts of the earlier generations to get the government to listen to them. Some lakes were being privatized in the past and some citizen groups took the matter to the High Court and stopped it.

Bangalore, I feel is a place where citizen activism is quite high. If we find something wrong happening around us, we raise our voices. PNLIT may have been the first group to have signed an MOU (memorandum of understanding) with the BBMP (Bruhat Bengaluru Mahanagara Palike), but now, there are around 50 to 60 citizen groups in Bangalore that are looking after many lakes. I am immensely proud of the citizen initiatives in various issues, especially where lake conservation is concerned.

So, one thing that I would like to tell everybody is, speak up when you see something wrong happening in your neighbourhood. Initially, I used to think this was not my responsibility. Nobody knows me in the city. But I later realized that if I wait for someone else to take the lead, the lake might not as well be there. So, we must stop giving excuses for not doing things and start doing them. Especially, when it concerns the future and the environment.

“We always talk about people's right to water. But we never ask what the responsibility of people towards water is.”

Because water is not an endless resource. We have seen several places facing water shortages. Why can't we make places rich in water, air, and natural resources? Because nature will always heal itself but we will not be able to do that. It is high time that we think about these concerns.

Q3. Every city has its challenges followed by its ways of dealing with the different environmental problems. Could you please help us in understanding, how you overcome the challenges you face in the maintenance of the wetlands, and how have those measures evolved in these past years?

We gained a lot of knowledge in these last few years working on lakes and wetlands conservation. As I already mentioned we created AFIs, but we also learnt that a huge amount of silt enters the lake and wetlands. If the silt is not removed, it will reduce the holding capacity of the wetland. Water will simply enter and pop out. That is why we introduced intervening rockbound, enclosing all 4 inland pipes (in working condition). This allows the silt to rest in this setup as it enters along with the water, and through drainage, it enters the main body of the lake. We then found it started becoming easier to manually remove the silt from this siltation chamber. This lends our wetland a dual-chamber design; the first chamber being where the water along with silt enters the siltation chamber and the silt settles at the base. The next chamber is the biofiltration chamber which has the AFIs for water purification of the wetland. The treated water pipe has been attached with a sprinkler such that both the chambers will get agitated.

We took the help of a researcher to document the entire process for us to measure the progress and work. We also plan to share the information with other lake groups to let them know how this approach has been working, through water parameters. We are getting the water tested regularly and documenting the dual design of the wetland. This has been an incredibly good learning experience and we have come a long way from the first time we saw the degrading condition of the wetland. With all the AFIs built, the visitors found it to be a scenic attraction, and with the new sprinklers added, we hope it adds more aesthetic to it.



Q4. Madam, would you like to give some suggestions on how to save a dying lake and start a wetland conservation movement?

Always be aware and take a stand. What holds us back is the fear of making mistakes and people's opinions. But when things are already going so bad when it comes to our environment, each of us needs to take up a role and execute it well. It all begins with a seed of an idea that I turn into fruition. The lake conservation is on similar lines. The more time we spend understanding the technicalities; for

example, methods like phytoremediation, the better it helps us get accurate results. The lake is like a baby to us and the next challenge will be to look for more parents to take care of the baby. It is important to be aware of what are the things you can do in your capacity and thus work towards it. If we can do it, then you can do it better than us. Do not be held back, by your imagined fears and doubts. You do not know how much you can do, till you do it. If you fail, it only means you did not do it well enough, so you must try better.



MANGROVES REFORESTATION PROJECT IN SENEGAL: A Critical Analysis

Mangroves are essential from an ecological perspective as they serve nature by contributing to multiple functions in the ecosystems such as nutrient cycling, preventing floods and erosion, etc. alongside sequestering coastal blue carbon which helps in mitigation of climate change. Senegal solely hosts around 185,000 ha of mangrove estuaries which span 700 ha of mangrove forests. We can understand the variability in the mangrove forests through a specific scenario of Somone Estuary in Senegal from 1946 to 2006, through a diachronic study implemented to estimate the area occupied by mangrove forests through GIS.

- Between 1946 to 2006. The change in total surface area is divided into three key periods:
- Decrease from 1946 to 1978,
 - Stabilization from 1978 to 1992, and
 - An increase from 1992 to 2006

From 1967 to 1969, it was found that the closing of the inlet had aggravated the loss of estuaries. Traditional wood harvesting in the 1900s by locals had left 85% of barren and unvegetated mudflats in the supratidal and intertidal areas respectively, resulting in a loss of 44,000 m² year⁻¹. The impact was magnified due to an extended drought leading to a lack of water renewal, water acidification, and hyper-salinization. Only a small mangrove area was stabilized between 1978 and 1989.

Consequently, in the early 1990s, the state government banned mangrove harvesting and sand mining in the habitat and the local population also launched a mangrove restoration program in 1992. Other factors such as the influence of groundwater, tidal flooding, the ban on wood harvesting, and the low net accretion rate of 0.2-0.3 cm year⁻¹ further promoted this

restoration. In addition, three campaigns launched by Rhizophora led to an increase of 0.2km² of the mangrove area. All these restoration efforts spanning from 1992 to 2006 increased the mangrove area by 63,000m² year⁻¹Such scenarios then inspired some NGOs to extend this restoration practice in the area. One of them is Océanium, which launched the Livelihoods-Senegal Project in 2009 involving 10,000 locals from 350 villages. They successfully restored around 10,000 hectares of land in 3 years being the largest mangrove restoration project in the world covering almost 80 million mangroves planted between the deltas of Casamance and Siné Saloum rivers. It received 10% funding from the government and the rest through carbon financing by companies laying the foundations for the Carbon Livelihoods Fund to collaborate with private and public organizations to tackle the loss of habitat and climate change in the coming years.

Reforestation Impact Analysis

Reforestation of wetlands undoubtedly brings numerous socio-economic, ecological, and health benefits. This project has sequestered more than 1,60,000 tons of CO₂ as of 2019 and is expected to sequester 6,00,000 tonnes of the same in its 20 years life span as per Verra, one of the major organizations for laying down carbon standards.

However, the extent of benefits and negative impacts are dependent on the practical implementation of reforestation programs be it in Senegal or elsewhere. The legal definition of

the forests had been altered in Senegal where it is dominated by groves, to mark the success internationally, thereby making the restoration program not ideal.

Monospecific replantation with Rhizophora mangle owing to its easier plantation over Avicennia sp. which is riskier to plant but highly beneficial and adaptable to the ecosystem is another grave issue. Further, the lack of pre-and-post-scientific studies for biological and cultural diversity led to an increase in the level of spatial competition between the shellfish harvesting practices and space used by birds, putting negative socio-cultural impacts on the local community. The non-involvement of local dwellers in the decision-making has led to these loopholes being left unconsidered and unsolved.

Therefore, for the reforestation program to be highly beneficial; the approach and attitude to the program is the major determinant. Case-specific, the reforestation program, to say, is the biggest in terms of area but lacks scientific studies and approaches to assess, manage, reduce and mitigate the negative impacts to an optimal extent hence, leading to some undesired impacts on the ecosystem health and livelihood sources. An ideal reforestation program should begin with extensive research to understand the social, economic, historical, cultural, and environmental systems of the targeted region, and then, these systems should be handled sensibly for achieving the optimal benefits in all areas of life.



Mangrove reforestation in Senegal
Photo source: Livelihoods Funds



Collaborative Entrepreneurial Spirit in Wetlands' Conservation: The Need of the Era

When we discuss environmental conservation, it is hard to ignore the role of businesses and entrepreneurial ventures. Over the years, there has been an increasing trend in the business interventions towards conserving wetlands. Some ventures tackle the pressing environmental concern of diminishing wetlands areas, while others appear with the business motivation of conserving the wetlands to save the tourism or agriculture/fisheries of the place. Whether the driving factor of the businesses to act is light green (self-conservation approach) or dark green (environmental activist approach), it seems only proper and necessary for businesses to intervene and play an integral role in wetlands conservation.

In an example of social entrepreneurial spirit highlighted in Uttaran, a Bangladesh citizen sector organization founded by Ashoka Fellow Shahidul Chowdhury, which engaged the local and national civil society to create pressure on the government to stop projects that cause waterlogging of tidal wetlands solution and to conserve wetlands in southwest coastal Bangladesh. The efforts were made by the organization to conserve and sustain the livelihood of the farmers and fishers depending on the wetlands for their livelihood.

On a global scale, various NGOs (non-governmental organizations) and corporations are working together to bring about sustainable development around wetlands. An epitome of such a partnership was shown by WWF and the world's largest brewer, AB InBev, the parent company of Zambian Breweries. They studied the feasibility of creating a pipeline of sustainable bankable water projects in the Kafue Flats which would help communities,

businesses and nature alike. This would not only help in the restoration of wetlands along the Kafue but also be a boost to the country's 2030 sustainable development agenda.



Like them, it is high time for businesses and other stakeholders worldwide to recognize that wetlands like, "The lower Kafue River is the lifeblood of our economies" and business as usual models that overexploit such precious resources are not only harmful ecologically but are also unsustainable from a socio-economic point of view.

The case of Narayanapuram wetland, part of the massive Pallikaranai marshland in Chennai shows how, when the government teams up with NGOs and the corporate sector, can lead to the restoration of the most severely compromised ecosystems. By 2015, large-scale construction activities had shrunk this lake to such an extent that it flooded the nearby residential complexes during monsoon. This compelled the NGO Care Earth to team up with the Public Works Department and draw up a restoration project for this wetland. This project

was funded by the multinational company VA Tech WABAG as a part of its corporate social responsibility (CSR) activity.

Thus together, the NGO, the MNC (multinational companies), the government as well as the residents pitched in and wrote the success story of the restoration of the Narayanapuram wetland. Similar partnerships and interventions are needed to ensure that the stakeholders and decision-makers have a deep understanding of the science behind wetlands so that in the future, developmental activities are well planned and sustainable.

The cases discussed here serve as the testimonials of the scenario of collaborative

partnerships among multiple stakeholders, and how, the interventions by the businesses, government, self-help group, or other sectors are bringing in positive change in the direction of conserving and restoring the wetlands. When the businesses start seeing the environment as a stakeholder, instead of seeing it as a mere raw materials provider, holistic business ideas appear. When stakeholders realize the need of working together for long-term sustainability, collaborative ideas appear – Collaboration, not Competition! For the conservation and restoration of wetlands, along with ensuring the social and economic well-being of the society, systems thinking from all the stakeholders with common goals and just execution of it would enrich the co-living and flourish of all!



BIOMIMICRY

Biomimicry provides a compassionate, interrelated knowledge of how life functions and, ultimately where humans fit in. Biomimicry is the study of an imitation of nature's forms, processes, and ecosystems to create more sustainable designs.

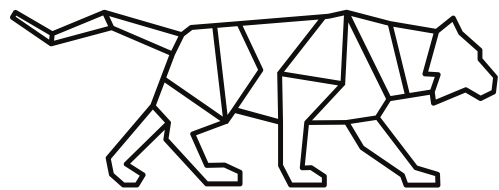
Biomimicry Methodology

1) IDENTIFY: The scope of work and basis of design needs to be determined. For example The need for water with very less chemical and biological contamination for reuse (i.e. for drinking, irrigating, bathing, etc.)

2) INTERPRET: At this stage the basis of design is confirmed and identification of external factors influencing the decision is done.. For example we assume a contaminated water body that needs to be treated and assume that there are three types of contamination (organic, inorganic, and biological)

3) DISCOVER: Identification of nature's model which meet the functions identified is done and also the technologies available. For example, for wastewater treatment, we focus on -

- Ecosystem Technologies (like wetlands)
- Filtration Technologies
- Flow Management Technologies



Nature represents balance and in order to be sustainable, we need to be inspired by that balance and understand what frugal ways nature has to offer in our fight against climate change. These are some of the many solutions that we have bio mimicked all we need to do is observe the voice of nature.

Biomimicry Examples



**Floating Island International
Bright water company**

These man-made floating islands are created by Bruce Kania, to filter nutrients and pollutants from water by mimicking the role of the wetland.



**Eco Machines
John Todd
Ecological**

Dr. John Todd created the eco machine, a type of wastewater treatment that speeds up nature's water purification process. They include bacteria, fungi, snails, and fish that thrive by decomposing and digest inorganic pollutants.



**Natural System
Utilities
Naturally Wallace
Consulting
Whole Water
Systems**

To provide sustainable solutions for municipal, commercial and industrial wastewater treatment, this biomimicry approach has integrated on-site treatment, reuse, and natural systems.

BIOLOGGING: APPLICATIONS IN WETLAND ECOLOGY

With the advances in technology, scientists have developed more effective and efficient methods to analog and study the movement patterns and behaviour of wild animals. Biologging is one such new and ever evolving method. It is generally defined as using small instruments mounted on animals to measure their behaviour and surroundings and also to keep a tag on their movement and location. Currently, Biologging has certain applications used predominantly in wetland ecology:

Geolocation:

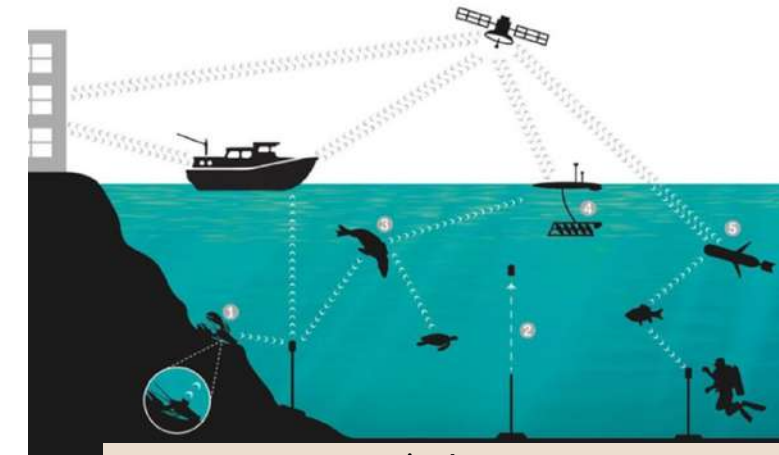
An application where researchers use electronic geolocators to measure the ambient light levels on migratory birds. It is used for documenting their migration routes and their relative location on the basis of sunrise and sunset.

Accelerometer:

It measures the three dimensional acceleration of the animal to investigate the movement patterns. In the wetland ecosystem of Eleuthera, The Bahamas, tri-axial accelerometer biologgers were used to measure the different behaviours (resting, swimming, foraging) of bonefish. Visual observations were also carried for 4 hours per day in a 5 day period. From the results obtained, a tree model and classification algorithm was established to analyse and understand the energy dynamics of the bonefish.

GPS Telemetry:

This particular technology has been a revolution in the field of animal spatial ecology. The technology is compact to conduct studies on a diverse range. A prime example of this study is their application on Burmese Pythons. These snakes are large constrictors and are considered as highly invasive species in the swamps of the South Florida Everglades. Due to their high egg-laying capacity and absence of natural predators, their numbers have shot up quickly over the years. Electronic GPS taggers were used on 13 pythons and 7 stationary platforms in Everglades. From corresponding satellite data received from these taggers, GPS location data was obtained to observe habitat analysis and hatching patterns.



Acoustic telemetry:
To study behaviour and migration patterns of aquatic animals.

Acoustic Telemetry:

It involves transmitting and receiving sounds to collect information on fish movements like migration patterns, habitat use etc. Large scale acoustic telemetry is majorly used for research in fisheries. Small acoustic telemetry devices are inserted into the bodies of the fishes. The signals emitted by the transmitter are collected by various receiving stations. Although they are mostly focused on the marine environment, certain examples like the Great Lakes Acoustic Telemetry Observation System (GLATOS) are also present in large freshwater habitats. A case study on spawning patterns of Northern Pike in Great Lakes was also conducted by the GLATOS system to keep a tab on the fish population and its revival over the years.

Though acoustic telemetry is a convenient technology for tracking aquatic organisms, it has its limitations in shallow environments due to noise disturbance interfering with the accurate transmission readings. Similarly, GPS telemetry has its limitations in deep water environments.

Most of the time, manual tracking is adopted by the researchers for biologging and tracking. It is quite convenient and cheap as it can be done on foot, boat or plane. However, a combination of these methods are implemented by the researchers to get accurate and precise results for analysing and understanding the various parameters revolving around an animal's habitat, ecology and lifespan.

Conserving it All with

Dr. Harini Nagendra

Harini is an Indian Ecologist, working at Azim Premji University. She's the director of the Research Centre and professor of sustainability at Azim Premji University. She's an author as well and has co-authored 3 amazing books titled Nature in the City, Cities and Canopies and Reforesting Landscapes: Pattern and Process. Harini has been working on Bangalore lakes for a long time. Her understanding of Land Use Change and Land Ecology is truly enlightening and that's what brought us to her for an interview



Q. What makes any natural resource "common"? How do wetlands fit into the definition of commons?

When we say commons, we are defining two different things that are a common pool and a common property regime. A common-pool resource is something that satisfies the needs of multiple groups of people. Therefore, the wetland is a common good resource. Wetlands can be used for fishing, grazing, silt collection, recreation, boating, bird watching, recharging water tables, etc. Wetlands are not just common goods for human resources but for all kinds of life forms. In this way, wetlands are a common pool resource. Now, when it comes to common property regimes, the wetlands were used as a common property regime earlier but now it's often not the case. In many parts of Asia and South Asia, communities often held rights for this. Now the wetlands have either become the property of the government or drained and converted to private property. So, either they have become public goods or private goods. If these things happen access to these sources is denied to the common people and it no longer remains common

Q. The loss of forest cover has impacted most of the major wetland regions. How have the polycentric institutions made an impact to help mitigate this current issue?

A short answer would be, not sufficient. The water flows down from the hills and then comes down to the wetlands where it holds the water before it flows down to the ponds or lakes.

“The connection between forests and wetlands is very intimate.”

Wetlands are the most endangered type of land in India. We can't protect the wetland without protecting everything else. The survey boundary shows that the area is protected but the lake is not protected and that is the place where the real estate construction would take place. In this process of construction, they dump the debris there. This debris dumping changes the slope configuration. Due to this the area that used to be a wetland would now have 30-40 feet of debris dumping and the place would be starved of water. This becomes polycentric as now the area which was a wetland, the area around the wetland, and the connection with the stream which gave the wetland water and then whichever water body that feeds that stream all of that will have to be connected. We need all the government agencies which are part of this interconnected system to give the entire chain some kind of protection. Let's say that Bangalore receives its water from the Cauvery basin, then a cutdown in Coorg impacts Bangalore. So those governing bodies involved in these areas have to come up together in order to protect these wetlands. So polycentric institutions are very important but we can rarely find these types of policy approaches taking place in the practical world.



Q: From the historical times, people had a rich connection with their surrounding wetlands with regard to its conservation and protection. However today, we observe their deterioration and pollution due to a lack of commitment. What change in mindset is necessary for the local people to be actively involved in the management of these wetlands?

I think there are multiple things that we need. First challenge is that people used to be locally dependent on these wetlands. Taking the story of Bangalore for instance, the lakes and the surrounding wetlands used to provide the drinking water supply to the city in the 1890s. By 1892, the 1st pipe drinking water project came into use. Originally it was supposed to supplement the water supply to Bangalore. But once it started supplementing, the authorities decided to remove all the dependence on local lakes and wetlands and completely provide pipe water to everyone. Within 2-3 years, we observed that people have stopped appreciating the value of these lakes. Removal of the local loop of dependence is a big change. In many places, people have started protecting lakes as the groundwater table has started going down. They have understood that there is a direct consequence if we don't start protecting these wetlands. The second challenge is how to enable the control of the local people. We require some cooperation from the government. In many places, people are willing to step up for the conservation and protection of the wetlands but enough resources and rights are not being given to them.

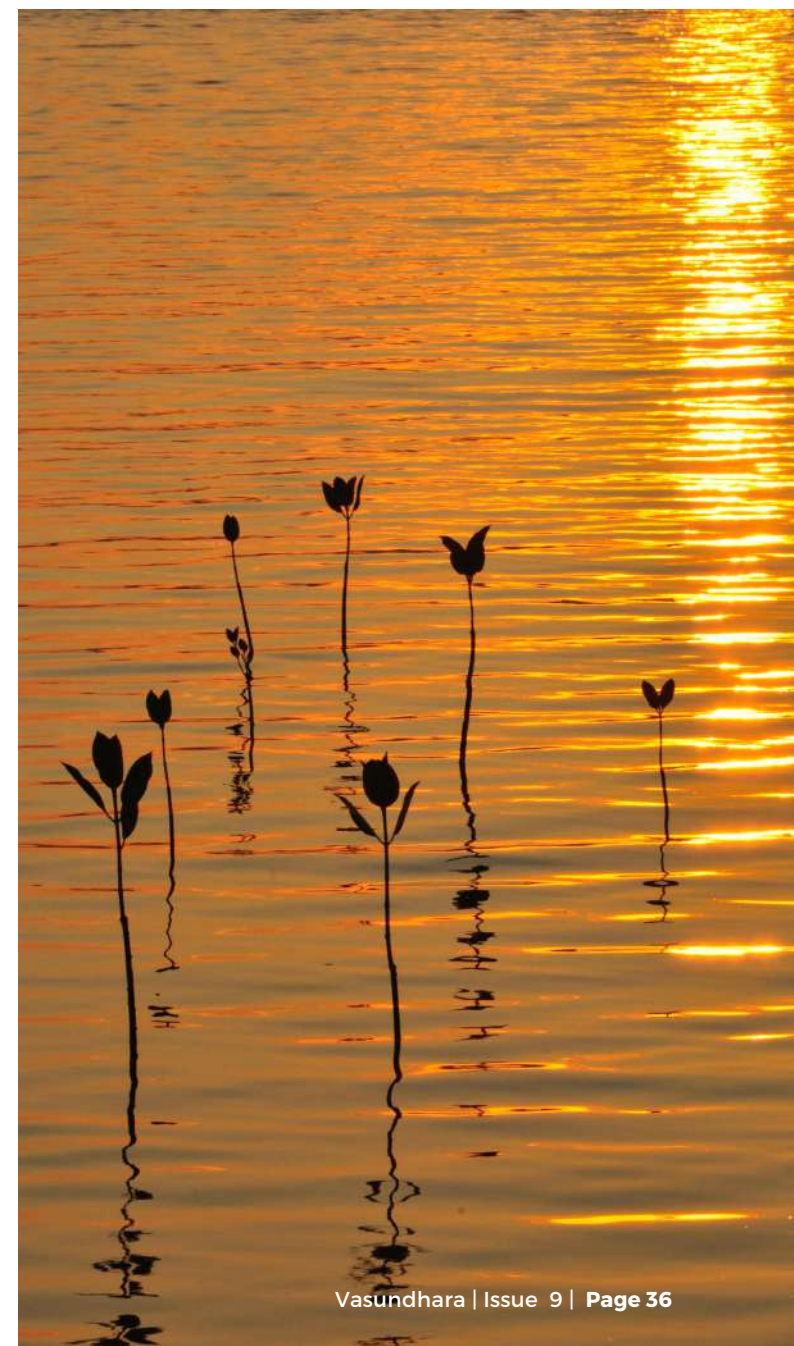
Q: How far has India reached in terms of using remote sensing and satellite images to assess changes in biodiversity conservation and monitoring?

India was a pioneer in the field of remote sensing and satellite imaging. Indian Remote Sensing Satellite Series has been around for a long time. Because of the ISRO program, we have a number of trained scientists across India, who have been doing a lot of work involving remote sensing for biodiversity, landscape mapping, wetland mapping and estimation of natural resources. We also have a lot of high resolution satellite series that can be used for either precision mapping of agriculture, water or underground mining material resources. Radars and SAR imaging is becoming much more useful in India. On the issue of "What can we do?" We should be able to do a lot more in terms of

providing automated maps of landscape cover, especially focused on natural resources. We do not lack the technology and capacity.

“We have the satellite imaging resources to do a much better job of mapping and we also have the web resources to release this.”

We have an amazing set of satellites and trained people to work on this. Once we get transparent information, a lot can be done to protect these resources.





CAREER GUIDE

As an attempt for continuous innovation in Vasundhara, we have brought this section to you. One cannot bring the change unless it becomes an active part of the on-field organization at the initial stage of its career. This is inevitable to understand the process of transformation to a more sustainable world and we at Vasundhara always aim at inspiring our readers for this transformation.

Here are the opportunities available-

CENTRE FOR SCIENCE AND ENVIRONMENT (CSE)



CSE is a public interest research and advocacy organization based in New Delhi. It researches into, lobbies for, and communicates the urgency of development that is both sustainable and equitable. CSE accepts students from universities, schools, and colleges all over the world as per their project requirements.

Location: New Delhi

Minimum Duration: Varies as per the project

Compensation: Nil

Designation: Intern

Field: Policy Advocacy on Environmental Issues

Qualification Eligibility: Nothing specific. Students can get associated for part fulfilment of their course requirement.

For more details regarding the internship. Visit:
<https://www.cseindia.org/internship-at-cse-1392>



Blue Sky Analytics

BLUE SKY ANALYTICS

Blue Sky Analytics is a Climate Tech start up building an API- based catalogue of Environmental Datasets by leveraging Satellite data, AI, and cloud.

Location: Gurugram, Haryana

Minimum Duration: Full time

Compensation: Not specified

Designation: Climate and Sustainability Associate

Field: Sustainability

Qualification Eligibility: One plus years of experience in business or executive roles or other relevant roles. Candidates should possess exceptional problem-solving skills, critical thinking, strong verbal and written communication skills, customer empathy and business judgement.

For more details, check:

<https://apply.workable.com/blueskyhq/j/190F111442/>

S&P Global

S&P GLOBAL

S&P Global is one of the leading providers of the ESG data for investors, corporates, and other stakeholders. It focuses on collecting a broad range of ESG data through a variety of company and governmental sources, to provide users with an in-depth, multi-faceted view into the nature and strength of a company's resistance to changes in ESG components, liaise with various critical stakeholders in understanding and building the content set.

Location: Gurgaon / Hyderabad/ Ahmedabad

Duration: Full time

Compensation: Not specified

Designation: Research Specialist

Field: ESG

Qualification Eligibility: Bachelor's or Master's degree required in a related field. Candidates should possess experience in the ESG data ratings and proficiency in using MS Office.

Further details can be accessed at:

<https://careers.spglobal.com/jobs/265691?lang=en-us>

COUNCIL ON ENERGY, ENVIRONMENT AND WATER



The CEEW is one of Asia's leading not-for-profit policy research institutions. CEEW uses data, integrated analysis, and strategic outreach to explain – and change – the use, reuse, and misuse of resources.

Location: New Delhi/Remote

Minimum Duration: 3 Months

Compensation: Not Specified

Designation: Research Intern

Field: Low Carbon Pathways

Qualification Eligibility: Master's degree with a specialisation in Climate Policy, Environmental Science/Studies, Public Policy, or related field.

As per our sources, CEEW is open for research internships on a competitive compensation basis. However, the internships are for a minimum of three months and are intense.

Hence, they cannot be pursued alongside academic studies. CEEW is also open to various job positions with varied eligibility criteria, which can be checked: <https://www.ceew.in/careers>

TREE AND HUMAN KNOT



Tree and Human Knot is a social enterprise initiative of by Rising India. It aims at bringing pragmatic solutions for sustainability, and making people, communities and companies, agents of change, which is possible by simple solutions. It resonates with Sustainable Development Goals (SDGs), set by United Nations.

Location: Remote

Minimum Duration: 45 days

Compensation: Not specified

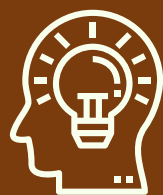
Internship Program

Field: Sustainability

Qualification Eligibility: PG / PhD/ Master's aspirants or experienced professionals who thrive towards entrepreneurial career and have a passion to work in sustainability and development sector.

Further details regarding the opportunity. Visit:

<https://www.risingindia.in/internship>



KNOWLEDGE UPGRADE

PERU OIL SPILL



On 15th January 2022, an oil spill was triggered when a tanker at the La Pampilla refinery was hit by Tonga volcanic eruption in the coast of Lima, Peru. Initially said to be seven gallons, the oil spill turned out to be more than 10,000 barrels, the environment ministry said, and has led Peru to call for international aid. Oil slick in the ocean has now spread to an area of 320 football fields killing countless marine species. The Peruvian government has declared an "environmental emergency", in the damaged coastal territories.

CARBON CAPTURE



Direct air capture machines suck carbon dioxide from the atmosphere. DAC is just one of several proposed technologies designed to remove emissions from the atmosphere, which also include repurposing offshore oil and gas platforms to grow seaweed and turn it into fire-resilient bricks. So, DAC works a little bit like a household dehumidifier, but instead of stripping water out of the air, it removes carbon dioxide.

FLYWAYS

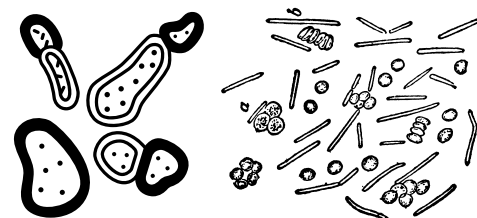


A 'Flyway' is the "entire range of a migratory bird species, through which it moves on an annual basis from the breeding grounds to non-breeding areas, also including the intermediate stoppages made for feeding and resting.

There are 9 major waterbird flyways according to Wetlands International. Three of the nine flyways pass through India -- Central Asian Flyway (CAF), East Asian Australasian Flyway (EAAF) and Asian East African Flyway (AEAF).

VERTICAL MAP OF AIRBORNE MICROORGANISMS

Scientists from the Singapore Centre for Environmental Life Sciences Engineering (SCELSE) at NTU Singapore, conducted a study of airborne microorganisms from ground level up to 3500 metres. They have found out that bacteria and fungi populate the planet's lower atmosphere in specific ways and if changed, may negatively impact human health and food supply. The researchers have found that temperature is a crucial factor, influencing the composition of airborne microbial communities. Scientists can now also model and predict the changes in the air microbiome if temperatures were to rise by two degrees or more.



CHILE REWRITES ITS CONSTITUTION

In December 2021, lithium rich Chile elected 155 members to rewrite its constitution, while the state remains in a "climate and ecological emergency". The leader of the Military Junta - Augusto Pinochet - wrote Chile's current constitution in 1980 - allowing mining investments and the sale of water rights. Some problems that the constitutional convention will attempt to address include how mining should be governed and what role local communities should have in mining.



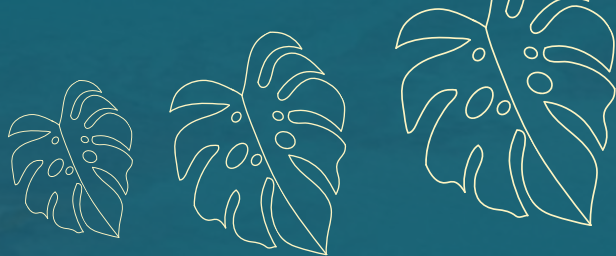
WORLD'S LARGEST FRESHWATER WIND FARM



Windpark Fryslân, the world's largest freshwater wind farm, became fully operational in December on the Netherlands' Lake IJssel. The Zuiderzeewind consortium of Royal Van Oord, a Dutch maritime contracting company, and Siemens Gamesa, a renewable energy provider, built the freshwater wind farm. The wind farm is owned and developed by Ventolines, a renewable energy firm. It is expected to generate 1.5 terawatt-hours of electricity each year.

COMIC CORNER





FUN

ZONE

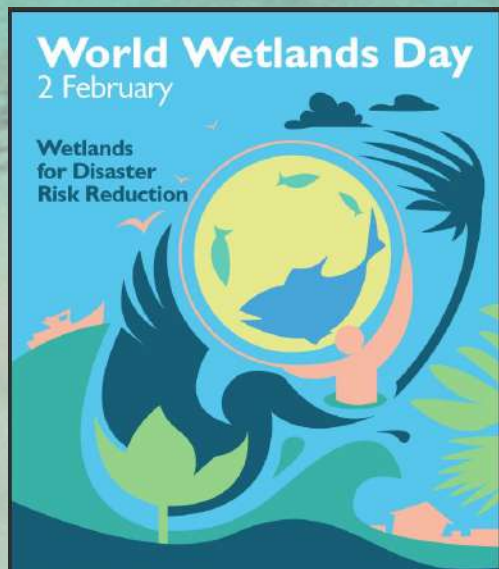


DID YOU KNOW?

On the occasion of World Wetlands Day, on 2nd February 2022,

Two new Ramsar sites were added in India, to the previous tally of 47 wetlands, thus taking the new count to 49. India now has the highest network of Ramsar sites in South Asia.

The two new Ramsar sites are Khijadiya wildlife sanctuary in Gujrat and Bakhira wildlife sanctuary in UP.



THE WETLAND CANVASS

Q1. Which type of wetland is formed near the mouth of rivers and contains tall grasses for migratory birds?
Ans: **Marsh**

Q2. Which is the largest protected wetland of the world?
Ans: **Llanos de Moxos**

Q3. Which wetland was designated as the first Indian wetland of international importance under the Ramsar convention and in which year?
Ans: **Chilika Lake, In 1981**

Q4. Which type of wetland is usually characterized by the growth of woody plants such as Cypress and tupelo trees?
Ans: **Swamp**

Q5. Which wetlands of India are registered under Montreux Record?
Ans: **Keoladeo National Park and Loktak Lake**

Q6. Which is the Glaciatic Wetland in India?
Ans: **Chandertal, Himachal Pradesh**

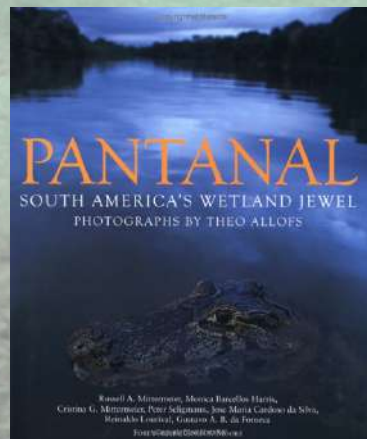
Q7. In which year did the Ramsar Convention come into force in India?
Ans: **1982**

Q8. How much area do the wetlands cover in India?
Ans: **4.7% of the total geographical area**

Q9. What is the theme of World Wetlands Day 2022?
Ans: **Wetlands Action for People and Nature**



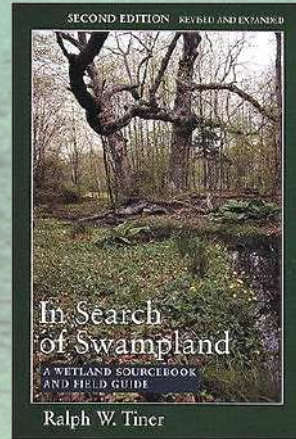
RECOMMENDATIONS



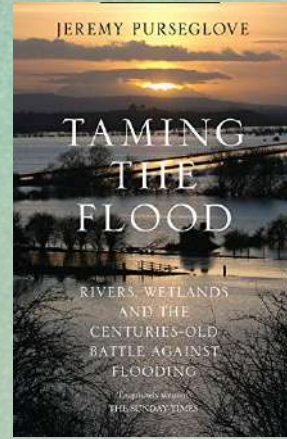
Pantanal
South America's Wetland Jewel



Into The Okavango
(Documentary)

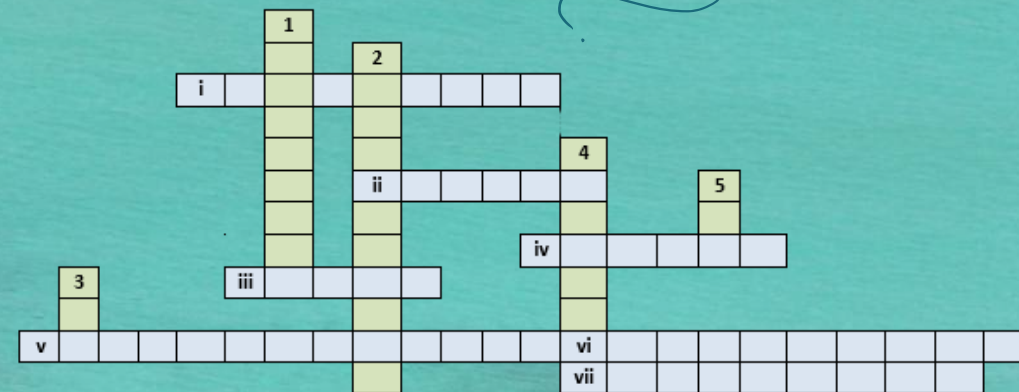


In Search of Swampland
Author: Ralph W. Tiner



Taming The Flood
Author: Jeremy Purseglove

CROSS WORD PUZZLE



DOWN

1. A dark oil consisting of only hydrocarbons
2. An aggregation or continuous network of urban communities
3. Tenet of business sustainability
4. A perimeter near the river often flooded
5. Marshy area (impede)

ACROSS

- i) High ground surrounding the drainage basin
- ii) Indigenous to the locality
- iii) 100 cities initiative launched under NDA government in 2014 in line with SDG 11
- iv) The precipitate produced by sewage treatment
- v) Saltier than freshwater but not more than seawater
- vi) A movie on government's gross neglect on an approaching disaster (2021) starring Leonardo DiCaprio
- vii) Coastal grassland- flooded by seawater

(i) Watershed (ii) Native (iii) Smart (iv) Sludge (v) Brackish water (vi) Don't look up (vii) Saltmarsh (viii) Petrolium (ix) Urban sprawl (x) CSR (xi) Wetlands (xii) Bog

RECOMMENDATIONS



Wild Wetlands
(Documentary)



Wetlands - Miracles in Mumbai
(Documentary)



Everglades of the North
(Documentary)

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An Eco Club Initiative @TERI SAS

