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LANDSCAPE

A Forum for Young Geographers

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UNIVERSITY OF DELHI

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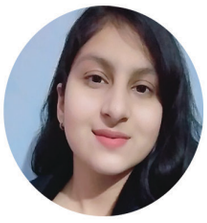

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It gives me immense pleasure to know that Department of Geography, Shaheed Bhagat Singh College is bringing its Annual Magazine, Landscape on the theme "Coastal Landscape: Human-Environment Interface"

Coastal landscapes are home to a wide range of plant and animal species that are specially adapted to survive in the particular habitat. Hence, it is important to learn about Coastal Landscape and how human actions influence it.

This magazine is a testament to the dedication and hardwork of the Geography Department. I would like to appreciate, Dr. Suraj Mal, Teacher-in-charge, Dr. Amrita Bajaj, Staff Advisor and Prof. Kavita Arora, Magazine Advisor for their belief in the magazine and it's spirit. I would also like to congratulate the editorial team for the hard work they have put into this magazine and last but not the least, praiseworthy are also the students who made significant contribution through sending their entries.

Best Wishes!

Dr. Suraj Mal
Teacher In-Charge
Department of Geography
Shaheed Bhagat Singh College
University of Delhi

The Department of Geography, Shaheed Bhagat Singh College is pleased to announce the publication of its annual magazine, "Landscape," this year under Prof. Kavita Arora's direction. Coastal Landscape: Human-Environment Interface being the theme of the current year's magazine, got an endearing reaction as articles, blogs, writeups and so forth. Consolidated and altered by our young and excited students, the magazine stressed on the idea of Waterfront Scene this year. " Coastal Landscape: Human-Environment Interface" refers to both the shifting coastal boundaries of today, the threats posed to them by humans as well as the shifting patterns of climate and land use over time. The theme of coastal landscapes is particularly relevant in today's world, as we are facing increasing threats to our natural environments and the delicate ecosystems that inhabit them. The articles on this issue shed light on the complex relationship between humans and the environment, and the ways in which we can work together to protect and preserve our coastal regions.

It's crucial that we find ways to balance our human needs with the needs of the environment, and this magazine provides valuable insights into how we can do so.

Overall, the issue is an engaging and informative exploration of the human-environment interface, and I hope "Landscape" serves the purpose of its uniqueness, insightful and thought provoking as always.

We got a wide range of viewpoints and ideologies on our topic from the collection of essays and articles we received from students across the University of Delhi and from various departments, Making landscape a beautiful thread that connects a variety of perspectives, understandings, and interpretations. Hope readers would enjoy reading the magazine.

Best Wishes!!

Dr. Amrita Bajaj
Staff Advisor
Department of Geography
Shaheed Bhagat Singh College
University of Delhi

It is my pleasure to address all of you through this Department Magazine. I hope this message finds you in good health and high spirits.

It's a matter of joy and pride that the Department of Geography is here with the 16th volume of it's Annual Magazine, "Landscape". The theme of this year's magazine is Coastal Landscape: Human-Environment interface which is of utmost significance nowadays since Coastal landscapes are dynamic environments, they are shaped by a range of natural and human driven processes, such as tides, waves, erosion, and sediment deposition. These processes create a complex environment for humans.

At the same time, humans also have significant impact on coastal landscapes, altering them through activities such as urbanization, agriculture, and resource extraction. These activities have often had negative consequences for the health and resilience of coastal ecosystems, leading to issues such as habitat loss, pollution, and coastal erosion.

To address these issues and promote sustainable interactions between humans and coastal landscapes, it is important to understand the natural processes and dynamics of the coastal landscape, and how they are impacted by human activities.

Promoting sustainable practices that minimize negative impacts on coastal ecosystems, such as reducing plastic pollution and managing coastal development is need of the hour.

Hence, I congratulate the magazine committee for coming up with such a relevant theme and would like to appreciate those who have contributed to this magazine for their unwavering efforts.
Hope readers would have a fruitful reading!

Prof. Kavita Arora
Landscape Magazine Advisor
Department of Geography
Shaheed Bhagat Singh College
University of Delhi

It gives us immense joy and satisfaction to present 2022-23 issue of our annual magazine “LANDSCAPE”.

I congratulate the editorial team of LANDSCAPE and the contributors for the sincere efforts in bringing out the magazine as “COASTAL-LANDSCAPE”.

Coasts are very dynamic places and are interesting source of learning the physical and human geography. They are regularly changing by crashing waves, winds, strong currents, tidal waves, climate change and hazards such as tsunamis, they all transform coasts. People too bring about changes to coastal landscape. These changes range from small human activities such as walking across the sand dunes to major activities like making the sea ports or building a sea wall or converting the sea areas into new land forms. Because coasts are dynamic, or constantly changing, they are important ecosystems. Coasts help us understand natural events, such as weather and changing sea levels. At present They are facing triple environmental crisis (1) The impact of climate change on oceans and coasts- the largest global carbon sink; (2) Biodiversity losses and (3) Waste disposal and pollution. These are endangering the safety, livelihoods, and food security of people.

Billions of people worldwide rely on healthy coastlines as a source of livelihood, energy generation, recreation and food, which emphasize the urgent need to sustainably use, manage and protect our coasts.

Being in an extreme continental climate of Delhi and thinking, understanding and working on coastal landscape required a distinct impulse, which has gone into the making of this issue. We hope you enjoy reading the magazine.

Abinash Debbarma
Magazine Coordinator

It gives me great pleasure to announce the publication of the 16th volume of Landscape - Annual Magazine of the Department of Geography, Shaheed Bhagat Singh College, University of Delhi.

The theme for this year's edition is Coastal Landscape: Human-Environment Interface.

The coastal area is the stretch of neighboring ocean space and dry land where land uses and activities directly influence ocean uses and processes and vice versa. This region is home to a highly complex ecological system because of the interplay between the land and the ocean. There are always risks in the coastal zone, both natural and man-made. They are susceptible to a variety of internal and external influences that have the potential to drastically alter the entire system and have an impact on human health, marine resources, and urban infrastructure.

Along with the most well-known natural catastrophes, such as earthquakes, tropical cyclones, and tsunamis, human-caused oil spills, red tide, and water pollution are currently the major concerns to the environment. Given the substantial concentration of major cities and economic hubs in coastal areas, the results of inaction in terms of coastal environmental protection and sustainable development could be severe. Therefore, the theme of the magazine is apt for thinking, writing and implementing the measures accordingly.

I would like to express my sincere gratitude to Prof. Kavita Arora, the magazine advisor, for her perpetual support and direction in compiling the thoughts of many contributors. Additionally, I would like to appreciate the editorial team for all of their efforts in compiling the entries and seeing them through to a successful conclusion.

Happy Reading!

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The Department of Geography
Shaheed Bhagat Singh College
University of Delhi

Events organised by Department of Geography

Orientation Ceremony

The Geography Department at Shaheed Bhagat Singh College organized the orientation ceremony with the 1st year students along with their parents on 2nd November, 2023. At the orientation ceremony, the students received an overview of the department. All the teachers of the department were present there to talk about the various activities and opportunities offered by the Department. On this day, the newly joined students and their parents were given confirmation by the teachers that the students will be getting the best education and exposure in the Department and will look after the interest of the students. The Staff Advisor apprised the students about various activities of the Department and facilities available at the College. Faculties also guided them with the support they offer to students throughout their academic journey within the college.

Rookies'23

The Geography Department organized the Fresher's Party for the 1st year students on 31st January, 2023. The official welcome was given the name "Rookies."

On that day, all the teachers of the Department were present to give their auspicious blessings to the beginners. The Fresher's Day was brimmed with fun, music, and excitement. During the freshers, a talent hunt was organized where beginners could present their talent. The students felt motivated and enthusiastic after attending the freshers.

Field Trip

Semester VI

The Department organized the field work trip of sixth semester students between 17th to 22nd of March 2023. The group of students along with teachers left Delhi on 17th and reached Porbandar on 18th. The topic of the Fieldwork was "Relief and Reconstruction: Studying the Impacts and Response of Tauktae Cyclone in Gujarat." For field work the students opted the methods of questionnaire survey, interview and observation to analyse and obtain the necessary information and results. The students had their respondents from villages of Adri, Nava Bandar, Navadra and Una (District)

After concluding the fieldwork, the team returned back to Delhi on 22nd of March.

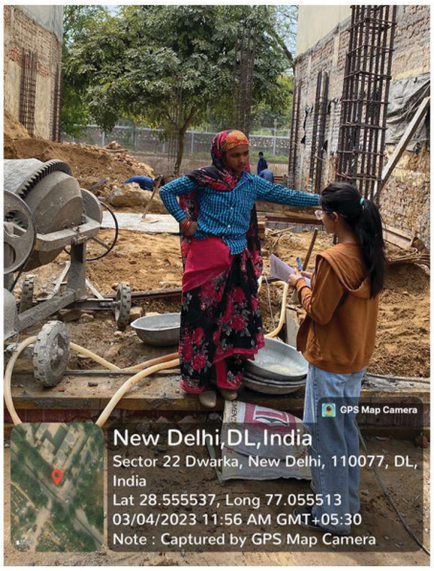
Semester IV

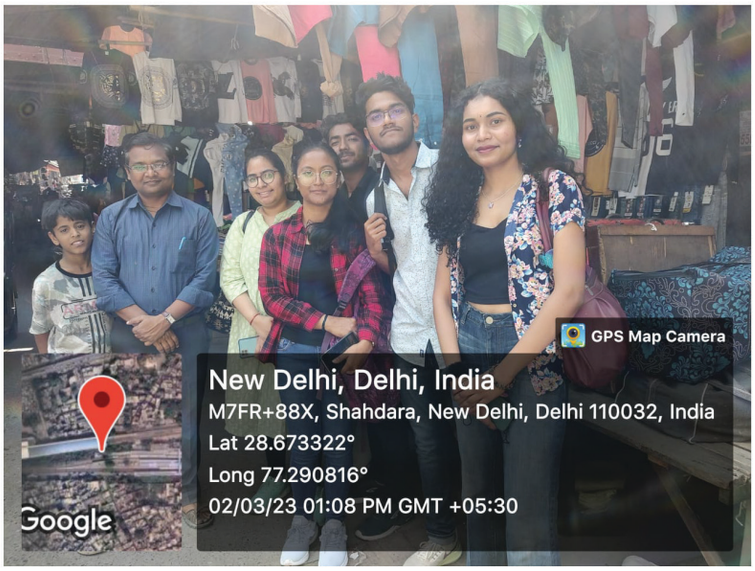
Students of semester four carried out their fieldwork between 27th of February to 5th of March, as a part of their paper called "Fieldwork and research methodology". The students chose dynamic and thought provoking themes for the fieldwork, for instance, Understanding the potential impact of human interference on Sanjay Van, Climate Change perspectives of the local population of Delhi (Core and periphery) etc. The area of fieldwork was also different for different groups and individuals, suitable as per the respective themes.

The students implemented various field techniques and tools learned in classrooms such as interview, questionnaire survey, transects, etc. After analyzing the data collected during the field work, students compiled their reports as per guidelines issued by the Department of Geography, University of Delhi.

Jahanpanah City Forest

Gopalpur Village, Delhi





Assessment of fire risk and vulnerability in Shahdra

Sanjay Van, Delhi

Jagdamba Camp
(Health and sanitation in slums and posh areas)

Vasundhara'23

The Department of Geography organized its Annual Festival, VASUNDHARA 2023 on 1st and 2nd of April, 2023 on the theme "Geographical Indications and Intangible Cultural Heritage." Prof. Anindita Datta, Head at the Department of Geography, Delhi School of Economics, University of Delhi was the keynote speaker at the inaugural ceremony of the fest.

On the 1st day, Verbatim: The debate competition, Impasto: The poster making competition and Mudra: The dance competition were organized. Participants from various educational institutions turned up in these competitions making them successful.

Mudra: The Dance Competition

Impasto: The Poster Making Competition

On 2nd Day, Rangmanch: Theatre competition along with Tarang: The instrumental competition were organized. In the list of events, there was an online photography competition named picturesque as well.

Rang Manch: The Theatre Competition

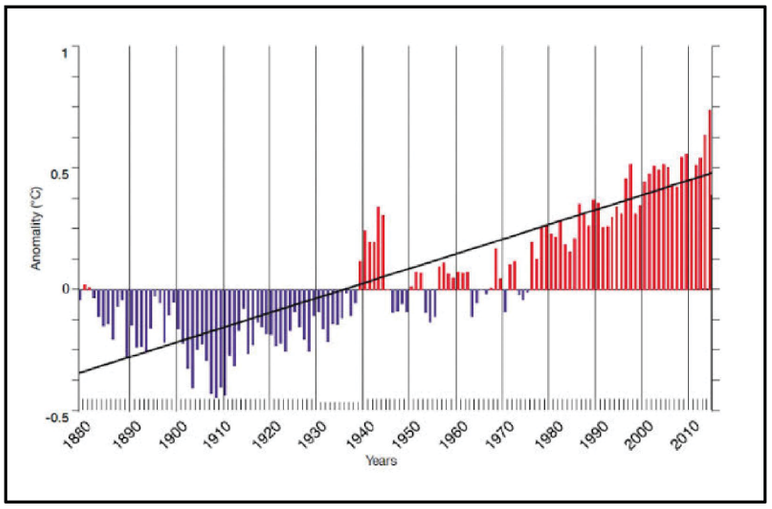
Tarang: The Instrumental Competition

At the Valedictory Ceremony, the winners of each event were awarded and the recently joined teachers of the Department were also felicitated by Principal, Staff Advisor and Teacher In- Charge of the Department.

CLIMATE CHANGE AND COASTAL ENVIRONMENT

Devesh Singh
B.A.(H) Geography 1st Sem
Shaheed Bhagat Singh College

Climate change is the shift of weather patterns and conditions. Simply, it is a change in average weather conditions. These shifts may be natural, such as through variations in the solar cycle. These changes lead to heavy storms, melting glaciers, floods etc. Global warming is one aspect. Some of the forces or factors that contribute to climate change are the emission of greenhouse gasses (such as :- carbon dioxide, and methane), deforestation, air pollution, industrial gas, etc. These led to major climatic changes. It affects the livelihood, health and resources and also impacts the water, air and land. Moreover, it reduces the quality of drinking water, damages property, pollutes the air. Additionally, impact flora and fauna. As climate change is curbing the lives and resources of the earth, we need to look out for extreme measures to avert climate change. The impacts of climate change have worsened the situation in coastal areas.



Some emerging problems in coastal areas due to climate change are:-

1. Sea level rise:
   Growing populations and development along the coasts increase the vulnerability of coastal ecosystems to sea level rise.

2. Storm Surge and Precipitation:
   Coastal areas are also vulnerable to increases in the intensity of storm surge and heavy precipitation.

3. Coastal temperature:
   Coastal waters have warmed during the last century, and are very likely to continue to warm in the 21st century potentially by as much as 4 to 8°F.

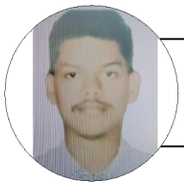
4. Impacts on Coral Reefs and Shellfish:
   Higher sea surface temperatures increase the risks of coral bleaching, which can lead to coral death and the loss of critical habitat for other species.

Appropriate strategies to tackle climate change—

- Create social awareness on climate change.
- Prohibit deforestation and cutting down of trees.
- Making policies and agreements to reduce climate change.
- Protect flora and fauna.
- Reduce the consumption of energy.

These are some ways to reduce climate change. If necessary, actions are not taken on time, we might see an increase in the weather conditions, shortage of drinking water, agricultural yields and a direct impact on livelihood. Therefore, we must focus on reducing anthropogenic activities which affect our environment negatively so that we can breathe fresh air and drink clean water. These are some of the small steps which can help to protect the environment and its resources.

SEA FLOOR MINING



Pradum Kumar
Maharaja Agrasen College

The oceans are much deeper than we think. These deep oceans have now become an opportunity for various countries and companies to mine out the resources from there. But the question is **Why they all are behind it?**

The answer lies in the abundance of resources present over there. When sea floor mining is compared to the extraction through terrestrial mining former produces 3 to 4 times resources more than of the latter one just from one site!

So, what actually is this?

Seafloor mining is much like terrestrial mining. Minerals or metals of interest are found and extracted when economically viable. Seabed mining activities are targeting different kinds of mineral ores and deposits found both within and outside national waters, spanning a variety of environmental conditions and regulatory contexts. Various minerals like cobalt rich ferromanganese and polymetallic sulfides could be mined from here. In addition to this, mining companies often explore the deep seabed to find Polymetallic nodules. Polymetallic nodules are composed of different metals in varying ratios. The largest part is often manganese, with smaller and more valuable nickel, copper or cobalt deposits.

But a question remains:

How mining is possible in such a deep seabed?

Over the last few years, technology has also taken a great leap and that has made the mining of deep-sea ore deposits more viable. Be it :-

- **Hydraulic mining systems-** It picks up the nodules with a towed or self-propelled harvester and then lifts them to the surface with simple hydraulic.

- **Submersibles-** The Deep Sea Technologies are involved in the exploration of deep ocean mineral resources such as poly-metallic manganese nodules.

- **Deepwater ROV - ROSUB 6000-** The development of 6000 m depth-rated deep-water work class Remotely Operated vehicles (ROV) by the National Institute of Ocean Technology (NIOT) was initiated by the Polymetallic Nodule Management (PMN) Board of the Ministry of Earth Sciences (MoES), Govt. of India. The ROV is equipped with multifunctional tools and sensors for offshore applications such as deep ocean mineral exploration, seabed imaging, gas hydrate exploration, pipeline routing, submarine cabling, wellhead detections, sampling etc.

- **Polar ROV (PROVe)-** The vehicle is equipped with underwater video cameras, lights, scientific sensors (CTDO), underwater spectral irradiance meter, scanning sonar, navigation sensor and ice coring devices. The PROVe shall be used for oceanographic investigation, search and recovery in port and harbors, biodiversity mapping, coral reef monitoring, ice thickness measurement, visual support etc.

What would we gain from this?

By exploring the bottom of the ocean and exploring minerals, millions of years old, that could be used to make electric car batteries. As land-based resources are becoming increasingly difficult to access, it could be an alternative to mining the required resources. Terrestrial deposits of nickel, copper and cobalt are decreasing or depleting and simultaneously demand for these metals is rising. Knowledge about deep seabed opens the road to untap those metals which would be further needed for clean technologies. Scientific American Magazine reported in 2020 that clean-energy technologies will require a 500% increase in the production of lithium and cobalt by 2050 to keep up with growing demand. Similarly, the International Energy Agency predicts that between 2020 and 2040, demand for copper will triple, while demand for manganese will increase 8 times, nickel 19 times and cobalt 21 times. With many terrestrial mines reaching near to depletion and opposition to land-based mining, growing investors are increasingly turning to the sea which would make it more lucrative.

Criticism-

Turning our gaze to the sea simply as a substitute to mining the land is not an option.

According to Woods Hole Oceanographic Institution, the result could be tantamount to “replacing an old growth forest with a field of dandelions.”

- Cobalt, nickel, copper, and manganese: the four horsemen of a potential deep-sea apocalypse. In recent years, the mining of these polymetallic

nodules has emerged as a solution to worldwide mineral demands. However, it's a latent cause for environmental devastation that researchers have just begun to discover.

- According to environmentalists, In the race of exploring seabed as a substitute for terrestrial mining we would wipe out many species living in that ecosystem. Deep-sea mining would add to these stressors, resulting in the loss of biodiversity and ecosystem functioning that would be irreversible on multi-generational timescales.

- Deep-sea biology is expensive. Not only do observation instruments have to cope with remote communication, corrosive seawater, extreme pressures and no light, but creatures on the sea floor can't be taken to the surface without killing them. The deeper you go, the more it costs.

Way forward and current situation

- IUCN – Members of Canadian federal departments adopted Resolution 122 in September 2021. It requests a moratorium on deep seabed mining until certain conditions are met, including "rigorous and transparent impact assessments."

- There should be consultation within the region before any exploration or extraction takes place as those nations would be most affected by that. Recently Tuvalu Minister of Foreign Affairs Simon Kofe (widely known for giving a COP26 statement in water to highlight climate change threats) said there should be consultation within the region before any exploration or extraction takes place.

- Without more information about these deep-sea environments, researchers don't even know how to define the risks. "What is serious harm?" "There are some clear red lines, but there's no definite answer to that question yet," says Gordon Paterson, an ecologist. Scientists know that mining will cause local extinction of species in the CCZ, but are we talking about the extinction of species across the CCZ or just in the mined area? It is complicated, he says.

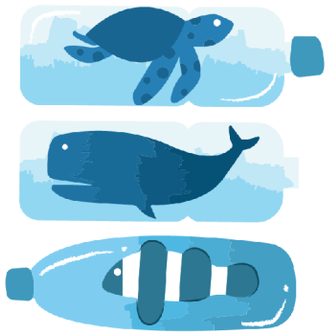
So, in **conclusion**, For the reasons outlined above, exploitation of mineral resources from sea bed could be done with a low pace or could be paused until sufficient and robust scientific information has been obtained to make informed decisions as to whether deep-sea mining can be authorized without significant damage to the marine environment and, if so, under what conditions.

MARINE POLLUTION: A RISING CONCERN IN INDIA

Butool Naqvi
BSc Hons (Geography) 5th semester, 3rd year
Khwaja Moinuddin Chisti Language University, Lucknow

The uncontrollable use of plastic in India and inefficient waste management practices have led to plastic waste either piled up on dumpsites or finding their way into the ocean and therefore contributing to the global problem of marine plastic pollution.

The Indian Ocean is the third largest ocean on earth covering about 20 percent of the earth's surface, about 40 countries rely on the Indian Ocean for various purposes. The Indian Ocean is surrounded by some of the world's most densely populated like almost every other water body on earth. The Indian Ocean is also in an alarming situation of marine pollution. Marine pollution can be described as contamination of water bodies caused by waste generated by human activities posing a severe threat to aquatic life. The primary sources observed are chemicals, oil spillage and plastic. According to the International Union for Conservation of Nature (IUCN) at least 8 million tons of plastic end up in the oceans everywhere. Over 300 million tons of plastic are produced every year, half of which is used to design single use items such as shopping bags, straw etc. It is estimated that 15-28 percent of all plastics are entering oceans via the riverine ecosystem, coming from the world's most polluted river. Two of the river systems are located in India namely Ganga and Brahmaputra.



The dreadful thing about plastic is it can take hundreds to thousands of years to decompose depending on the type of plastic and where it has been dumped. It results in the most disturbing impacts like ingestion, suffocation and entanglement of hundreds of marine species, floating plastic may also contribute to the spread of invasive marine organisms and bacteria which disrupt ecosystems. Plastic is a petroleum product so it also contributes to global warming if plastic waste is incinerated, it releases carbon dioxide therefore increasing carbon emission.

The plastic waste management rules 2016, banned plastic which is less than 50 microns thick, it also stated that local bodies should provide separate collection storage and processing of plastic waste in their area, eliminating single use plastic. Recycling and reuse of plastic materials can be an effective action to reduce open landfills. It is time for every individual to contribute their effort. Together we can make a difference.

Sustainable Development and Coastal Environment

Siddharth Rajkumar
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Shaheed Bhagat Singh College

Coastal Environment a place of great beauty,

a home for diverse life, a wonder to see

But it's under threat from development and more

we must act with care to preserve and restore

Sustainable Development, a crucial goal

To balance the needs of both people and the soul

Of the earth and its ecosystem, wild and free we must find a way to coexist happily

We can't take for granted the gifts that we have been given

We must be mindful of how we live and how we are driven

To consume and two build to exploit and to grow we must find a balance that allows us to flow

With harmony and respect for the earth and its creations

We can build a future full of hope and elation

A world that is healthy for all who live and thrive

That's the dream we can work towards as we strive

For sustainable development and a coast environment

A place of great beauty for all to enjoy and experience.

MARINE RESOURCES AND MANAGEMENT

Ashish Kumar
B.A. (H) Geography 4th Semester
Shaheed Bhagat Singh College

Marine resources are biotic and abiotic entities that are found in the ocean's water and bottoms. Humans have been using oceans from time immemorial, for instance, for sea voyages, trade, and fishing. These days, apart from traditional ways of exploitation, men are using advanced technology in fields like marine cultures, aquaculture, and ocean ranching (the taming and training of sea mammals like dolphins). Nowadays, over 3 billion people depend on marine and coastal resources for their livelihood.

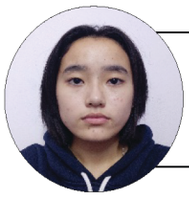
Classification

Marine resources can be classified into biological resources, mineral resources, and energy resources. Firstly, biological resources include animals, food, plant resources, nekton (swimming animals), and benthos (which live on the sea bottom). Marine food resources are generally rich in protein, for example, fish. The contribution of fish to the world's annual income from marine resources stands second after trade and transport. Fish contains protein, amino acids, and vitamin B12 in the right proportions. In addition to it, medicinal plants are also found in the ocean that can cure different diseases, as illustrated by anti-cancer plankton, dinoflagellates, and detoxifying plants. Secondly, oceans also contain minerals like heavy metals (barium, gold, zirconium, platinum) and nonmetals (diamond, gravel). An estimate says 4 grams of gold can be obtained from every 1 million tons of seawater. Moreover, sodium and chlorine make up nearly 85% of the salt dissolved in seawater. Thirdly, the ocean forms one of the largest yet least explored renewable energy sources on earth. Waves, tides, and ocean currents are sources that can be used for electricity generation.

Marine Resource Management

Contamination of harmful substances such as oil spills, plastics, sewage, and agricultural runoff is causing marine pollution, which has made the oceans one of the Earth's most threatened ecosystems. Most of the debris in the ocean doesn't decompose and remains there for years. It is also causing eutrophication and disruption in the food chain. Therefore, to get there, continued yield and optimum utilization of marine resource management are required. Several laws have been enacted in this regard, such as the law of the high seas and the law of sea bottom exploitation, and life below water is also included in the SDGs as goal 14, but these are insufficient. There is a need for strict and effective laws relating to deep sea resources, military uses of the sea, and well-regulated exploitation with the help of international agencies to keep the ocean free from pollution, as the ocean is not a garbage can.

Maritime Boundary and Geopolitics



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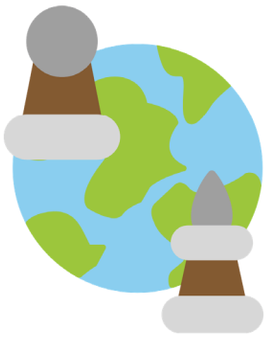
B.A. (H) Geography 1st Semester
Shaheed Bhagat Singh College

In the 1400s, the world was rocked by the Age of Exploration, which lasted until the 1600s. A time when nations, particularly European ones with access to coastal land, rushed to join the maritime race and the search for the unknown. They found new ways to get to India, most of the far east, the Americas, and the Far East. The goal of the majority of these maritime expeditions was to acquire wealth and untapped resources.

The Great British Empire, Spain, Portugal, and the Netherlands were notable contenders from Europe. The sphere of influence that these seafaring nations left behind are still felt today. During this brief time, a significant portion of the unknown world was mapped, resulting in numerous navigation and mapping advancements. In time, the size of Great Britain would surpass that of all European nations. As a result, from the Napoleonic Wars to the Second World War, Britain ruled the seas.

After the end of the Cold War, the world became polarized, with the United States and its allies siding with the Soviet Union. The rivalry resulted in a hostile race, including maritimely. The US hegemony prevailed in the aftermath and had a significant impact on maritime issues like international water patrolling and the law of the sea.

The current situation of maritime accessibility and international water navigation is quite complicated. The main areas of the sea are used for shipping and fishing. Minds from the seafloor contained numerous additional minerals, natural gas, oil, sand and gravel, gold, and other resources. The timeless principle of "Freedom of the Sea" faded into the background as trade grew in the 20th century and sea use became unsustainable. In addition, the geographical variation in the position of landlocked nations, as well as in the continental shelf, slope, and abyssal plain, presented an extremely contentious scenario. In general, nations of all sizes have attempted to gain access to open water, even if it meant shedding a lot of blood and spending a lot of political capital.



The period during which the Law of the Sea was codified was quite turbulent. There were numerous disagreements and claims. The conflict between India and Sri Lanka over the Ram Setu bridge is a classified example of a marine dispute. After 1945, when the United Nations was established, the UN Security Council and Secretariat decided that the existing rules need to be codified, especially logically and that a permanent solution needed to be found for any country's maritime territorial limit. The UN Convention on the Law of the Sea was enacted as a result. It is a treaty signed on a global scale that establishes guidelines for how to use the oceans and seas around the world, how to use and conserve marine resources, and how to ensure the survival and safety of all sea creatures. The treaty went into effect in 1994 and was signed on December 10, 1982, in Montego Bay, Jamaica. By this, a coastal nation's territorial water was restricted to 12 nautical miles from the baselines, where they competed for sovereignty, while the Exclusive Economic Zone had a 200-nautical-mile jurisdictional area. Furthermore, as long as they obtain transit from another coastal nation, landlocked nations could access international water.

Water that lies outside of any nation's "territorial sea" is referred to as "international water." The doctrine of "mare liberum" refers to the area that does not fall under the jurisdiction of any state. In addition to scientific research, states have the right to fish, navigate, fly, and lay cables and pipelines. The following are some of the unresolved disputes regarding whether or not particular bodies of water are international water:

1. Norway, Denmark, Russia, and Canada claim internal water in the Arctic Ocean, while the United States and Europe oppose it.

2. Australia asserts an Exclusive Economic Zone around its Antarctic territorial claim.

3. The Area around Okinotorishima Japan asserts that the Okinotorishima islet is within its exclusive economic zone, but its neighbors defy it.

4. South China Sea One of the most contentious areas in the global maritime arena is the South China Sea. The competing claimants—the Philippines, Indonesia, Malaysia, Brunei, and Vietnam—have been at odds with China because of its sweeping claim to sovereignty over the sea and untapped resources.

Even international vessels have been disrupted by rampant piracy, armed robbery, and illegal waste disposal on the Somalia coast.

We must acknowledge the gravity of how interconnected we are, even though the invisible constraint of maritime partition may make us, inhabitants of other continents, feel foreign. For instance, pollution has spread to vast oceans, destroying vast areas beyond repair. Countries all over the world must unite politically now to address the imminent threat to the marine environment.

Effects of Ocean Acidification on Marine Biodiversity

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Contents

1. Introduction

The immense increase in the emission of carbon dioxide from fossil fuels (about 90%) and industrial processes (about 78%) has made us replace the talk of global warming with global change. One of the important catalysts of global change is Ocean Acidification, which is exactly what we are going to talk about. Ocean Acidification is one such activity that disrupts not only marine biodiversity on major scales but also the process of cloud formation, which in return plays an important role in balancing global warming. To see how the acidification of our oceans is directly related to our living and the various operations of our planet, there's a detailed case study as well on the Indian Ocean.

2. Background

2.1 Definitions

Definition 1 (Ocean Acidification) The oceans have a natural tendency to absorb CO2 that gets emitted into the atmosphere due to the burning of fossil fuels, industrial output, deforestation, and other human activities. The carbon dioxide absorbed by the alkaline ocean water gets dissolved and forms acidic ocean water. In the past 3 census years, the production of around 5189 million metric tons of CO2 in the atmosphere has increased the percentage capacity of CO2 intake by the oceans. Usually, the ocean can absorb anywhere between 27% to 30% of the atmospheric CO2.

2.2 Cause - The pH scale

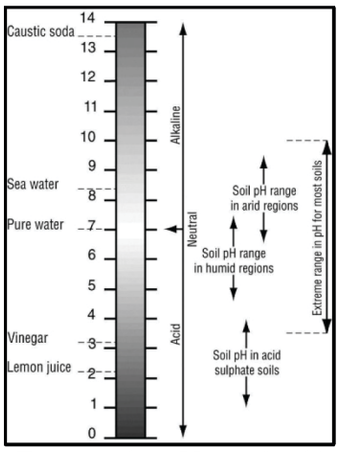

Figure 1: pH scale[1]

1. The pH scale was introduced by Soren Sorensen.
2. pH or potential of H+ ion scale measures the acidity to alkalinity of a solution.
3. The pH scale ranges from 14 to 0,0 being the most acidic and 14 being the most basic/ alkaline.7 shows the neutral.
4. H+ ions contribute to increasing the acidic value. The more the H+ ions,the more the scale will tend towards 0.

The pH scale plays a very important role in understanding the nature of seawater and its respective.

3.The Chemical Process of Ocean Acidification

The industrial cloud of carbon dioxide (CO2) present in our atmosphere is absorbed by the ocean waters(H2O) which leads to a series of chemical compositions and further the release of [H+] ions. These [H+] ions are nothing but the potential hydrogen that increases the acidity of the seawater.

$$[h!]CO_2 + H_2O \dashrightarrow H_2CO_3 \qquad (3.1)$$

$$^{-1}_{3} + H^+$$

$$^{-1}_{3} + H^+ \longrightarrow \quad ^{-2}_{3} + 2H^+$$

Equation (3.1) shows the first step when the CO2 from the atmosphere breaks down into seawater(H2O) to form carbonic acid(H2CO3). Now, each carbonic acid molecule presents in the water releases one of its hydrogen ions [H+] to give bicarbonate(HCO3–1); which is exactly what is shown in equation (3.2). Further,(equation (3.3)) this bicarbonate molecule breaks down into carbonate(CO3–2) again losing [H+] ions.

The issue with this whole chemical process of ocean acidification is that both the molecules of bicarbonate and carbonate are formed by losing one H+ ion each. The release of H+ ions in ocean water means adding to its acidic nature.

It‘s good to state that each step towards the acidity on a pH scale is a factor of 10 since the pH scale is logarithmic. Meaning, if the value falls from 7 to 6, the acidity of ocean water will increase by 10.

Now imagine if one molecule of CO2, when absorbed by ocean water is resulting in the release of 3 [H+] ions then how many more H+ ions are being released by 30-40% of absorbed atmospheric CO2? The pH value of Indian Ocean [60◦N - 60◦S] is 8.07, the acidity tends to fluctuate by– 0.02

4. Effects of Ocean Acidification on Marine Biodiversity: A Study of Indian Ocean

4.1 Coral Reefs

Coral reefs are one of the most spectacular marine life and are not only the building blocks but also a habitat for many marine animals. Acidification of ocean water disbalance the proposition of the chemical need for the corals to be healed or rather be alive. Corals are made of Calcium and Carbonate ions i.e. calcium carbonate. The whole process is quite a simple one, the carbonate or CO3–2 usually reacts with the calcium(Ca) ions to give calcium carbonate or CaCO3. Now, when the pH of ocean water reduces, there are more and more reactive H+ ions free to form an ionic bond with CO3 and ultimately result in bicarbonate. This means the available CaCO3 ions get busy with the more charged H+ ions and there‘s less left for calcium ions to form CaCO3.

$$^{-2}_{3} \longrightarrow$$

The Indian Ocean is one of the largest providers of coral reefs, after the Pacific Ocean. Following the eastern coastline of India, the Andaman and Nicobar Islands are home to 89% of the reefs in India. Coral reefs are very sensitive to temperature, the CO2 absorbed by ocean water traps the heat which leads to the destruction of zooxanthellae, which is a very important alga for corals since they provide food via photosynthesis. Further, an increase in acidification reduces the

CaCO3 content in water which weakens the skeletal of corals and eventually leads them to break down even under minute pressure.

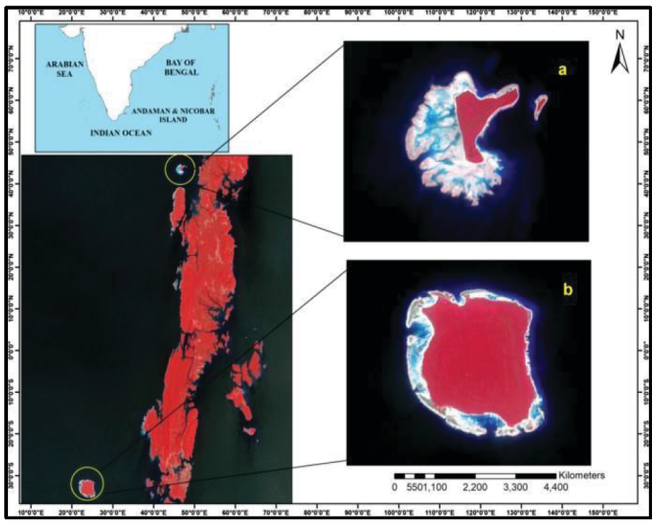

Figure 2: Spatio-Temporal Mapping of Coral Bleaching in South Andaman and Nicobar[2]

4.2 Planktons

Planktons are one of the most vital microorganisms for marine life. There are mainly two types of plankton, phytoplankton, and zooplankton. Phytoplankton is a plant-based microorganism, they thrive in clean upper levels of water since they need sunlight to live. Zooplankton are tiny marine animals with the plankton gene, they could be as tiny as 2mm. Planktons are crucial for the food chain of the marine ecosystem. Since zooplanktons survive on phytoplankton as a food source in return, the zooplanktons become a very reliable food source for various fish, crustaceans, and various marine animals.

Acidification of ocean water leads to an increase in CO2 which disrupts the process of photosynthesis. The phytoplanktons start dying in acid-concentrated water. Extinction puts the whole food chain of marine ecosystems in danger. The Western Indian Ocean holds a large percentage of phytoplankton out of which 30

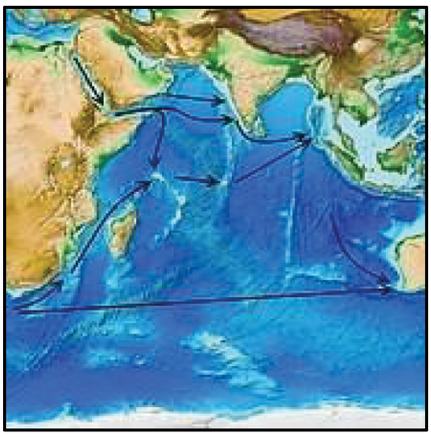

Figure 3: Study Area Map - Western Indian Ocean(Map not to scale) [3]

4.3 Coccolithophores

These are single-celled algae with a calcite-coated body. Essentially they look like little pods of rocks or “liths" and are important for cloud formation, which in return contributes to reducing global warming. The calcite-made coccolith bodies use calcium carbonate CaCO3, this calcium carbonate-made coccolithophores are known to be one of the very few natural sources of sulfur emission to the atmosphere. Coccolithophores emit a particular kind of sulfur known as dimethyl sulfide or C2H6S. DMS contributes to cloud formation which radiates the sun’s rays and hence keeps the Earth cool. Acidification in the Indian Ocean led to an increase in the concentration of CO2 which in return decreased the emission of dimethyl sulphide, especially in the eastern part of the Indian ocean where there‘s a large concentration of coccolithophores.

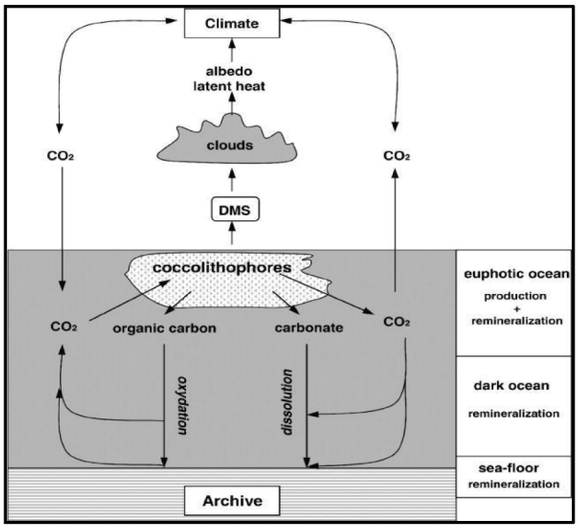

Figure 4: The natural process of DMS emission by Coccolithophores[4]

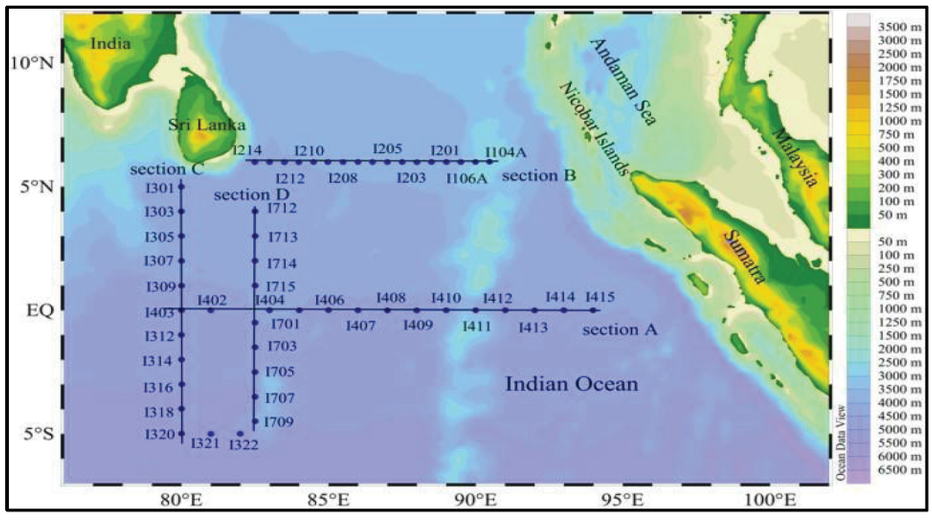

Figure 5: Study Area Map- Eastern Indian Ocean [80 -94 E, 6 N-5S] [5]

4.3 Sea Fishes and other Marine Animals

Increases in the acidification of the ocean not only have an impact on calcareous creatures but also on fishes that are not composed of calcium. The North Eastern part of the Indian Ocean is home to some of the best species of Mackerel, Sardine,

Shark, Ribbon Fish, and much more. The increase in CO2 level affects the immune system of these species which leads to improper functioning. This is a case of Hypercapnia, where there's excess found in the body fluids of the organisms. Another, harmful impact of Ocean Acidification on Marine animals is that CO2 increases ocean noise which harms the sensory mechanism of animals, especially the ones who use echolocation.

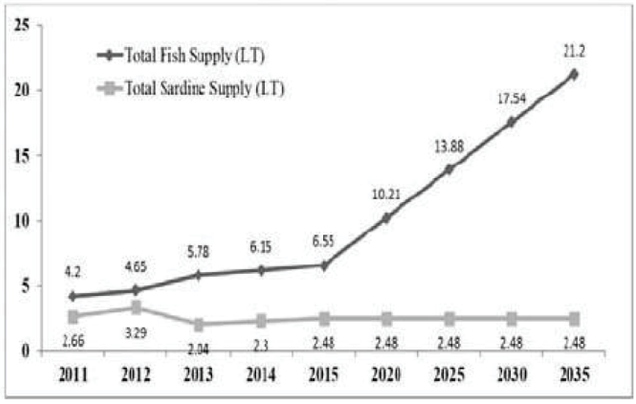

Figure 6: Data of Fall in Sardine in North Eastern Indian Ocean.

5. Conclusion

Ocean Acidification is a major global problem, or as it is said "the other carbon problem". Even though it might seem ideal at first since the CO2 in the atmosphere is getting absorbed in water and there's less carbon dioxide left in the atmosphere, eventually the increase in the acidity of ocean water impacts the diverse marine biodiversity and global warming as well.

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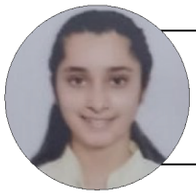
Mangroves Restoration & Rehabilitation



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AIM

- Understanding how mangroves can help mitigate climate change with the help of expanding innovative technology.

GOALS

- Goals of mangrove restoration or rehabilitation often include conservation, coastal protection, timber production forests, or mixed-use forests for high sustainable yields.

PROBLEMS

- How expanding agricultural practices are degrading the mangrove forests.
- Impacts on mangrove forests due to coastal development especially port development & trading activities.
- Shrimp farming & Industrial effluents threatening the mangrove forests.

OBJECTIVES

- Knowing the Mangroves & their importance in our natural ecosystem
- Understanding how coastal communities can help in mangrove restoration
- Increasing recognition of these blue carbon ecosystems.

KNOWING MANGROVES!

Mangroves are a diverse group of ±70 tree, shrub, and fern species that grow in anoxic and saline peaty soils of tropical coasts. They can grow in harsh tropical, sub-tropical & equatorial regions only and they cannot withstand extremely low temperatures, between latitudes 30° N and 30° S, with the greatest mangrove area within 5° of the equators.

Mangrove families first appeared during the Late Cretaceous to Paleocene epochs and got widely distributed in the world due to the tectonic plates' movement. The oldest known fossils of mangrove palms are from around 75 million years ago. Out of 110 mangrove species, only about 54 species in 20 genera from 16 families consist of "true mangroves", species found exclusively in mangrove habitats only. It grows in the area including estuaries and marine shorelines offering a natural habitat for young organisms to grow & thrive like algae, oysters, sponges, shrimps, and lobsters, etc., Mangroves are salt-tolerant trees, also called halophytes, and easily adapts to live in harsh coastal climatic conditions as well as to the low-oxygen conditions of waterlogged mud. They contain a complex salt filtration system and root system to cope with continuous saltwater immersion and wave action happening near the coast.

Mangroves are viviparous, they disperse propagules through the water with varying degrees of embryonic development while the propagule is attached to the parent tree. When the propagule drops from the parent tree it remains in the water for some time. During this period embryonic development continues. They are buoyant and thus float on the water before rooting themselves on suitable soil. When the propagule gets a "favorable" condition, the primary roots and cotyledons appear.

Beginning in 2010 remote sensing technologies and global data are being used to assess areas, conditions, and deforestation rates of mangroves around the globe. A study in 2022 on losses and gains of tidal wetlands estimates that around 3,700 km2 net decrease in global mangrove extent from 1999–2019 happened, which was compensated by gains of 1,800 km2 only. Mangrove loss continues due to anthropogenic activities, with a global annual deforestation rate estimated at around 0.16%, and per-country rates as high as 0.70%. Degradation in the quality of remaining mangroves is also a key area of concern, globally.

Rehabilitation and restoration of mangroves have been practiced for decades globally & locally. Mangrove restoration means bringing back the exploited mangrove forest to its original condition, before human interventions. Aims to the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed whereas mangrove rehabilitation refers to planting more mangrove saplings over the degraded land. Countries having large mangrove cover are Indonesia, Brazil, Australia, Mexico, Nigeria, Malaysia, and Myanmar & Papua New Guinea.

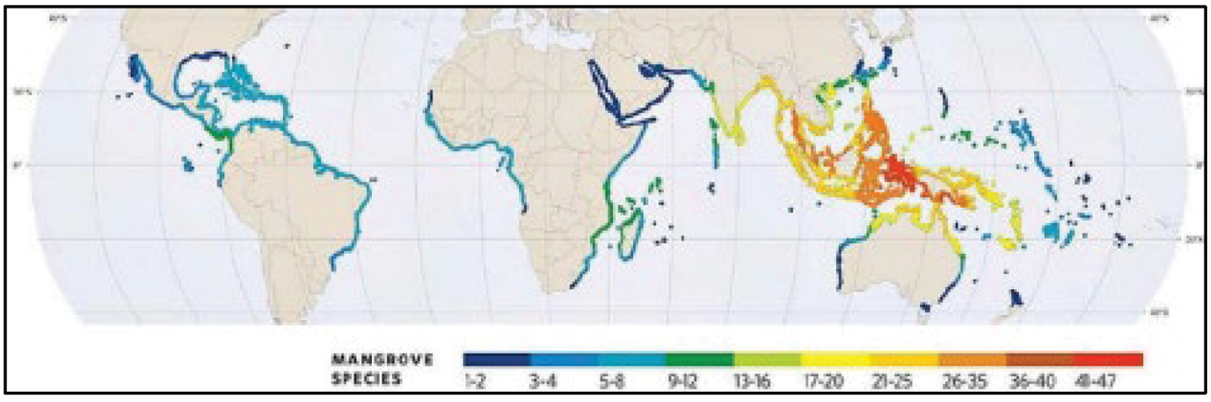


Image1: Distribution of Mangrove species globally, Source: Jacqueline-Michel, publication

HISTORY OF MANGROVE REHABILITATION AND RESTORATION!

The fossils of mangroves found to date majorly belong to the tertiary period. Not only along the east coast of the Tethys Sea but also widely distributed by the Late Eocene. Four exclusively mangrove genera–Bruguiera, Ceriops, Kandelia, and Rhizophora– occur in the family Rhizophoraceae, and this family contains all the modern mangrove forests. The earliest known mangrove fossils are Maastrichtian pollen grains assignable to the extant palm genus Nypa (Germeraad et al., 1968), and Palaeocene/Eocene fruits & seeds in the extinct genera Wetherellia and Palaeowetherellia (Mazer & Tiffney, 1982).

Mangrove forest restoration and rehabilitation programs are increasingly undertaken at distinct levels for reviving ecosystem services as a step initiated

for community-based biodiversity conservation. Early mangrove rehabilitation programs focused on establishing forest cover for extracting timber and for coastal protection without the aim of conserving or safeguarding nature & biodiversity. Several rehabilitation projects throughout the world have been initiated in Thailand, Pakistan, Australia, Bangladesh, Sri Lanka, Vietnam, and Kenya (Bosire et al., 2003).

However, there is limited knowledge regarding the effectiveness of the natural development, survival, and growth characteristics of these mangroves being rehabilitated, compared to the stands of indigenous forests, over time. There had been no previous detailed assessment reports on the monitoring of mangrove rehabilitation projects that were undertaken, and the satellite-based analyses failed to identify any success of these projects including mangrove saplings with sensors that monitored real-time information about soil, PH, and salinity levels. Globally, there is mixed evidence for the effectiveness of the rehabilitation projects, due to the limited supporting scientific evidence, the lack of standardized ecological restoration practices, and socio-political reasoning at local levels. Understanding the structural features and spatial patterns of rehabilitated mangroves is vital for assessing the successes and failures of these various rehabilitation projects.

Recent developments in cloud computing platforms, advanced cloud, and shadow detection algorithms, and time series analyses provide a valuable set of tools that provides accurate information on the development of mangroves forest over time.

In 2008, the United Nations launched the "Reducing Emissions from Deforestation and forest Degradation (REDD)" program to combat climate change through the reduction of carbon emissions and enhancement of carbon sinks from mangrove forests under Emerging place-based conservation payment strategies, such as various payment for ecosystem services (PES) schemes, program under the UN (United Nations) Framework Convention on Climate Change.

Conservation through management, education, and restoration projects, such as the Mangrove Action Project, Mangroves for the Future, Western Indian Ocean Mangrove Network, the Mangrove Alliance, the International Society for Mangrove Ecosystems, IUCN's Pacific Mangrove Initiative, and Mangrove Watch. The mangroves for the Future (MFF) initiative, led by the IUCN (International Union for Conservation of Nature) and UNDP (United Nations Development Programme), encourages the rehabilitation of mangroves by engaging with local stakeholders and creating a platform for bringing change.

Mangrove restoration and protection are also seen as a climate change mitigation strategy under COP21, the international agreement to target climate change, with countries being able to submit the act in their Nationally Appropriate Mitigation Approaches (NAMAs). NAMAs are supported and enabled by technology, financing, and capacity-building and are aimed at achieving a reduction in emissions relative to 'business as usual' emissions in 2020. Ten of the world's least developed countries are today prioritizing mangrove restoration in their NAMAs.

In the IPCC (Intergovernmental Panel on Climate Change) AR5 report, the potential of ecosystem-based adaptation (EBA) to climate change is deeply discussed, which includes the restoration of mangrove forests.

International protected area conventions and programs: The Ramsar Convention on internationally important wetlands protects mangroves at 278 sites in 68 countries, the World Heritage Convention includes 26 sites that protect mangroves, as do 88 biosphere reserves under the UNESCO Man and the Biosphere Program.

IMPORTANCE OF MANGROVES IN OUR NATURAL ECOSYSTEM!

Mangroves create natural habitats for many terrestrial (land), intertidal, and marine species, along with stabilizing the shorelines, monitoring nutrient cycling in our ecosystem, reducing coastal erosion, energy flow through the forests & most importantly helping to mitigate global climate change through the sequestration of carbon from the atmosphere and acting as large sinks for greenhouse gas emissions.

Mangroves inhale carbon dioxide when they perform the photosynthesis process and store the carbon dioxide in their leaves, branches & roots. They then convert this carbon dioxide into biomass made of complex carbon compounds. The Biomass while decaying remains green in nature as it does not release extra carbon dioxide. Being the most carbon-rich tropical forest, mangroves are highly productive and important as they store three to four times more carbon than any other tropical forest. This is known as blue carbon.

Coastal communities rely on these forests for their livelihood as they extract construction material, fuel wood, and food as well as non-timber forest products such as medicinal plants, palm leaves, and honey & has cultural importance as well also indigenous knowledge plays a vital role in their conservation. Mangrove forests, along with the animal species they provide shelter, represent globally significant sources of biodiversity and provide humanity with valuable ecosystem services vital for their survival. They are used by mammals, reptiles, and birds for feeding and breeding grounds, and provide crucial habitats for fish and crustacean species that also have huge commercial importance. Mangroves sequester more than 25.5 million Tonnes of Carbon per year. The medical properties of mangroves can be used for relieving pain, decreasing inflammation, treating diabetes, and treating many more illnesses. Products from mangroves are also used in soaps, cosmetics, perfumes, and insecticide manufacturing.

Recent fine-scale analysis of global mangrove forest cover yielded an estimate of approximately 84,000 km2 spread across 105 countries over the globe. An estimate shows that the total mangrove area worldwide in 2005 was 152,000 km2 which came down from 188,000 km2 in 1980, nearly 20% of the world's mangroves, were lost over a period of twenty-five years & in turn released 10% of global CO2 emissions from deforestation that was stored in their roots.

Mangrove forests area were majorly destroyed to make room for industry, housing, and tourism sector development; for aquaculture, primarily shrimp farms; and for agriculture, such as rice paddies, livestock pasture, and salt production. The mangrove forests create employment & income opportunities for local fishermen & local communities. It sustains the lives & livelihoods of millions of people worldwide. The market price of mangrove forest products is high, it generates income from tourism as well and has an extremely high value in carbon markets. Thus, these forests provide at least US $1.6 billion (about $5 per person in the US) each year in ecosystem services.

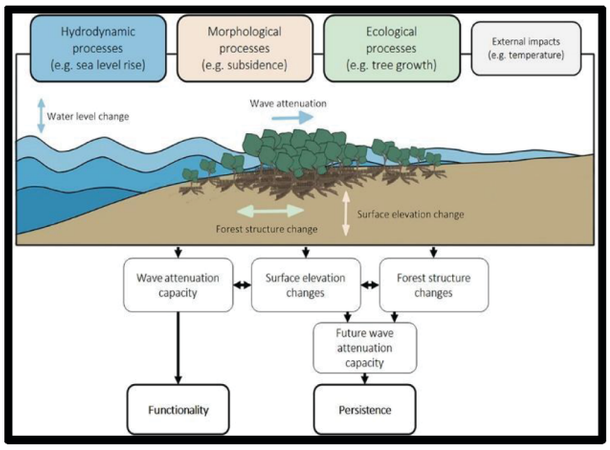


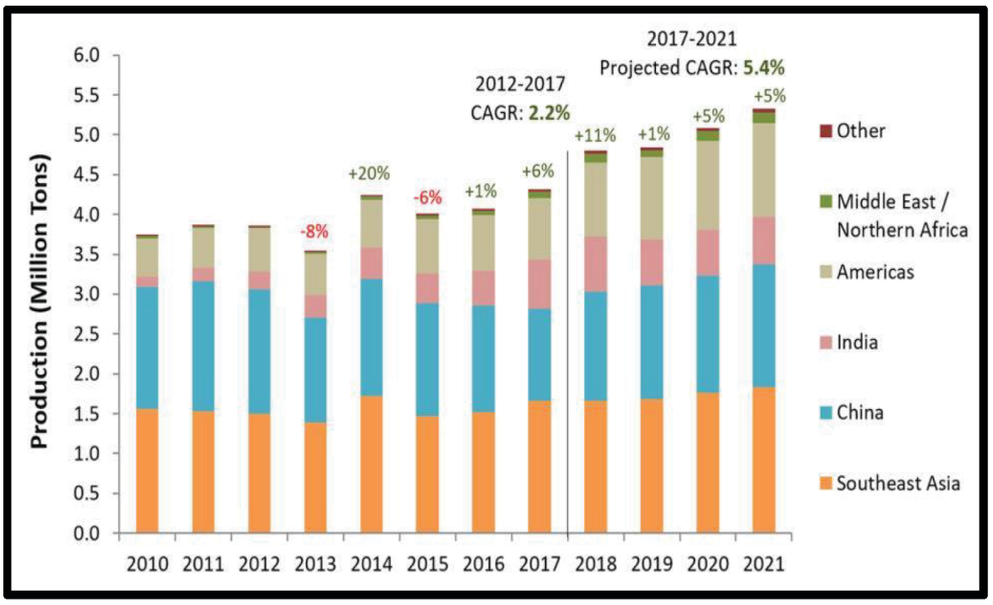
Image 2.0: Carbon sequestration technique of Mangrove, Source: Mapping Ocean wealth, The Nature Conservancy

Image 2.1: Interacting hydrodynamic, morphological & ecological processes of Mangroves, Source: Nature Based Engineering review article, 2021

THREATS TO MANGROVES!

Out of the total known ±70 species of mangrove forests, 11 (16%) are at threat of getting extinct as per the IUCN Red List of Threatened Species™. Mangroves are disappearing at the rate of 1% per year, with a few estimates showing it as high as 2-8% per year. Most mangrove forests were lost during the 20th century. Globally, the highest proportion of threatened mangrove species is found along the Atlantic & Pacific coasts of Central America. Major threats to mangrove forests are as follows:

1. **Shrimp farming:** Fisheries and aquaculture are important contributors to food security, livelihoods, and global food security, especially in low-income and third-world countries. Due to the introduction of the blue revolution- intensive & unsustainable single-species aquaculture was being practiced worldwide. The ideal conditions offered by mangroves, such as brackish water, abundant fry, cheap land, and a low-lying area, along with convenient and easily exploitable settings promoted shrimp aquaculture. The loss of mangroves along the coastline cause coastal erosion, and saltwater intrusion, threatening biodiversity and the long-term livelihood of mangrove communities. Fishermen use fishing nets that damage the ocean bed and trap many species besides shrimp, like corals leaving marine habitats damaged and local fisheries depleted. (PÁEZ-OSUNA, F. et al.,2001)



Shrimp farming production by region. Sources: FAO (2019) and GOAL surveys (2011 to 2018) for 2010 to 2017

2. **Coastal development:** Due to the continuous rise in global population, urban encroachment into mangrove forests can be witnessed globally. Setting up concrete buildings creates various issues such as pollution, waste generation & introduction to invasive species that affect the hydrology, salinity, sediments & biodiversity of these regions. It destroys the coastal biodiversity & natural ecosystem of Mangrove forests. The effects of urban encroachment can also be recorded by the damage it causes to the coastal infrastructure. It affects homes, communities, and businesses and disrupts essential services, resource flows, and transport & communication networks along with many cultural heritage assets. The global bill for storms & typhoon damage in the past 50 years is around $521 billion. Floods cost $115 billion, with $377 billion of the storm and flood losses occurring in Europe alone. (E K Paleologos .et al., 2019)

3. **Agricultural practices:** The world economy relies on agriculture to meet its food demand and maintain food security. Clearing mangrove forests and converting them into agricultural fields is widely being practiced worldwide in the last few decades. The fertilizers, pesticides & machinery used in farming damage the natural ecosystem for mangroves to thrive along with destroying the biodiversity on which the local communities rely for their livelihood.

4. **Tourism:** Unfortunately, one of the major factors responsible for destroying our coastal lines rich in coastal forests. The tourism industry is booming and every year thousands of tourists visit the coastal sites for sightseeing & enjoying and they bring with their garbage, sewage, noise, fumes, lights, and other disturbances that damage mangrove forests and the surrounding ecosystems. Walking off paths, lighting fires, feeding wildlife, anchoring on reefs, and collecting shells and plants are also destructive to the coastal ecosystems.

5. **Timber requirements:** Rapid chopping of mangrove forests for timber extraction used as a building material, fuel & medicinal purpose possesses a serious threat to the coastal ecosystems. More than 26% of worldwide mangrove forests are degraded due to over-exploitation for fuelwood & timber production.

6. **Climate Change:** Due to rising global temperature many changes can be witnessed worldwide, one of them being rising sea levels. The rate of change is so rapid that the mangroves cannot adapt to it. This is exerting pressure on the coral reefs & seagrasses causing ocean acidification & bleaching. (Atwood, T. B., Connolly, R. M., Almahasheer, H., Carnell, P. E., Duarte, C. M., Lewis, C. J. E., et al. 2017)

7. **Hyper Salinity:** A situation where the water salinity is more than 40. They are found in tropical, arid, and warm temperate climates with low or highly seasonal rainfall. Mainly caused by a reduced or closed connection with the ocean, high evaporation, and low freshwater input. It leads to the mass extinction of flora-fauna and damages the livelihood of coastal communities. (Ball, M. C. 1988)

8. **Oil Pollution:** There have been at least 238 notable oil spills along mangrove coastlines worldwide. In total, at least 5.5 million Tonnes of oil have been released into mangrove-lined, coastal waters, oiling up to around 1.94 million ha of mangrove habitat, and killing at least 126,000 ha of mangrove vegetation since 1958. Oil or gas exploration, petroleum production, and accidents by large oil tankers cause grave damage to mangrove ecosystems and it takes decades for them to restore and come back to their original state.

9. **Other threats** include upland runoff of pollutants, sewage, and sediments, petroleum pollution, storms, and hurricanes, solid waste, conversion to landfills, terrestrial agriculture, and pharmaceuticals.

CASE STUDY OF LIBERIA, WEST AFRICA

In Liberia, deforestation related to urbanization, overuse, and exploitation of natural resources threatens mangrove ecosystems, increasing climate-associated risks and the loss of local livelihoods. An ambitious project led by Global Mangrove Alliance and Conservation International, in partnership with the Coastal and Marine Protected Area Network in Liberia, seeks to solve this issue by establishing 35% of Liberia's mangroves as a protected area, increasing the country's coastal resilience along with benefiting local communities.

The project focused on using the power of land-use participatory planning to halt mangrove degradation and strengthen conservation, community engagement, and the sustainable use of the ecosystem. During its first year of implementation, the project has built capacity and has raised the awareness of local government

and communities from Northern Liberia, with tangible outcomes such as 20% of prioritized mangroves areas being delimited and now having a management plan, and a 15% reduction in the deforestation of prioritized mangroves and their buffer zones.

CASE STUDY OF SUNDERBANS, INDIA

Sundarbans is the largest mangrove ecosystem in the world which is named after the dominant mangrove tree species, Heritiera fomes, known as sundry in Bengali, Sundarbans itself means 'beautiful forest' in Bengali. This mangrove supports a large population of Asia's largest predator and numerous exotic species. The Sundarbans Mangrove ecoregion lies in a vast delta, an area of over 10,000 formed by the convergence of South Asia's largest rivers, the Ganges, Hooghly, Padma, Brahmaputra, and Meghna.

Other mangrove trees include species of Avicennia, Xylocarpus, Sonneratia, Bruguiera, Cereops, Aegicera, and Rhizophora. About half of the mangrove forests have been cut for fuelwood, Shrimp fry collected at unsustainable levels to supply the shrimp grow-out industry, and forests are cleared for grow-out ponds. River diversion and water storage projects upriver are affecting the delicate balance of salinity and tidal fluxes that maintain this ecosystem. Restoration of native mangrove species needs to be prioritized to save the Sundarbans.

The history of conservation in the Sundarbans can be noticed from the Mughal period (1526–1765) to British colonial rule (1765–1947). After independence in 1947, various laws and policies were implemented to conserve this natural ecosystem. English Lord Daniel Hamilton established the 'Gosaba' cooperative model in 1903. This colonial scheme-initiated mangrove deforestation in India's islands. Currently, 54 out of 102 islands are colonized by humans without any trace of mangroves. A study indicates that a density of 30 mangrove trees per 100 square meters can reduce the flow of extreme events such as tsunami waves, by up to 90%. Restoration of mangroves is the only solution to save the 4.6 million people residing in the Indian Sundarbans from natural disasters. Natural methods are sustainable, eco-friendly as well as economically viable over technological alternatives. Policymakers must prioritize mangrove restoration to cope with the impending climate change crisis.

SOLUTIONS

1. **Engineering solutions:** Many of the restoration & rehabilitation efforts failed because the underlying soil and hydrological requirements of the mangroves were not adequate. Some methods reduce wave impact and allow sediment accumulation along the coastline that helps the mangroves to thrive better without much loss.

2. For mangroves to thrive well in a natural environment requires a well-balanced quantity of **incoming sediments** from the sea. Upstream water logging and intensive agricultural practices around the river plains increase sediment runoff into the seas. Excessive sedimentation damages the growing seeds.

3. **Natural renew period:** Natural renewable of mangroves is possible given that its tidal and freshwater hydrology is functioning normally and there is an adequate supply of seedlings. If natural renewal does occur, (Twilley et al. 1996) predict that species composition will be determined by the very earliest saplings to colonies the recovering stand. This prediction is supported by the actual studies of (Clarke et al. 2000, Clarke et al. 2001, Ross et al. 2006 and Sousa et al. 2007).

4. One of the approaches is the **Ecological Mangrove Restoration** method which suggests the following steps for healthy mangroves in the surrounding area:
    i. Assess the ecological aspects, specifically reproduction and distribution patterns, of the mangrove species around the coasts,
    ii. Map the topographical elevations and hydrological patterns that determine how seedlings will thrive in the coastal zones;
    iii. Assess the changes made to the site that currently prevent the site from recovering by itself. • Design a restoration plan that focuses on restoring the normal range of elevations and tidal hydrology of mangroves; and
    iv. Monitor the coastal site well to determine if the restoration has been successful as expected.

5. **Technological Innovation:** Restoring mangroves using traditional methods can be a slow & arduous process. Alternative technology like quadcopters can be used to carry and deposit seed pods. According to Irina Fedorenko and Susan Graham of Bio-Carbon Engineering, a drone can do an amount of work in days that is equivalent to weeks of planting by humans using traditional methods, at a fraction of the cost. Drones can also carry and plant seeds in difficult-to-reach areas where humans cannot work easily. Drones can be used to develop planting patterns for areas and to monitor the growth of new forests.

6. Undertaking capacity building and training exercises at the local & regional levels for creating awareness among the masses and **involving locals** and using their **indigenous knowledge** in the decision-making process & other conservation initiatives.

7. **Limiting anthropogenic activities** around the sensitive mangrove coastal ecosystems such as urban encroachment & construction activities, so that the mangroves can thrive & grow without any human interventions, naturally & safely. (Environmental Conservation, Volume 29, Issue 3, September 2002, pp. 331 – 349)

CONCLUSION

Efforts for over a century have been made with a focus on conservation and restoration for preserving biodiversity and generating ecological benefits for local communities in Coastal wetlands. They support sustainable coastal and marine ecosystems. They protect nearby areas from tsunamis and extreme weather events, carbon sequestration and storage, and mitigate climate change.

The success of mangrove restoration & rehabilitation depends heavily on the engagement of local stakeholders/communities as they face the effects of these

projects first, they should be involved in the process as much as possible, from decision-making to maintenance over the long term as their involvement and local knowledge is very crucial. They are one of the most carbon-dense ecosystems in the world, with the potential to act as long-term carbon sinks and there is an urgent need to collectively save these forests from disappearing from our world.

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URBANIZATION IN THE COASTAL ENVIRONMENT

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Introduction

Humans have always settled near water since the known human history. Coastal regions, sustaining a large biodiversity and the livelihood of millions, have always been among the most habitable regions in the world. Around one-third of the world's total population lives within 100 km of the coast, at a population density twice the global average (UNEP). Coastal areas have significant socio-economic and cultural value, which makes them the focal point of ambitious urban development projects. The microclimate (moderating influence of the sea results in mild climate) and the desire to live near coasts (than the urban core) have increasingly catalyzed the process of urbanization in coastal zones. Coastal cities are of significant regional importance due to their role as the target center of many economic activities, development of ports, and transportation and defense roles.

This article, in the light of the multi-sectoral significance of coastal regions in various aspects such as biodiversity, climate change, population pressure, tourist trade, livelihood sustenance and pollution load, analyzes the impacts urban intrusion has created in the coastal regions over the recent years advocating integrated approaches to coastal management in planning mechanisms.

Urban intrusion over recent years

Coastal regions can be broadly defined as the area adjoining a coastline. It's the land-sea interface. Urbanization can be defined as the growth of population in towns and expansion of urban areas. Urbanization is a complex phenomenon which is accompanied by socio-economic, cultural, political and structural changes. It is also accompanied by urban land-use change, often disturbing the natural ecosystem, and demographic shifts.

Who would not desire a home just a stone's throw away from the seaside? Consequently, the coastal regions are being heavily valued as real estate and have become a prime destination for tourists as well. Urban projects have already intruded the coastal boundary, evident in ambitious projects such as land reclamation and creation of artificial islands. The intrusion has placed pressure on the natural coastal resources.

Uncontrolled expansion of coastal cities and consequent anthropogenic pressures have degraded the marine ecology around the world in recent decades. Researchers say that half of all coastal environments are heavily affected by human activity.

With massive urbanization occurring in the recent decades, the urban intrusion in the coastal areas directly impacts regional biodiversity as well as life below water. Their vulnerability can be directly defined as biodiversity loss and environmental degradation. The threats that urbanization poses to the coastal regions are evident from the fact that there is a decline in mangroves along the shorelines in recent years. Mangroves line approximately 8% of the world's coastline (Burke et al, 2000) and 1/4th of the tropical coastlines (Spalding et al. 1997: 23). The area of mangroves has decreased over the years under pressures of human activity as they are cut down for developmental activities. Their loss has been linked to intrusion by the development of ports and coastal cities.

The natural equilibrium of the coastal ecosystems is altered by human modification of shorelines. The coastal habitats with natural buffers are being modified by developmental activities and replaced by artificial structures. This anthropogenic intrusion puts coastal cities at a greater risk of flood-related catastrophes. They are most vulnerable to climate change driven sea-level rise, which has severe implications for low-lying islands, coastal cities and communities.

World's coastal regions are becoming increasingly urbanized; major coastal cities like Bangkok, Shanghai, Los Angeles, São Paulo, Jakarta etc., being prime collection and distribution centers, sustain a larger population density, and increased urbanization-induced migration places extra pressure on coastal resources. As people settle near coasts, the economy expands and diversifies, with more people being pulled, leading to a higher pace of urbanization. Most coastal cities of the world are experiencing higher growth and development rates. The sea cucumber fishing crisis in Galápagos is an example of potential consequences of rapid migration to coastal cities, where new fishing techniques and increased availability of credits and markets resulted in overexploitation of the species.

Though coastal zones attract many tourists and have significant economic importance, aiding urban development, the counter effects and opportunity costs are great as population pressure poses a threat to the coastal ecosystem. Tourist trade has greatly degraded this land-sea interface in the last decade.

The indigenous fishing communities that depend heavily on the oceans for their livelihood face another greater threat of being displaced because of urbanization. As coastal areas begin to be valued as real estate, the local communities are displaced, and their livelihoods are threatened.

Coastal ecosystems provide the vital service of maintaining water quality. The link between increased urbanization in coastal zones and water quality degradation is much to worry about. Increased frequency of algal blooms indicates over-nourishing and excessive nutrient runoff in the coastal waters. Over the decades, urbanization in the coastal environment has contributed to coastal pollution, as pollutants are directly discharged to estuaries and coastal waters. As the coastal population grows, the pollutant load increases.

Planning mechanisms

Around half of the world's coastal regions are threatened by urban developmental activities. The increasing threat to this land-sea interface has become a challenge for urban planners as they look out to balance the local interests and national economic interests. Conversion of coastal land for urban land use is a permanent

and irreversible effect. The challenges are great, as a significant number of the population lives within 100 km from the coast, which on average accounts for only 22% of the land mass (WRI 2000).

Managing population pressures and urban growth is a difficult task as coastal zones encompass multifarious aspects- physical, economic (tourism, transport), oil and gas, fishing and agriculture. A large population is already dependent on coastal resources. Integrated approaches to coastal management should be incorporated in coastal management plans. The stakeholders must be identified and policy framing and implementation should be undertaken by planners and policymakers considering balanced interests. Since coastal regions and economies contribute significantly to the national interests, multisectoral efforts by government institutes at all levels are crucial to balancing local interests and national economic interests.

Climate change adaptive planning should be adopted for coastal cities, which are more vulnerable to sea level rise and flooding. Disaster risk reduction and mitigation plans become indispensable for vulnerable coastal towns.

Local communities (mainly fishing communities) are displaced, and their land rights are threatened as more ambitious urban projects subsume the coastal land. Planning regimes should incorporate the sociocultural structure, and the apprehensions and interests of the local communities whose livelihood depends on the coastal ecosystem. Population dynamics should be included in the planning mechanisms.

Very little or no data is available on coastal degradation at local levels. Research should be encouraged in this domain to identify local and suitably adaptive techniques and methodologies to control the pace of urbanization in coastal areas. Data available should be utilized in assessing the rates of degradation and identifying critical threats. Proper zoning and identification of vulnerable zones becomes crucial in planning regimes.

More than a land-sea interface, a coastal zone is a human-environment interface with human activities becoming increasingly intertwined in the coastal ecosystems. With increasing wealth and affluence and increasing demand on given natural resources, humans began settling near the coasts, and their imprints have become permanent. It is more or less impossible to reverse the effects because of the increasing population pressure. Holistic planning and its implementation are crucial in the efforts to create a balanced state between the natural and human elements, as human activities have become increasingly merged into the coastal ecosystems over time.

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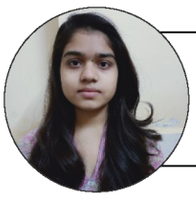
मैं तट हूँ !



प्रिया परिहार
द्वितीय वर्ष
दयाल सिंह कॉलेज

कुओं - सा समुंदर , नारी- सी धरा
कुओं - सा समुंदर , नारी- सी धरा

इनके बीच पनघट हूँ

हाँ, मैं तट हूँ !

नदी है मुझसे बहकर जाती
मुझपर ज्वारंदमुख बनाती
उस मुख की मुस्कुराहट हूँ
हाँ, मैं तट हूँ !

लहरे, ज्वार आती हैं

बार बार टकराती हैं

बहुत मानता इसका शोक
कंकड़ पत्थर भर जो लाती हैं
उससे बनाया अपना थोक

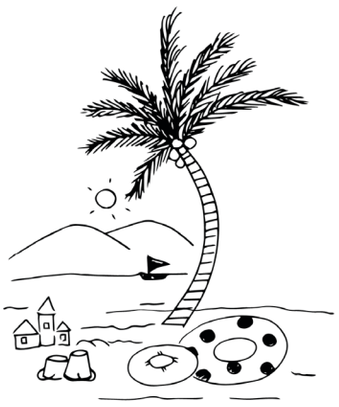
सोचा क्यों ना बड़ा हो जाऊँ

मनुष्य को विशाल समुंदर से बचाऊँ
बाढ़ में बह जाते घर व्यापार
सुनामी भी लगाती हैं हुंकार

जल से घर का पट हूँ

हाँ, मैं तट हूँ !

हुआ बड़ा और पेड़ उगाए
बाढ़ भूस्सखलन से जो बचाए
सोचा क्यों ना बड़ा हो जाऊँ



मनुष्य को विशाल समुंदर से बचाऊँ
बाढ़ में बह जाते घर व्यापार
सुनामी भी लगाती हैं हुंकार

जल से घर का पट हूँ
हाँ, मैं तट हूँ !

हुआ बड़ा और पेड़ उगाए

बाढ़ भूस्सखलन से जो बचाए

मानव ने काटा उसको , अपना
महल बनाता हैं

न प्रकृति की चिंता करता , इतना
लोभी बनता जाता
जान गवाने रहता तैयार

बच्चे लगाते माँ को पुकार

उस पुकार की आहत हूँ

हाँ, मैं तट हूँ !

जिसने मुझे सवारा हैं

ना प्रदूषण फैलाया हैं
पर्यावरण को महत्व दिया हैं
पर्यटन उसका समृद्ध हुआ हैं
उस देश की दौलत हूँ

हाँ, मैं तट हूँ !

जलधारा

संध्या देवी
तृतीय वर्ष
देशबंधु कॉलेज

हिम शिखर से बहता हुआ
सतत् प्रवाह की धारा है,
हिम से आकर नद में मिल
जल की अमृत धारा है।

सूखे कंठ की आशा होकर
जीवन तुझसे ही प्यारा है,
परिश्रम कर खोज लिया
मिले कहीं ना जलधारा है।
हिम से आकर नद में मिल
जल की अमृत धारा है।

कम हो तो चाह बने हो
अति हो तो आह बने हो,
अनावृष्टि सा हाल किए
जल की ही एक धारा है।
हिम से आकर नद में मिल
जल की अमृत धारा है।

कम में भी हैं तड़प रहे
अति में भी हैं बिलख रहे,
भूख प्यास से व्याकुल होकर
भय में जीवन धारा है।
हिम से आकर नद में मिल
जल की अमृत धारा है।

बिन जल के तपन बढ़ी है
अति हिम से गलन बढ़ी है,
हर जन की जलन देखकर
पुकार रहा एक तारा है।
हिम से आकर नद में मिल
जल की अमृत धारा है।

नदी घट कूप सब हुए विराम
तुझसे ही जीवन अभिराम
धन दौलत सब छोड़ छाड़ कर
प्यासे को तू प्यारा है।
हिम से आकर नद में मिल
जल की अमृत धारा है।

हे इंसा सुन ले पुकार
संतुलित हर काम करो,
पंचतत्व का कर ख्याल
बचा जल, जीवन प्यारा है।
हिम से आकर नद में मिल
जल की अमृत धारा है।।

जब जननी इनको माना है..

हर्षित पाठी
तृतीय वर्ष
शहीद भगत सिंह महाविद्यालय

हर युग में जिस से मानव ने
हर विकास कार्य पूर्ण किया
क्यों न करूँ संरक्षण उसका ?
जिसने हर पल सहयोग दिया।

कृषि से लेकर सभ्यता तक
हर व्यापार में भी है साथ दिया
हर पीढ़ी को कल-कल करता
अमृत सलिल भरपूर दिया ।

शिव की जटा से निकली गंगा ही
हरिधाम पहुंचाती है।
वहीं यमुना का पावन तट
मन कृष्णा का हर्षाती है।

पर अब भारत के इन आभूषणों पर
संकट ऐसा छाया है
हर तरंगिनि प्रदूषण से ग्रसित है
हमने वसुंधरा को रुलाया है
क्या खुद जीवित भी रह पाएगा?

बरसाते घन की आस में अंबर
देख देख मर जाएगा
फिर यूँ न कभी मुस्कुराएगी
जल की ही नहीं परन्तु इनके
दर्शन की भी तृष्णा तड़पाएगी।

मां गंगा, यमुना और हर तटिनी
सबके जीवन का आधार है
आओ मिलकर करें रक्षा इनकी
देश की यही पुकार है।

केवल जल धारा नहीं है नदियां
ये तो जीवन धारा है
करेंगे रक्षा नदियों की हम
उज्वल भविष्य इसको प्यारा है।
न होने देंगे इनको ओझल
हमने मिलकर ठाना है।
क्यों न करें संरक्षण इनका
जब इनको जननी माना है।

बढ़ते जल स्तर ..

संध्या देवी
तृतीय वर्ष
देशबंधु कॉलेज

आषाढ़ सावन
करते उत्तर में मनभावन है
किंतु दक्षिण तट में
वह तो जान खिलावन है ।
तटीय शहर भी कहराता दिखा
जब बढ़ते जल स्तर भी उसे निगल लिया ।

चक्रवात झंझावात,
उठी सुनामी की लहर
वर्षा की पावन छटा में,
बहती यहां तूफानी भी वो लहर ।

कुछ के बंधु ,कुछ के सखा,
कुछ के जीवनदाता थे
इस कहर में खो गए जो,
वो अपने भी तो भ्राता थे।

कहीं मयूर नृत्य कर रहे,
कहीं दादुर है बोल रहे
इस पावन घटा से परे,
सब रक्षा हे प्रभु बोल रहे ।

पानी का विशाल स्वरूप,
अब तो यह बना अविराम
शिशु से मां की ममता छीनी,
छीन लिया जीवन अभिराम ।

जन मन धन की हानि हुई है
पशु पंछी की क्या दशा हुई है
हम इंसान तो कह जाते हैं
बेजुबां की तो व्यथा मौन है ।

नदियाँ..

सोनिया
द्वितीय वर्ष
शहीद भगत सिंह महाविद्यालय

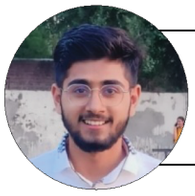
नदियाँ - जो कभी संकरी सी
तो कभी चौड़ी सी
जिनका पर्वत से होता उद्गम और
सागर में करती अपना विसर्जन ।

कभी कभी अपना विशाल उफनता रूप दिखाती
तो कभी इतनी शांत
मानो माँ की ममता का छाँव नज़र आती
जिसकी कोई दिशा नहीं,
बस मंज़िल हैं
और राह में होता उसका अनेको से मिलन हैं ।

गाँवों , शहरों के बीच से गुज़रती
कभी लहराती तो कभी बलखाती सी
बाढ़ में भयंकर रूप दिखाती
जान माल को उजाड़ती
तो कभी राहगीरो की अपनी शीतलता से प्यास बुझाती ।

पर आज तटीय शहर डूबती हुई प्रतीत होती
समुंदर की कोख में कचड़े की ढेर लगती दिखती।
मोती के बजाय
जलीय जीवों की मृत शरीर हाथ लगती ।
आओ हम इस रीत का बदलाव करें
कभी बहाव तो कभी ठहराव वाली
नदी की जिंदगी से एक जुडाव करे ।

मुझे कभी दूषित न करना..



सागर ठकराल
द्वितीय वर्ष
शहीद भगत सिंह महाविद्यालय

हजारों बादलों का दिल हुआ पानी बहुत मचला
हिमालय धूप के आहोश में आकर नहीं पिघला
घूला चंदा घुला सूरज घूली स्वरूप की किरणें
मगर इस झील के पानी ने अपना रंग नहीं बदला।

के वसुंधरा पर बहती है जब यह नदियां
कि धरती के एक कण-कण को पवित्र करती नदियां
नदियो के भरोसे चलता है हर मानव का जीवन
के इनकी वजह से आज महकती जीवन की बगियां।

पहनकर चांद की नथनी सितारों से भरा आंचल
नये जल कि नयी बूंदे नयी घूँघरू नयी पायल
नया झूमर नयी टिकुली नयी बिंदिया नया काजल
पहन आयी मै हर गहना के तेरे संग ही रहना

कि मैंने अपनी लहरों पर
प्राण कितनों के ढोहे है
कि आकर मेरे तट पर पाप
दुनिया ने अपने धोए हैं
के तट से मै टकराती हूँ
नावों से डरती रहती हूं
मेरी रक्षा तुम्हीं करना
तुम्हे हाथ जोड़ कर कहती हूं।

तुम्हारी मैं प्यास बुझती हूं
जल्द से सैकड़ों बीमारियों भगाती हूं
तुम्हारे शरीर में जाकर
शक्ति का अहसास कराती हूं।

कि मुझमें फैलाओ जहर न इतना
मुझे मीठी मीठी धार रखना
मुझे दूषित कभी न करना
चाहे मेरी पूजा मत करना।

तटीय कृषि

मुकेश
द्वितीय वर्ष
शहीद भगत सिंह महाविद्यालय

तटीय क्षेत्र, कृषि के लिए उत्कृष्ट मिट्टी और जलवायु परिस्थितिया प्रदान करते हैं! यह अक्सर उद्योग के लिए भोजन और कच्चे माल के साथ अर्थ व्यवस्था में महत्वपूर्ण भूमिका निभाता हैं! कृषि उत्पादों के पर्यटन और शिल्प में बाज़ार मिल सकते हैं, जबकि बंदरगाह सुविधाएं व्यापार की सुविधा प्रदान कर सकती हैं! हालाँकि, तटीय कृषि को अस्थाई महासागर गतिविधियों के कारण खारी हवा और पानी पैदा करने और तटीय भूमि के बाढ़ और कटाव के कारण कई चुनौतियों का सामना करना पड़ता हैं !

अपस्ट्रीम गतिविधियां पानी की गुणवत्ता और उपलब्धता को प्रभावित कर सकती हैं !

सकारात्मक और नकारात्मक क्रियाओं के कारण 'कृषि' सहयोगी क्षेत्रों से भी प्रभावित होती हैं!

नकारात्मक प्रभाव भूमि, जल, पूंजी, श्रम और तटीय और बाहरी क्षेत्रों में उत्पन्न होने वाले प्रदूषण और सिचाई प्रथाओ जैसे अपने स्वयं के नकारात्मक प्रथाओ के लिए प्रतिस्पर्धा हैं! प्रबल बंदरगाहों में एग्रोकेमिलक्स और सिल्टिंग से मतस्य पालन और समुद्री जैव विविधता के लिए प्रदूषण हो सकता हैं और अन्य क्षेत्रों पर भी नकारात्मक प्रभाव पड़ सकता हैं!

नकारात्मक प्रभाव से बचने के लिए पर्यावरण के अनुकूल संरक्षण कृषि की सुविधा प्रदान की जानी चाहिए! फसल पैटर्न और खेती के तरीको में बदलाव सहित सभी हितधारको को शामिल करते हुए एक सहभागी दृष्टिकोण की आवश्यकता हैं!

B.A (H) GEOGRAPHY BATCH (2022-23)

First Year

Second Year

Third Year

STUDENTS LAURELS (2022-2023)

Seema

- 2nd Prize, 1500m running race, Inter course tournament – SBSC
- 2nd Prize, 400m running race, Inter course tournament – SBSC

Abhishek Rajhans

- 2nd Prize, Parliamentary Debate, Shaheed Bhagat Singh Evening College
- Honorary Award, Advisory body, National Disaster Management Authority
- Central Students Council 1976-77 Scholarship

Adarsh Kumar Yadav

- 3rd Prize, Shotput, SBSC Sports Department

Harshit Pathi

- 1st Prize, Indian Instrumental Competition, Shivaji College
- 2nd Prize, Indian Classical Instrument Competition, Dr. Bhim Rao Ambedkar College
- 2nd Prize, Solo Instrumental Music Competition, Sri Aurobindo Competition
- 1st Consolation, Nadigaan Vachan Rashtriya Pratiyogita, Shaheed Bhagat Singh College
- 3rd Prize, Geographer's Got Talent, Kamla Nehru College

Rohit Modi

- 1st Prize, Quiz Competition, SUP Eco club
- 1st Prize , Podcast Competition, Satyawati College
- 1st Prize, Debate Competition, Jesus and Mary College
- 2nd Prize in Just a minute, Hindu College
- 2nd Prize, B plan Competition, Hult Prize,SBSC
- 2nd Prize, Debate Competition, Shyam Lal College
- 2nd Prize, Debate Competition, Aurobindo College
- 2nd Prize, Debate Competition, Institute of Home Economics
- 3rd Prize, Debate Competition, Shaheed Rajguru College of Applied Sciences for Women
- 3rd Prize, Extempore Competition, Delhi College of Arts and Commerce
- Special mention, Extempore Competition, Goonj

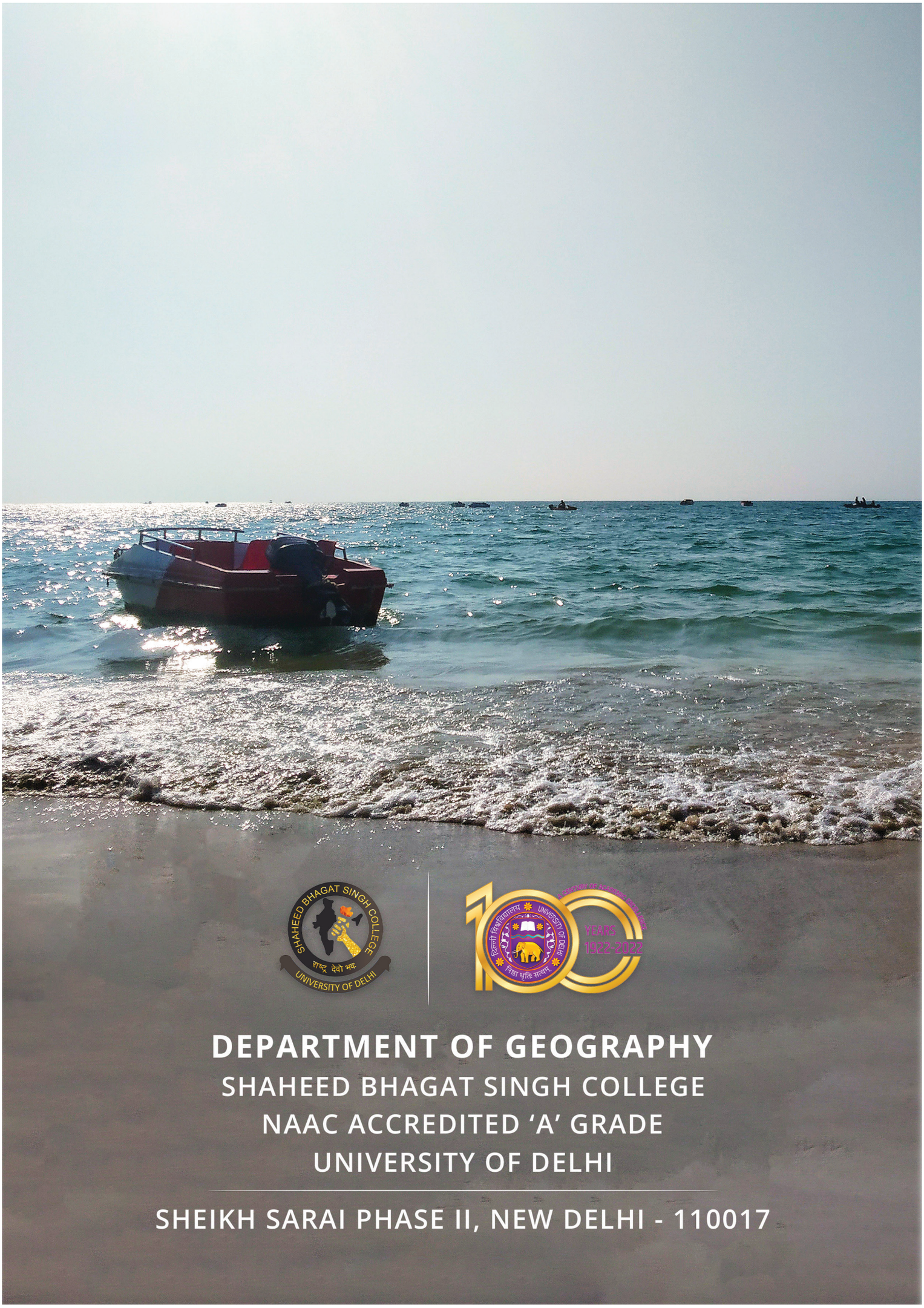
GUJARAT TRAVELOGUE

Gujarat, situated on the shoreline of the Arabian Ocean, is the sixth biggest state in India with regards to region and the ninth biggest concerning populace. The state is well-known for its vibrant festivals, mouthwatering food, diverse cultural heritage, and picturesque landscapes. Gujarat has a different economy with huge ventures in horticulture, materials, synthetic compounds, and petrochemicals. The Rann of Kutch, the Somnath temple, and the Gir Forest National Park are among the state's most popular tourist attractions.

Situated on the western coast it has had its fair share of natural disasters including cyclone tauktae, bhuj earthquake, etc. It becomes important that disaster management is taken up in Gujarat and it can withstand these natural calamities. Early warning systems, structure planning, education and awareness among communities can help in mitigating the adverse impact of these disasters. Despite the challenges posed by natural disasters, Gujarat remains a popular tourist destination with many attractions to explore. Visitors can enjoy a wide range of experiences, from exploring historic monuments to enjoying the natural beauty of the Rann of Kutch or relaxing on the beaches of Diu. The state's resilience and preparedness in the face of natural disasters only add to its charm and appeal as a tourist destination.

The semester VI students of batch 2022-23 undertook a field trip on March 16-21, 2023 to the disaster prone region of Gujarat in order to study the impacts of cyclone that has hit parts of the state in 2021, where they learned the concept and constructs of Disaster Management more efficiently. Regions like Somnath, Diu, Dwarka and the birthplace of Mahatma Gandhi, Porbandar were explored and for all of them, it was an enriching experience where they not only understood the practical and technical aspects of disaster management but also enhanced the interpersonal skills and learned to appreciate distinct cultures. The beautiful memories during the trip will remain forever etched into the minds of these learners.


GPS Map Camera
Dwarka,GJ,India
Okhamandal, Dwarka, 361335, GJ, India
Lat 22.240377, Long 68.959275
03/17/2023 02:59 PM GMT+05:30
Note : Captured by GPS Map Camera



DEPARTMENT OF GEOGRAPHY

SHAHEED BHAGAT SINGH COLLEGE

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UNIVERSITY OF DELHI

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