1. What are the most potent threats to India's marine biodiversity? Discuss. What measures have been taken to protect marine biodiversity? Examine.

Approach- Candidate can explain the threats to marine diversity of India and discuss the various international treaties signed for the same along with the domestic laws and rules.

Introduction

The marine ecosystem is home to the richest and most diverse faunal and floral communities. India has a coastline of 8,118 km, with an exclusive economic zone (EEZ) of 2.02 million sq km and a continental shelf area of 468,000 sq km, spread across 10 coastal States and seven Union Territories, including the islands of Andaman and Nicobar and Lakshadweep Indian coastal waters are extremely diverse attributing to the geomorphologic and climatic variations along the coast.

Body

Marine biodiversity of India

- The coastal and marine habitat includes near shore gulf waters creeks tidal flats mud flats coastal dunes mangroves marshes wetlands seaweed and seagrass beds deltaic plains estuaries, lagoons and coral reefs.
- There are four major coral reef areas n India-along the coasts of the Andaman and Nicobar group of islands the Lakshadweep group of islands the Gulf of Mannar and the Gulf of Kachchh The Andaman and Nicobar group is the richest in terms of diversity.
- Mangrove ecosystems are found along both the east and west coasts of India covering an estimated area of 4 120 sq km Important mangrove areas are in the Sundarbans, Bhitarkanika Krishna and Godavari delta of Andhra Pradesh, Andaman and Nicobar Islands, Gulf of Kachchh, and the Pichavaram-Vedaranyam area of Tamil Nadu coast.

What are threats to marine biodiversity?

- Sewage: Sewage or polluting substances flow through sewage, rivers, or drainages directly into the ocean.
- Toxic Chemicals From Industries: Industrial waste which is directly discharged into the oceans, results in ocean pollution. Also, they raise the temperature of the ocean and cause thermal pollution. Aquatic animals and plants have difficulty surviving at higher temperatures.
- Land Runoff: Land-based sources (such as agricultural run-off, discharge of nutrients and pesticides and untreated sewage including plastics) account for approximately 80% of marine pollution. The runoff picks up man-made, harmful contaminants that pollute the ocean, including fertilizers, petroleum, pesticides and other forms of soil contaminants.
- Large Scale Oil Spills: Pollution caused by ships, is a huge source of ocean pollution, the most devastating effect of which is oil spills.

- Ocean Mining: Ocean mining sites drilling for silver, gold, copper, cobalt, and zinc create sulfide deposits up to three and a half thousand meters down into the ocean.
- Plastic Pollution: In 2006, the United Nations Environment Programme estimated that every square mile of ocean contains 46,000 pieces of floating plastic.

What measures have been taken to protect biodiversity?

- The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention was adopted on 2 November 1973 at IMO. It came into force in 1983 after much deliberation.
- Prevention of Marine Pollution is also dealt with by Merchant Shipping Rules, 2009 framed under the Merchant Shipping Act, 1958.
- Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircarft (1972) The Oslo Convention Convention for the Prevention of Marine Pollution from Land-based Sources (1974)The Paris Convention.
- Global Programme of Action for the Protection of the Marine Environment from LandBased Activities is another initiative and the only global intergovernmental mechanism directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems.
- Also in 2015, India ratified the International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001 (Bunker Convention) which ensures adequate, prompt, and effective compensation for damage caused by oil spills.
- Wetland (Conservation and Management) Rules 2010 have been framed for the protection of wetlands, in the States. The Centrally Sponsored Scheme of National Plan for Conservation of Aquatic Eco-System also provides assistance to the States for the management of wetlands including Ramsar sites in the country.

Conclusion

India is gifted with huge marine biodiversity, global threats like climate change adversely affects the marine ecology along with that many types of pollutants present threat to resources. With international efforts, coordinated efforts within states and at national level has to be taken to protect the environment and the livelihood of millions dependent on it.

2. Examine the problem of pollution of water bodies in North India. What measures would you suggest to address this problem?

Approach

Since the question is asking you to examine, you have to probe deeper into the topic and understand the topic in detail. Here you are expected to investigate and establish the key facts and issues related to the question.

Introduction

Water pollution is a major environmental issue in India. The largest source of water pollution in India is untreated sewage. The other sources include agricultural runoff and unregulated small-scale industries. Most rivers, lakes and surface water sources in India are polluted but the problem of pollution of water bodies in North India is way more than that of south India.

Body

THE PROBLEM OF POLLUTION OF WATER BODIES IN NORTH INDIA

- There is a huge gap between the generation and treatment of domestic waste water in North India.
- The problem is not only that North India lacks sufficient water treatment capacity but also that the sewage treatment plants that exist are either not maintained properly or are not in operation.
- The majority of the government-owned sewage treatment plants remain closed most of the time due to improper design or poor maintenance or lack of reliable electricity supply to operate the plant, together with absentee employees and poor management.
- The waste water generated in these areas normally percolates into the soil and evaporates.
- The uncollected waste accumulates in urban areas causing unhygienic conditions and releasing pollutants that leach into surface and ground water basins.
- Rapid growth of population and urbanization in North India during the recent decades has given rise to a number of environmental problems such as water scarcity, wastewater generation and its collection, treatment and disposal.
- Many industries in North India are located on river banks and use the rivers as open sewers for their effluents. The rivers are greatly polluted by such industrial wastes or effluents. All these industrial wastes are toxic to life that consumes this water.

MEASURES TO ADDRESS THIS PROBLEM

India is taking several steps to rebalance the quality of its water source, from flocculation and reuse of industrial water to the contributions that local Indian start-ups are making. But there are lessons we need to learn and we have to take similar measures like other states have taken. Examples include:

- In Chennai, a city in Eastern India, industrial water reuse rose from 36000 to 80000 cubic meters in 3 years, from 2016 to 2019.
- VA Tech Wabag, a water company quartered in Chennai, also built numerous water reuse plants all across India.
- n Gujarat, a state of more than 70 million citizens, the government launched its Reuse of Treated Waste Water Policy, which aims to drastically decrease the use of Narmada river, It will install 161 sewage treatment plants all across Gujarat in order for industrial and construction sectors to use the treated water.
- Evaluations offer that in 2015, the Indian government installed almost 16000 reverse osmosis plants in Karnataka and 281 solar electrolytic defluorination plants in Madhya Pradesh.

Conclusion

Around 80% of India's water is severely polluted because people dump raw sewage, silt and garbage into the country's rivers and lakes. This has led to water being undrinkable and the population having to rely on illegal and expensive sources. Water pollution in India has taken away people's lives, especially the lives of children who are particularly vulnerable to waterborne infections. The accomplishments North India has made should not be a stop in its battle with the water crisis, but only the beginning because many still cannot access clean water.

3. Share your views on the suitability and sustainability of river interlinking project for addressing the issue of water scarcity and floods.

Approach:

The student is expected to write about the inter-linking river project of the country, give a brief account of it. Then the student should write about the need of it and the sustainability of the projects over the course of time.

Introduction:

Inter Linking of Rivers refers to inter-basin water transfers between 2 or more rivers through human interventions on natural systems.
India's National Water Development Agency (NWDA) has suggested the interlinking of rivers of the country. The interlinking of rivers has two components: the Himalayan and the Peninsular. All interlinking schemes are aimed at transferring of water from one river system to another or by lifting across natural basins. The project will build 30 links and close to 3000 storages to connect 37 Himalayan and Peninsular rivers to form a gigantic South Asian water grid.

Body:

Large variation in rainfall and subsequent availability of water resources in space and time. Because of this variability of available water, floods and drought coexist in our country in same time and space. (Kerala, T.N and South Karnataka is facing drought while Rajasthan, Gujarat, Assam reeling under floods)

- It will most likely lead to Improved and expanded irrigation i.e., the project claims to provide additional irrigation to 35 million hectares in the water-scarce western and peninsular regions.
- The river interlinking project claims to generate total power of 34,000 MW (34 GW). It will lead to Ground water Recharging.
- The inter-link would create a path for aquatic ecosystems to migrate from one river to another, which in turn may support the livelihoods of people who rely on fishery as their income. It will contribute to flood and drought hazard mitigation for India Any multipurpose storage reservoirs in upstream countries, such as Nepal and Bhutan, would facilitate energy generation and other benefits.
- It also appears to promote national integration and a fair sharing of the country's natural water wealth.
- It will unify the country by involving every Panchayat as a share holder and implementing agency.
- Provide for enhancing the security of the country by an additional waterline of defense.
- Provide employment avenues for more than 10 lakh people for the next decade. It will most likely eradicate the flooding problems which recur in the northeast and the north every year.
- Solve the water crisis situation by providing alternative, perennial water resources.

- The large canals linking the rivers are also expected to facilitate inland navigation too.
- It aims at increasing food production from about 200mn tones a year to 500mn tones.
- It will most likely boost the annual average income of farmers, from the present $40 per acre of land to over $500

River Linking Project involves multifaceted issues and challenges related to environmental, economic, ecological, legal, political and social costs. It has potential for disastrous and irreversible adverse after-effects which has been comprehensively discussed below:

- Ecological Costs: Water scientists and Environmentalists have remarked that the water flowing into the sea is not waste. It is a crucial link in the water cycle. With the link broken, the ecological balance of land and oceans, freshwater and sea water, also gets disrupted It is feared that diversion of water from the Brahmaputra and the Ganges, which provide 85% of the country's fresh water flow in the dry season, would result into an ecological disaster.
- Economic Costs: As this project is of massive estimated cost, a long term planning and a sound financial simulation are required to meet the standard for such proposals. The huge expenditure of the project and the maintenance costs associated with the dams, canals, tunnels, and captive electric power generation will involve huge financial burdens. This may generate fiscal problems that are difficult to handle. This certainly requires financial assistance from the private sector as well as global capital agencies. Mobilization of global capital may ultimately entail the risk of destroying social welfare measures.
- Environmental costs: It will result in massive diversion of forest areas and submergence of land leading to deforestation and soil- erosion. (For example The Ken-Betwa link project puts in danger over 4,100 hectares of forest land or 8% of the Panna National Park). There will be destruction of rivers, aquatic and terrestrial biodiversity, fisheries and groundwater recharge. Possible downstream impacts, salinity ingress, pollution concentration, and increased methane emission from reservoirs are other adverse repercussions. Scientists are also of the view that river diversion may bring significant changes in the physical and chemical compositions of the sediment load, river morphology and the shape of the delta formed at the river basin. It could most likely create trigger points of natural disasters like landslides, earthquakes etc. as seen in case of Koyna dam and Tehri dam.
- Legal costs: Domestic and regional geo-politics play a pivotal role on the discussions on ILR. As of now, there is no mechanism as of now to deal with matters concerning inter-basin transfers. There are also important institutional and legal issues to be sorted out. Each of the 30 schemes of the ILR is supposed to get through several statutory, legal and procedural steps.
- Social Costs: Reconstruction and rehabilitation due to displacement is not an easy task as seen before. The construction of reservoirs and river linking canals in the peninsular component alone expect to displace more than 5, 83,000 people and submerge large areas of forest, agriculture and non-agriculture land. It is likely to

create social unrest/psychological damage and cultural alienation due to forced resettlement of local indigenous tribal community.

- Political Implications: Water being a state subject, the ILR plan further complicates existing water sharing and management problems between the riparian states. Some of the ILR schemes have international implications, which may create strained relationship with neighbouring countries like Bhutan, Nepal and Bangladesh.

Conclusion:

NRLP has its fair share of positives and negatives. Though there are enough apprehensions over the project but they are not backed by any comprehensive scientific evidence to it. Inter basin water transfer is not a new concept.

Large direct benefits of irrigation, water supply and hydropower and indirect benefits navigation, tourism, employment generation etc can be accrued in ILR program.

Formation of River Basin Authority for coordinated action and subsequent building up of consensus among concerned States is prima facie needed. Legal provisions for implementation of ILR related to rehabilitation and appropriate afforestation through CAMPA is to be concurrently addressed.

It is essential that needed environmental safeguards such as comprehensive EIA and SIA are properly implemented in a coordinated manner by various agencies. Therefore, strengthening and expansion of cooperative efforts among the co-basin states and countries will foster co-riparian relationships.

India's river linking project shows and promises a great concern for water conservation and optimum use of available water resources. Undoubtedly, it is the need of the hour to have a water mission like as IRL, which will enable availability of water to the fields, villages, towns and industries throughout the year post a comprehensive scientific assessment.

4. How do vaccines create immunity against viral infections? Explain with the help of suitable examples.

Approach

A simple and straightforward question where in the candidate needs to explain how vaccines create immunity against viral infections with the help of suitable examples.

Introduction

Many viruses infect humans and most are controlled satisfactorily by the immune system with limited damage to host tissues. Some viruses, however, do cause overt damage to the host, either in isolated cases or as a reaction that commonly occurs after infection. Vaccines help in combating such viral infections.

Body

- The immune system is a network of cells, tissues and organs that work together to help fight off infection from harmful viruses. When a disease-causing agent, such as virus, invades body, immune system recognises it as harmful and will trigger a response to destroy it.
- One of the ways immune system fights off infection is by creating large proteins known as antibodies. These antibodies act as scouts, hunting down the infectious agent, and marking it for destruction by the immune system.
- Each antibody is specific to the virus that it has detected and will trigger a specific immune response. These specific antibodies will remain in the immune system after the infection has gone. This means that if the same disease is encountered again, immune system has a 'memory' of the disease and is ready to quickly destroy it before a person gets sick.
- Sometimes, however, the immune system doesn't always win this initial battle against the harmful bacteria or virus and people can become very ill or – in extreme cases – die.
- Vaccination is the safest and most common way to gain immunity against a virus that one's body has yet to encounter. Vaccines contain a harmless form of the virus that causes the disease one is being immunised against.
- Vaccines help develop immunity by imitating an infection. This type of infection, however, almost never causes illness, but it does cause the immune system to produce T-lymphocytes and antibodies.
- Sometimes, after getting a vaccine, the imitation infection can cause minor symptoms, such as fever. Such minor symptoms are normal and should be expected as the body builds immunity.
- Once the imitation infection goes away, the body is left with a supply of "memory" T-lymphocytes, as well as B-lymphocytes that will remember how to fight that disease in the future. However, it typically takes a few weeks for the body to produce T-lymphocytes and B-lymphocytes after vaccination.

- Therefore, it is possible that a person infected with a disease just before or just after vaccination could develop symptoms and get a disease, because the vaccine has not had enough time to provide protection.
- Scientists take many approaches to developing vaccines. These approaches are based on information about the infections (caused by viruses) the vaccine will prevent, such as how germs infect cells and how the immune system responds to it.

Four types of vaccines are currently available –

- **Live virus vaccines** use the weakened (attenuated) form of the virus. The measles, mumps, and rubella (MMR) vaccine and the varicella (chickenpox) vaccine are examples.
- **Killed (inactivated) vaccines** are made from a protein or other small pieces taken from a virus or bacteria.
- **Toxoid vaccines** contain a toxin or chemical made by the bacteria or virus. They make you immune to the harmful effects of the infection, instead of to the infection itself.
- **Biosynthetic vaccines** contain manmade substances that are very similar to pieces of the virus or bacteria. The Hepatitis B vaccine is an example.

Conclusion

Viral diseases have a major impact on the health of all Indians. With the burgeoning population, zoonotic niche that were previously undisturbed are increasingly being encroached by humans. As a consequence, many viral diseases that were previously unheard-of are emerging, while those that were quiescent for decades are re-emerging. Vaccines help in conferring protection against many of these emerging viral diseases.

5. What are the regions in India that suffer from the challenge of desertification. Explain the causative factors that lead to desertification.

Approach:

Candidates are expected to write about desertification and also highlight the regions that suffers the challenge of desertification in India. Also explain the causative factors that lead to the desertification.

Introduction

As per UNCCD Desertification is not the natural expansion of existing deserts but the degradation of land in arid, semi-arid, and dry sub-humid areas. It is a gradual process of soil productivity loss and the thinning out of the vegetative cover because of human activities and climatic variations such as prolonged droughts and floods.

Body

Regions suffering from desertification in India:

- According to Desertification and Land Degradation of Selected Districts of India, an atlas published by the ISRO SAC, some 96.40 million ha, or about 30 per cent of the country's total area, is undergoing degradation.
- In terms of India's total geographical area, the states of Rajasthan, Gujarat, Maharashtra, Jammu and Kashmir, and Karnataka have the highest area of lands undergoing degradation/desertification, amounting to 18.4% (out of India's total 29.3%) while all the other states each had less than 2% of degraded lands.
- But when considering the area within the states, Jharkhand followed by Rajasthan, Delhi, Gujarat, and Goa, had the highest area of degraded lands, representing more than 50% of their area. In comparison, the land area undergoing degradation/desertification in Kerala, Assam, Mizoram, Haryana, Bihar, Uttar Pradesh, Punjab, and Arunachal Pradesh was less than 10%.

Causative factors for desertification:

- Soil Erosion: It is responsible for 10.98 percentage of desertification. Soil Erosion is the loss of soil cover mainly due to rainfall and surface runoff water. Water erosion is observed in both hot and cold desert areas, across various land covers and with varying severity levels.
- Vegetation Degradation: It is responsible for 8.91 percentage. Vegetation degradation is observed mainly as deforestation / forest-blanks / shifting cultivation and degradation in grazing/grassland as well as in scrubland. Destruction of vegetation, most often by humans, accelerates desertification.
- Salinity: It occurs mostly in cultivated lands, especially in the irrigated areas. Soil salinity refers to the water dissolvable salt present in the soil. Salinity can develop naturally, or human-induced.

- Cultivation of sugarcane: Sugarcane, which is only grown in 4% of the total cultivable land, guzzles 80% of the water resources. As a result, a slight change in the meteorological cycle is enough to cause a full-blown water crisis.
- Government neglect: For example Under Maharashtra Irrigation Act of 1976, the government can notify people in the command area not to go in for water-intensive crops like sugarcane in the case of acute water scarcity. But there have been no efforts from the government side especially in Marathwada region.
- Unplanned urbanisation: Economic development has led to expansion of urban and industrial land. Much of the present urban and industrial development has taken place on agricultural land. The expansion of cities has resulted in the encroachment of forest areas and wetlands. For example, rapid urbanisation triggered by a population increase in coastal areas has caused coastal land degradation.
- Climate Change: Climate change plays a huge role in desertification. As the days get warmer and periods of drought become more frequent, desertification becomes more and more eminent. Further rise in incidents like forest fires are destroying forests and leading to rise in desertification.

Way forward:

- Afforestation: Forest degradation accounts for the major share of land degradation costs of India highlighting the need to prevent forest degradation. Further, strategy to reduce forest dependence for fuelwood, fodder and non-timber forest products should be made. Efforts must be made for afforestation.
- Preventing overgrazing: Farmers should be discouraged from overgrazing activities. They must be made aware of the harm of overgrazing to land productivity.
- Sustainable agriculture: Climate resistant crops need to be developed and used. Efforts must be made to make farmers aware of overuse of chemical fertilisers. Subsidy may be removed for the same and replaced by Cash transfer.

Conclusion

Ending desertification is the best chance the world has to stabilize the effects of climate change, save wildlife species and protect our well-being. Protecting the forest is our mutual responsibility, which should be carried out by people and governments worldwide.