



# TARGET PRELIMS 2024

## BOOKLET-13; EB&CC-3

### WATER – RIVER, GROUND WATER AND OCEANS

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## 2. INTERNATIONAL EFFORTS – CONVENTIONS, REPORTS, MEETS ETC.

### 1) WATER CONVENTION

- Negotiated under: United Nation Economic Commission for Europe.
- Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) was adopted in Helsinki in 1992 and entered into force in 1996.
  - » It is a legally binding instrument and aims to protect and ensure the quantity, quality and sustainable use of transboundary water resources by facilitating cooperation.
  - » It provides inter-governmental platform for day-to-day development and advancement of transboundary cooperation.
  - » It was initially negotiated as a regional (Pan-European) instrument. Later, it turned into a universally available legal framework for transboundary water cooperation, following the entry into force of amendments in Feb 2013, opening it to all UN Member States.
- It has emerged as a powerful tool to achieve the objective of SDG 6 (clean water and sanitation)
- **Is India a member?**
  - » No
- **Report:** "The Water Convention: 30 Years of Impact and Achievements on the Ground"

### 2) WORLD WATER DAY: 22<sup>ND</sup> MARCH

- **About World Water Day**
  - » WWD is an annual UN Observance Day which highlights the importance of fresh water. The day is used to promote awareness related to water conservation and advocate sustainable management of the freshwater resources.
  - » **UN-Water** is the convener for World Water Day and selects the theme for each year in consultation with UN organizations that share an interest in that year's focus.
  - » The day was first formally proposed in the 1992 UN Conference on Environment and Development in Rio de Janeiro. UNGA adopted the resolution regarding this in Dec 1992.
  - » The **first WWD** was observed on 22nd March 1993.
- **World Water Day, 2023**
  - » The theme for the year 2023 is "Accelerating Change."
    - It focuses on accelerating change to solve water and sanitation issues.

### 3) THE UN WORLD WATER DEVELOPMENT REPORT, 2023

- **Who Publishes the report.**
  - The UN World Water Development Report (WWDR) is an **UN-Water's flagship report** on water and sanitation issues, focusing on a different theme each year.
  - The report is published by UNESCO, on behalf of UN-Water and its production is coordinated by the UNESCO World Water Assessment Program.

- **Key Highlights of the 2023 Report:**
  - It assesses the role of partnerships and cooperation among the stakeholders in water resources management and development and their role in accelerating progress towards water goals and targets.

### 3. INITIATIVES IN INDIA

#### 1) REPORT: COMPOSITE WATER MANAGEMENT INDEX (CWMI)

- **Introduction**
  - The CWMI is a first of its kind, comprehensive scorecard for identifying, targeting and solving problems in water sector across the country. It was first published in 2018.
  - **It is expected to:**
    - » Promote data-based decision making and thus scientific management of water.
    - » Encourage competitive and cooperative federalism.
    - » Establish a clear baseline and benchmark for state-level performance on key water indicators.
    - » Uncover and explain how states have progressed on water issues over time, including identifying high-performers and under-performers, thereby inculcating a culture of constructive competition among states.
    - » Identify areas of deeper engagement and investment on the part of the states.
    - » Eventually, the NITI Aayog plans to develop the index into a composite national-level data management platform for all water resources in India.
- **The indicators in the Water Index have been grouped into nine major broad themes.**
  - i. Source Augmentation and Restoration of water bodies
  - ii. Source Augmentation (ground water)
  - iii. Major and medium irrigation (supply side management)
  - iv. Watershed development - supply side management
  - v. Participatory Irrigation Practices - Demand side management
  - vi. Sustainable on-farm water use practices - Demand side management
  - vii. Rural Drinking water
  - viii. Urban water supply and sanitation
  - ix. Policy and Governance
- **Note:** CWMI 3.0 is worked in progress; CWMI 2.0 was published in Aug 2019
- **Note:** NITI Aayog now plans to combine CWMI 3.0, 4.0, 5.0 and 6.0 to cover the years 2021-22, and 2022-23. It is also contemplating data coverage to district level.

#### 2) GOVERNMENT INITIATIVES

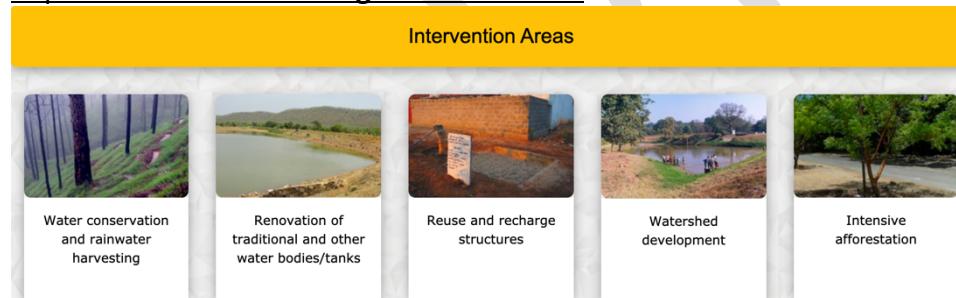
##### A) MINISTRY OF JAL SHAKTI

- A Unified Ministry of Jal Shakti was launched in May 2019 as an immediate response to the escalating water crisis in the country.

- The ministry was formed by **merging of two ministries**: Ministry of Water Resources, River Development & Ganga Rejuvenation and Ministry of Drinking Water and Sanitation.
- **Functions** of the new ministry ranges from providing clean drinking water, international and inter-state water disputes, cleaning Ganga river, its tributaries and sub tributaries.
- **Why?**
  - All water related initiatives are complementary to each other and therefore it's better to have one ministry for better coordination and integrated data management system.

## B) JAL SHAKTI ABHIYAN

- **What is Jal Shakti Abhiyan?**
  - » It is Jal Shakti Ministry's flagship **water-conservation campaign**.
- **Need of the program:**
  - » In 1951, per-capita water availability in India: 5,000 cu m per year
  - » In 2011 -> 1,545 cu m per year
- **Jal Shakti Abhiyan-1**
  - » **Campaign was first launched in 2019** which was focused on water-stressed districts and blocks (256 districts and 1592 blocks). It was run through citizen participation during Monsoon season. (July - Sep and Oct - Nov (for states receiving north-east retreating Monsoon))
  - Under this, Gol worked with state and district officials in this water stressed districts to promote water conservation and water resource management by focusing on accelerated implementation of five target interventions:



- **Special Intervention Areas**

Special Intervention Areas				
<b>Block and District Water Conservation Plan</b> Development of Block and District Water Conservation Plans (To be integrated with the District Irrigation Plans)	<b>Krishi Vigyan Kendra Mela</b> Krishi Vigyan Kendra Melas to promote efficient water use for irrigation (Per Drop More Crop), and better choice of crops for water conservation	<b>Urban Waste Water Reuse</b> In urban areas, plans/approvals with timebound targets to be developed for waste water reuse for industrial and agriculture purposes. Municipalities to pass by-laws for the separation of grey water and blackwater	<b>Scientists and IITs</b> Scientists and IITs to be mobilised at the national level to support the teams	<b>3D Village Contour Mapping</b> 3D Village Contour Maps may be created and made accessible for efficient planning of interventions

- It was aimed at **making water conservation a Jan Andolan** through asset creation and extensive communication.
- **No separate funds** were allocated for JSA-1 and funds from convergence of different central and state government schemes were utilized.
- **Jal Shakti Abhiyan 2.0** couldn't be undertaken due to **COVID-19 restrictions**.
- However, Ministry of Jal Shakti has taken up the "***Jal Shakti Abhiyan: Catch the Rain***" (**JSA: CTR**) with the theme "Catch the rain, where it falls when it falls" covering both rural as well as urban areas of **all districts in the country**, during the pre-monsoon and monsoon period - i.e., upto 30th Nov 2021.
- "Jal Shakti Abhiyan: Catch the Rain" (JSA: CTR) -2022, **the third in the series of JSAs**, has been launched on 29.3.2022.
  - » It covers all blocks of all districts (rural as well as urban areas) across the country during 29th March 2022 to 30th Nov 2022 - the pre-monsoon period.
  - » The targeted interventions of the campaign in the current year are (1) water conservation and rainwater harvesting (2) enumerating, geo-tagging & making inventory of all water bodies; preparation of scientific plans for water conservation based on it (3) Setting up of Jal Shakti Kendras in all districts (4) intensive afforestation and (5) awareness generation.
  - » In this campaign, additional activities/ sub-interventions have been incorporated under the intervention 'water conservation & rainwater harvesting' which include spring shed management, protection of water catchment areas and creation/ renovation of 'amrit sarovars'

#### C) JAL JEEVAN MISSION (JJM) (WATER FOR LIFE) (HAR GHAR NAL SE JAL)

- JJM was launched in 2019 to provide **functional household tap connection (FHTC)** to every household by the end of 2024
- **Need:**
  - » Water inequality is a major concern in India. 81% of households in India were without tap connection (14.6 cr /17.87 cr)
  - » Safe drinking water together with a comprehensive sanitation program is important for reducing the disease burden of the poor.
- **Details**
  - » JJM restructures and subsumes the National Rural Drinking Water Program (running since 2009). The scheme is also known as **Har Ghar Nal Se Jal (HGNSJ)**.
- **The Broader Objectives of JJM are:**
  - » To provide Functional Household Tap Connections (FHTC) to every rural household by 2024 with a service level of 55 litres per capita per day (lpcd).
  - » To prioritize provision of FHTCs in quality affected areas, desert areas, drought prone areas and Sansad Adarsh Gram Yojna villages.
  - » To provide functional tap connection to Schools, Anganwadi centres, GP buildings, Health centres, wellness centres and community buildings



- » To monitor functionality of tap connections.
  - » To promote and ensure voluntary ownership among local community by way of contribution in cash, kind and/ or labour and voluntary labour (shramdaan)
  - » To assist in ensuring sustainability of water supply system, i.e. water source, water supply infrastructure, and funds for regular O&M
  - » To empower and develop human resource in the sector such that the demands of construction, plumbing, electrical, water quality management, water treatment, catchment protection, O&M, etc. are taken care of in short and long term.
  - » To bring awareness on various aspects and significance of safe drinking water and involvement of stakeholders in manner that make water everyone's business.
  - » A dedicated fund called '*Rashtriya Jal Jeevan Kosh*' has been set up by Ministry of Jal Shakti to mobilise and accept contributions received from other sources such as Corporate Social Responsibility to fund JJM.
- **Cost:** The total project is estimated to cost Rs 3.60 lakh crore.
- » **Center: State:** 50: 50 (90:10 for NE and Himalayan States and 100% for UTs)
- **Implementations**
- » JJM is implemented by the Department of Drinking Water and Sanitation (DDWS) under the recently formed MJS.
- **Steps which are planned:**
- » augment local water sources.
  - » recharge existing sources and.
  - » promote water harvesting and de-salination wherever required.
  - » Reuse grey water or discharged water.

#### D) MISSION AMRIT SAROVAR

- **Ministry:** Ministry of Rural Development (MoRD)
  - Mission Amrit Sarovar was launched on National Panchayati Raj Day on 24 April 2022 with the objective to conserve water for the future.
  - The Mission is aimed at developing and rejuvenating 75 water bodies in each district of the country during this Amrit Varsh, 75th Years of Independence.
- **The impact of this initiative has been.**
- » About 32 crore cubic meters of water holding capacity has been enhanced.
  - » Water Users' groups have been associated with each Amrit Sarovar inter-alia improving the livelihoods base of the local community.
  - » Participation of freedom fighters, Martyr's families, Padma Awardees, and other eldest citizens of the local areas helped in community participation at a large scale, promoting social harmony and patriotism, and making this mission a mass movement.
  - » People's participation has been seen in this mission in a form of "Shram -Daan".
  - » This will result in the creation of a total carbon sequestration potential of 1,04,818 tonnes of carbon per year.

### 3) JALDOOT APP

- **Ministry: MoRD**
- MoRD has developed 'JALDOOT App' which will be used across the country to capture water levels of selected wells.
  - » It will enable Gram Rojgar Sahayak (GRS) to measure the water level of selected wells twice a year (pre-Monsoon post-Monsoon).
  - » In every village adequate number of measurement locations (2-3) have to be taken

#### A) NATIONAL WATER AWARDS

- **Why in news?**
  - 5th National Water Awards Launched on Rashtriya Puraskar Portal ([www.awards.gov.in](http://www.awards.gov.in)) (Oct 2023)
    - Application for awards could be filed here. Last date for submitting applications is 15th Dec 2023.
- **Department and Ministry:** The Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD, & GR), Ministry of Jal Shakti .
- **Details**
  - NWA were instituted to recognize and encourage exemplary work and efforts made by states, districts, individuals, organizations, Panchayats, ULB, School, Industry, Society, Water User Association, Individual etc. across the country in attaining the government's vision of a 'Jal Samridh Bharat'.
  - It also strives to create awareness among the people about the importance of water and motivate them to adopt the best water usage practices.
  - SO far, it has provided a good opportunity to start-ups as well as leading organizations to engage and deliberate with senior policymakers on how to adopt the best water resources management practices in India.
  - The first National Water Award was launched by the Jal Shakti Ministry in 2018.

## 4. WATER POLLUTION RELATED ISSUES

### 1) RIVER POLLUTION

- **Why in news?**
  - » The number of polluted stretches in India's rivers has fallen from 351 in 2018 to 311 in 2022, though the number of most polluted stretches is practically unchanged: Report by CPCB (made public in Dec 2022)
- **Current River Pollution Situation in India (Dec 2022)**
  - » CPCB in association with pollution control boards/committees in different states/Uts monitors water quality of rivers and water bodies across the country through a network of monitoring

stations under the **National Water Quality Monitoring Program**. Total 4,484 locations in 28 states and 7 UTs including rivers, lakes, creeks, drains and canals are observed.

» **Standards of measurement by CPCB:**

- CPCB measures pollution level on the basis of **Biological Oxygen Demand**. If BOD is less than 3mg/L, it means the river stretch is fit for 'outdoor bathing'. If BOD of a point is > **3.0 mg/L**, it is identified as polluted locations.
  - Two or more polluted locations on a river in a continuous stretch are considered as a "polluted river stretch".
- **Polluted stretches** are classified between **Priority1** (BOD of 20-30 mg/L) to **Priority-5** (BOD of 3-6 mg/L).
- The success of river cleaning program is measured on the basis of how the river stretches are moving from Priority-1 to Priority 5 and if the priority-5 stretches are getting reduced.

» **Situation in 2018 report:** Number of stretches under various priorities:

- P1 (45); P2 (16); P3 (43); P4 (72); P5 (175);

» **Situation in 2022 report**

- P1 (46); P2(16); P3 (39); P4 (65); P5 (145);

» **Thus, there are no changes or slight changes in Priority 1 and 2.** This indicates that number of worst polluted regions remain the same.

- **Gujarat and Uttar Pradesh** have the maximum number (6) of Priority 1 river stretches.
- **Maharashtra** has the maximum number of polluted river stretches.

- **Factors:**

- **Discharge of untreated or partially treated sewage and Industrial effluents** from cities/towns in their respective catchments is the main cause of river pollution in states.
- **Illegal dumping of solid waste** on the banks of the rivers
- **Shortage of STP/ETP Capacity**
  - As per CPCB report (March 2021), the sewage generation in urban areas is at **72,368 million liters**/ day whereas total operational treatment capacity was only 26,869 MLD.
- **Poor operations and maintenance of Sewage and Effluent Treatment plants**
- **Non-points sources of pollution**
- **Rapid Industrialization and Urbanization** is further compounding the issue.
- **Min-Ecological flow** is not being ensured in many rivers.

- **Key steps being taken.**

- » It is the responsibility of states/UTs/local bodies to ensure treatment of sewage and industrial effluents before it being discharged into water bodies.
- » **MoEF&CC** is contributing in conservation of rivers by **providing financial and technical assistance** for abatement of pollution in identified stretches of rivers in the country through the Central Sector Scheme of Namami Gange for rivers in Ganga Basin and the Centrally Sponsored Scheme of National River Conservation Plan (NRCP) for other rivers.
- » Further, under MGNREGA, rejuvenation of small rivers is being prioritized.

- » In Addition, sewerage infrastructure is created under the AMRUT and Smart Cities Mission of MoHUA.
- » **Law and Regulations:**
  - As per the Environmental (Protection) Act, 1986 and the Water (Prevention and Control of Pollution), Act 1974, the industrial units are required to install effluent treatment plants (ETPs) and treat their effluents to comply with stipulated environmental standards before discharging into river and water bodies.
  - CPCBs, SPCBs and Pollution Control Committees (PCCs) monitor the industries with respect to treatment of effluent discharge standards and act for non-compliance under the provision of various acts.

## 2) NAMAMI GANGE

- **Introduction**
  - There have been several initiatives to clean Ganga so far. **National Ganga Action Plan 1** was started in 1986, **NGA-2** in 1993 and later extended to other states. Till 2014, more than 4,000 crores had been spent. But the river had remained dirty.
  - So, when government launched the Namami Gange in mid-May 2015, there was a new hope.
- **Namami Gange Program** was launched from June 2014 to 31<sup>st</sup> March 2021 to rejuvenate River Ganga and its tributaries with a budget of Rs 20,000 crores.
  - A total of Rs 14,084 crores has been released by GoI to NMCG, from FY15 to 31<sup>st</sup> Jan 2023, out of which Rs, 13,607 crores have been released by NMCG to state governments, state mission for clean ganga, and other agencies for the implementation of projects related to Ganga Rejuvenation.
  - In 2023, Government approved **Namami Gange Mission-II** with a budgetary outlay of Rs 22,500 crores till 2026. It includes projects of existing liabilities (Rs 11,225 crores) and new projects/interventions (Rs 11,275 crores)
  - **Eight Mains Pillars of Namami Gange Scheme**
    - Sewage Treatment Infrastructure
    - River Surface Cleaning
    - Industrial Effluent Monitoring
    - Ganga Gram
    - Afforestation
    - River Front Development
    - Biodiversity Protection
    - Public Awareness
- **Improved Governance Structure under Namami Gange:**
  - **Implementation** by NMCG and its state counterparts - State Program Management Groups (SPMGs).
  - **National Ganga Council** (replaced NGRBA) which is headed by PM and has chief ministers of five ganga basin states - UK, UP, Bihar, Jharkhand and West Bengal.

- It has the overall responsibility for the superintendence of pollution prevention and rejuvenation of River Ganga Basin, including Ganga and its tributaries.
  - **For Monitoring**
    - High level task force chaired by Cabinet secretary and assisted by NMCG.
    - State level committee chaired by Chief Secretary and assisted by SPMG.
    - District level committee chaired by the District Magistrate.
  - An **empowered task force**, headed by Union Water Resource Minister, was created and it has on board the chief secretaries of the five Ganga basin states. It is supposed to meet every three months.
  - **State Ganga Committee** have been formed. These committees would be the **nodal agency to implement the Program in states**. Further, they would also conduct safety audits of the river and river remedial measures.
  - **Synergy between different ministries** - Ministry of Jal Shakti have signed MoUs with 10 other ministries to synergize the activities under Namami Ganga.
  - **Focus on involvement of more stakeholders** including states, ULBs and PRIs, People and private sector (through PPP projects)
  - **4 Battalion of Ganga Eco-Task force** has also been envisaged to spread awareness and for protecting the river.
- **Mains Focus** on Namami Gange is on **pollution abatement interventions** which include
- Interception, diversion and treatment of waste water through bio-remediation, in-situ treatment, innovation technologies, STPs, Effluent Treatment Plants etc.
  - **Rehabilitation** of existing STPs
  - Immediate short-term measures for arresting pollution at exit points on river front to prevent inflow of sewage etc.
- **Other Steps under the Namami Gange Program**
- i. Hariyali is a plantation project along the stretch of Ganga in all five states through which it flows.
  - ii. **Ganga Gram Yojana**
    - To develop STP, toilets etc. in all villages along the river ganga. Based on Sichewal model (a Punjab village) which is based on cooperation of villagers for water management and waste disposal.
    - Government will spend Rs 1 crore per village in this plan.
  - iii. **Smart Ganga Cities**
    - Program for infra development along cities on Ganga river.
  - iv. **Promotion of organic farming** in villages along the Ganga.

## A) NATIONAL GANGA COUNCIL (NGC)

### - About National Ganga Council

- » National Ganga Council (NGC) chaired by the Prime Minister is an authority created in Oct 2016 under the River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016, dissolving the National Ganga River Basin Authority.
- » It has been given the overall responsibility for the superintendence of pollution prevention and rejuvenation of River Ganga Basin, including Ganga and its tributaries.

### - Composition

- » PM is the ex-officio chairperson.
- » Union Minister of Jal Shakti is the ex-officio Vice Chairperson.
- » The other ex-officio members of the council are from various ministries and CMs of the corresponding states among other stakeholders.

### - Jurisdiction

- » The Jurisdiction of NCG extends to states through which Ganga, its tributaries and sub-tributaries flow - Himachal, Uttarakhand, Uttar Pradesh, Haryana, NCR of Delhi, Rajasthan, Madhya Pradesh, Bihar, Chhattisgarh, Jharkhand, West Bengal etc.

## 3) ECOLOGICAL FLOW OF RIVERS

### - What is ecological flow (e-flow) of a river?

- Ecological flow (or environmental flow) is the acceptable flow regimes that are required to maintain a river in the desired state. It is the quantity and timing of water essential for the river to fulfil its ecological, social and economic functions.

### - In Oct 2018, the central government **notified the minimum e-flow for River Ganga** with an aim to maintain the natural pattern of the river flow (*Aviral Dhara*)

- NMCG has laid down these norms. It's applicable to the upper Ganga River Basin - starting from the Originating Glacier to **Haridwar** - and the main stem of Ganga upto Unnao district in Uttar Pradesh.
  - The e-flow notification specifies that the upper stretches of the Ganga — from its **origins in the glaciers and until Haridwar** — would have to maintain:
    - **20% of the monthly average flow of the preceding 10-days between November and March**, which is the dry season.
    - **25% of the average during the 'lean season' of October, April and May; and**
    - **30% of monthly average** during the monsoon months of June-September.

## 4) GROUND WATER ISSUES

### Introduction: Global Situation

- As per World Water Development Report, 2022, Ground water accounts for 99% of the liquid freshwater on earth. It has continued to serve humankind for many millennia and currently around 50% of water used in domestic purpose and 25% of water used for irrigation globally comes from groundwater.

### India's Situation:

**Annual extractable** groundwater availability in India (2017) is **393 BCM**.

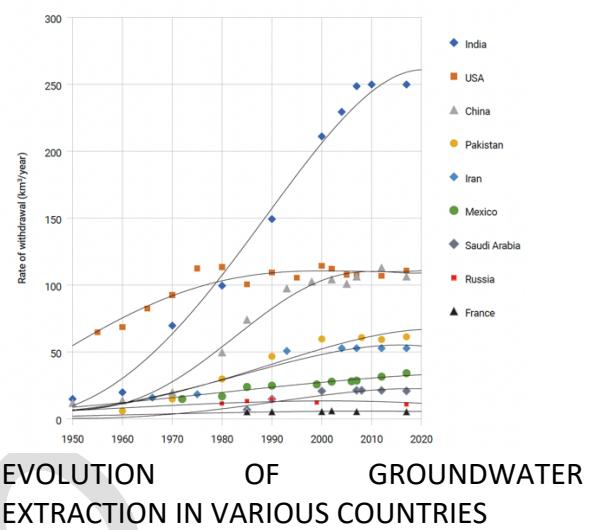
- India is the largest user of ground water in the world, extracting **253 BCM** per year, which is 25% of the global ground water extraction. It extracts more groundwater than USA and China combined together.

Most of the ground water extracted in India is for **Irrigation** (228 billion Cubic Meter (BCM)) which accounts for 90% of the total extraction.

- In India, 60% of irrigation requirement is fulfilled by groundwater.

The remaining **10%** (225 BCM) is for drinking, domestic as well as industrial uses.

- **Industrial use** accounts for only 5% of the total extraction



EVOLUTION OF GROUNDWATER EXTRACTION IN VARIOUS COUNTRIES

- **Satellite Gravimetry** has provided convincing evidence in support of the alarming rates of groundwater depletion.
- The data is supported by local level water table measurements in wells, where in 61% decline has been seen by CGWB.
- As per the 2022 assessment by the CGWB, 14% of assessments units in the country (1006/7089) have been categorized as 'Over-exploited' where the annual groundwater extraction is more than annual available Ground Water Resource. 4 States/Uts viz. Haryana, Punjab, Rajasthan, Dadra & Nagar Haveli and Daman & Diu have stage of Ground Water Extraction greater than 100%.
- **Key Challenges:**
  - **Depletion due to Over-extraction:**
    - » Over the years, groundwater has become the dominant source of irrigation as well as for domestic purpose. This is primarily due to unavailability of surface irrigation in regions such as Rajasthan.
    - » Installation of tube-wells have increased in north-western plains. Since the 1980s, 77% of the total addition to irrigation has come from tubewells. This has allowed farmers in the region to grow water intensive crops like Wheat and Rice. It has also allowed increase in cropping intensity by allowing for sowing of crops during dry winters.
    - » **Electricity Subsidy for agriculture and increased rural electrification** has also been a factor behind over-exploitation of ground water.

- » Expansion of solar powered irrigation systems which have led to very affordable cost of ground water extraction.
- » Weak law and regulations to prevent or limit diffuse groundwater pollution.
- » Industry that withdraws groundwater include manufacturing, mining, oil, and gas, power generation, engineering, and construction.
  - Bottled water industry is emerging as a major extractor.
- Destruction of wetlands, aquifers etc. which used to act as water sinks and contributed to ground water recharge.
- Pollution: (Both from Agriculture and Industry)
- Irreversibility: Once polluted, the aquifers tend to remain with polluted water.
- Climate Change: CC impacts groundwater through impacting precipitation, leakage from surface water, sea water intrusion into coastal aquifers

- Key Efforts for Groundwater:

- Recent Schemes:
  - » Jal Shakti Abhiyan: First launched in the year 2019, it focuses primarily upon effectively harvesting the monsoon rainfall through creation of artificial recharge structures, watershed management, intensive afforestation, awareness generation etc. JSA for the year 2023 was launched on 4th March 2023 with the theme "Source Sustainability for Drinking Water".
  - » Amrit Sarovar Mission - launched in April 2022 - focuses on developing and rejuvenating 75 water bodies in each district of the country as part of celebration of Azadi ka Amrit Mahotsava.
  - » Atal Bhujal Yojana is being implemented by central government in collaboration with states. It has an outlay of Rs 6,000 crores and is being implemented in certain water stressed areas of Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. The Primary aim of the scheme is demand side management through scientific means based on water budgeting of the area involving local communities at village levels leading to sustainable groundwater management in targeted areas.
- Institutions:
  - » Central Ground Water Authority (CGWA) has been constituted under Section 3(3) of the "Environment (Protection) Act, 1986" for the purpose of regulating and control of ground water by industries, mining projects, infrastructure, projects etc. in the country.
    - The latest guidelines in this regard with Pan- India applicability was notified by Ministry in 2020. CGWA and State issues No Objection Certificate (NOC) for extraction of groundwater to various industries/project proponents as per their jurisdiction and as per the extant guidelines.
  - » CGWA is also implementing National Aquifer Mapping Program (NAQUM) in the country. These reports along with management plans are shared with States/Uts for suitable intervention.

- MoHUA has formulated Model Building by Laws (MBBL), 2016 for the states/ Uts, wherein adequate focus has been given on requirement of rainwater harvesting and water conservation measures. 35 states/Uts have adopted the features of the Model Bye Laws.
- Major and Medium projects under Accelerated Irrigation Benefit Program are also reducing dependency on ground water extraction.

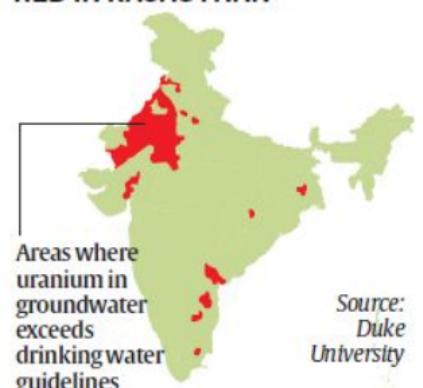
#### A) INSTITUTIONS FOR GROUND WATER

- Central Ground Water Authority, Ministry of Jal Shakti has the mandate of regulating ground water development and management in the country.
  - It has been doing it through measures such as issue of advisories, public notice, grant on NOC for ground water withdrawal etc.
  - It has been constituted under section 3(3) of the Environment (Protection) Act, 1986 to regulate and control development and management of ground water resources in the country.
- Central Ground Water Board (under ministry of Jalshakti) monitors water levels and quality through a network of 23,916 "National Hydrograph Monitoring Stations" - 6,503 dug wells and 16,693 piezometers.
  - Note: **Piezometer** is a device placed in a bare hole to monitor the pressure of groundwater.

#### 5) URANIUM CONTAMINATION OF GROUND WATER

- How much of Uranium in Water is acceptable?
  - » WHO has set a provisional safe drinking water standard of 30 micrograms of Uranium per liter for India. This standard is also consistent with the US Environment Protection Agency Standards.
  - » In India, the Indian Standard IS 10500: 2012 for Drinking Water specification has specified the maximum acceptable limits for radioactive residues as alpha and beta emitters, values in excess of which render the water not suitable.
    - But Individual radioactive elements have not been specifically identified.
    - As per Information provided by Bureau of Indian Standards (BIS), they are **working to incorporate** maximum permissible limit of Uranium as 30 micrograms/liter.
- Situation in India:
  - » According to a study published in *Environmental Science and Technology* - there is **high Uranium Contamination in Ground Water of 16 Indian States**.
  - » A report by Duke University, USA in association with Central Ground Water Board and State Ground Water Departments states that Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, MHA, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, UP, WB and J&K have localized occurrence of Uranium concentration.

#### RED IN RAJASTHAN



- » WHO has also said that there is prevalence of concentration above 30 mg/l of Uranium in some localized pockets of few states/UTs in the country.
- » Why the contamination?
  - Ground Water Depletion and Nitrate Pollution may be aggravating the already present natural uranium contamination to dangerous levels.
  - Process:
    - Many of India's aquifers are composed of clay, silt and gravel carried down from Himalayan weathering by streams or uranium-rich granitic rocks. When over-pumping of these aquifers' groundwater occurs and their water levels decline, it induces oxidation conditions that, in turn, enhance uranium enrichment in the shallow groundwater that remains.
    - Though the primary source is geogenic, anthropogenic factors such as ground water table decline and nitrate pollution may further enhance uranium mobilization.
- » Impact
  - Uranium contamination of drinking water may be responsible for chronic kidney diseases. Radioactivity is not an issue here, but the toxicity is.

## 6) DETERGENT AND WATER POLLUTION

- Water pollution caused by detergents is emerging as a big concern all over the world.
- How much of detergent is consumed in different countries?
 

Country	Per capita detergent consumption per year
India	2.7 kg
Phillipines and Malaysia	3.7 kg
USA	10 kg
- Pollution due to detergents
  - Nonylphenol, a hazardous chemical present in detergents, is known to enter water bodies and food chain. It also bio-accumulates and can cause severe environmental and health risks.
    - » It has been detected from human breast milk, urine and blood.
    - » The Bureau of Indian Standards (BIS) has set the standard of phenolic compounds in drinking water at 0.5 mg/L and surface water at 5.0 mg/L.
  - The detergents are also suspected to contain carcinogenic compounds.
  - Many laundry detergents contain 35 - 75% of phosphate salt. This can cause many water pollution problems.
    - » It can inhibit biodegradation of organic substances.
    - » Eutrophication can also be caused by phosphate salts.
      - This may choke water bodies with algae and other plants. It can also deprive water of available oxygen, causing the death of other organisms.
      - » In Belgium, phosphate has been restricted since 2003 in detergents.
  - Detergents can also harm biodiversity

- » They are capable of destroying the external mucus layers that protect the fish from bacteria and parasites, causing severe damage to the gills.
  - Fish can die at detergent concentration near 15 ppm. Even at a concentration of 5 ppm, fish eggs would be killed.
- Detergents may also cause the water to grow murky. This blocks out light and disrupts the growth of plant. Turbidity also clogs the respiratory system of some fish species.
- **Way forward**
  - Finding **sustainable substitutes for harmful components** (for e.g. for Nonylphenol)
  - Efficient Use - Reduce
  - **Nanotech** - to develop newer varieties of fiber -> don't need harmful chemical detergent to wash.
  - **Improved Regulation** for chemical sector -> identify harmful chemicals; phase out these chemicals.

## 7) FRESH WATER SALINATION SYNDROME (FSS)

- **Introduction**
  - » Approx. 70% of the earth is covered by water; only 2.5% of that is fresh water.
- **How is FSS caused?**
  - » Road salts
  - » Human accelerated weathering of infrastructure, rocks and soils
  - » Sea-level rise and saltwater intrusion
  - » Evaporative concentration of salt ions from hydrologic modifications and climate
  - » Disturbance in vegetation and local groundwater hydrology.
- **Impacts**
  - » Increased water toxicity
  - » Reduction in freshwater resources
  - » FSS also increases chances of heavy metal pollution of water.
    - For e.g. saltwater can mobilize elevated levels of arsenic in water.
  - » Salination may degrade fertile land and make agriculture unviable.

## 8) HEAVY METAL POLLUTION

- **Heavy Metals and their Health Impacts**
  - » Heavy Metals are metals with relatively high densities, atomic weights, and atomic numbers.
    - Some heavy metals are either essential nutrients (Iron, Cobalt, Zinc etc.) or relatively harmless (such as ruthenium, silver, indium etc.), but can be toxic in large amounts.
    - Other heavy metals like (**Lead, Cadmium, Mercury, Chromium, Arsenic etc.**) are highly poisonous.
      - **Lead** was the most common cause of heavy metal poisoning. But with phasing out of leaded petrol all across the world, this would go down.

- Lead poisoning may lead to damage to brain, nervous system, Kidney etc. It may also interfere with the development of RBCs
  - **Mercury** - covered separately in details.
  - **Cadmium** - Industrial waste, batteries etc. are the most important source of cadmium poisoning. It negatively hampers the heart condition. It may also cause cancer and organ system toxicity such as skeletal, urinary, reproductive, cardiovascular etc.
  
- » Long term exposure to heavy metals may result in slowly progressing physical, muscular, and neurological degenerative process.
  
- » Once dispersed in the biosphere, these metals **cannot be recovered or degraded**. Hence, environmental effects of metal pollution tend to be permanent.
  
- **Sources of Heavy Metal Poisoning:**
  - **Mining**
    - For e.g. mining releases chromium, cadmium, lead and mercury - all toxic heavy metals.
    - Raniganj in West Bengal, Jharia in Bihar and Singrauli in Madhya Pradesh are considered some of the "hot spots" of metal pollution.
  - **Tailings**
  - **Industrial Waste**
  - **Agricultural runoffs**
  - **Occupational exposures**
  - **Paints**
  - **Treated Timber**

#### **A) LEAD POISONING**

- **Lead:**
  - » It is a naturally occurring toxic metal found in the Earth's crust. Its widespread use has resulted in extensive environmental contamination, human exposure and significant public health problems in many parts of the world.
  
  - » There is no safe level of lead in the body.
    - Mental impairment can occur due to the presence of five micrograms of lead per deciliter (mcg/dL) of blood. Levels in excess of 100 mcg/dL can be fatal.
  
  - » **Where is lead used?**
    - More than 3/4th of the global lead consumption happens in manufacture of lead acid batteries for motor vehicles.
    - It is also used in products like pigments, paints, solder, stained glass, lead crystal glassware, ammunition, ceramic glazes, jewellery, toys and some cosmetics and traditional medicines.
  
  - » **Important sources of environmental contamination:**
    - **Mining**
    - **Smelting**

- Manufacturing
  - Recycling activities
  - Use of leaded paint and leaded aviation fuel
  - Drinking water - delivered through lead pipes or pipes joined with lead solder may contain lead.
- » Much of the global use of lead is now obtained through recycling.
- Health Issues:
    - » Young children are particularly vulnerable to the toxic effects of lead. It also causes long-term harm in adult, including increased risk of high blood pressure and kidney damage.
    - » Pregnant women, if exposed to high level of lead, may suffer from miscarriage, stillbirth, premature birth or low birth weight.
  - Sources and routes of exposure:
    - » Inhalation of lead particles generated by burning materials containing lead for e.g. during smelting, recycling, stripping etc.
    - » Ingestion of lead contaminated dust, water (from leaded pipes) and food (from lead-glazed or lead soldered containers).
    - » Some traditional medicines (in India, Mexico and Vietnam), also had presence of lead.
  - World Freed from toxic leaded Petrol: UNEP (Aug 2021)
    - » Details
      - A global campaign led by the UNEP and its Partnership for Clean Fuels and Vehicles (PCFV) have successfully led to freeing world from the toxic leaded petrol.
    - » India and leaded Petrol
      - India was among the early countries to take steps against lead. The process of phase down started in 1994 and got completed in 2000.

## B) MERCURY POLLUTION

- Introduction
  - » Mercury occurs naturally in the earth's crust, but human activities, such as mining and fossil fuel combustion, have led to widespread global mercury pollution.
  - » Mercury emitted into the air eventually settles into water or onto land where it can be washed into water. Once deposited, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish and animals that eat fish.
- Prescribed standards by Indian government and WHO
  - » Drinking water: 0.001 mg/l
  - » Industrial waste: 0.01 mg/l
- Sources of Mercury Pollution
  - » An element in the earth's crust.
  - » Other Natural sources include volcanic eruptions and emissions from the ocean.
  - » Anthropogenic Sources include:
    - Coal burning power plants are the largest human caused source of mercury.
    - Use of Mercury to separate gold from ore bearing rock (another major source of mercury pollution)

- Other sources of mercury pollution includes.
    - Burning hazardous waste
    - Producing chlorine
    - Breaking mercury products and spilling mercury
    - Improper treatment and disposal of or wastes containing mercury (Kodaikanal Mercury Poisoning by Hindustan lever)
- **Exposure**
  - Most human exposure to mercury is from eating fish and shellfish contaminated with methylmercury
  - **Breathing mercury vapor:** When products that contain elemental mercury break and release mercury to the air, particularly in warm poorly ventilated indoor spaces.
- **Harmful effects:** Mercury is **poisonous in all forms** - inorganic, organic or elemental. It is a neurotoxin; it is particularly harmful in the early stages of development, it can impair motor skills and can adversely affect immune system
- **Airborne Mercury**
  - » Until recently species that do not eat fish were thought to be safe from the harmful effects of Mercury. However recently researchers have documented mercury in Bicknell's thrushes, terrestrial birds that inhabit mountain top in northeast Illinois, where habitat lie downwind of the coal burning epicenter of the Ohio.
- **Mercury Pollution in India**
  - Mercury contamination in India is reaching alarming levels largely due to the discharge of mercury-bearing industrial effluents ranging from 0.058 to 0.268 mg/liter.
  - **Centre for Science and Environment** have compiled data from various sources to identify critically polluted mercury regions in India:
    - High level of mercury in fish stocks have been found, mainly in coastal areas.
      - Mumbai, Kolkata, Karwar and North Koel (in Bihar) are some of the severely affected areas.
      - Koel river showed mercury concentration almost 600-700 times above the limits.
    - Mercury in ground water and Surface water was detected throughout the country
    - Further, near **industrial units** such as chlor-alkali, cement, chemical units and thermal powerplants, levels higher than the permissible limits were found.
- **Minamata Convention on Mercury**
  - It is an international treaty designed to protect human health and the environment from anthropogenic emissions and release of mercury and mercury compounds.
    - Convention was ratified by delegates from 140 countries in January 2013.
  - **Why is global response needed?**

- **Mercury pollution is global problem** that requires global action because it moves with air and water, transcends political boundaries, and can be transported thousands of miles in the atmosphere.
- **Major Highlights**
  - **Bans new mercury mines; phase out existing mines.**
  - **Control measures on air emissions** from power plants.
  - **Regulate informal sectors like small scale gold mining.**
  - **Phase out or reduce mercury use** in products like batteries switches etc.;
  - Addresses supply and trade, safer storage and disposal and strategies to address contaminated sites.
  - Technical assistance, information exchange, public awareness and research and monitoring
  - Parties to **report** on measures taken to implement certain provisions.
- **India ratified** the convention in 2018.
  - This allows India to get technological and financial assistance in the fight against mercury pollution.
  - The convention has given five year time to India to control and reduce emissions from new power plants and 10 years' time for already existing power plants.
- **Minamata COP-5 (Nov 2023)**
  - Held in Geneva
  - Parties decided new dates to phase out mercury-added products including cosmetics,
  - Strengthened ties with indigenous people.
  - Advanced the first effectiveness evaluation of the convention.
  - Reached an agreement on a threshold for mercury waste.

## C) ARSENIC POLLUTION

- **Introduction**
  - » **Arsenic** is an odorless and tasteless metalloid which is widely distributed in the earth's crust.
  - |                       |   |
|-----------------------|---|
| <b>Periodic Table</b> | Elemental arsenic is a member of Group VA of the periodic table, with nitrogen, phosphorus, antimony and bismuth. It has an atomic number of 33 and an atomic mass of 74.91 |
|-----------------------|---|
  - » **Arsenic contamination of the ground water is one of the most serious drinking water issue** being faced in India.
  - » **BIS** stimulates a permissible limit of 0.01 mg/L of arsenic in water. But, as per the latest CGWB study, **21 states** across the country have pockets of arsenic levels higher than this limit.
- **Key Areas impacted by Arsenic Pollution in India**
  - » The states in **Ganga-Brahmaputra-Meghna** river basin are the most affected. They include - UP, Bihar, Jharkhand, WB, and Assam.
  - » Other arsenic affected areas include Punjab, Haryana, Manipur, Chhattisgarh and Karnataka.
- **Sources of Arsenic Pollution**

- » Arsenic is introduced in soil and groundwater through weathering of rocks and minerals followed by subsequent leaching and runoff.
- » **Anthropogenic sources** - coal fired power plants, burning vegetation, and Volcanism.
- » **Ground water contaminated with Arsenic** is also entering food chain.
  - The chemical has found its way into rice, wheat and potato. A unique observation was that in several samples, arsenic content in food items was higher than that in drinking water.



#### - Impact

- Long-term intake of arsenic polluted water leads to **arsenic poisoning** or arsenicosis, with **cancer of skin, bladder, kidney or lung or diseases of skin, blood vessels of legs and feet**.
- **Key Recent steps:**
  - Under Jal Jivan Mission (Har Ghar Nal se Jal), since, planning, implementation, and commissioning of piped water supply scheme based on a safe water source may take time, purely as an interim measure, state and Uts have been advised to install community water purification plants (CWPP) especially in Arsenic and Fluoride affected habitations to provide potable water to every household at the rate of **8-10 litres per capita per day** to meet their drinking and cooking requirements.

## D) RADIOACTIVE POLLUTION IN WATER

#### - Details

- » Radioactive pollution of water is a newly emerging, but grave concern of water pollution and human health.
- » Radioactive elements are naturally found in earth's crust. Percolation of naturally occurring radioactive materials (NORM) from the soil sediments to the aquifer causes groundwater contamination.
- » **Anthropogenic sources include:**
  - Nuclear weapon investigation.
  - nuclear calamities.
  - nuclear powerhouse;
  - dumping of radioactive waste are the major sources.
  - Use of radioisotopes in industries and scientific laboratories are the minor sources.
- » This pollution is more prevalent in groundwater as compared to surface water since it is much exposed to radioactive elements found in rocks. Sometimes magma also releases radioactive gases in environment.

- » A number of radionuclides are found in surface and sub-surface waters, among which 3H, 14C, 40K, 210Pb, 210Po, 222Rn, 226Ra, 228Ra, 232Th, and 234,235, 238 U are common.
  - **Uranium, thorium, and actinium** are three NORM series that contaminate water resources.
  - **Radium**, a descendent of NORM series, is one of the decidedly radiotoxic elements found in aquatic systems and can be penetrated into groundwater via (i) aquifer rock dissolution (ii) decaying of 238U and 232Th, or (iii) desorption process
- **How is radioactivity measured?**
  - » It is measured in **Becquerel** (SI unit) or in curies.
    - Energy absorbed per unit mass is measured by Gray, while the unit Sievert measures the quantity of radiation absorbed by human tissues.
- **A small amount** of radiation is found in all types of water, but the extended amount of radiation is harmful to human health.
- **Harmful Impacts of nuclear radiation:**
  - » Immediate: recoverable consequences distressing skin, lungs, genitals, and causing of hair fall.
  - » Long standing: permanent outcomes such as various infections like radiation damage, bone marrow fatality, cataract initiation, cancer stimulation, cholera, etc.
  - » Genetic effects: ionizing radiation induces mutations in germ cells
- **WHO guidelines:**
  - » Guidelines for drinking water quality and a permissible limit of reference dose level of 0.1 microsieverts per year.

#### **E) THERMAL POLLUTION: WATER POLLUTION FROM THERMAL POWER PLANTS**

- **Thermal Pollution** is the degradation of water quality by any process that changes ambient water temperature.
- **Heat** is considered a **water pollutant** if it is caused by human activities.
- **Major causes of thermal pollution include:**
  - **Coolant from thermal power plants**
  - **Industry effluents**
  - **Alteration of vegetation cover** - increases the heating of water.
- **Negative impact of Thermal Pollution**
  - **Oxygen** deficiency (reduced solubility and high metabolism)
  - **Temperature** sensitive aquatic organisms die.
  - **Decrease in decomposition of organic matter** (oxygen deficiency leads to aerobic decomposers not functioning effectively)
  - **Primary productivity and diversity** of aquatic plant species decline
- **Note:** Even unnatural lowering of temperature of a water body is harmful.
  - Aquatic biodiversity is very sensitive to temperature change.

## 9) MARINE POLLUTION

### A) LISBON DECLARATION

- Why in news?
  - All 198 members of the UN have unanimously adopted the Lisbon Declaration on Ocean Conservation in July 2022 on the last day of the UN Ocean Conference 2022.
- Details
  - Participants agreed to work on preventing, reducing and controlling marine pollution. It includes:
    - Nutrient Pollution
    - Untreated Wastewater
    - Solid Waste Discharges
    - Hazardous Substances
    - Emissions from the marine sector, including shipping, shipwrecks
    - Anthropogenic underwater noise
  - The nations committed to follow science based and innovative action on an urgent basis.
  - They also agreed that developing countries (particularly small island developing states) and LDCs need assistance with capacity building.
  - Developing and promoting innovative financing solutions to help create sustainable ocean-based economies as well as expanding nature-based solutions to help conserve and preserve coastal communities.
  - Member nations also committed to empowering women and girls, recognizing their participation is crucial to building a sustainable ocean-based economy and achieving the UN-mandated SDG14.
- The conference has set the stage for the fifth session of the intergovernmental conference on an international legally binding instrument for the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

### B) HIGH SEAS TREATY

- Why in news?
  - Negotiators from almost every country in the world finalized a new global treaty meant for conservation of sustainable use of biological resources in the high seas (March 2023)
- Background:
  - The High seas are open ocean areas that are outside the jurisdiction of any country. It consists of around 64% of the ocean surface and around 43% of earth. These are home to millions of marine species and trillions of micro-organisms.
  - Existing Legal Framework for High Seas:
    - UNCLOS
    - Antarctic Treaty System
  - Limitations:

- UNCLOS is not primarily focused on sustainability and environment protection. Though, it asks countries to protect the ocean ecology and conserve its resources, it doesn't provide the specific mechanisms or processes to do so.
- Technical Name of the Treaty: the 'Agreement under the UNCLOS on Conservation and Sustainable use of marine biodiversity in areas beyond national jurisdiction (BBNJ)'
- Key Highlights of the Treaty:
  - The nations of the world have agreed to a Framework for the Conservation and Sustainable Use of Resources in the open oceans.
  - The **High Seas Treaty** will work as an implementation agreement under UNCLOS, much like Paris Agreement under UNCLOS.
  - Key Provisions:
    - The treaty has **Four Main Objectives**:
      - Demarcation of **Marine Protected Areas** (MPAs), rather like there are protected forest and wildlife areas.
        - Under this, a state or group of states can submit a proposal for MPA along with relevant information. It also provides guidelines for implementation, monitoring, and review of MPAs established.
        - **Note:** As of now, only 1.44% of high seas are protected according to IUCN.
      - Sustainable use of marine genetic resources and equitable sharing of benefits arising from them.
      - Initiation of the process of Environmental Impact Assessments for all major activities in the oceans
        - The agreement includes an obligation to conduct EIAs for activities with potential impacts on the high seas that will apply to new activities such as geo-engineering.
        - It also includes a new impact threshold to trigger a screening process, which means more activities will now be subject to at least some assessment.
      - **Capacity building and Technology transfer.**

<b>Marine Protected Areas</b>	MPAs are where ocean systems, including biodiversity, are under stress, either due to human activities or climate change. These can be called the national parks or wildlife reserves of the oceans. Activities in these areas will be highly regulated, and conservation efforts similar to what happens in forest or wildlife zones, will be undertaken
<b>Marine Genetic Resources</b>	Oceans host very diverse life forms, many of which can be useful for human beings in areas like drug development. Genetic information from these organisms is already being extracted, and their benefits are being investigated. The treaty seeks to ensure that any benefits arising out of such efforts, including

	monetary gains, are free from strong intellectual property rights controls, and are equitably shared amongst all. The knowledge generated from such expeditions are also supposed to remain openly accessible to all
<b>Environmental Impact Assessment</b>	The high seas are international waters that are open for use by all countries. Under the provisions of the new treaty, commercial or other activities that can have significant impact on the marine ecosystem, or can cause large-scale pollution in the oceans, would require an environmental impact assessment to be done, and the results of this exercise have to be shared with the international community
<b>Capacity Building and Technology Transfer</b>	The treaty lays a lot of emphasis on this, mainly because a large number of countries, especially small island states and landlocked nations, do not have the resources or the expertise to meaningfully participate in the conservation efforts, or to take benefits from the useful exploitation of marine resources. At the same time, the obligations put on them by the Treaty, to carry out environmental impact assessments for example, can be an additional burden

- **COP**, which acts as the decision making body of the treaty, will take the work forward and will also act as a platform to work with existing authorities that regulate fishing, shipping and mining.
- **Difficult road ahead:**
  - The treaty is a result of 20 years of protracted negotiation. The details of all the major contentious provisions, including EIA, sharing of benefits from genetic resources, and mobilization of funds for conservation activities, are still to be worked upon. Many issues remain unaddressed, including mechanisms for policing the protected areas, the fate of the projects that are addressed to be heavily polluting, and resolution of disputes.
  - Process of ratification is also not going to be easy. (UNCLOS took 12 years to become international law and Kyoto Protocol took 8 years - because necessary number of ratifications were not achieved)
    - Treaty must be ratified by a minimum 60 countries for it to come into force

### C) MARINE LITTER / MARINE PLASTIC POLLUTION

- **Introduction:**

- » **What is marine litter?**

- It's any man-made, long standing solid material that humans have incorrectly disposed of and that has ended up on the beach, in estuaries, rivers, seas and ocean.
- **Plastic** is the most common type of litter found at sea. Around 8 million tonnes of plastics end up in the world's ocean every year. It is estimated that more than 1 lakh of turtles and marine mammals die every year due to these plastic marine litter. It is estimated that around 18,000 plastic pieces are floating on every square kms of the world's ocean.

- » **Reasons for Increasing Marine Litter:**

- Very slow rate of degradation of litter items, mainly plastic
- Continuously growing quantity of the litter and debris disposed in oceans due to increased population, industrialization, single use plastics etc.
- **Harmful impacts**
  - Affects public health (plastics have now been found in human blood).
  - Threatens marine ecosystem
    - Animals get trapped in this litter. They also sometimes confuse marine litter with food.
    - Ghost Fishing: Nets, Fish Aggregation Devices (FAD) and other gears continue to fish for decades after getting discarded.
  - Impacts fishery and tourism sector

- **Key steps taken by India:**

- **Marine Plastics Survey Program of NCCR (National Centre for Coastal Research)**
  - This program studied the distribution of microplastics in coastal locations in the Bay of Bengal and Arabian Sea in particular along the International Shipping Routes.
  - It found that 50% composition of marine litter was by single use plastics from 2018 - 2021 at various beaches of India.
- **2021 Amendment to Plastic Waste Management Rules, 2016**
  - Ban on several single use plastic from July 2022;
  - Increase in thickness of plastic bags.
- **EPR guidelines related to Plastic packaging materials.**
- **Swatch Sagar Surakshit Sagar:**
  - Commemorating the 75th year of India's independence, a coastal cleanup drive was carried out at 75 beaches across the country across 75 days over 7500 km long coastline. This unique first ever national campaign culminated on "International Coastal Clean-Up Day" on 17th Sep 2022.
  - This drive was aimed at removing 1,500 tonnes of garbage from the sea coast which will be a huge relief to marine life and the people staying in coastal regions.
- At UN Ocean Conference in Lisbon, India has assured the world community that under PM Modi, it is committed to protecting at least 30% of our lands, waters and oceans, and thus adhere to its commitment of 30X30 by 2030 in a mission mode.
  - **Note:** India is part of the High Ambition Coalition for Nature and People, which was initiated at the "One Planet Summit" in Paris in January 2021, to promote an international agreement to protect at least 30 per cent of the world's land and ocean by 2030
- **International Cooperation:** Under the Commonwealth Litter Program (CLIP), the UK's Centre for Environmental Fisheries and Aquaculture Sciences (CEFAS) and India's National Centre for Coastal Research (NCCR) launched a pilot project to understand deteriorating sea water quality due to marine litter.

- **Key International Initiatives:**

- **London Dumping Regime** (of International Maritime Organization): it regulates deliberate dumping of plastic waste at sea from vessels and platforms.
- **International Convention for the Prevention of Pollution from Ships (MARPOL)**: It regulates both deliberate and accidental discharge of plastics from vessels.
- But, the **problem with both these rules is lack of enforcement**. It is hard to monitor and enforce the prohibition on plastic pollution from vessels on the high seas. Flag states often lack incentives to do so.

## D) OCEAN DEOXYGENATION

- **Ocean Deoxygenation**
  - » It is the phenomenon of oxygen loss in ocean caused by excessive growth of algae due to nutrient pollution. The nutrient pollution may be caused by fertilizers, sewage, animal or aquaculture waste.
- **The IUCN Report 'Ocean deoxygenation: Everyone's problem'** is the largest peer reviewed study to date of the causes, impacts, and potential solutions to ocean deoxygenation.
- **Key Findings**
  - » **Ocean regions with low oxygen concentration** have expanded to all depths of the Ocean
  - » The **volume of area depleted with oxygen**, known as "**anoxic waters / dead zones**" have **quadrupled**.
  - » **What if the present situation continues?**
    - Under a business-as-usual scenario, the ocean is predicted to lose 3-4% of its global oxygen by 2100.
      - **Local changes** will be more severe.
    - Further, **most of the oxygen loss** will take place in the upper 1,000 meters, which is the richest part of the Ocean for biodiversity.
- **Reasons for Ocean Deoxygenation**
  - » **Climate Change and Nutrient Pollution** are the main drivers of the ocean oxygen loss.
  - » Ocean oxygen loss is also closely related to Ocean Warming and Acidification caused by anthropogenic carbon dioxide emissions and biogeochemical consequences related to anthropogenic fertilization of the ocean.
- **Adverse impact of low oxygen levels**
  - » **Balance of Marine Life**: The IUCN report has started impacting the balance of marine life, favoring species tolerant of low-oxygen conditions, like jellyfish, some squid and microbes, at the expense of species sensitive to low-oxygen, including most fish and many marine species.
  - » Negatively hamper **cycles of nitrogen and phosphorus**

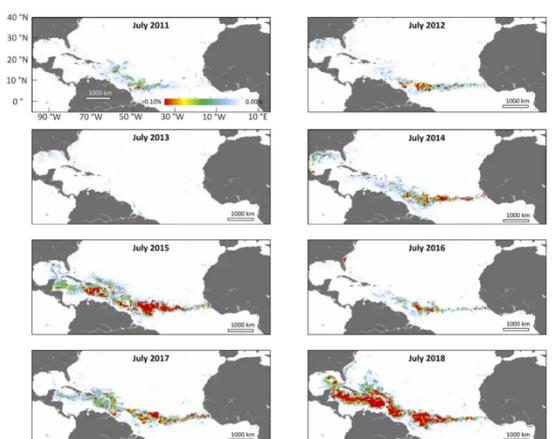
## E) SARGASSO SEA WEED

- **About Sargasso Seaweed**
  - » **Between 2000-2010** there was little sea weed in the central Atlantic: most was found in the Gulf of Mexico and Saragossa Sea.

- » **Explosion** in Sargassum seaweed first materialized in 2011. It developed in subsequent years into a vast band - in 2018 this stretched for 5,500 miles.
  - The bloom peaks in the middle of the year and develop larger from small populations of the seaweed in the central Atlantic, with some contributions from west Africa.
  - A number of natural and man-made factors align together to make this happen.
- » **Problems caused by this explosion.**
  - Thick mats can block sunlight
  - Sometimes, when they die and sink, they may be deadly for fish and Corals.
  - They are also proving disastrous for humans. Increasingly huge quantities are washing up in tourist destination, creating stinking masses that threaten the tourism industry and pose a threat to health.
- » **Reasons:**
  - Alignment of circumstances like conducive sea-surface temperature and salinity combining with an increase in nutrients - in part from the upward movement of cool, nutrient rich water in the eastern Atlantic and an increase in discharge from the Amazon in the preceding years.

#### - About Sargasso Sea

- » Located entirely within the Atlantic Ocean, it is **the only sea without a land boundary**. While all **other seas in the world are defined at least in part by land boundaries**, the Sargasso Sea is **defined only by ocean currents**. It lies within the Northern Atlantic Subtropical Gyre. The Gulf Stream establishes the Sargasso Sea's western boundary, while the Sea is further defined to the north by the North Atlantic Current, to the east by the Canary Current, and to the south by the North Atlantic Equatorial Current. Since this area is defined by boundary currents, **its borders are dynamic**, correlating roughly with the Azores High Pressure Center for any particular season.
- » It has been named after genus of a free floating seaweed called Sargassum.
  - While there are many different types of algae found floating in the ocean all around world, the Sargasso Sea is unique in that it harbors species of sargassum that are 'holopelagic' - this means that the algae not only freely floats around the ocean, but it reproduces vegetatively on the high seas. Other seaweeds reproduce and begin life on the floor of the ocean.
  - Sargassum provides a home to an amazing variety of marine species.
    - Turtles use sargassum mats as nurseries where hatchlings have food and shelter. It also provides essential habitat for shrimp, crab, fish and other marine species.



## F) DEAD ZONES

### - Introduction

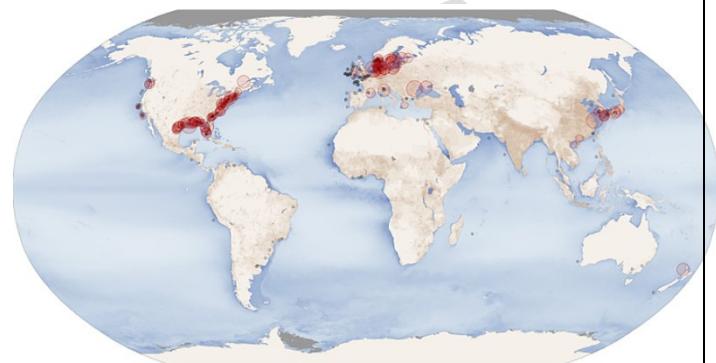
- » Excess nutrient pollution in oceans/lakes create a situation of **hypoxia** i.e. reduction in availability of oxygen in the water. This situation is often referred as **Dead zone** as most marine life either dies, or if they are mobile, leave the area. Because of creation of dead zones, habitats which are normally teeming with life become essentially **biological deserts**.

### - Can Dead zone occur naturally?

- » Yes, dead zones may occur naturally. But, environmentalists are concerned about those which are created or enhanced by human activities.

### - Key factors responsible for creation of dead zones?

- » There are many physical, chemical and biological factors that combine together to create dead zones, but **nutrient pollution is the primary cause** of those zones created by human activities.
- » **Nutrients -> Algae -> Decomposition -> Oxygen Depletion.**
- » **Climate Change -> Rising temperatures ->** reduce the dissolved oxygen, increase metabolism rate and oxygen demand.



## G) THE GREAT PACIFIC GARBAGE PATCH (GPGP)

- The Great Pacific Garbage patch is located about halfway between Hawaii and California. It is the largest accumulation zone of ocean plastic on earth.
- It consists of higher concentration of waste item, but much of the debris is actually small pieces of floating plastic that are not immediately evident to naked eyes.
- While great pacific patch is a term regularly used in the media, it doesn't paint the correct picture of the marine pollution problem in the North Pacific Ocean. Marine debris concentrates in various regions of the North-Pacific, not just in one area. The exact size, content, and location of the "garbage patches" are difficult to accurately predict.



### • Why is it difficult to clean up the patches?

- i. Very large and shifting area
- ii. Uneven distribution of debris

- iii. Small pieces of plastic forms the largest chunk
- iv. Marine life doesn't allow simple skimming of these debris

## 10) PROTECTION OF COASTAL REGION

- **Introduction**
  - » Coastal zones are places of enormous ecological, cultural, social and economic significance. They contain unique and sensitive ecosystem of great natural and economic value and is home to numerous endangered species. The region also serves as home to 50% of the world's population and generated 40% of the global economic activities.
- **Key Problems Faced by Coastal Regions:** Recent decades have seen drastic increase in population, rapid industrialization, increased pollution and climate change. All these factors have negatively hampered the coastal region.
  - Along much of the earth's coast **a warming climate and sea level rise** are already negatively affecting natural ecosystems and human communities
  - **Coastal Erosion** has started hampering a number of coastal regions. E.g. Vishakhapatnam
  - **Rapid Industrialization and Deforestation**
  - **Pollution** due to mining, municipal waste disposal and industrial waste disposal are also leading to environmental problems in coastal regions.
  - **Invasive Species** -> Biodiversity loss
- **Efforts by India to Protect Coastal Regions**

### A) COASTAL REGULATION ZONE

- » CRZ notification is issued under the **Environmental Protection Act, 1986** for regulation of activities in the coastal area by the MoEF&CC. The first CRZ was issued, in 1991 which was replaced by the 2003 and then by 2011 notification.
- » It classifies the coastal land upto 500 m from the HTL and a stage of 100 m along the banks of creeks, estuaries, backwater and river subject to tidal fluctuations as the **Coastal Regulation Zone (CRZ)**. The **CRZ** are further classified in **four categories**:

  - **CRZ-1** are ecologically sensitive areas.
    - **CRZ 1-A** constitute the ecologically sensitive area and the geomorphological features which play a role in maintaining the integrity of the coast viz: Mangroves, corals, sand dunes, salt marshes, national parks, WLS, Reserved forests, nesting grounds for turtles, birds etc.
    - **CRZ 1-B** consist of inter-tidal zones (between HTL and LTL)
  - **CRZ-2** are areas that have been developed upto or close to the shoreline. Unauthorized structures are not allowed in this zone.
  - **CRZ-3** are areas that are relatively undisturbed (both urban and rural)
  - **CRZ-4** are areas covered between Low Tide Line and 12 nautical miles seaward

- » **CRZ Notification, 2018: Easing of Norms for CRZ** approved by Cabinet (Dec 2018)
  - The comprehensive review was necessitated because of **demands of various stakeholders** to review the CRZ notification, 2011 as it was hindering developmental activities.
  - **Aimed at streamlining of CRZ clearances** and promoting economic growth while keeping in mind conservation principles of coastal regions.
  - The notification is based on the recommendations of the **Shailesh Nayak** (former secretary, Ministry of Earth Science) headed committee.
- » **Key Changes**
  - **Delegation of Project Clearance Power to State Governments.**
    - **Only Projects in CRZ-1 and CRZ-IV will require permission from Union Ministry.** The Powers to clear projects in CRZ-2 and CRZ-3 have been **delegated to State Governments**
  - **Defreezing of Floor Area Ratio (FAR)** in construction norms
    - Earlier, for CRZ-2, it was frozen to 1991 Development Control Regulation (DCR) levels, Now, it will be based on laws which are in vogue.
  - **Relaxation of No Development Zone (NDZ) criteria**
    - Densely populated (density > 2,161 per sq km) rural areas (under CRZ-III) referred as CRZ-III-A, now have a NDZ of 50 m from the High Tide Line (HTL) as against earlier 200 meters.
    - Further, for island close to the mainland coast and for all backwater islands the new NDZ is 20 m.
  - To **fight pollution**, treatment facilities have been made permissible activity in CRZ-I B area, subject to necessary safeguards.
  - **Steps to Facilitate Tourism:**
    - Permission of temporary tourism facilities such as shacks, toilet blocks, change rooms, drinking water facilities etc, in beaches even in the NDZ of the CRZ-III.

## 11) BLUE FLAG BEACHES

- **Why in news?**
  - » Two more Indian Beaches enter the coveted list of Blue Beaches (Oct 2022)
- The iconic blue flag is one of the world's most recognized voluntary eco-labels awarded to beaches, marinas, and sustainable boating tourism operators.
  - » The Blue flag program was started in France in 1985 and in areas out of Europe in 2001.
  - » The certification is provided by the **Foundation for Environmental Education (FEE)**.
  - » To get blue flag certification **33 stringent criteria** under **four major heads** should be met and maintained.
    - Environment Education and Information
    - Bathing Water Quality
    - Environment Management and Conservation
    - Safety and Services
- **Spain** with 620+ blue flag beaches have highest number of blue flag beaches in the world.

- **Blue Flag Beaches in India**
  - » As of Jan 2024, **12 Indian beaches** have blue flag certifications.
  - » **Two Beaches - Minicoy Thundi Beach and Kadmat Beach** - both in Lakshadweep were awarded the certification in Oct 2022.
    - The Thundi Beach is one of the most pristine and picturesque beaches in Lakshadweep archipelago where white sand is lined with turquoise blue water of the lagoon. It is a paradise for swimmers and tourists alike
    - The Kadmat beach is specially popular with cruise tourists.
    - Both these beaches comply with all 33 criteria mandated by the Foundation for Environment and Education.
  - » **Two beaches** - the Eden Beach in Puducherry and Kovalam Beach in Tamil Nadu were awarded Blue Flag certification in Sep 2021.
  - » **Eight Beaches** under blue flag certification earlier were: Kappad (Kerala), Shivrajpur (Gujarat), Ghoghla (Diu), Kasakod and Padubidri (Karnataka), Rushikonda (Andhra Pradesh), Golden (Odisha) and Radhanagar (Andaman and Nicobar Islands)

## 12) COASTAL EROSION

- **Introduction:**
  - Coastal erosion refers to wearing away of land and the removal of beach and dune sediments by wave action, tidal currents, drainage or high winds.
  - **Wave action** is the main cause of coastal erosion. Wave energy is a result of three factors: the speed of the wind blowing over the surface of the sea; the length of fetch; and the length of time the wind has been blowing.
- **Causes of Coastal Erosion** can be divided into two broad categories: **Natural or Manmade**:
  1. **Natural Causes:**
    - i. These include waves, winds, tides, near shore currents, sea level rise etc.
    - ii. Another major natural factor is phenomenon of subsidence. It is a regional phenomenon that lowers the surface area in a specific region.
    - iii. Catastrophic events like severe storms, tidal surges, and cyclones can cause severe erosion.
  2. **Manmade Factors:**
    - i. **Infrastructure creation in coastal regions**: For e.g., building houses via land reclamation or within sand dune areas.
    - ii. **Sand removal above replenishable quantities** from the coast upsets the longshore sand transport budget and can result in erosion.
    - iii. **Coral Mining and other means of damaging protective corals** may cause beach degradation.
    - iv. **Structures like seawalls, breakwaters** also have a side effect as it increases erosion of adjacent areas.
    - v. **Deforestation**: Damaging of mangroves and other coastal vegetation is a major factor.
    - vi. **Climate Change** which is mostly human induced is leading to sea level rise which is eroding more and more coastal regions.

## vii. Unscientific Coastal Management

### - Factors that influence Erosion Rates

» The ability of waves to cause erosion of the cliff face depends on many factors.

#### • Primary Factors

- **Erodibility of sea facing rock** is controlled by rock strength and the presence of fissures, fractures, and beds of non-cohesive materials such as silt and fine sand.
- Power of the waves
- Beaches ( they dissipate wave energy on the foreshore and provide a measure of protection to adjoining land)
- The Adjacent bathymetry, or configuration of the sea floor, controls the way energy arriving at the coast, and can have an important influence on the rate of cliff erosion.

#### • Secondary Factors

- Weathering and transport slope processes.
- Slope Hydrology
- Vegetation
- Human Activity
- Resistance of cliff foot sediment to attrition and transport.

### - Impact of Coastal Erosion

- Floods including worsening impact of high tide flooding.
  - Saltwater penetration into rivers, coastal agriculture plains

### - Coastal Erosion Control Strategies: There are three coastal erosion control methods.

#### - Soft Erosion Controls/ Non-Structural Methods

- These methods are **temporary options of slowing the effects of erosion**.
  - **Artificial nourishment** of beaches
  - **Coastal Vegetation** such as mangrove and palm plantation
  - **Dune Reconstruction/rehabilitation**
  - Other options are **beach scraping** and **beach bulldozing** which allows for the creation of artificial dunes in front of building or as means of preserving building foundation.

#### - Most common method is the **Beach nourishment** projects.

- It involves placing **additional sand on a beach** to serve as a buffer against erosion or to enhance the recreational value of the beach.

- Because nourishment doesn't stop erosion, it has to be repeated to maintain the beach.

#### ▫ **Advantages**

- Restores and widens recreational beach
- Beach nourishment doesn't leave hazards on the beach or on the surf zone.

#### ▫ **Disadvantages**

- Erodes faster than natural sand so continuous refurbishing required.

- Number of Storms affecting the beach makes the life time of the nourishment vary.
  - Expensive, and must be repeated periodically.
  - Process of nourishment may damage, destroy or otherwise hurt marines and beach life by burying it, squishing it under bulldozers, changing the shape of the beach, or making the water near the beach too muddy.
  - Difference in "grain size" of the added sand affect the way waves interact with beach. This will affect surf conditions and bars on the submerged part of the beach.
- **Hard Erosion Controls/ Structural Measures**
  - More permanent solution than soft erosion methods.
  - **Seawalls and groynes (or groin)/breakwaters** serve as permanent infrastructure; Tetrapod-based seawall are also included in the category.
  - **Limitations**
    - » Not immune from normal wear and tear and will need **refurbishment or rebuilt**.
    - » Further, as the understanding of natural shoreline function improves, there is a growing acceptance that structural solution can cause more problems than they solve. It interferes with natural water currents, and prevent sand from shifting along coastline.
    - » They also cause erosion to adjacent beaches and dunes and lead to unintended diversion of stormwater and waves onto other properties.
- **Combination of the Structural and Non-Structural Methods** (i.e. combination of hard erosion control and soft erosion control)
  - This hybrid method reduces limitations of both the methods and provides better efficacy and efficiency.
  - Some of the common approaches of combination are:
    - a. **Combining Beach nourishment with artificial headlands/groynes**.
    - b. **Revegetation with temporary offshore breakwaters/ Artificial reefs** is commonly used.
  - Using a combination of beach nourishment and groynes/artificial headlands promotes the trapping of the downdrift movement of the sediments, thus reducing downdrift erosion. This also reduces the frequency of re-nourishment.
- **Relocation**
- **Situation of Coastal Erosion in India:** Ministry of Earth Sciences has informed the Lok Sabha that about 34% of coastal region in India is under varying degree of erosion.
  - Of the rest, 40% is stable and 26% is accreting in nature.

### 13) BIOLUMINESCENCE

- **Why in news?**

- Vishakhapatnam Beaches are glowing due to a phenomenon called **bioluminescence** (April 2023)
- **Details**
  - Bioluminescence, the glow of the waves, is caused by tiny marine organisms called **Phytoplankton**, which emit light on the ocean surface at night.
  - It is best experienced during a moonless night.
- **Bioluminescent** is widespread among deep sea animals in general. Many marine creatures like sponges, jellyfish, worms, species of fish, arthropods, echinoderms, and unicellular algae exhibit bioluminescence to either evade predators, attract prey or during mating.
- **Why did it happen in Vishakhapatnam?**
  - In Vishakhapatnam this phenomenon is most likely the result of algal bloom (Significant accumulation) of the **dinoflagellate species of noctiluca and ceratium**. These emit light when disturbed by breaking waters. This occurs when the luciferase enzyme reacts with luciferin compound in the presence of oxygen to produce a cold light.



- Some other beaches in India where this phenomenon is visible are - Havelock Island in the Andamans, Thiruvanmiyur beach in Chennai, Mattu beach in Karnataka and Bangaram Island in Lakshadweep.