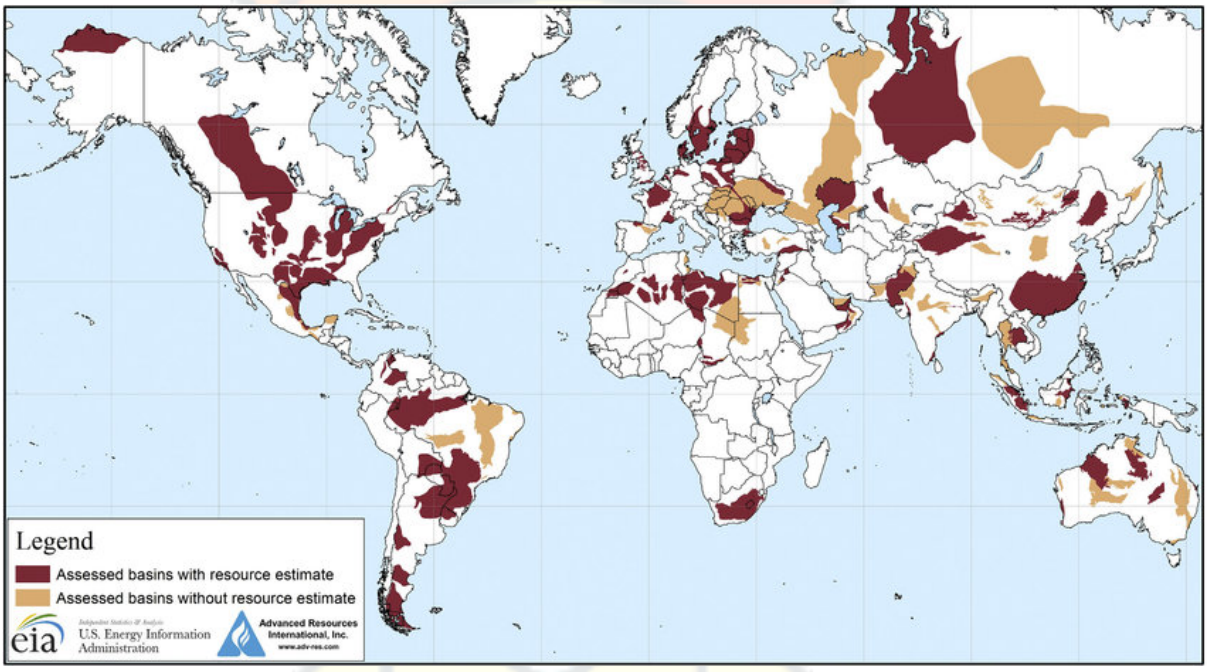
1. Discuss the distribution of major natural gas basins in the world. Also, examine the potential of natural gas as a remedy of world's energy security woes.

Introduction:

Natural gas is a mixture of gases which are rich in hydrocarbons. All these gases (methane, nitrogen, carbon dioxide etc) are naturally found in atmosphere. Natural gas reserves are deep inside the earth near other solid & liquid hydrocarbons beds like coal and crude oil.

Body:

Nearly 80% of the world's total proven natural gas reserves are located in ten countries. According to the ranking of OPEC, 10 major natural gas basins distributed around the world are:



- **Russia**: Holds the largest amount of natural gas reserves in the world, accounting for about one fourth of the world's total proven gas reserves. Majorly located in Siberia, namely Yamburg, Urengoy and Medvezh'ye.
- **Iran**: World's second biggest natural gas reserves. More than 60% of Iran's natural gas reserves are located offshore. South Pars is the largest gas field. North Pars, Kish and Kangan are the other major natural gas fields in Iran.
- **Qatar**: Holds the third largest natural gas reserves in the world, accounts for around 13% of the world's reserves. Qatar is also the single largest LNG supplier in the world. A vast majority of the country's natural gas reserves are located in the giant offshore North Field.
- **Turkmenistan**: Most of Turkmenistan's proven gas reserves are located in the Amu Darya basin in the south-east and in the Murgab South Caspian basins in the western part of the country. The South Yolotan area in the eastern region of Turkmenistan also contains significant gas reserves.

- **USA**: The Barnett play located in Texas and Montana, Haynesville play in the Texas-Louisiana Salt Basin, Marcellus Shale play in the Appalachian Basin, Fayetteville play, Woodford play in Oklahoma and Texas and the Eagle Ford play, in the Western Gulf Basin of South Texas, are the major shale plays contributing to the country's natural gas expansions.
- **Saudi Arabia**: Associated gas at the giant oil fields, such as the Ghawar onshore field and the offshore fields Safaniya and Zuluf, account for about 57% of the country's proven gas reserves. Karan gas field and the Arabiyah and Hasbah gas fields are other major non-associated gas fields.
- **UAE**: About 94% of the country's proven natural gas reserves are located in Abu Dhabi. Sharjah and Dubai account for four percent and 1.5% of UAE's total gas reserves respectively.
- **Venezuela**: World's biggest oil reserves holding country, possesses the eighth largest gas reserve. Onshore fields such as Anaco, Barrancas and Yucal Place and Plataforma Deltona, Marsical Sucre and Blanquilla-Tortuga areas off the north-east coast of Venezuela, and the gas blocks in the Gulf of Venezuela in the north-western part of the country.
- **Nigeria**: Most of natural gas reserves of the country are located in the Niger Delta.
- **Algeria**: More than half of Algeria's proven natural gas reserves are contained in the country's largest gas field, Hassi R'Mel. Associated and non-associated fields in the south and south-east regions of the country comprise the remaining gas reserves of the country.
- **India**: Ranks 23rd in the proven natural gas reserves. KG basins, Assam, Gulf of Khambhat, Cuddalore district of Tamil Nadu, Barmer in Rajasthan etc are major regions.

Potential of natural gas:

- **Economy**: Natural gas is cheaper compared to other fossil fuels and cheaper than electricity when used for supplying home appliances. Natural gas appliances are also cheaper compared to electrical ones.
- **Environment:** It does not pollute the ground or the underground water because its by-products are in gaseous form. Another important fact is that natural gas burns without releasing any soot or sulphur dioxide. It also emits 45% less carbon dioxide than coal and 30% less than oil.
- **Transportation:** Transportation is made via sea (tankers) and land (pipelines and small tanks). This fact allows natural gas to be easily transferred from power plants to residential areas.
- **Multi-uses**: Natural gas is a multi-use fuel. It is used inside the house for cooking, heating, drying, etc. It can be used for generating electric power, powering vehicles (by substituting for diesel and gasoline), producing plastics, paints, fertilizers, and many more uses.
- **Availability**: It is abundant and almost worldwide available.
- **Conversion to Hydrogen Fuel**: It is currently the cheapest fossil fuel source for producing hydrogen.

Challenges associated:

- **Flammable and Toxic:** Natural gas leaks can be proven to be extremely dangerous. The main risk comes from the fact that it is naturally odourless and cannot be detected by smell, unless an odorant has been added to the gas mixture.
- **Environmental Impact**: Although, it is cleaner than other fossil fuels (oil, coal, etc.) as far as by-products are concerned, natural gas leaks can become more hazardous due to production of greenhouse gases.
- **Processing**: In order to use it as a fuel, the processing results in several by-products: hydrocarbons (ethane, propane, etc.), sulphur, water vapour, carbon dioxide, and even helium and nitrogen.
- **Non-Renewable**: It is a finite source of energy and cannot be considered a long-term solution to our energy supply problem.
- **Installation**: The whole pipe installation may be very expensive to construct since long pipes, specialized tanks, and separate plumbing systems need to be used. Pipe leakage may also be very expensive to detect and fix.
- **Efficiency in Transportation**: When natural gas is used as a fuel in cars, the mileage is lower than gasoline.
- **Conversion to Hydrogen Fuel**: A drawback in producing hydrogen from natural gas is that efficiency drops to almost 50% compared to the original chemical energy.

Conclusion:

Despite the disadvantages, it is remarkable that the entire cycle of producing, processing, transporting and using natural gas provides us with a total energy efficiency of almost 90%. With new drilling techniques and effective mitigation norms we can have inexpensive energy and a cleaner environment, however, over-exploitation of any resource is bound to have its own repercussions.

2. Examine the potential of oceans as world's next resource frontier. In this light, explain the concept of blue economy.

Introduction

Blue economy is a term in economics relating to the exploitation and preservation of the marine environment. Its scope of interpretation varies among organizations.

Facts:

- The oceans cover 71 percent of the Earth's surface and contain 97 percent of the Earth's water. Less than 1 percent of the Earth's water is fresh water, and 2-3percent is contained in glaciers and ice caps. The oceans contain 99 percent of the living space on the planet.
- The worldwide ocean economy is valued at around valued at around US$1.5 trillion per year.
- Eighty per-cent of global trade by volume is carried by sea.

- 350 million jobs world-wide are linked to fisheries.
- By 2025 it is estimated that 34% of crude oil production will come from offshore fields.

Body

Potential of oceans:

- **Fishing:** Fisheries of today provide about 16% of the total world's protein with higher percentages occurring in developing nations. The Viking trade of cod and then continuing with fisheries like those found in Europe, Italy, Portugal, Spain and India.
- **Shipping:** It is safe and profitable for economies around the world.
- **Maritime transport:** Maritime transport can be realized over any distance by boat, ship, sailboat or barge, over oceans and lakes, through canals or along rivers. Shipping may be for commerce, recreation, or for military purposes.
- **Tourism:** Tourism is in the top five economic contributors to 83% of all countries and the most important economy for 38% of countries.
- **Entertainment and leisure**: Sea angling from boats, sea angling from the shore, sailing at sea, boating at sea, water skiing, jet skiing, surfing, sail boarding, sea kayaking, scuba diving, swimming in the sea, bird watching in coastal areas, whale/dolphin watching, visiting coastal natural reserves, trips to the beach, seaside and islands.
- **Mining**: Metal compounds, gravels, manganese nodules, sands and gas hydrates are mined in the ocean. Example: South China Sea. Example: English channel, Suez canal
- **Renewable energy:** Offshore wind power or offshore wind energy is the use of wind farms constructed in bodies of water, usually in the ocean on the continental shelf, to harvest wind energy to generate electricity. Example: Tamilnadu coastline, Hywind in Scotland.
- **Petroleum and natural gas**: Underwater petroleum and natural gas deposits were created millions of years ago when tiny sea plants and animals died and were turned into hydrocarbons. Example: Gulf of Cambay, Gujarat
- **Oxygen production:** Phytoplankton accounts for possibly 90% of the world's oxygen production because water covers about 70% of the Earth and phytoplankton are abundant in the photic zone of the surface layers.
- **Bio prospecting:** It is the process of discovery and commercialization of new products based on biological resources. These resources or compounds can be important for and useful in many fields, including pharmaceuticals, agriculture, bioremediation, and nanotechnology, among others.
- **Submarine communications cable:** It is a cable laid on the sea bed between land-based stations to carry telecommunication signals across stretches of ocean and sea.
- **Natural shield:** oceans provide protection and development of more intangible 'blue' resources such as traditional ways of life, carbon

sequestration, and coastal resilience to help vulnerable states mitigate the often devastating effects of climate change.

Challenges:

- Current economic trends that have been rapidly degrading ocean resources.
- The lack of investment in human capital for employment and development in innovative blue economy sectors.
- Inadequate care for marine resources and ecosystem services of the oceans.
- Ships release air pollutants in the form of sulphur dioxide, nitrogen oxides, carbon dioxide, hydrocarbons and carbon monoxide.

Conclusion

According to the World Bank, the blue economy is the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem". The cooperation towards conservation and sustainable use of the oceans, seas and marine resources are outlined in the goal 14 of the Sustainable Development Goals (SDG 14- "life below water")

3. Explain the concept of biodiversity as a scarce resource. What are the ongoing and potential impacts of biodiversity loss on the resource front? Examine.

Introduction

Biodiversity can be defined as 'the variety of life forms, the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form'

Body

Biodiversity as a scarce resource:

- Biodiversity underpins the health of the planet and has a direct impact on all our lives. It provides Ecosystem services. That could be water, soil formation and protection, pollution breakdown and absorption, climate stability and recovery from natural disasters.
- According to IUCN, the World Conservation Union, the monetary value of goods and services provided by ecosystems is estimated to amount to some US$33 trillion per year.
- Biodiversity changes affect ecosystem functioning and significant disruptions of ecosystems can result in life sustaining ecosystem goods and services.

Impacts of biodiversity loss on the resource front:

Food security:

- Put simply, reduced biodiversity means millions of people face a future where food supplies are more vulnerable to pests and disease, and where fresh water is in irregular or short supply.

- About 100 million metric tonnes of aquatic life, including fish, molluscs and crustaceans are taken from the wild every year.
- Meat from wild animals forms a critical contribution to food sources and livelihoods in many countries, especially those with high levels of poverty and food insecurity.

Biodiversity loss also means that we are losing, before discovery, many of nature's chemicals and genes, of the kind that have already provided humankind with enormous **health benefits.**

Nutritional impact of biodiversity

- Nutritional composition between foods and among varieties/cultivars/breeds of the same food can differ dramatically, affecting micronutrient availability in the diet.
- Healthy local diets, with adequate average levels of nutrients intake, necessitates maintenance of high biodiversity levels.

Importance of biodiversity for health research and traditional medicine:

- Traditional medicines are estimated to be used by 60% of the world's population and in some countries are extensively incorporated into the public health system.
- Medicinal plant use is the most common medication tool in traditional medicine and complementary medicine worldwide. Medicinal plants are supplied through collection from wild populations and cultivation.

Loss of Livelihood

- Many communities rely on natural products collected from ecosystems for economic, cultural and medicinal purposes, in addition to food.

Others

Biodiversity also provides

- Raw materials Eg. Clothing,
- Cultural identity of tribes,
- Opportunities for recreation, tourism,
- Scientific research and education etc.,

Conclusion

It is the poor, particularly those in developing and emerging economies, who stand to suffer the most from the loss of ecosystem services. Preserving biodiversity is thus necessary if we are to fight global poverty and attain the Sustainable Development Goals.

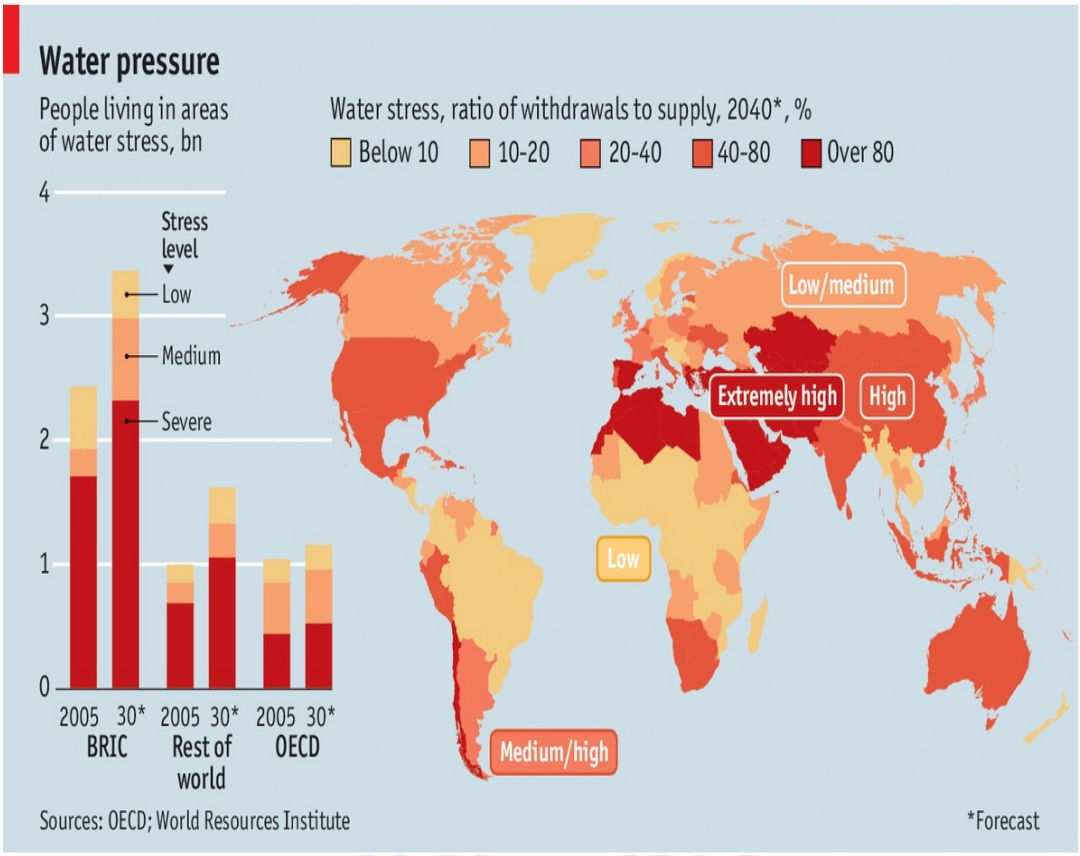
4. Which parts of the world are suffering from acute water scarcity? It is being feared that the situation will worsen even further? Why? Analyse.

Introduction

Water touches every aspect of development and it links with nearly every Sustainable Development Goals (SDG).It drives economic growth, supports healthy ecosystems, and is essential and fundamental for life itself. Niti Aayog in its Composite Water Management Index Report highlights the fact that about 600 million Indians are about to face water scarce condition by 2030.

Body

Water scarcity conditions can be observed in the picture given below:



Cape Town, Karachi water crisis has adversely affected the locals, and caught global attention. Even India is not immune from this, recent Chennai water crisis is one such example.

Worsening future:

- Increasing Demand- Population growth, Industrialization, Urbanization etc would add on to the present crisis.
- Overexploitation of groundwater- Almost 50% of world population depends upon groundwater for its drinking needs. In India, almost 85% of underground water is used for agriculture and with the provisions such as free electricity, the depletion is taking place rapidly.
- Changing rainfall pattern- this can be seen by the delays in monsoon, reduced pre-monsoon rains and prevalent drought conditions.

- Water Pollution- this has been leading to eutrophication of surface water and contamination of groundwater.
- Poor water harvesting practices- water management has been really poor, poor implementation of water harvesting provisions in building codes.

Way Forward-

- Water harvesting practices- Encouraging the water harvesting movement, mandatory provisions for water conservation in building codes.
- River water Interlinking- this can reduce the disparity among regions and minimize the effects of drought and floods.
- Discouraging wasteful activities- can learn from "Day Zero" by Cape Town, where water taps in city are turned off and people had to use communal water taps to conserve water. Recently, the Central Ground Water Authority (CGWA) has come up with guidelines for Water Conservation Fee (WCF), which has the potential to reduce wasteful use of water.

Conclusion

Recently government has constituted Jal Shakti Ministry and started #JalShaktiAbhiyan mass movement to encourage water conservation and sustainability. Even the recent letter written by Prime Minister to all sarpanchs, to undertake water conservation at village level is believed to bring behavioural change at local level.

Additional Information

- Water stressed condition- when annual per capita water availability is less than 1700 cubic metres.
- Water scarcity condition- when annual per capita water availability is less than 1000 cubic metres.
- Annual per capita water availability in India- 1545 cubic metres (2011), 1300 cubic metres (2030- Estimated by Niti Aayog).
- 21 Indian cities including Delhi, Bengaluru, Chennai will run out of groundwater by 2020 (Niti Aayog CWMI Report).
- Water is a state subject.
- India is home to 16 percent of world population but has only 4% of planets fresh water.
- IPCC Report 2014 warned that around 80% of world population suffers a severe threat to its water security.

Q5. Can outer space be considered a resource? How? What measures must be taken to ensure that space doesn't meet the fate of forests and oceans?
Introduction:

Space, also known as outer space, is the near-vacuum between celestial bodies. It is where everything (all of the planets, stars, galaxies and other objects) is found. On Earth, space begins at the Karman line (100 km above sea level). This is where Earth's atmosphere is said to stop and outer space begins.

Body:

Outer Space as Resource:

Space exploration and development have been stimulated by a complex mixture of motivations, including scientific inquiry, intense competition between national governments and ideologies, and commercial profit. Underlying them has been a vision of the outward movement of humans from Earth, ultimately leading to permanent settlements in space or on other celestial bodies. There are multiple applications of space technologies in various sectors. It will cover agriculture, education, weather forecasting, rural health, telecommunications, urban development, sanitation, resource mapping navigation, remote sensing and any other areas.

Issues Related to Outer space:

- **Space debris:** A satellite that is destroyed by a missile disintegrates into small pieces, and adds to the space debris. The free-floating space debris is a potential hazard for operational satellites and colliding with them can leave the satellites dysfunctional.
- **Weaponisation of outer space:** Weaponization of outer space emerges as the battleground, sometimes referred to as the "fourth frontier of war". This includes placing weapons in outer space or on heavenly bodies as well as creating weapons that will transit outer space or simply travel from Earth to attack or destroy targets in space. Examples include the placing of orbital or suborbital satellites to attack enemy satellites.
- **Space traffic:** With countries launching more and more satellites, this may lead to traffic in satellite orbits and may lead to collisions in future.

Global Rules related to Space:

International treaties are governing the use of space that mandate that outer space and celestial bodies like the Moon, must only be exploited for peaceful purposes. Some relevant international treaties that address aspects of the outer space issue are

- **Outer Space Treaty, 1967:** The Outer Space Treaty prohibits only weapons of mass destruction in outer space, not ordinary weapons.
- **Limited Test Ban Treaty of 1963:** It prohibits nuclear tests and any other nuclear explosions in the atmosphere or outer space
- **Astronauts Rescue Agreement of 1968:** It requires the safe return of astronauts and objects launched into space to their country of origin;
- **Liability Convention of 1972:** It establishes procedures for determining the liability of a state that damages or destroys space objects of another state;
- **Registration Convention of 1976:** It requires the registration of objects launched into space

- **Moon Agreement of 1984:** It took the first steps to establish a regime for exploiting the natural resources of space.

Way Forward:

- The Outer Space Treaty should ban all military activities within space or the weaponization of space.
- Space, however, must be used only for peaceful purposes and any weaponisation of Outer Space should not be tolerated in the larger interest of people.
- The safety and security of space-based assets should be ensured through international cooperation.
- Need for formulating a comprehensive treaty for preventing outer space from becoming a domain for testing destructive devices. This will include the formation of a global regulatory regime to address the growing militarization in space.
- Bring transparency and build confidence among nations.
- Mitigating problems such as space debris by using technologies like Harpoon and Net capture.
- Innovation and R&D for clearing space debris. Launch of more missions like Remove Debris.