Rapid Expansion of Himalayan Glacial Lakes

For Prelims: National Green Tribunal (NGT), glacial lake outburst floods (GLOFs), EWS, Hindu Kush Himalayas, Synthetic-Aperture Radar imagery,

For Mains: National Green Tribunal (NGT), glacial lake outburst floods (GLOFs), NDMA (National Disaster Management Authority), EWS, National Disaster Response Force (NDRF), ITBP

Source: TH

Why in News?

The **National Green Tribunal (NGT)**, taking suo motu cognisance of a news report, has recently issued a notice to the central government regarding the alarming increase in Himalayan **glacial lakes**, which have expanded by approximately 10.81% over the past 13 years due to rising temperatures.

What are Glacial Lakes?

- **About:** A glacial lake is a water body formed from a glacier, usually located at its base, but it can also develop on, within, or beneath the glacier.
- **Formation:** Glacial lakes form when glaciers erode the land, creating depressions that fill with meltwater as the glacier retreats.
    - Natural dams, made of ice or moraines, can also form glacial lakes, but these dams can be unstable and prone to bursting, leading to potential flooding.
- **Glacial Lake Expansion:** The NGT highlighted the report's finding that the surface area of glacial lakes in India has **increased by 33.7% from 2011 to 2024**, with **67 lakes identified as high-risk for GLOFs (glacial lake outburst floods)**.
    - This poses a significant threat to infrastructure and human lives in regions like **Ladakh, Himachal Pradesh, Uttarakhand, Sikkim**, and **Arunachal Pradesh**.
- **Causes of Glacial Lake Expansion:**
    - **Global warming** is raising temperatures in the Himalayas, which accelerates **glacier melting.**
    - **Retreating glaciers** contribute water to lakes and expose new land surfaces, facilitating the formation of new glacial lakes.
    - **Thawing permafrost** creates water-collecting depressions, expanding glacial lakes as it loses its natural drainage barrier.

What is a GLOF?

- A **glacial lake outburst flood (GLOF)** occurs when a glacial lake's dam fails, releasing large volumes of water, often due to rapid glacier melting or heavy precipitation.
- These floods can be triggered by glacier volume changes, lake water level fluctuations, and earthquakes.
    - According to the **National Disaster Management Authority**, climate change-induced glacial retreat in the **Hindu Kush Himalayas** has created many new glacial lakes, leading

to GLOFs.

- **Cases of GLOF in India**
  - In June 2013, Uttrakhand had received an unusual amount of rainfall leading to the melting of the Chorabari glacier and the eruption of the Mandakini river.
  - In August 2014, a glacial lake outburst flood hit the village of Gya in Ladakh.
  - In October 2023, the South Lhonak Lake, a glacial lake located at an altitude of 17,000 feet in the state's northwest, experienced a rupture as a result of continuous rainfall.

What are the Concerns of the Rapid Expansion of Glacial Lakes in the Himalayas?

- **Impact on Downstream Communities:** Communities downstream face **displacement, loss of life**, and **property damage**, with agriculture severely affected by floods.
  - Many high-risk lakes lack monitoring and early warning systems, leaving communities unprepared.
  - The **NGT highlighted** this issue for **67 lakes in Ladakh**, **Himachal Pradesh**, and **Uttarakhand**, pointing to weak enforcement of disaster preparedness laws.
- **Feedback Loop:** Rising global temperatures **accelerate glacial retreat**, expanding glacial lakes and increasing risks.
  - The **IPCC's 6th Assessment Report** highlights the unprecedented rate of Himalayan glacier retreat, worsening climate-induced hazards.
- **Infrastructure Vulnerability:** Critical infrastructure like **roads, bridges**, and **hydropower plants** are vulnerable to GLOF-induced floods, causing significant damage, economic losses, and delays in development.
- **Ecosystem and Biodiversity Disruption:** Floods from glacial lakes alter sedimentation and water flows, impacting aquatic biodiversity and disrupting habitats, as seen in the **2023 Sikkim floods** affecting downstream river ecosystems.
- **Triggering Secondary Disasters:** The destabilization of slopes due to melting ice and increased water pressure can trigger landslides. Apart from GLOFs and landslides, the rapid expansion of glacial lakes can also lead to:
  - **Debris Flows:** As glaciers retreat, they expose loose material that can be mobilized during heavy rainfall or seismic activity, causing debris flows that threaten settlements.
  - **Erosion:** Increased water levels in glacial lakes can accelerate bank erosion, leading to habitat destruction and loss of arable land.
- **Climate Change Impact:** The increase in glacial lakes is directly linked to climate change, particularly **rising temperatures** leading to accelerated glacier melting.
  - The Himalayan glaciers, crucial for rivers like the **Yangtze and Ganges**, support over a billion people, **highlighting significant environmental changes** affecting water resources and ecosystems.

What Risk Mitigation Strategies can be Adopted to Address Glacial Lake Expansion?

- **Enhanced Monitoring Systems:** Establishing comprehensive monitoring systems for glacial lakes is crucial. This includes **satellite surveillance** and **ground-based assessments** to track changes in lake volume and surface area, enabling timely responses to emerging threats.
  - Promoting use of **Synthetic-Aperture Radar imagery** (a form of radar that is used to create two-dimensional images) to automatically detect changes in water bodies, including new lake formations, during the monsoon months.
- **Early Warning Mechanisms:** Developing **early warning systems for GLOFs** can significantly reduce disaster risks. These systems should integrate **meteorological data with hydrological models** to predict potential outburst events and communicate risks effectively to local communities.
- **Transboundary Water Management:** Given that many Himalayan rivers cross national borders, international cooperation is essential for effective management of water resources affected by

glacial changes.
    - **Collaborative frameworks** can help share data, best practices, and resources among neighboring countries.
- **Funding and Resource Mobilisation:** Engaging with international organizations for funding can support infrastructure development aimed at mitigating disaster risks associated with glacial lake expansion.
    - This includes investments in resilient infrastructure and sustainable practices that align with global climate goals. One such example is **Coalition for Disaster Resilient Infrastructure (CDRI).**
- **Training Local Manpower:** Apart from pressing specialised forces such as **National Disaster Response Force (NDRF)**, the NDMA emphasises the need for trained local manpower.

Drishti Mains Question

Discuss the implications of rapid expansion of Himalayan glacial lakes on natural disaster risks in India. What measures should be taken to mitigate these risks while ensuring compliance with environmental regulations?

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. When you travel in Himalayas, you will see the following: (2012)

1. Deep gorges
2. U-turn river courses
3. Parallel mountain ranges
4. Steep gradients causing land sliding

Which of the above can be said to be the evidence for Himalayas being young fold mountains?

(a) 1 and 2 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

Ans: (d)

Mains

Q. Dam failures are always catastrophic, especially on the downstream side, resulting in a colossal loss of life and property. Analyze the various causes of dam failures. Give two examples of large dam failures. (2023)

Q. Bring out the causes for more frequent landslides in the Himalayas than in Western Ghats. (2013)

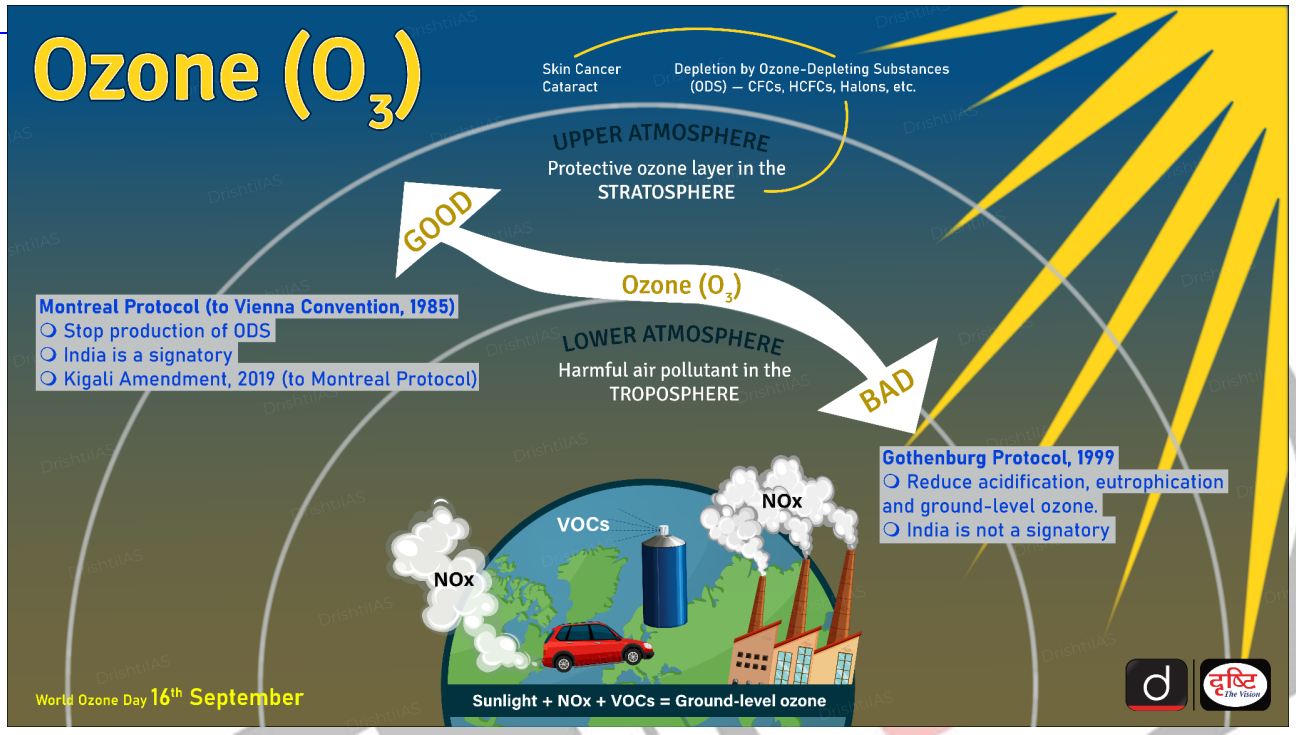
Ground Level Ozone Pollution

Source: PIB

Why in News?

Recently, the Ministry of Environment, Forest and Climate Change (MoEF&CC) highlighted the **steps being taken to control Ground Level Ozone Pollution(GLOP) in India.**

//



What is Ground Level Ozone Pollution?

- **Ground Level Ozone Pollution:** Ground-level **ozone (O_3)** pollution refers to the excess presence of **ozone at the Earth's surface,** which is formed through chemical reactions in the atmosphere.
  - Unlike the ozone layer in the stratosphere, which protects life from harmful ultraviolet radiation, ground-level ozone is a harmful pollutant that poses significant health risks and environmental damage.
- **Formation of Ground Level Ozone:** Ground-level ozone is a **secondary pollutant,** meaning it is not directly emitted but **formed through chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs).**
  - NOx (emitted by vehicles, power plants, and industrial processes) and VOCs (emitted from vehicles, petrol pumps, solvents, and waste burning).
  - These reactions occur in the **presence of sunlight,** making ozone formation more significant during sunny days and warmer seasons.
- **Regulation:** The **Central Pollution Control Board (CPCB**) in India has set **National Ambient Air Quality Standards (NAAQS) for ozone,** including an **8-hour average limit of 100 µg/m³ and a 1-hour limit of 180 µg/m³.**
  - Ground-level ozone is monitored under the **National Air Quality Monitoring Programme (NAMP),** managed by CPCB in collaboration with **State Pollution Control Boards (SPCBs)** and the **National Environmental Engineering Research Institute (NEERI).**
- **Impact:**
  - **Health Effects:** Ground-level ozone causes **respiratory issues** and worsen conditions like **asthma and heart disease.** Chronic exposure may reduce lung capacity, cause permanent damage.

    - By 2050, ozone exposure could lead to over a million deaths in India if emissions are not controlled.
    - **Environmental Impact:** Ozone damages crops, reducing agricultural productivity, and harms forests by inhibiting growth and photosynthesis.
- **Measures to Control GLOP:**
    - **Ozone Depleting Substances (ODS):** MoEF&CC has notified the **Ozone Depleting Substances (Regulation and Control) Rules, 2000,** to regulate the use, import, and export of ODSs in India.
        - ODS, like **Chlorofluorocarbons (CFCs)**, harm the ozone layer. They are **stable in the troposphere** but break down under UV light in the **stratosphere**, leading to ozone depletion.
    - **Cleaner Fuels**: The government has encouraged the use of **Compressed Natural Gas, Liquefied Petroleum Gas,** and **ethanol-blended fuels** to reduce vehicular and industrial emissions.
    - **Vapour Recovery Systems (VRS)**: Installation of VRS at petrol pumps, particularly in Delhi-NCR, to minimize VOC emissions during refueling operations.
    - **PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM-E Drive)**
    - **Electric vehicles (EVs)**
    - **National Clean Air Programme (NCAP**
    - **Bharat Stage - VI(BS-VI) compliant vehicles**

Air Pollutants

Sulphur Dioxide (SO_2)

It comes from the consumption of fossil fuels (oil, coal and natural gas). Reacts with water to form acid rain.

Impact: Causes respiratory problems.

Ozone (O_3)

Secondary pollutant formed from other pollutants (NOx and VOC) under the action of the sun.

Impact: Irritation of the eye and respiratory mucous membranes, asthma attacks.

Nitrogen Dioxide (NO_2)

Emissions from road transport, industry and energy production sectors. Contributes to Ozone and PM formation.

Impact: Chronic lung disease.

Carbon Monoxide (CO)

It is a product of the incomplete combustion of carbon-containing compounds.

Impact: Fatigue, confusion, and dizziness due to inadequate oxygen delivery to the brain.

Ammonia (NH_3)

Produced by the metabolism of amino acids and other compounds which contain nitrogen.

Impact: Immediate burning of the eyes, nose, throat and respiratory tract and can result in blindness, lung damage.

Lead (Pb)

Released as a waste product from extraction of metals such as silver, platinum, and iron from their respective ores.

Impact: Anemia, weakness, and kidney and brain damage.

Particulate Matter (PM)

PM10: Inhalable particles, with diameters that are generally 10 micrometers and smaller.

PM2.5: Fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

Source: Emitted from construction sites, unpaved roads, fields, fires.

Impact: Irregular heartbeat, aggravated asthma, decreased lung function.

Note: *These major air pollutants are included in the Air quality index for which short-term National Ambient Air Quality Standards are prescribed.*

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. Consider the following: (2019)

1. Carbon monoxide
2. Methane
3. Ozone
4. Sulphur dioxide

Which of the above are released into atmosphere due to the burning of crop/biomass residue?

(a) 1 and 2 only
(b) 2, 3 and 4 only
(c) 1 and 4 only
(d) 1, 2, 3 and 4

Ans: (d)

Capacity Building Program

Source: PIB

Recently, the **6th** edition of the **Capacity Building Program** for **Sri Lankan Civil Servants** commenced at the **National Centre for Good Governance (NCGG)** in Mussoorie.

- The program hosted 40 mid-career civil servants from Sri Lanka, focusing on **governance, policy frameworks, AI in governance,** and India's successful models in **public administration.**
- **NCGG:** It was established in **2014** by the Government of India as an **autonomous institution** under the **Ministry of Personnel, Public Grievances, and Pensions.**
    - It evolved from the **National Institute of Administrative Research (NIAR)**, founded in **1995** by the **Lal Bahadur Shastri National Academy of Administration (LBSNAA)**.
    - NIAR was later integrated and renamed as NCGG, which focuses on training civil servants from India and **over 20 countries**, covering diverse topics like governance reforms, **Digital India, SVAMITVA, SDGs**, and Ayushman Bharat.

Read More: Capacity Building Program at NCGG Mussoorie

---

ecDNA Challenging Genetics Principles

Source: TH

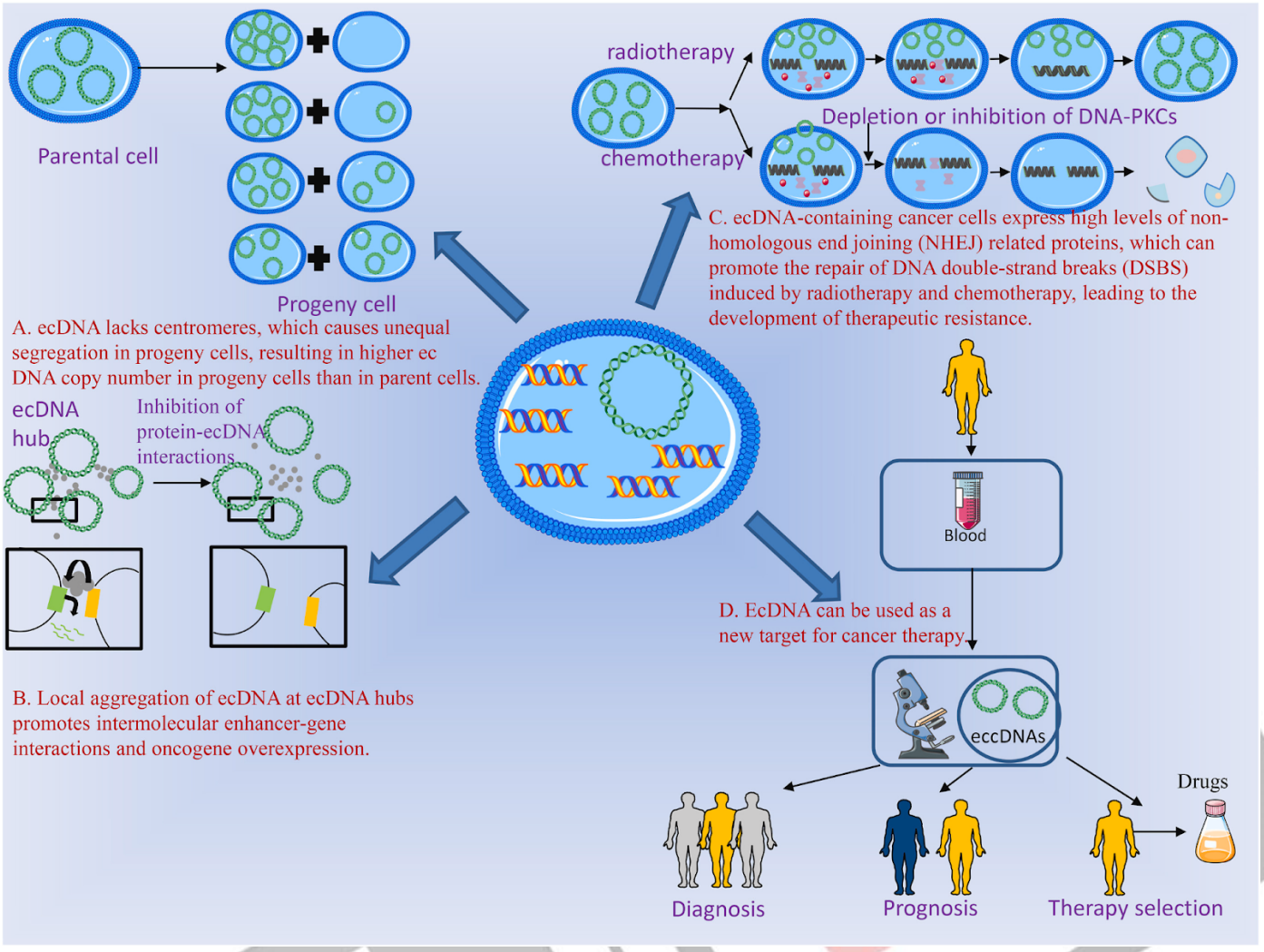
Why in News?

Recently, a study published in ***Nature*** has revealed that **extrachromosomal DNA (ecDNA)**, a previously overlooked component of **genetic material**, plays a significant role in **cancer progression and drug resistance**.

- These findings challenge the conventional understanding of genetics and open new avenues for understanding and treating cancer.

What is ecDNA and How It Challenges Conventional Genetic Principles?

- **About: ecDNA** is a type of **DNA** that **exists outside of chromosomes** in the nucleus of cells.
  - **DNA** stores **genetic information** crucial for an organism's growth, function, and reproduction. In eukaryotic cells, it is coiled into **chromosomes**.
  - Humans have **23 pairs of chromosomes**, with genes on them encoding proteins and determining traits.
- **Formation: ecDNA** forms when **portions of DNA break away from chromosomes** due to processes like **chromothripsis** (chromosomes are broken and rearranged) or **errors** in DNA replication, creating **circular structures** that exist independently within the nucleus.
- **Significance:** ecDNA is commonly **found** in **cancer cells**, where it can contain **multiple copies of oncogenes**, contributing to **tumor growth, genetic diversity**, and **drug resistance.**
- **Challenges to Conventional Law of Genetics:** The conventional principles of genetics are primarily based on **Mendelian inheritance** and the **chromosomal theory of inheritance**, which is challenged by **ecDNA in following ways:**
  - **Disruption of Random Gene Distribution:** Traditional genetics holds that genes are distributed randomly and independently during cell division. ecDNA **defies this principle by forming clusters of multiple genes** that are passed as intact packages, allowing cancer cells to inherit advantageous genetic combinations reliably.
  - **Facilitated Inheritance of Oncogenes:** ecDNA clusters often contain **oncogenes (genes promoting cancer growth)** and other regulatory elements that support tumor survival. This grouping ensures that **cancer cells can inherit and amplify beneficial traits** in a non-random, purpose-driven manner, enhancing their adaptability and resistance to treatments.
  - **Preservation of Favorable Genetic Combinations:** Chromosomes undergo crossing over and recombination during meiosis, leading to genetic diversity. In contrast, **ecDNA preserves specific advantageous** combinations without recombination, maintaining traits critical for tumor progression.



How ecDNA Contributes to Cancer and Drug Resistance?

- ecDNA can carry **multiple copies of oncogenes**, leading to **increased expression of cancer-promoting genes** and **tumor growth.**
    - It can take **regulatory elements (enhancers)** from other parts of the **genome**, causing **abnormal gene activity** that promotes cancer.
- The **non-Mendelian inheritance of ecDNA** creates **genetic diversity within tumors**, complicating targeted treatments.
- ecDNA can **increase the number of genes that help cancer cells pump out drugs** or **change their targets,** making it harder for chemotherapy to work.
    - It allows **cancer cells to quickly develop new mutations**, helping the **tumor resist treatment** and adapt to drugs.

Mendel's Laws of Genetics on Inheritance of Traits

- **Law of Dominance:** Dominant traits always express if present; recessive traits appear only when both gene copies are recessive.
- **Law of Segregation:** Each parent passes one gene copy to offspring during gamete formation.
- **Law of Independent Assortment:** Genes for different traits are inherited independently, unless located close on the same chromosome.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelim:

Q. Consider the following statements:

1. Genetic changes can be introduced in the cells that produce eggs or sperms of a prospective parent.
2. A person's genome can be edited before birth at the early embryonic stage.
3. Human induced pluripotent stem cells can be injected into the embryo of a pig.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 2 only
(d) 1, 2 and 3

Ans: (d)

Inequality and the Role of Charitable Organizations

For Prelims: Care Economy, LPG Reforms, Foreign Contribution (Regulation) Act, Pradhan Mantri Awas Yojana, Ayushman Bharat, Direct Benefit Transfers (DBT), Sustainable Development Goal 10

For Mains: Economic Inequality in India, Role of Philanthropy in Addressing Inequality, Role of Government in Wealth Redistribution

Source: TH

Why in News?

Warren Buffett (considered to be the greatest investor of all time) has donated over USD 52 billion to **charities,** emphasizing his belief that wealth should help equalize opportunities rather than **perpetuate inequality.**

- His philosophy aligns with **luck egalitarianism** and has sparked debates about the role of **charitable organizations** in addressing inequality.

Note: A charitable organization is an organization whose primary objectives are **philanthropy and social well-being** (e.g. educational, religious or other activities **serving the public interest or common good).**

How Does Buffett's Philosophy Align with Luck Egalitarianism?

- **Luck Egalitarianism:** Warren Buffett's philosophy aligns with **luck egalitarianism,** which argues that **inequalities from unchosen circumstances, like birthplace or socio-economic status,**

are unjust and should be mitigated.
    - Buffett credits his success to both personal effort and structural advantages, like being born a white male in a prosperous US economy, believing his opportunities came from being in the **"right place at the right time."**
    - Researchers support this view, noting that **birthplace and national economic conditions** significantly influence individual wealth potential.
- **Philanthropy as Moral Responsibility:** Philanthropy, as a practical application of luck egalitarianism, redistributes resources to equalize opportunities.
    - Accumulating wealth across generations **perpetuates inequality and undermines meritocracy.** Using surplus wealth to create opportunities for the disadvantaged ensures fairness in societal outcomes.

What are the Factors Contributing to Inequality?

- **Economic Factors:**
    - **Neoliberal Policies**: Since the 1980s, deregulation, **privatization,** and reduced state intervention have **concentrated wealth among a small elite,** leaving wages stagnant for the majority.
        - In India, **LPG (Liberalization, Privatization, Globalization) reforms** have boosted growth but also led to wealth concentration and stagnant wages.
            - The **'World Inequality Report 2022'** shows India's extreme inequality, with the **top 10% and 1% holding 57% and 22%** of national income, while the **bottom 50% share is just 13%.**
        - Globally, **71% of the population lives in countries with worsening inequality.**
    - **Monopolies**: Dominance by a few corporations stifles competition, leading to **higher profits for a few** and limited opportunities for others.
        - Companies like **Amazon, Microsoft, and Google** have amassed significant wealth through **near-monopolistic power,** often **undermining fair competition.**
    - **Financialization**: Growth in financial markets benefits investors and shareholders while sidelining wage earners.
        - Since the **2008 financial crisis,** the number of billionaires has nearly doubled.
            - Rising incomes for the wealthiest drive inequality. In 2018, the **26 richest people owned as much wealth as the poorest 3.8 billion (half of the global population).**
- **Technological Factors:** Technological advances **benefit high-skilled workers, displacing low-skilled ones.** Limited access to technology and the internet restricts opportunities for marginalized communities.
- **Social Factors:** Women face wage gaps, limited leadership roles, and a heavy burden of **unpaid care work.**
    - Minority groups encounter racial and ethnic discrimination in employment.
    - In India, **caste, religion, and class hierarchies** hinder upward mobility for marginalized groups. **People with disabilities** face discrimination, limited job opportunities, and higher healthcare costs.
- **Health Inequalities:** Limited healthcare access, **chronic illness**, and **malnutrition** hinder productivity and development, perpetuating **poverty** in low-income and marginalized communities.
- **Governance:** Policy choices on taxation, welfare, and market regulation shape wealth distribution. **Corruption diverts resources,** worsening inequality, while weak labor rights contribute to wage stagnation and poor working conditions.
- **Environmental Factors:** **Climate change** and resource scarcity disproportionately harm poorer communities, while **environmental injustice** leaves marginalized groups exposed to pollution and poor health outcomes.

What is the Role of Charitable Organization in Addressing Inequality?

- **Providing Immediate Relief:** Charitable organizations provide essential services like **food, shelter, healthcare, and education** to those affected by poverty and inequality, offering **short-term relief** and helps bridge the gap where government programs or markets are

insufficient, and support marginalized communities.

- **Social Awareness and Advocacy:** Charitable organizations advocate for **policy changes by raising awareness about social injustices,** helping to inform the public and encourage reforms.
    - For example, they may campaign for **gender equality, workers' rights, or access to healthcare,** influencing public opinion and policy.
- **Wealth Redistribution:** Charitable organizations help redistribute wealth by funding programs that address inequality, such as **poverty alleviation, education, and healthcare.**
    - For example, Bill and Melinda Gates have donated billions to global health and education initiatives to reduce inequality.
- **Supporting Long-Term Development:** Some charitable organizations focus on long-term solutions like **sustainable agriculture, microloans, and local entrepreneurship,** empowering women and communities.
    - Tata Trusts' Lakhpati Kisan Initiative empowers tribal farmers with improved agricultural practices to create **sustainable livelihoods.**

Laws Governing Charitable Organizations in India

- **Income Tax Act, 1961**: Provides **tax exemptions** for charitable donations and defines "charitable purposes."
- **Constitution of India (Article 19(1)(c))**: Citizens have the freedom to form social, cultural, economic, or political associations or unions.
- **Indian Trusts Act, 1882**: Governs private charitable trusts.
- **Societies Registration Act, 1860**: Regulates charitable societies.
- **Companies Act, 1956 (Section 25)**: Allows **non-profit companies** to operate as charities.
- **Foreign Contribution (Regulation) Act, 2010**: Charitable organizations can receive foreign funds, but they must be registered under the **Foreign Contribution (Regulation) Act, 2010 (FCRA)** to ensure that donations are used for legitimate, non-political purposes.

What are the Limitations of Charitable Organization in Addressing Inequality?

- **Temporary Solution**: Charitable organizations alleviate immediate suffering **but don't address root causes** of **wealth inequality like deregulation and monopolistic practices.**
    - Wealth accumulation by the rich often results from systemic policies. Charity doesn't challenge issues like **stagnant wages and poor working conditions.**
- **Dependency on Individual Will**: Charitable organizations rely on the **voluntary generosity of the wealthy,** making it **inconsistent and insufficient** to address widespread inequality.
- **Perpetuates Status Quo:** Charitable organizations can perpetuate the status quo by giving the **wealthy social legitimacy** without addressing root causes of inequality. It may **reduce pressure for structural reforms,** serving the interests of the rich and maintaining existing power dynamics, delaying **necessary systemic changes.**
- **Lack of Accountability:** Charitable organizations may not be held accountable for the effectiveness of their programs or the long-term impact of their initiatives on reducing inequality.
- **Misuse of Charitable Donations:** Some individuals and organizations use donations to **trusts as a way to evade taxes**.
    - By making large donations to charitable trusts, they can claim tax deductions without the funds being used effectively for the intended charitable purposes.

India’s Initiatives to Address Inequality

- **Pradhan Mantri Jan Dhan Yojana (PMJDY)**
- **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)**
- **Deendayal Antyodaya Yojana- National Urban Livelihoods Mission (DAY-NULM)**
- **Pradhan Mantri Awas Yojana (PMAY)**
- **Ayushman Bharat**
- **Direct Benefit Transfers (DBT)**

- **Swachh Bharat Mission**

Way Forward

- **State-Led Redistribution:** Recognize that charitable organizations cannot substitute for systemic change and **support state-led redistribution.**
    - Advocate for state-led efforts focusing on welfare programs, social safety nets, and sustainable growth to reduce inequality, aligning with **Sustainable Development Goal 10 (reduced inequalities)**. **India as a welfare state,** should spearhead these initiatives.
- **Reform Economic Policies:** Implement **progressive taxation systems** to redistribute wealth and fund public goods. Strengthen antitrust laws to prevent monopolies and ensure fair market competition.
    - Address the root causes of wealth inequality, such as deregulation and neoliberal economic policies.
- **Equity and Opportunity**: Ensuring equal access to resources, technology, and basic services is essential to bridging the divide.
- **Rethink Corporate Practices:** Enforce higher wages, better working conditions, and fair profit-sharing for workers.
- **Promote Global Cooperation:** Address global inequality through international trade reforms, debt relief for poorer nations, and cracking down on tax havens.

Drishti Mains Question:

Discuss the limitations of charity in addressing inequality and whether wealth redistribution through government policies should take precedence over philanthropy.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Mains

Q. Public charitable trusts have the potential to make India's development more inclusive as they relate to certain vital public issues. Comment**. (2024)**

Google's Quantum Computing Breakthrough

Source: BS

Google has unveiled a **new quantum computer** featuring a chip called **Willow**, capable of performing calculations in **under five minutes** that would take the most advanced **supercomputers** over **10 septillion years** (a length of time that exceeds the age of the known universe).

- This achievement, described as "**quantum supremacy**," signifies that Google's quantum computer can perform tasks beyond the reach of traditional computers.
    - However, these tasks, such as generating random numbers, are **primarily theoretical** and lack immediate practical applications like **drug discovery**.
- A significant breakthrough includes surpassing the **"error correction threshold,"** an important milestone toward reducing computational errors and enabling practical applications.
- Scientists are now shifting focus toward achieving "**quantum advantage**," where quantum

computers could drive advancements in practical fields like AI, chemistry, and medicine.

- **Traditional Computing vs Quantum Computing:** Traditional computers process information as **"bits,"** each representing either a 1 or a 0, to perform calculations.
    - In contrast, **quantum computers** leverage **"qubits,"** which can exist as both 1 and 0 simultaneously, harnessing the principles of quantum mechanics.
    - This unique property **allows qubits to exist in multiple states** at once, enabling exponential increases in computational power.

Read More: India & Quantum Computing

Surge in Agricultural Employment

For Prelims: Informal Economy, Services Sector, Manufacturing Sector, Artificial intelligence , Data analytics, Gross Value Added, Production Linked Incentive,

For Mains: Surge in Agricultural Employment and Its Implications, Employment in India, Structural Issues in India's Labor Market

Source: LM

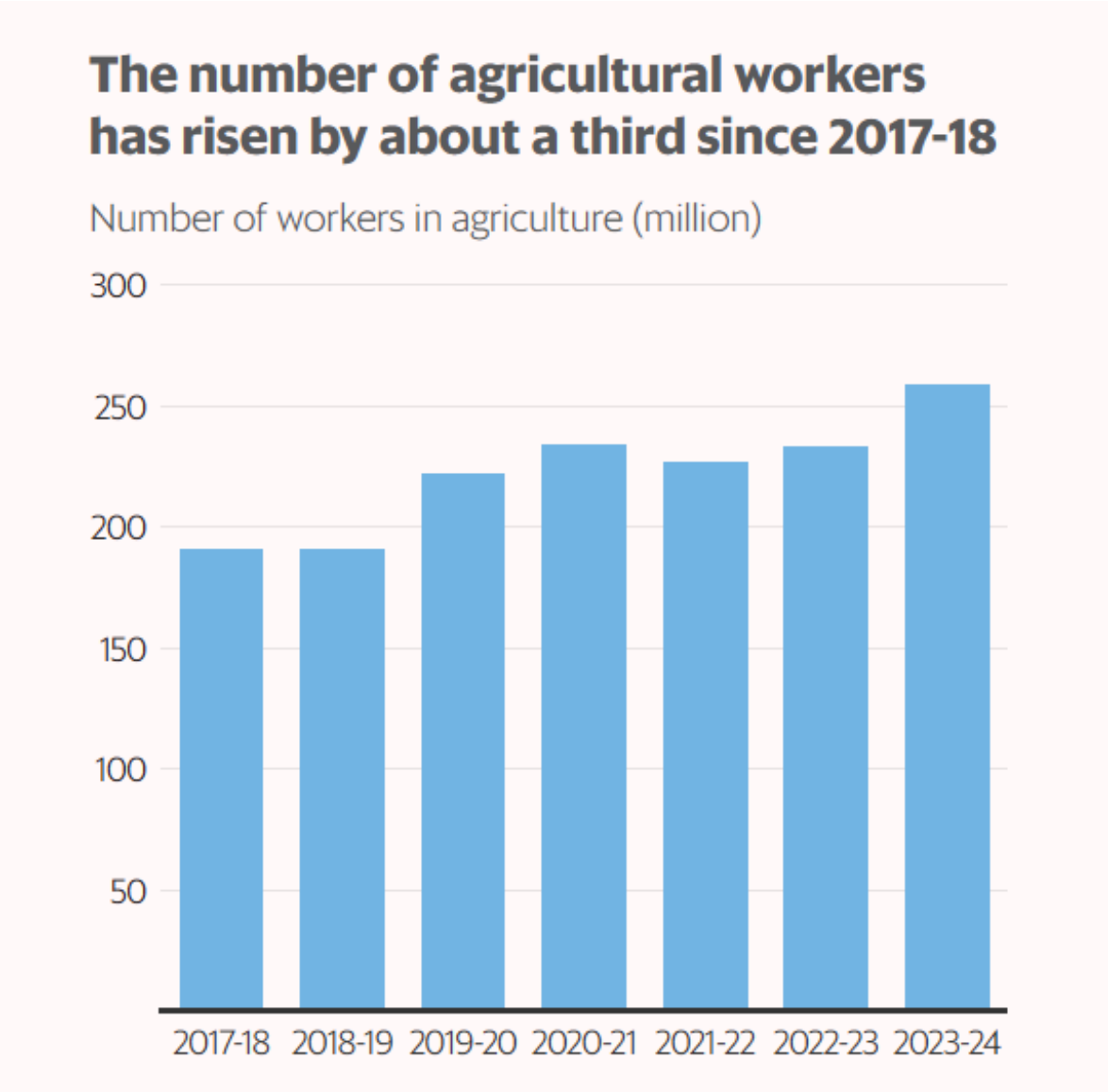
Why in News?

The number of **Indians working in agriculture** has risen significantly by **68 million between 2017-18 and 2023-24,** reversing the earlier trend of workforce decline in the sector.

- This shift, driven primarily by **women workers** and concentrated in **economically weaker states**, raises concerns about structural challenges in the labor market.

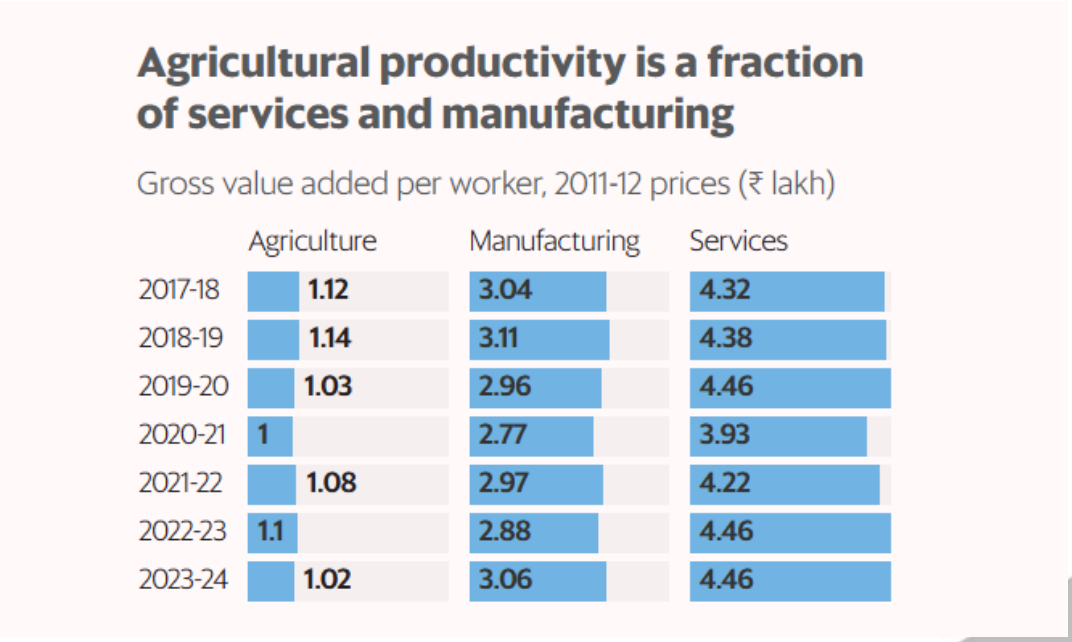
What are the Factors Driving the Surge in Agricultural Employment?

- **Economic Reversal:** After a decline of **66 million** agricultural workers between 2004-05 and 2017-18, India has witnessed a significant increase of **68 million** agricultural workers between 2017-18 and 2023-24, signaling a reversal of this trend.
- **Impact of Covid-19 Pandemic:** Many workers, especially from **urban informal sectors,** returned to family farms during the **lockdowns.** Despite economic recovery, the trend of increased **agricultural employment** persisted.
- **Employment Dynamics:** Agriculture remains a fallback option due to the lack of sufficient non-agricultural job opportunities.
    - The increase in agricultural employment is largely driven by **women,** with their numbers rising by **66.6 million between 2017-18 and 2023-24**, indicating a significant shift in gender dynamics.
- **Economic Conditions in Key States:** The surge in agricultural employment is most notable in economically weaker states like **Uttar Pradesh, Bihar, and Madhya Pradesh**, where limited employment opportunities have **driven higher demand for agricultural labor.**



What are the Concerns Regarding the Surge in Agricultural Employment?

- **Reversal of Economic Transition:** As economies grow, the workforce **generally transitions from agriculture to manufacturing and services** due to higher productivity and better wages.
    - India's reversal of this trend highlights **economic mobility issues,** with workers unable to move from agriculture to more productive sectors.
        - In 2023-24, **agricultural productivity was significantly lower,** with output 4.3 times lower than services and 3 times lower than manufacturing.
    - This indicates that workers are **stuck in low-productivity, low-wage jobs** with limited advancement opportunities.



- **Economic Inefficiency:** The rise in agricultural employment, even during periods of **Gross Domestic Product (GDP) growth,** highlights insufficient job creation in higher productivity sectors.
    - The inability of manufacturing and services to absorb surplus labor reflects structural flaws in India's economic policies.
- **Underemployment in Agriculture:** Many agricultural jobs are **seasonal and low-paying, often indicating underemployment** where people work out of necessity, earning less and working fewer hours than in other sectors.
    - This reliance perpetuates **rural poverty and inequality.** With more people employed than needed, labor is **inefficiently utilized, hindering innovation and mechanization.**
- **Increased Informality:** The surge may increase **informality in the labor market.** Informal workers lack legal protections, healthcare, and **social security,** making them vulnerable to economic shocks and poor conditions.
- **Gender Disparity and Unequal Wages:** The surge in agricultural employment worsens **gender inequalities,** with women **earning less than men in informal, low-paid roles.**
    - This deepens the **gender pay gap,** weakens **rural income stability,** and **reduces women's participation in urban jobs.**
    - Additionally, rural wages have not kept pace with inflation, eroding the purchasing power of agricultural workers.

What Factors Contribute to India's Insufficient Non-Agricultural Employment?

- **Stagnant Manufacturing Sector:** Developed economies traditionally transitioned from **agriculture to manufacturing and then to services** (e.g., China, Korea).
    - India, however, deviated by **highly relying on service sector growth,** with **manufacturing output and employment stuck at 20%,** constraining job creation.
    - While the **Production Linked Incentive (PLI) scheme** aims to generate 60 lakh jobs over five years, it is production-focused rather than employment-focused.
- **Service Sector Growth Challenges:** India's service sector is **polarized,** with high-tech services **(Artificial intelligence**, and **Data analytics)** generating output growth but **low-skilled services(customer service roles) creating most jobs.**
    - Domestic demand for high-tech services is low due to sluggish industrial growth.
    - The **Economic Survey 2023-24** notes that **Generative AI (GenAI),** is poised to disrupt sectors like **Business process outsourcing (BPO)**, potentially reducing employment opportunities over the next decade.
    - Around **10 million jobs must be added annually from 2024-25 to 2029-30 for India**

to sustain a 6.5% year-on-year **Gross Value Added(GVA)** growth.

- **Skill Deficit and Education Quality:** India produces 2.2 million **Science, Technology, Engineering and Mathematics (STEM) graduates** annually, yet many remain unemployable due to poor educational quality.
    - Approximately **8-10 million new workers enter the job market annually, with aspirations unmet by available job opportunities.**
    - With a **median age of 28,** India faces mounting **pressure to create high-value jobs** to avoid turning its **demographic dividend into a burden.**
- **Informal Economy:** The rise in **informal sector** workers post-pandemic reflects economic distress, where workers likely turned to informal work due to the absence of formal employment options.

India's Initiatives for Non-Agricultural Employment

- **Prime Minister's Employment Generation Programme (PMEGP)**
- **Pradhan Mantri Mudra Yojana (PMMY)**
- **Atmanirbhar Bharat Rojgar Yojana (ABRY)**
- **e-Shram Portal**
- **National Career Service (NCS)**
- **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)**
- **Pradhan Mantri Garib Kalyan Rojgar Abhiyaan (PMGKRA)**

Way Forward

- **Non-Agricultural Employment:** Enhance investment in manufacturing and service sectors to create high-productivity jobs.
    - Leverage schemes like **Make in India** and **Skill India** to develop employable skills in rural areas.
- **Gender-Specific Interventions:** Ensure **pay parity for women** in agriculture through better wage policies. Promote women-centric self-help groups and entrepreneurship opportunities.
    - By 2050, the elderly population will reach 34.7 crore, requiring significant **care services.** Investing in the care economy could **boost female labor participation** and create 11 million jobs with 2% of GDP investment.
- **Increase Agricultural Productivity:** Promote mechanization and modern farming techniques to raise productivity. Expand initiatives like **Digital Agriculture Mission** for better resource management.
    - Engaging rural youth and women in **food-processing** can shift workers to more productive roles. Initiatives like **Mega Food Park** can support logistics, credit, and **marketing for agro-processing jobs.**
- **Strengthen Rural Infrastructure:** Build robust rural infrastructure to support industrial and service-sector growth.
- **Green Jobs**: Transitioning to **green technologies** and adopting **Environmental, Social, and Governance (ESG) standards** offer new job creation opportunities in the green economy.
- **Implement Universal Social Security:** Provide a **safety net for rural workers** through targeted social security schemes.

Drishti Mains Question:

Discuss the challenges faced by India in transitioning its workforce from agriculture to manufacturing and services. How can this transition be accelerated?

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Pradhan Mantri MUDRA Yojana is aimed at (2016)

(a) bringing the small entrepreneurs into formal financial system
(b) providing loans to poor farmers for cultivating particular crops
(c) providing pensions to old and destitute persons
(d) funding the voluntary organizations involved in the promotion of skill development and employment generation

Ans: (a)

Q. Disguised unemployment generally means (2013)

(a) large number of people remain unemployed
(b) alternative employment is not available
(c) marginal productivity of labour is zero
(d) productivity of workers is low

Ans: (c)

Mains

Q. Most of the unemployment in India is structural in nature. Examine the methodology adopted to compute unemployment in the country and suggest improvements. **(2023)**

Innovative Strategies in Malaria Prevention

Source: TH

Why in News?

Recent advancements in **malaria prevention** have shifted focus from genetically modified mosquitoes to **genetically modified malaria-causing parasites.** This innovative approach aims to enhance immune system priming during the liver stage of the parasite's life cycle, potentially leading to more effective **malaria** vaccines.

How do Genetically Modified Parasites Help Prevent Malaria?

- **Genetically Modified Parasites:** Malaria causing parasites were genetically altered to study their behavior, prevent diseases, or deliver treatments. They are designed to **prime the immune system** in the liver, preventing disease before entering the bloodstream.
    - Malaria-causing parasites cause infection and symptoms begin to show only when they move into the bloodstream from the liver stage.
    - This method allows for better protection against malaria when exposed to unaltered parasites later, improving overall vaccine efficacy.
        - Additionally, genetically modified mosquitoes can spread resistance to malaria by mating with wild mosquitoes.
    - **Immune priming** is a process by which a host improves its immune defences following an initial pathogenic exposure, leading to better protection after a subsequent infection with the same – or different – pathogens.
- **Trial Efficacy:** In the trial conducted, 89% of participants exposed to late-arresting genetically modified parasites (*p falciparum*, in this case) were protected from malaria compared to only 13% for early-arresting parasites.

    - Early-arresting refers to killing the parasite on day 1 of entering the liver whereas late-arresting refers to killing it on day 6.
- **Comparison with Traditional Methods:** Traditional methods, such as radiation-sterilized mosquitoes and radiation-attenuated **sporozoites** (the infective stage of malaria parasites), require significantly higher exposures (up to 1,000 mosquito bites) for similar protection levels.

What is Malaria?

- **About:**
    - Malaria, a life-threatening disease caused by **Plasmodium parasites**, is transmitted by **female Anopheles mosquitoes**. Of the five species infecting humans, ***P. falciparum*** and ***P. vivax*** are the most dangerous.
    - After biting an infected person, a **mosquito transmits malaria parasites to the next person** it bites. The parasites travel to the **liver**, mature, and then **infect red blood cells** .
- **Highlights of Malaria in India:**
    - According to the **National Vector Borne Disease Control Programme (NVBDCP)**, malaria remains a significant public health challenge in India, with approximately **1 million cases reported annually.**
    - Approximately 95% of the population lives in malaria-endemic regions, with 80% of cases occurring in tribal, hilly, and inaccessible areas that house 20% of the population.
    - **In 2022, India** represented **66% of malaria cases** in the **WHO South-East Asia Region,** with ***Plasmodium vivax*** responsible for nearly **46% o**f these cases.
- **Treatment:**
    - **WHO**-recommended malaria vaccine like **RTS,S/AS01** and **R21/Matrix-M**
- **Global Initiatives:**
    - **World Malaria Day – 25th April** (launched in **2007**)
    - **WHO Global Malaria Programme (GMP)** (launched in **2015**)
- **Government Initiatives Related to Malaria:**
    - **National Malaria Control Programme (NMCP) – 1953**
    - **National Vector-Borne Disease Control Programme – 2003**
    - **Malaria Elimination Research Alliance-India (MERA-India)** – Launched on the eve of **'World Malaria Day' in 2019.**
    - **National Strategic Plan: Malaria Elimination 2023-27**

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Widespread resistance of malarial parasites to drugs like chloroquine has prompted attempts to develop a malarial vaccine to combat malaria. Why is it difficult to develop an effective malaria vaccine? (2010)

(a) Malaria is caused by several species of Plasmodium

(b) Man does not develop immunity to malaria during natural infection

(c) Vaccines can be developed only against bacteria

(d) Man is only an intermediate host and not the definitive host

Ans: (b)

DHARINI 3D Foetal Brain Atlas

Source: IE

Researchers at Indian Institute Of Technology (IIT) Madras have developed a revolutionary tool known as **DHARINI, a detailed 3D map of foetal (**unborn offspring that develops in the uterus of a mammal**) brain,** that holds significant implications for understanding brain disorders.

- DHARINI is the world's largest and most detailed high-resolution 3D foetal brain atlas, mapping over 5,000 brain sections and 500 brain regions.
    - The atlas focuses on brains from the **second trimester** (at 14, 17, 21, 22 and 24 weeks of pregnancy)**,** a key period for rapid growth and development.
- The tool can help identify brain disorders such as **autism** and provide insights into conditions like **cerebral palsy** and mental health issues like depression and **bipolar disorder.**
    - The research utilized thin slices of still-born brains, allowing for detailed cellular-level imaging.
- DHARINI is the only brain atlas to capture the growing brain in fetuses. The only other similar publicly available atlas, released by the **US Allen Institute in 2016, mapped the brain of an adult woman**.
- DHARINI is expected to support future advancements in **Artificial Intelligence and machine learning,** helping scientists better understand the human brain and improve **artificial intelligence models.**

- Researchers from IIT Madras used the brains of five still-borns in the second trimester — at weeks 14, 17, 21, 22, and 24 of pregnancy
- The brains were frozen and thinly sliced using complex robotic instrumentation
- These thin, transparent slices were then stained and microscopically imaged in extreme detail
- The digitised images were then put together to create a 3D map – offering a rare insight into the insides of a foetal brain

Read more: [Brainware]