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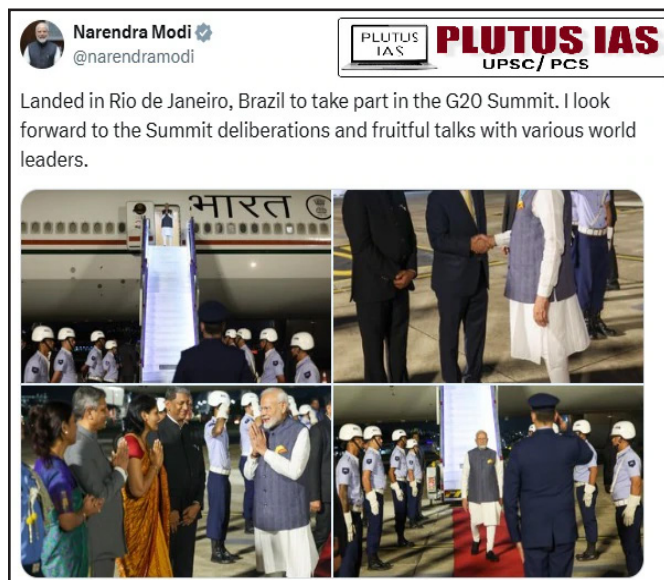
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PLUTUS IAS

“PRIME MINISTER MODI ARRIVES IN BRAZIL FOR G20 SUMMIT, READY FOR STRATEGIC TALKS”

WHY IN THE NEWS?

Prime Minister Narendra Modi arrived in Rio de Janeiro, Brazil, on Monday to attend the 19th G20 Leaders' Summit, set to take place on November 18 and 19. Upon his arrival, he expressed his eagerness to engage in discussions with global leaders and fruitful deliberations during the summit.



WHAT IS G-20?

The G-20, or Group of Twenty, is an international forum for governments and central bank governors from 19 major countries and the European Union. The group was created to bring together the world's largest economies to discuss and coordinate policies on economic issues and address global challenges.

Key Features of the G-20:

Membership: The G-20 includes 19 individual countries and the European Union and African unions, representing both developed and emerging economies. The member countries are:

Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom, the United States, and the European Union (EU) and South Africa.

Global Impact:

The G-20 represents about 85% of the world's GDP, 75% of global trade, and two-thirds of the global population.

This makes the G-20 a powerful platform for addressing the most pressing global challenges, including economic crises, climate change, trade, health, and development.

History:

The G-20 was established in 1999 in response to the Asian Financial Crisis of 1997-98. Initially, it was a forum for Finance Ministers and Central Bank Governors to discuss global financial issues.

In the aftermath of the 2007-2008 Global Financial Crisis, the G-20 was elevated to the level of Heads of State and Government and became recognized as the “premier forum for international economic cooperation.”

Meetings and Summits:

The G-20 holds an annual summit where leaders (Heads of State or Government) of member countries meet to discuss major global issues. In addition, there are various meetings and discussions throughout the year involving finance ministers, central bank governors, and other officials.

The summit is hosted by the country holding the presidency, which rotates annually.

Key Areas of Focus:

Economic Cooperation: Promoting global economic stability, growth, and trade.

Climate Change: Addressing the global impact of environmental issues and seeking sustainable solutions.

Global Health: Managing health crises, such as pandemics (e.g., COVID-19), and strengthening healthcare systems.

Global Security: Fostering peace and stability through coordinated diplomatic and economic policies.

Digital Economy: Promoting technology and innovation for economic development.

Sustainable Development: Working towards the Sustainable Development Goals (SDGs), such as poverty reduction, education, and inclusive growth.

Two Tracks of Engagement:

Finance Track: Involves discussions among Finance Ministers and Central Bank Governors on global financial stability, economic policies, and financial systems.

Sherpa Track: Led by the Sherpas (personal representatives of the leaders), this track focuses on broader issues such as trade, development, and diplomacy.

Rotating Presidency:

The presidency of the G-20 rotates among its member countries. Each year, the country holding the presidency sets the agenda for the summit and hosts the key meetings.

The presidency also leads the troika, a group comprising the current, past, and future presidencies to ensure continuity and coordination in the G-20 process.



EVOLUTIONS OF G-20 GROUPING AS THE MAIN FORUM:

1. 1999: Establishment

Purpose: Created after the Asian Financial Crisis to bring together Finance Ministers and Central Bank Governors from major economies to discuss global economic issues.

Focus: Financial stability, policy coordination, and global economic issues.

2. 2008: Global Financial Crisis

Elevated to Heads of State/Government: In response to the Global Financial Crisis, the G-20 was upgraded to include leaders (not just economic ministers), making it the premier forum for international economic cooperation.

Washington Summit: World leaders coordinated responses to stabilize the global economy and financial markets.

3. 2009-2010: Post-Crisis Recovery

London Summit (2009): Coordinated global stimulus packages, bank reforms, and a commitment to reforming financial institutions like the IMF and World Bank.

G-20 Focus: Economic recovery, financial market regulation, and global financial reform.

4. 2011-2015: Expanding Agenda

Global Growth and Security: The G-20 began addressing global trade, job creation, climate change, sustainable development, and global security alongside economic coordination.

2014 Brisbane Summit: Focus on inclusive growth, addressing unemployment and promoting green growth.

5. 2016-2019: Broader Global Issues

Paris Agreement (2015): Increased focus on climate change and sustainability.

Hamburg Summit (2017): Focus on global trade, protectionism, and inclusive development.

Technological Transformation: Emphasis on digital economy and cybersecurity.

6. 2020: COVID-19 Response

Pandemic Response: The G-20 addressed global health challenges, coordinated efforts for vaccine distribution, and supported economic recovery with fiscal and monetary policies.

Global Coordination: Focus on health security, economic resilience, and support for vulnerable nations.

7. 2021-2023: Recovery and Sustainability

Sustainable Development Goals (SDGs): Emphasis on inclusive growth, climate change, and post-pandemic recovery.

India's G-20 Presidency (2023): Prioritizing green development, inclusive growth, digital transformation, and the LiFE (Lifestyle for Environment) movement for sustainable living.

8. 2024: Future Agenda

Brazil's G-20 Presidency: Likely to focus on inclusive growth, global security, sustainability, and technological transformation in a post-pandemic world.

SIGNIFICANCE OF G-20:

- 1. Global Economic Leadership:** Represents 85% of global GDP and 75% of global trade, influencing the world economy and economic policies.
- 2. Crisis Management:** Coordinates responses to global crises, such as the 2008 financial crisis and the COVID-19 pandemic, stabilizing the global economy.
- 3. Inclusive Growth:** Focuses on poverty reduction, job creation, and economic inclusion, ensuring growth benefits all nations, especially developing ones.
- 4. Sustainable Development:** Promotes green growth, climate action, and alignment of economic development with the Sustainable Development Goals (SDGs).
- 5. Global Trade and Investment:** Supports open markets, reducing trade barriers, and boosting global trade and investment flows.
- 6. Multilateral Cooperation:** Fosters global collaboration on economic policy, financial stability, and global governance reforms.
- 7. Shaping Global Standards:** Sets key global policy frameworks on taxation, corporate governance, and the digital economy.
- 8. Global Security and Diplomacy:** Addresses global security, health, and geopolitical challenges, promoting peace and stability.

ROLE OF INDIA AT G-20:

- 1. Global Economic Influence:** As a major emerging economy, India represents the Global South and advocates for inclusive growth and economic empowerment for developing nations.
- 2. Champion of Sustainability:** Leading initiatives like the LiFE (Lifestyle for Environment) movement, India promotes climate action, green growth, and sustainable development.
- 3. Inclusive Growth:** India pushes for policies addressing poverty, gender equality, job creation, and financial inclusion, ensuring benefits for all nations, especially developing ones.
- 4. Digital Transformation:** Advocating for digital public infrastructure and tech-enabled development, India promotes financial inclusion and digital solutions for global challenges.

- 5. Global Health & Security:** India has played a leading role in pandemic response, vaccine equity, and global health, and is a voice for peace and multilateralism.
- 6. Global Governance Reforms:** India calls for more inclusive, fair global institutions, pushing for reforms in organizations like the IMF and World Bank.
- 7. Leadership in G-20 Presidency (2023):** India's theme, "Vasudhaiva Kutumbakam" (One Earth, One Family, One Future), emphasized sustainable development, inclusive growth, climate finance, and women empowerment.

WHAT ARE THE KEY ISSUES WITH THE G-20?

- 1. Lack of Binding Authority:** G-20 decisions are non-binding, limiting enforcement of agreements, especially on climate action and trade.
- 2. Diverging Interests:** Conflicting priorities between developed and developing nations make consensus difficult on issues like economic growth and climate justice.
- 3. Geopolitical Tensions:** Rivalries (e.g., U.S.-China, EU-Russia) can hinder cooperation and affect global trade and security discussions.
- 4. Inequitable Representation:** Smaller, poorer nations often feel marginalized, as the G-20 is dominated by major economies.
- 5. Slow Climate Action:** Differences over climate finance and carbon reduction delay progress on global environmental goals.
- 6. Overlapping Institutions:** The G-20's work often overlaps with other bodies (like the UN or IMF), creating redundancy and inefficiency.
- 7. Power Imbalance:** Wealthier countries (like the U.S. and China) dominate the decision-making process, limiting the influence of smaller nations.
- 8. No Enforcement Mechanisms:** Lack of accountability structures makes it hard to ensure commitments are implemented.

WAY FORWARD:

- 1. Strengthen Enforcement:** Establish mechanisms to hold countries accountable for climate, trade, and financial commitments.

2. **Ensure Inclusivity:** Provide greater representation for developing nations and include a consultative process for non-members.
3. **Align Climate and Trade:** Integrate green policies with trade frameworks to support sustainable economic growth.
4. **Better Coordination:** Work closely with other global institutions (e.g., UN, IMF) to avoid redundancy and ensure coherent governance.
5. **Promote Digital Inclusion:** Focus on digital infrastructure and financial inclusion for developing countries.
6. **Expand the Agenda:** Broaden focus beyond economics to address global health, security, and peace.
7. **Strengthen Diplomacy:** Use the G-20 as a platform for geopolitical dialogue and conflict resolution.
8. **Drive Green Development:** Increase climate finance and support sustainable technologies for inclusive growth. Establish mechanisms to hold countries accountable for climate, trade, and financial commitments.

CONCLUSION:

The G-20 plays a vital role in global economic cooperation but faces challenges like lack of binding authority, geopolitical tensions, and inequitable representation. To improve, the G-20 must strengthen enforcement mechanisms, ensure inclusivity, and align climate and trade policies. It should also expand its focus to include health, security, and digital inclusion.

PRELIMS QUESTION:

Q. With reference to the “G20 Common Framework”, consider the following statements (UPSC Prelims 2022)

1. It is an initiative endorsed by the G20 together with the Paris Club.
2. It is an initiative to support low-income countries with unsustainable debt.

Which of the statements given above is/are correct?

- A. 1 only
- B. 2 only
- C. Both 1 and 2

D. Neither 1 nor 2

Answer: C

MAINS QUESTION:

Q. How can the G-20 better address the concerns of smaller and poorer nations while balancing the interests of larger economies?

(250 words, 15 marks)

“JAN YOJNA ABHIYAN: EMPOWERING CITIZENS THROUGH GOVERNMENT SCHEME

WHY IN THE NEWS?

The Ministry of Panchayati Raj has initiated the People’s Plan Campaign (Jan Yojana Abhiyan) to formulate Panchayat Development Plans (PDPs) for the period 2025–26. This campaign aims to ensure the active participation of local communities in the planning process, promoting bottom-up development. It encourages Gram Panchayats to identify their needs and priorities, fostering inclusive growth at the grassroots level.

WHAT IS JAN YOJNA ABHIYAN?

Aim: The primary goal of the Jan Yojana Abhiyan is to accelerate people’s participation in the process of preparing the Panchayat Development Plan (PDP). It encourages active community involvement in shaping local development initiatives.

Launched: The campaign was launched by the Ministry of Panchayati Raj on 2nd October 2018 under the name ‘Sabki Yojana Sabka Vikas’.

Implementation: The campaign is implemented at all three tiers of Panchayats—Gram Panchayat, Block Panchayat, and District Panchayat—with active participation from Elected Representatives, Government Front-line Workers, Community-Based Organizations (CBOs) like Self-Help Groups (SHGs), and other relevant stakeholders.

Components of the Campaign:

1. **Structured Meetings:** Ward Sabha, Mahila Sabha, Gram Sabha, Block Sabha, and District Sabha are organized to prepare Gram Panchayat Development

Plans (GPDP), Block Panchayat Development Plans, and District Panchayat Development Plans for FY 2025-26.

2. **Identification of Development Gaps:** The campaign involves preparing a Gram Sabha-wise calendar and identifying thematic developmental gaps based on the Panchayat Development Index (PDI), which is then presented during the Gram Sabha meetings.
3. **Thematic Approach:** The campaign adopts a thematic approach based on the localization of Sustainable Development Goals (SDGs) using a 'Whole of Government and Whole of Society' approach to ensure comprehensive development.
4. **Panchayat Development Index (PDI):** The PDI is a multi-domain and multi-sectoral index designed to assess the overall development, performance, and progress of Panchayats, serving as a critical tool for planning and tracking development.
5. **Inclusive Participation:** Special efforts are made to engage youth and elderly individuals (especially those over 75 years) in the preparation of GPDPs, ensuring that all sections of society have a voice in local planning.
6. **Collaboration with Unnat Bharat Abhiyan (UBA):** Over 15,000 students from Higher Education Institutions (HEIs) participated in the campaign this year, contributing to the preparation of development plans in rural areas.
7. **Digital Transparency:** The approved Gram Panchayat Development Plans (GPDPs) are published on the e-Gram Swaraj portal, ensuring transparency and accessibility for all stakeholders.

CONSTITUTIONAL PROVISIONS:

1. Article 40(Directive Principles of State Policy – DPSP): This article emphasizes the organization of Village Panchayats and empowers them with the necessary authority to function effectively as units of self-government. It aims to decentralize governance and promote local democracy.

The 73rd and 74th Constitutional Amendment Acts further institutionalized the system of Local Self-Governments, providing them with constitutional legitimacy. These amendments paved the way for the establishment of a robust framework for governance at the grassroots level, ensuring the involvement of local communities in decision-making.

2. Article 243G: This article recognizes Panchayats as essential institutions of self-government and mandates them to prepare plans for economic development and social justice within their jurisdiction. It entrusts Panchayats with the responsibility of managing local affairs, ensuring a participatory approach to development. The preparation of such plans must be based on the 29 subjects listed in the Eleventh Schedule of the Constitution, which covers areas such as agriculture, education, health, and infrastructure, ensuring a comprehensive and localized approach to development.

SIGNIFICANCE JAN YOJNA ABHIYAN:

1. **Enhancing Participatory Governance:** The campaign promotes active citizen involvement in local governance, ensuring that development plans reflect community needs and priorities.
2. **Decentralized Development:** By empowering Panchayats as self-governing bodies, it fosters decentralized planning, allowing for tailored, localized solutions to development challenges.
3. **Alignment with SDGs:** The campaign supports the localization of Sustainable Development Goals (SDGs), ensuring that local plans contribute to broader global development agendas.
4. **Holistic Development:** Through the Panchayat Development Index (PDI), it ensures a multi-sectoral approach to development, addressing education, health, infrastructure, and more.
5. **Inclusive Empowerment:** The campaign focuses on engaging marginalized groups, including youth and the elderly, promoting social inclusion and equity.
6. **Transparency and Accountability:** The e-Gram Swaraj portal enhances transparency by making development plans publicly accessible and fostering responsible governance.
7. **Collaboration with HEIs:** Partnering with institutions like Unnat Bharat Abhiyan brings fresh perspectives and technical expertise to local development.
8. **Strengthening Local Institutions:** The campaign builds the capacity of Panchayats and community organizations, ensuring sustainable and effective governance.

CHALLENGES OF JAN YOJNA ABHIYAN:

1. **Awareness and Capacity Building:** Limited awareness and lack of training for local leaders hinder ef-

fective participation and planning in remote areas.

2. **Inadequate Infrastructure and Resources:** Many Panchayats face resource and infrastructure constraints, affecting the execution of development plans.
3. **Digital Divide:** Poor internet access and digital literacy in rural areas limit the effectiveness of online platforms like e-Gram Swaraj.
4. **Inconsistent Participation:** Varying levels of community engagement, especially from marginalized groups, can undermine inclusive development goals.
5. **Coordination Issues:** Challenges in aligning goals and coordinating between stakeholders, such as government bodies and NGOs, slow down progress.
6. **Financial Constraints:** Limited funding at the Panchayat level restricts the implementation of comprehensive development plans.
7. **Monitoring and Evaluation:** The lack of robust monitoring mechanisms makes it difficult to track progress and assess the effectiveness of development plans.
8. **Resistance to Change:** Traditional practices and lack of trust in government initiatives may lead to resistance to adopting new development strategies.

WAY FORWARD:

1. **Policy Integration:** Align participatory planning with existing government policies to enhance effectiveness and inclusivity in development.
2. **Strengthening Local Governance:** Streamline local self-government processes to ensure greater community involvement and smooth plan implementation.
3. **Technological Integration:** Use digital tools like participatory GIS to improve citizen engagement and data-driven decision-making.
4. **Community Capacity Building:** Raise awareness about the importance of participation, particularly among vulnerable groups, and encourage their involvement.
5. **Behavioral Change:** Shift public attitudes to foster active citizen engagement and empower communities to drive their own development.

6. **Resource Allocation:** Ensure adequate funding and resources for Panchayats to implement development plans effectively at the grassroots level.
7. **Monitoring and Feedback Mechanism:** Establish strong monitoring systems to track progress, assess outcomes, and incorporate community feedback into ongoing development efforts.

CONCLUSION:

The Jan Yojna Abhiyan is a key initiative aimed at empowering local communities through participatory governance and bottom-up development. It aligns Panchayat Development Plans with the Sustainable Development Goals (SDGs), fostering inclusive growth at the grassroots level. Challenges such as awareness gaps, resource limitations, and the digital divide must be addressed for effective implementation. Moving forward, integrating participatory planning with government policies, leveraging technology, ensuring adequate funding, and establishing robust monitoring mechanisms are essential to ensure the campaign's success in strengthening local self-governments and promoting sustainable development.

PRELIMS QUESTION:

Q. What is the primary aim of the Jan Yojna Abhiyan?

- A. To provide financial aid to Panchayats
- B. To accelerate people's participation in the preparation of Panchayat Development Plans (PDPs)
- C. To promote industrial development in rural areas
- D. To enhance digital literacy in villages

Answer: B

MAINS QUESTION:

Q. In the context of Jan Yojna Abhiyan, discuss the role of technology, specifically platforms like e-Gram Swaraj and participatory GIS, in improving transparency and accountability in local governance.

(250 words, 15 marks)

GENE EDITING IN POTATOES: A PATH TO REDUCING GREENHOUSE GAS EMISSIONS IN AGRICULTURE”

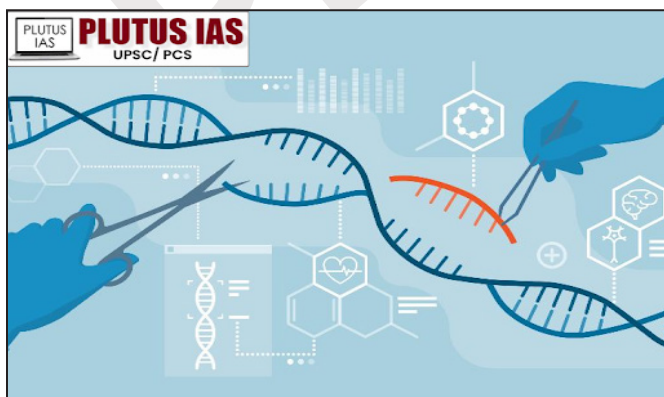
WHY IN THE NEWS:

Researchers have discovered that the StCDF1 gene, which controls potato growth, also regulates nitrogen management. This breakthrough could lead to potato varieties requiring less fertilizer, reducing costs and environmental impact. As potatoes are the third-most consumed food globally, this finding offers a promising solution to enhance food security and address agricultural challenge.



WHAT IS GENE EDITING?

Gene editing is a biotechnological method that allows scientists to modify an organism's DNA precisely. Techniques such as CRISPR-Cas9 enable researchers to add, remove, or alter specific genetic material within an organism's genome. This technology has revolutionized genetic research and agriculture by providing a way to enhance desirable traits, such as disease resistance, drought tolerance, and nutrient efficiency, without introducing foreign DNA.



GENE EDITING IN POTATO:

Potato editing refers to the application of gene editing

techniques specifically to enhance the traits of potato plants. In this case, researchers are focusing on the StCDF1 gene, which regulates tuber growth and nitrogen management. By disabling or modifying this gene, scientists aim to create potato varieties that can thrive in low-nitrogen environments, thereby reducing the need for chemical fertilizers. This approach not only has the potential to improve the health and yield of potato crops but also addresses environmental concerns related to fertilizer runoff and groundwater pollution.

SIGNIFICANCE OF THE NEW DISCOVERY:

Environmental Benefits: By developing potato varieties that need less nitrogen fertilizer, this research helps reduce environmental pollution, particularly from excess fertilizers contaminating groundwater.

Cost Reduction for Farmers: Lower fertilizer requirements lead to significant cost savings, making potato farming more affordable, especially for smallholder farmers who rely heavily on nitrogen fertilizers.

Improved Food Security: Potatoes, a staple food for millions, can be grown more efficiently with higher yields and better-quality tubers, contributing to enhanced food security globally.

Advancement in Agricultural Biotechnology: This breakthrough highlights the potential of gene editing and traditional breeding to address critical agricultural challenges like nutrient uptake and crop resilience.

Sustainability in Agriculture: The research offers a solution for sustainable agricultural practices, reducing reliance on chemical fertilizers and minimizing ecological damage, thus promoting long-term agricultural health.

Potential for Broader Crop Improvement: Techniques developed for potatoes can be applied to other crops with similar nitrogen efficiency issues, improving overall agricultural productivity.

Support for Global Agricultural Innovation: This discovery sets the stage for further advancements in agricultural biotechnology, leading to more resource-efficient and resilient farming systems worldwide.

CHALLENGES OF POTATO GENE EDITING

High Genetic Diversity: The highly heterozygous nature of potatoes makes it difficult to achieve consistent gene-editing results, especially in India's diverse agro-climatic conditions.

Tetraploid Complexity: Potatoes' tetraploid nature, with four sets of chromosomes, complicates precise gene editing, slowing the development of improved crop varieties.

Polygenic Traits: Many critical traits like disease resistance and tuber quality are controlled by multiple genes, requiring complex multi-gene editing strategies.

Off-Target Effects: Gene-editing tools like CRISPR/Cas9 can cause unintended genetic changes, potentially impacting crop stability and safety in Indian agricultural systems.

Regulatory Challenges: India's regulatory framework for genetically modified organisms (GMOs) is evolving, which may delay the approval and commercialization of gene-edited crops.

Public Skepticism: Indian consumers often view genetically modified crops with suspicion, requiring extensive efforts to build trust and awareness about the benefits of gene editing.

Low Transformation Efficiency: Achieving efficient transformation and regeneration of potato plants remains a technical challenge for Indian researchers, affecting large-scale adoption.

Environmental Impact: The ecological effects of introducing gene-edited varieties into India's environment need to be carefully studied through long-term research.

High Costs: Developing gene-edited crops requires substantial financial investment, which can be a barrier for smaller research institutions and farmers in India.

Intellectual Property Issues: Disputes over the ownership of gene-editing technologies and their applications can hinder collaboration and innovation in the Indian agricultural sector.

STRATEGIES TO ADVANCE POTATO GENE EDITING IN INDIA

Establish Regulatory Frameworks: Define clear guidelines distinguishing gene-edited crops from GMOs, with oversight by the Genetic Engineering Appraisal Committee (GEAC), aligning with frameworks like the Biosafety Guidelines, 1989.

Form Advisory Committees: Create a Gene Editing Advisory Committee to evaluate safety and ethics, inspired by bodies like the National Biodiversity Authority (NBA).

Promote Public Engagement: Build trust through educational campaigns and a Public Engagement Task Force, modeled on the Biotech Consortium India Limited (BCIL).

Enhance Collaborative Research: Establish a National Gene Editing Research Consortium, akin to the National Innovation Foundation (NIF), to foster partnerships and innovation.

Provide Funding: Support gene-editing research through initiatives like Rashtriya Krishi Vikas Yojana (RKVY) or new schemes for nitrogen-efficient potatoes.

Develop Risk Protocols: Standardize risk assessments, overseen by a global body inspired by the Cartagena Protocol on Biosafety.

Facilitate Global Cooperation: Form a Global Gene Editing Alliance, similar to the International Treaty on Plant Genetic Resources for Food and Agriculture ITPGRFA, for harmonized standards and research collaboration.

Monitor Outcomes: Set up a Gene Editing Monitoring Board, akin to the National Gene Bank, to evaluate field impacts and ensure transparency.

CONCLUSION:

Gene editing in potatoes can boost sustainability, cut greenhouse gas emissions, and strengthen global food security. Addressing technical, regulatory, and ethical challenges while fostering public trust is vital. Collaborative efforts and a balanced focus on safety, sustainability, and farmer benefits can pave the way for resilient agricultural systems.

PRELIMS QUESTION:

Q. With reference to gene editing in potato cultivation, consider the following statements:

1. Gene editing techniques like CRISPR-Cas9 allow for the precise modification of an organism's DNA.
2. The StCDF1 gene can be modified to improve nitrogen uptake in potatoes, leading to more efficient fertilizer use.
3. Gene editing introduces foreign DNA into the organism's genome to achieve desired traits.

How many of the above-given statements are correct?

- A. Only one
- B. Only two

- C. All three
D. None

ANSWER: B

MAINS QUESTION:

Biotechnology has revolutionized agriculture in India, but it also presents new challenges. Discuss the essential measures needed to ensure the sustainable use of biotechnology in Indian agriculture.

(Answer in 250 words)

“INDIA’S GSAT-N2 SATELLITE SET FOR LAUNCH BY SPACEX: A MAJOR MILESTONE”

WHY IN THE NEWS?

SpaceX successfully launched ISRO’s latest communications satellite, GSAT-20, from Cape Canaveral, Florida, using its Falcon 9 rocket. This marks the first significant commercial partnership between SpaceX and ISRO. The collaboration is estimated to cost between \$60-70 million. Previously, India relied on French commercial launch service provider Arianespace for the launch of heavy satellites. In addition, SpaceX and ISRO have entered into another agreement to send an Indian astronaut to the International Space Station (ISS) for \$60 million.



WHAT IS FALCON 9?

Falcon 9 is a cutting-edge, reusable orbital rocket developed by SpaceX to transport payloads, such as satellites, cargo, and even astronauts, to various orbits around Earth. The rocket is designed to be cost-efficient and highly reliable, with the unique capability to return to Earth after launching and be reused for future missions.

This innovation has fundamentally changed the economics of space travel.

Key Features and Specifications:

- 1. Height:** 70 meters (229.6 feet)
- 2. Weight:** 549,054 kg (1,207,920 lbs)
- 3. Payload Capacity:**

To Low Earth Orbit (LEO): 22,800 kg (50,265 lbs)

To Geostationary Transfer Orbit (GTO): 8,300 kg (18,300 lbs)

4. First Stage: The first stage of Falcon 9 houses 9 Merlin engines, which provide the necessary thrust to propel the rocket through the lower atmosphere. This stage is designed to be reusable, meaning it can land back on Earth for refurbishment and reuse in future launches.

5. Second Stage: The second stage uses a Merlin Vacuum engine optimized for operation in the vacuum of space. It carries the payload into its final orbit after the first stage has completed its job.

6. Launch Reusability: The Falcon 9 rocket is designed for reusability, which means that after launching, the first stage can return to Earth and land vertically, either on a landing platform at sea (autonomous spaceport drone ship) or on solid ground. This dramatically reduces launch costs.

7. Autonomous Operations: The rocket is equipped with advanced autonomous systems that enable the first stage to land back on Earth after completing its mission, without human intervention.

WHAT IS SPACEX?

SpaceX (Space Exploration Technologies Corp.) is an American private aerospace manufacturer and space transportation company founded by Elon Musk in 2002. The company’s main goal is to reduce the cost of space travel and make it possible for humans to live on other planets, particularly Mars.

Key Features:

- 1. Reusable Rockets:** SpaceX’s Falcon 9 and Falcon Heavy rockets are designed to be reused, drastically lowering launch costs.
- 2. Crew Dragon:** A spacecraft developed for NASA’s Commercial Crew Program, capable of transporting astronauts to the International Space Station (ISS).

3. Starship: A fully reusable spacecraft in development aimed at interplanetary missions, including Mars colonization.

4. Starlink: A satellite internet service aimed at providing global broadband coverage, especially to remote areas.

Achievements:

- 1. First Private Company to Reach Orbit:** With the Falcon 1 in 2008.
- 2. First Private Company to Dock with the ISS:** Using the Dragon capsule in 2012.
- 3. First Reusable Rocket:** Successfully landing the Falcon 9's first stage in 2015.
- 4. Crewed Mission to the ISS:** In 2020, Crew Dragon launched astronauts to the ISS.

WHY SPACEX?

The primary reason ISRO chose SpaceX for the delivery of the GSAT-20 satellite was the satellite's significant weight of 4,700 kg, which exceeded the capacity of India's indigenous rockets. ISRO's heaviest launch vehicle, the LVM-3, is only capable of launching payloads up to 4,000 kg. Given the need for a heavy-lift rocket, SpaceX's Falcon 9 became the ideal choice due to its ability to carry heavier payloads and its proven track record.

Several other factors also influenced the decision:

- 1. Unavailability of Arianespace:** The French commercial launch provider, Arianespace, faced challenges with operational rockets, making them unable to provide an immediate solution for ISRO's needs.
- 2. Geopolitical Constraints:** The Ukraine conflict disrupted Russia's space launch capabilities, leaving Russian rockets unavailable for international missions. Additionally, China remains off-limits due to political tensions, further limiting options for ISRO.
- 3. Cost-Effectiveness:** SpaceX's reusable Falcon 9 rocket technology significantly reduces the cost of space launches, offering a more affordable and reliable option compared to other providers.

This collaboration marks a significant milestone, not just for ISRO but also for NSIL (New Space India Limited), the commercial arm of ISRO. It signals the beginning of a new chapter in India's space industry, showcasing India's increasing collaboration with international space

agencies and private companies. This partnership with SpaceX also reflects India's growing presence in the global space arena, reinforcing its commitment to space exploration and technological advancement.

WHAT IS GSAT-20?

GSAT-20 is a communication satellite developed by ISRO (Indian Space Research Organisation) to enhance the country's communication infrastructure. It is also known as GSAT-N2 and weighs 4,700 kg, exceeding the weight capacity of India's indigenous rockets, necessitating the use of SpaceX's Falcon 9 for its launch.

Key Features of GSAT-20:

1. Mission Life: GSAT-20 has a mission life of 14 years, ensuring long-term, reliable service for India's communication needs.

2. High-Speed Data Transmission: Operating in the Ka-band, the satellite offers a capacity of 48 Gbps, which will significantly improve data transmission speeds, enhancing broadband services across the country.

3. Increased Coverage: The satellite is designed to provide high-speed internet and communication services across India, including remote and underserved regions, bridging the digital divide. It is especially crucial for improving internet connectivity in rural and remote areas.

4. Spot Beams for Regional Connectivity:

32 user beams: GSAT-20 is equipped with 32 user beams, offering highly focused coverage.

Northeast Region Coverage: Out of the 32 beams, 8 narrow spot beams are specifically dedicated to improving connectivity in the Northeast region, an area that often faces connectivity challenges due to geographical isolation.

Wide Spot Beams: The remaining 24 wide spot beams provide coverage across the rest of India, ensuring a vast area is served with high-speed communication and internet services.

5. Enhanced Broadband and In-Flight Connectivity: The satellite will not only enhance broadband services in India but also improve in-flight connectivity for passengers travelling within Indian airspace. This could be a key development in the Indian aviation sector.

6. Advanced Payloads: GSAT-20 carries advanced communication payloads designed to support the country's evolving needs in digital communication, television broadcasting, telemedicine, e-education, and more.

FEATURES:

1. Weight and Launch: Weigh 4,700 kg, requiring SpaceX's Falcon 9 for launch, as it exceeds the capacity of ISRO's indigenous rockets.

2. Mission Life: 14-year mission life for long-term, reliable communication services.

3. High-Speed Data: Operates in Ka-band with a 48 Gbps data capacity, enhancing broadband and communication.

4. User Beams:**32 user beams:**

8 narrow spot beams for the Northeast region.

24 wide spot beams for the rest of India.

5. Enhanced Connectivity: Boosts broadband services and in-flight connectivity and supports telemedicine and e-education.

6. Remote Area Coverage: Improves internet access in remote and underserved regions of India.

7. Advanced Payloads: Equipped with advanced communication payloads for various services.

8. Strategic Importance: Strengthens India's space communication infrastructure, supporting national security and development.

INSTRUMENTS OF GSAT-20:

1. Communication Payloads: High-Throughput Transponders: GSAT-20 carries high-throughput transponders operating in the C-band, Extended C-band, and Ka-band. These provide high-speed data and support advanced communication services.

2. User Beams:

The satellite is equipped with 32 user beams: 8 narrow spot beams focusing on the Northeast region of India.

24 wide spot beams covering the rest of the country, providing extensive communication services.

3. Digital Communication Payloads: GSAT-20 includes digital payloads that enhance the satellite's ability to handle high-capacity data transmission, supporting broadband, telecommunication, and other digital services across India.

4. Telemetry, Tracking, and Command (TTC) Systems:

These systems enable real-time monitoring and control of the satellite during its mission, ensuring smooth operations and efficient management of its services.

5. Antennas: The satellite features advanced antenna systems designed to direct signals precisely and ensure broad, reliable coverage for both narrow and wide beams across the Indian region.

6. Onboard Propulsion: GSAT-20 is equipped with chemical propulsion systems for orbit raising, station-keeping, and end-of-life disposal, ensuring the satellite's longevity and stability in orbit.

SIGNIFICANCE OF GSAT-20:**1. Communication Payloads:**

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CONCLUSION:

The GSAT-20 satellite marks a major leap in India's space and communication capabilities. Launched in collaboration with SpaceX, it enhances India's broadband infrastructure, especially in remote regions, and supports key services like telemedicine, e-education, and in-flight connectivity. With 48 Gbps of data capacity and 32 user beams, including specialized coverage for the North-east, it bridges the digital divide. The satellite's 14-year mission life ensures long-term benefits, strengthening India's position in global space exploration. This partnership with SpaceX signifies India's growing role in the international space arena, driving both technological progress and national development.

PRELIMS QUESTION:

Q. Which of the following bands do GSAT-20 operate in to enhance communication services?

- A. X-band and S-band
- B. Ka-band and C-band
- C. L-band and Ku-band
- D. VHF and UHF

Answer: B

MAINS QUESTION:

Q. "Discuss the role of advanced space technologies, like the GSAT-20 satellite, in contributing to India's socio-economic development, particularly in the fields of communication, education, and healthcare."

(250 words, 15 marks)

THE GROUND BENEATH US: SHAPING THE FUTURE OF SOIL AND AGRICULTURE"

WHY IN THE NEWS?

Union Minister of Agriculture & Farmers' Welfare and Rural Development, Shri Shivraj Singh Chouhan, addressed the inaugural session of the Global Soil Conference 2024 in PUSA, New Delhi, today through video conferencing. Indian Society of Soil Science (ISSS), New Delhi, under the aegis of the International Union of Soil Sciences, Italy, in collaboration with the Indian Council of Agricultural Research, National Academy of Agricultural Sciences, New Delhi organising this Global Soils Conference 2024 on "Caring Soils Beyond Food Security: Climate change mitigation & Ecosystem Services" in PUSA.



SOIL IN INDIA: CURRENT SCENARIO

Soil is a critical resource for agriculture, food security, and ecosystem services in India, where over 60% of the population depends on agriculture for their livelihood. However, soil health in India faces a number of challenges, and it is crucial to understand the current scenario to address these issues and ensure sustainable development.

Types of Soils

1. Alluvial Soils

Composition: Alluvial soils are made up of fine particles such as sand, silt, and clay and are rich in minerals like phosphorus, potassium, and organic matter. They are generally fertile due to periodic deposition by rivers and streams.

Distribution: These soils are predominantly found in the Indo-Gangetic plains, including parts of the Himalayan

foothills, the Ganges river basin, and the coastal regions of Odisha and West Bengal.

Major Crops: Wheat, Rice, Sugarcane, Maize, Vegetables and fruits

2. Black Soils

Composition: Black soils, also known as Regur soils, are rich in minerals like iron, calcium, and magnesium. They contain a high amount of clay and are rich in humus, which helps in moisture retention. They are known for their moisture retention capacity and swelling ability when wet.

Distribution: These soils are primarily found in the Deccan Plateau, particularly in the states of Maharashtra, Madhya Pradesh, Gujarat, Telangana, and Karnataka.

Major Crops: Cotton, Groundnut, Soybean, Jowar (Sorghum), Pulses like Chickpeas, Tobacco

3. Red Soils

Composition: Red soils are rich in iron and aluminium and are formed by the weathering of ancient crystalline and metamorphic rocks. These soils are often low in nitrogen but are good for crops when properly fertilized.

Distribution: Red soils are found in the southern and eastern parts of India, including Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, and parts of Maharashtra.

Major Crops: Groundnut, Pulses, Millets, Maize, Cotton, Tobacco

4. Laterite Soils

Composition: Laterite soils are rich in iron and aluminium oxides but are low in essential nutrients like nitrogen and potassium. These soils are typically acidic and contain a high amount of clay and sand.

Distribution: Laterite soils are found in areas with high rainfall and are commonly seen in the Western Ghats, northeastern states, parts of Karnataka, Kerala, and West Bengal.

Major Crops: Tea, Coffee, Rubber, Coconut, Spices like Cardamom and Pepper

5. Arid Soils

Composition: Arid soils are characterized by low organic content and are highly alkaline or saline in nature. They lack sufficient moisture and are often sandy in texture with limited fertility. These soils are prone to salinization.

Distribution: These soils are predominantly found in Rajasthan, Gujarat, Punjab, Haryana, and parts of Madhya Pradesh. They cover areas like the Thar Desert and other dry regions.

Major Crops: Wheat, Barley, Millets (in some irrigated regions), Chili, Gram (Chickpeas)

GOVERNMENT SCHEME AND POLICIES FOR SOIL CONSERVATION:

Soil conservation is vital for maintaining soil health, increasing agricultural productivity, and addressing challenges like erosion, fertility loss, and environmental degradation. The Government of India has initiated several schemes and policies to promote soil conservation and sustainable agricultural practices.

1. National Mission for Sustainable Agriculture (NMSA)

Objective: To promote sustainable agriculture and improve soil health across the country.

Key Actions:

Focus on organic farming, agroforestry, and integrated nutrient management.

Financial support to encourage soil health management and sustainable farming practices.

Enhances water-use efficiency, promotes conservation tillage, and integrates crop and water management.

2. Soil Health Card Scheme (SHCS)

Objective: To assess soil health and provide farmers with recommendations to improve soil quality.

Key Actions:

Regular soil testing to monitor key nutrients like nitrogen, phosphorus, and potassium (NPK).

Issue personalized soil health cards to farmers with guidance on appropriate fertilizer use.

Encourages balanced fertilization practices to maintain long-term soil fertility.

3. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

Objective: To enhance water-use efficiency and reduce water scarcity issues affecting soil health.

Key Actions:

Promotes micro-irrigation techniques such as drip and sprinkler irrigation.

Aims to prevent waterlogging, salinization, and other soil health issues caused by improper irrigation.

Supports watershed management and rainwater harvesting to improve soil moisture and fertility.

4. Integrated Watershed Management Program (IWMP)

Objective: To promote holistic watershed management to conserve soil, water, and vegetation in watershed areas.

Key Actions:

Focus on soil erosion control, afforestation, and water conservation measures such as check dams and contour bunding.

Encourages community participation and integrates soil and water management.

Supports sustainable farming techniques in erosion-prone regions.

5. National Watershed Management Project (NWMP)

Objective: To manage and improve the watershed for better soil and water conservation, especially in hilly and drought-prone areas.

Key Actions:

Focuses on soil erosion control, water conservation, and sustainable land use practices.

Implements afforestation, check dams, and soil bunding to prevent soil erosion.

Promotes agroforestry and rainwater harvesting in watershed areas.

6. Rashtriya Krishi Vikas Yojana (RKVY)

Objective: To promote agricultural growth and address soil health challenges through improved farming practices.

Key Actions:

Supports soil conservation through techniques such as terracing, check dams, and water-efficient irrigation.

Encourages organic farming, bio-fertilizers, and crop rotation to maintain soil health.

Provides financial assistance for the adoption of sustainable farming practices.

7. National Afforestation Programme (NAP)

Objective: To restore soil health and biodiversity through afforestation and reforestation projects.

Key Actions:

Promotes tree planting, particularly in erosion-prone areas, to stabilize soil.

Supports soil conservation through forest cover, which prevents soil erosion and enhances water retention.

Encourages community participation in afforestation activities to address soil degradation.

8. State-Level Soil Conservation Schemes

Objective: Various state governments have launched localized schemes to address soil conservation challenges in specific regions.

Key Actions:

Programs for soil erosion control in hilly areas, coastal regions, and drought-prone areas.

Financial support for soil conservation measures like check dams, bunding, and terracing.

Promotion of sustainable land management practices at the grassroots level.

9. Fertilizer Control Order (FCO)

Objective: To regulate the use of fertilizers and ensure balanced use for maintaining soil health.

Key Actions:

Prevents excessive use of chemical fertilizers, which deplete soil health.

Promotes the use of organic fertilizers, bio-fertilizers, and green manure to restore soil organic matter.

Encourages integrated nutrient management practices to optimize soil fertility.

REASONS FOR THE DECLINE IN SOIL PRODUCTIVITY:

Soil productivity is vital for agricultural sustainability, but over the years, the decline in soil productivity has become a significant concern. Several factors contribute to this decline, which affects crop yields, ecosystem services, and the overall sustainability of agricultural practices.

1. Soil Degradation

Erosion: Soil erosion, caused by wind, water, and poor agricultural practices (e.g., overgrazing, deforestation, and monoculture farming), washes away the topsoil, which is crucial for fertility.

Loss of Organic Matter: Overuse of chemical fertilizers, lack of crop rotation, and reduced organic farming practices have led to a decline in soil organic matter, which is vital for maintaining soil structure, moisture retention, and nutrient cycling.

2. Overuse of Chemical Fertilizers

Nutrient Imbalance: Excessive use of chemical fertilizers, particularly nitrogen, phosphorus, and potassium (NPK), without replenishing organic matter, has led to nutrient imbalances in the soil.

Soil Acidification and Alkalinization: Continuous use of chemical fertilizers can alter the soil's pH, making it either too acidic or too alkaline, which reduces its fertility and ability to support healthy crops.

3. Soil Salinization and Alkalinization

Irrigation Practices: Over-reliance on irrigation, particularly in arid and semi-arid regions, can cause salt to build up in the soil. This leads to salinization (high salt levels) or alkalinization (high pH levels), both of which reduce soil productivity and crop yield.

Improper Irrigation: Flood irrigation, without proper drainage, leads to waterlogging, which increases salt deposition and reduces soil fertility.

4. Monoculture Farming

Nutrient Depletion: Continuous cultivation of a single crop depletes specific nutrients in the soil, making it less fertile. Monoculture farming also leads to an increase in pests and diseases, further stressing the soil.

Reduced Soil Biodiversity: Monoculture farming reduces soil biodiversity by limiting the variety of crops and plants that support different microbial populations, which are essential for soil health.

5. Deforestation and Land Use Change

Loss of Soil Protection: The removal of vegetation and trees for urbanization or agricultural expansion leads to loss of organic matter and exposes the soil to erosion, reducing its productivity.

Disruption of Natural Processes: The conversion of forests into agricultural land disrupts natural soil-enriching processes like leaf litter decomposition and root systems that improve soil structure.

6. Overgrazing

Compaction and Erosion: Livestock overgrazing can lead to soil compaction, which reduces water infiltration, leads to erosion, and prevents the regeneration of vegetation. This significantly impacts soil fertility and its ability to support crops.

Loss of Vegetative Cover: Overgrazing also reduces plant cover, leaving the soil exposed to wind and water erosion, further degrading its quality.

7. Climate Change

Extreme Weather Events: Climate change is causing more frequent and intense weather events, such as droughts, floods, and unseasonal rains, which exacerbate soil erosion and nutrient loss.

Temperature and Moisture Stress: Rising temperatures and altered rainfall patterns can reduce soil moisture, affecting soil structure and reducing its productivity. Soil microbes, which are essential for nutrient cycling, are also sensitive to changes in temperature and moisture levels.

8. Pesticides and Herbicides

Impact on Soil Microorganisms: The widespread use of chemical pesticides and herbicides not only harms pests but also kills beneficial soil microorganisms, including nitrogen-fixing bacteria, fungi, and earthworms, which are essential for maintaining soil health.

Reduction in Soil Biodiversity: These chemicals can reduce soil biodiversity and disturb natural soil processes, leading to long-term fertility problems.

9. Waterlogging

Poor Drainage Systems: Inadequate drainage or poor irrigation practices lead to waterlogging, where excess water accumulates in the soil. This can suffocate plant roots, deplete oxygen levels, and lead to the accumulation of harmful salts or toxic substances in the soil, making it unfit for cultivation.

CONCLUSION:

Soil is vital for agriculture and food security, but in India, soil degradation, nutrient imbalances, and climate

change threaten its productivity. Government initiatives like the Soil Health Card Scheme, National Mission for Sustainable Agriculture, and PMKSY focus on improving soil health through balanced fertilization, efficient irrigation, and water conservation. Addressing issues like the overuse of chemical fertilizers, monoculture farming, and improper irrigation is key to restoring fertility. Sustainable practices, including crop rotation, agroforestry, and organic farming, can help mitigate climate change effects.

PRELIMS QUESTION:

Q. Which of the following government schemes aims to improve water-use efficiency and reduce soil salinization in India?

- A. Soil Health Card Scheme
- B. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)
- C. National Watershed Management Project (NWMP)
- D. Rashtriya Krishi Vikas Yojana (RKVY)

Answer: B

MAINS QUESTION:

Q. Soil degradation in India is caused by multiple factors, including overuse of chemical fertilizers, deforestation, and climate change. Examine these factors and suggest sustainable solutions to mitigate soil erosion and fertility loss.

(250 words, 15 marks)

“EMPOWERING INNOVATION: THE ROLE OF THE NATIONAL RESEARCH FOUNDATION (NRF)”

WHY IN THE NEWS?

The Anusandhan National Research Foundation is a key body that provides high-level strategic guidance for scientific research in the country. It will play a crucial role in initiating, supporting, and advancing research, innovation, and development across universities, colleges, research institutions, and R&D labs.



WHAT IS NRF?

The Anusandhan National Research Foundation (ANRF) has been established with Anusandhan National Research Foundation (ANRF) 2023 Act. The ANRF aims to seed, grow and promote research and development (R&D) and foster a culture of research and innovation throughout India's universities, colleges, research institutions, and R&D laboratories. ANRF will act as an apex body to provide high-level strategic direction of scientific research in the country as per recommendations of the National Education Policy (NEP). With the establishment of ANRF, the Science and Engineering Research Board (SERB) established by an act of Parliament in 2008, has been subsumed into ANRF. ANRF will forge collaborations among the industry, academia, and government departments and research institutions and create an interface mechanism for the participation and contribution of industries and State governments in addition to the scientific and line ministries.

STRUCTURE OF NATIONAL RESEARCH FOUNDATION:

1. Governing Board:

The Governing Board provides high-level policy guidance and strategic oversight and ensures that the NRF's activities align with national priorities.

President/Chairperson: The Prime Minister of India serves as the President/Chairperson of the Governing Board.

Vice Presidents:

Union Minister of Science and Technology

Union Minister of Education

Member Secretary: The Principal Scientific Advisor to the Government of India.

Other Members:

Secretaries to key government departments, such as:

Department of Science and Technology

Department of Biotechnology

Department of Scientific and Industrial Research

Member of NITI Aayog responsible for science and technology.

The President/Chairperson can appoint additional members from diverse sectors, such as business, social sciences, and humanities.

Secretaries from various central government departments, including:

Higher Education

Health Research

Agricultural Research

Defence Research

Atomic Energy

Space

2. Executive Council:

The Executive Council is responsible for implementing the policies and objectives set by the Governing Board.

Functions of the Executive Council:

Administrative Management: Oversees the administrative functions of the NRF.

Policy Implementation: Carries out the objectives of the Foundation as per the guidance of the Governing Board.

Financial Oversight: Examines applications for financial assistance and manages the budget and accounts.

ADDITIONAL FEATURES OF NRF :

- 1. Strategic Oversight:** The NRF will offer strategic leadership for scientific research in India, ensuring that research efforts are aligned with national priorities. It will focus on advancing key sectors such as health, technology, energy, climate change, and manufacturing.
- 2. Budget and Funding:** The foundation will receive substantial funding of ₹50,000 crore between 2023 and 2028. This funding will be utilized to support research projects, foster collaborations, and enhance infrastructure for scientific innovation.
- 3. Collaborative Research:** NRF will encourage collaboration between academic institutions, industry,

and research organizations. By incentivizing joint ventures and interdisciplinary research, the aim is to create a robust ecosystem where private-sector investments complement government-funded research.

- 4. Focus on State Universities and Colleges:** A significant portion of the funds will be directed towards state universities and colleges. The goal is to promote research excellence at all levels of the educational system, ensuring that institutions outside of elite research hubs can also contribute to national innovation.
- 5. Increased Private Sector Involvement:** One of the primary goals of the NRF is to increase the participation of the private sector in research and development (R&D). By providing grants, support, and incentives, the NRF seeks to build stronger ties between industry and academic research to foster technology commercialization and innovation.

FUNCTIONS OF THE NATIONAL RESEARCH FOUNDATION

The National Research Foundation (NRF) aims to guide and enhance India's scientific research, innovation, and entrepreneurship across various fields, including natural sciences, technology, health, agriculture, and social sciences.

Key functions include:

- 1. Strategic Roadmap:** Preparing short, medium-, and long-term R&D priorities aligned with national goals.
- 2. Research Funding:** Supporting the expansion of R&D infrastructure in universities and institutions and funding competitive, peer-reviewed grant proposals.
- 3. Commercialization:** Facilitating the transformation of research into market-ready technologies and fostering startups.
- 4. National & Global Engagement:** Strengthening India's role in global scientific and technological collaborations.
- 5. Private Sector Investment:** Encouraging public and private sector involvement in research.
- 6. Annual Research Surveys:** Monitoring research outcomes, spending, and impact.

SIGNIFICANCE OF THE NRF:

- 1. Democratization of Funding:** Prioritizes funding for underserved regions, including rural and semi-urban areas, ensuring equitable access to research opportunities.
- 2. Expanding Research Scope:** Supports a wide range of disciplines beyond natural sciences and engineering, including social sciences, arts, and humanities.
- 3. Efficient Management:** Implements an integrated system to manage large-scale missions like super-computing and quantum research, ensuring effective execution.
- 4. Enhanced Collaboration:** Fosters partnerships between academia, industry, government, and research institutions, leveraging private sector resources for sustainable, impactful research.
- 5. Promoting Innovation:** Encourages cutting-edge research that leads to technological advancements, fostering an innovation-driven economy.
- 6. Capacity Building:** Supports the development of skilled researchers and scientists through funding and mentorship, enhancing the country's research capabilities.
- 7. Global Competitiveness:** Strengthens international collaborations, positioning the country as a global player in science and technology through participation in global research initiatives.

LIMITATIONS OF NRF

- 1. Limited Government Funding:** Although ₹50,000 crore has been allocated for priority research areas from 2023 to 2028, approximately 70% of the funding is expected to come from the private sector. However, the NRF Act does not include a mechanism to guarantee this private-sector support, which raises concerns about the financial stability and long-term sustainability of the initiative.
- 2. Centralization:** The NRF Bill does not align with the principle of cooperative federalism, excluding state government representatives from the decision-making process. This limits regional input and may reduce the effectiveness of policies at the local level.
- 3. Exclusion of Key Stakeholders:** The NRF Act does not clearly define the roles of actors within economic and social ministries, limiting their input in the de-

cision-making processes that could impact key areas like public welfare and social research.

- 4. Absence of CPSE Involvement:** Central Public Sector Enterprises (CPSEs), which could serve as vehicles for transferring R&D from academic institutions to practical applications in manufacturing and strategic areas, are excluded from decision-making, limiting the impact of research on real-world innovation.
- 5. Lack of Transparency and Accountability:** The NRF Act does not establish clear guidelines for transparency in the allocation and use of research funds. Without stringent oversight mechanisms, there is a risk of mismanagement and inefficiencies in the funding process, undermining public trust.
- 6. Overemphasis on Private Sector Involvement:** While private sector funding is crucial, an over-reliance on it could lead to prioritizing commercially viable research over projects with long-term social, environmental, or fundamental scientific benefits.

WAY FORWARD:

- 1. Securing Stable Government Funding:** While private sector involvement is important, the NRF must ensure a reliable and consistent stream of government funding. A clear mechanism should be established within the NRF Act to ensure the promised private sector contributions, preventing over-reliance on one sector.
- 2. Promoting Cooperative Federalism:** The NRF should be restructured to include representatives from state governments in its decision-making processes. This would help ensure that regional needs and priorities are integrated into national research policies, fostering more inclusive and localized innovations.
- 3. Stakeholders:** The NRF should clarify and involve relevant actors from economic and social ministries, as well as other essential sectors, in its governance. Their inclusion would ensure that research outcomes align with national development goals and address pressing social issues.
- 4. Engaging CPSEs in Research Application:** Central Public Sector Enterprises (CPSEs) must be given a pivotal role in the NRF's decision-making and research application process. Their involvement would facilitate the translation of academic research into tangible products, especially in critical manufacturing and strategic sectors.

5. **Enhancing Transparency and Accountability:** The NRF should implement stringent transparency and accountability measures to ensure that research funds are allocated effectively. This could include periodic audits, public reporting, and clear criteria for fund distribution, fostering trust and efficiency.
6. **Balancing Research Priorities:** The NRF should aim for a balanced research portfolio, supporting both commercially viable and socially impactful projects. This would ensure that research benefits not only the economy but also societal welfare, addressing long-term global challenges such as climate change, health, and inequality.
7. **Strengthening International Collaboration:** The NRF should actively engage in global research initiatives, forming partnerships with international institutions. This would help elevate the country's position in the global scientific community and facilitate knowledge sharing and innovation.

CONCLUSION:

The National Research Foundation (NRF) aims to strengthen India's research ecosystem, driving innovation and global leadership in science and technology. By providing strategic oversight, fostering collaboration, and encouraging private-sector involvement, it seeks to advance critical sectors like health, energy, and manufacturing. To succeed, the NRF must ensure stable government funding, promote cooperative federalism, engage key stakeholders, and enhance accountability. Balancing research priorities and strengthening international partnerships will further boost its impact, making India a global leader in research and innovation.

PRELIMS QUESTION:

Q. which aspect of cooperative federalism is most affected by the NRF's current governance structure?

- A. The inclusion of local scientific councils in the decision-making process
- B. The representation of state governments in NRF's governing and executive bodies
- C. State universities being excluded from receiving funding
- D. The lack of focus on region-specific research needs

Answer: B

MAINS QUESTION:

Q. What role does the National Research Foundation (NRF) play in bridging the gap between academic research and industry applications in India? How can private sector involvement be balanced with public sector funding?

(250 words, 15 marks)

ADVANCING THE FUTURE: THE GROWTH AND IMPACT OF NANOTECHNOLOGY IN INDIA"

WHY IN THE NEWS?

Indian researchers have developed peptide-based tunable piezoresponsive nanomaterials with enhanced properties by controlling their self-assembly pathways. These materials can respond to mechanical stimuli and have potential applications in energy harvesting, biodevices, soft robotics, flexible electronics, and high-precision sensing devices, marking a significant advancement in nanotechnology for next-generation innovations.

NANOTECHNOLOGY

Nanotechnology involves the development and use of techniques to study physical phenomena and create new devices and materials at the **nanoscale (1-100 nanometers)**. It has significant implications across multiple fields due to its unique properties and applications.



RECENT KEY FINDINGS:

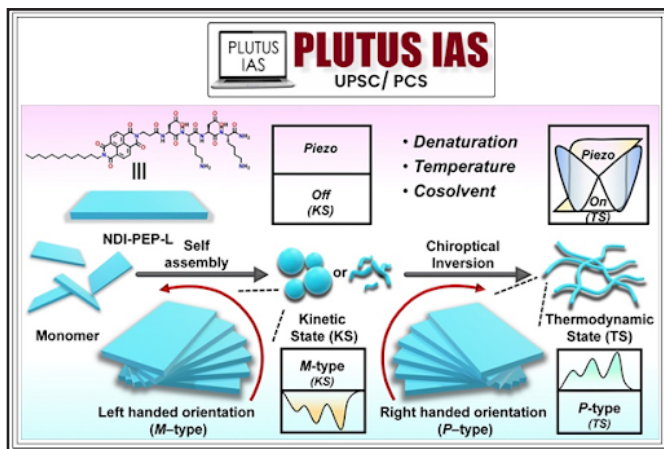
Controlled Supramolecular Self-Assembly: Researchers successfully manipulated the self-assembly processes of peptides by adjusting various parameters such as temperature and solvent composition, which is crucial in determining the final nanostructure and its properties.

Piezoresponsive Characteristics: The self-assembled peptide-based nanomaterials exhibited tunable piezoelectric behavior, allowing them to generate electrical charges in response to mechanical stress. This enhances their functionality in various applications.

Structural Asymmetry: The ability to create organized and asymmetric structures within the nanomaterials is essential for inducing piezoelectric properties, contributing to their responsiveness to mechanical stimuli.

Chiroptical Switching: The researchers observed a rare phenomenon where the rotation of polarized light switched direction during the denaturation of peptides, linked to the structural changes in the nanomaterials. This unique property can influence nanostructural formation, producing nanoparticles and nanofibers.

Dynamic Material Properties: The study demonstrates how alterations in the assembly process and external conditions can lead to significant changes in material properties, paving the way for the design of materials with customized functionalities.



KEY AREAS OF APPLICATION:

Materials and Manufacturing: Nanotechnology has enabled the development of **carbon nanotubes**, which are used to create aerospace and automotive composites that are significantly stronger, lighter, and more durable than traditional materials.

Electronics and Computing: **Quantum dots**, a breakthrough in nanotechnology, are now used in QLED televisions to produce vibrant and energy-efficient displays, revolutionizing visual technology.

Telecommunications and IT: Nanoantennas are paving the way for **ultra-fast and reliable 5G networks**, enhancing communication systems and enabling faster data transfer.

Medicine and Health: Nanoparticles are being used for targeted drug delivery in **cancer treatments**, allowing medicines to attack cancer cells specifically while minimizing side effects on healthy tissues.

Environmental Applications: **Nano-coated membranes** are employed in advanced water purification systems, making it possible to remove contaminants and desalinate seawater more effectively.

Agriculture: Nanosensors are transforming farming by monitoring soil health in real-time, providing data on nutrient and moisture levels to optimize crop yields.

Energy: Nanomaterials, such as **graphene**, are improving the performance of lithium-ion batteries, leading to faster charging and longer-lasting energy storage solutions.

Chemical and Biological Technologies: Nanostructured catalysts are revolutionizing industrial chemical processes by significantly increasing reaction **efficiency and reducing energy consumption**.

CHALLENGES TO STRENGTHENING NANOTECHNOLOGY IN INDIA

Funding Gap from the Government: Despite initiatives like the National Nanotechnology Mission, India's R&D expenditure remains around **0.7% of GDP**, far below countries like the US (2.7%) and China (2.1%). This gap hampers sustained progress in nanotechnology research and infrastructure.

Long Stagnation Period: Nanotechnology development often involves a lengthy research-to-implementation cycle, with technologies taking **10-15 years** to reach commercialization. The absence of sufficient early-stage funding and incubators further delays progress.

Limited Research Facilities: **Only a select few institutions, like IISc and IITs**, have access to state-of-the-art nanofabrication facilities. Over 60% of India's nanotechnology research output comes from these institutes, highlighting regional imbalances in resources and capabilities.

Lack of Commercialization: A 2022 report by **NITI Aayog** stated that **only 20-30% of nanotechnology** innovations in India progress from research to market. Weak collaboration between academia and industry, as well as limited venture capital investment, restricts the transition of technologies to scalable applications.

Insufficient Industry Collaboration: Indian industries often lack awareness or expertise in nanotechnology applications. **A FICCI report highlighted that less than 5% of Indian manufacturing firms integrate nanotechnology into their processes, compared to over 20% in advanced economies.**

Shortage of Skilled Workforce: Nanotechnology requires interdisciplinary expertise in physics, chemistry, and biology. However, India produces less than 10% of the global nanotechnology PhDs, creating a skills gap that limits innovation and scalability.

Inadequate Regulation and Standards: The lack of clear guidelines on the safe use and disposal of nanomaterials poses environmental and health risks. According to a TERI study, India lags behind countries like the US and EU in establishing regulatory frameworks for nanotechnology.

High Import Dependency: A majority of advanced nanotechnology tools and equipment, such as electron microscopes and nanolithography systems, are imported, making them expensive and delaying research. **India's import dependency on such equipment exceeds 80%**, as reported by the Department of Science and Technology (DST).

Environmental and Ethical Concerns: Public awareness about the potential risks of nanotechnology, such as nanoparticle toxicity and environmental damage, remains low. **The Global Nanotechnology Risk Report (2023)** warned that inadequate risk management can slow adoption and lead to public resistance.

WAY FORWARD TO DEEPENING NANOTECHNOLOGY IN INDIA:

Strengthening Research and Innovation Ecosystem: Expanding the **Centre of Excellence in Nanoelectronics (CEN)** to more institutions across India will ensure equitable access to advanced facilities. Programs like the **Indian Nanoelectronics Users Programme (INUP-i2i)** can be extended to smaller institutions and startups to promote broader participation.

Enhancing Commercialization Efforts: Stronger industry-academia partnerships must be promoted to accelerate the commercialization of research outputs. Collaborations similar to those facilitated by CEN, where technologies are licensed to startups, should be encouraged. Dedicated prototyping and incubation facilities supported by government schemes like **Startup India** will help bridge the gap between research and scalable manufacturing.

Increasing Funding and Reducing Import Dependency: Increasing R&D expenditure to at least 1.5% of GDP, aligning with the Atal Innovation Mission, can drive nanotechnology advancements. Establishing domestic production units for critical nanotechnology tools will reduce the current 80% import dependency, as highlighted by the Department of Science and Technology (DST).

Skill Development and Education: Nanotechnology education should be integrated into undergraduate and postgraduate curricula under initiatives like **Skill India**. Specialized training programs in nanofabrication, design, and computational nanoelectronics can build a robust talent pool. Increasing the number of funded PhD programs will double India's contribution to global nanotechnology research.

Developing Regulatory Frameworks: Comprehensive safety guidelines for nanotechnology applications must be developed to ensure ethical usage and minimize environmental risks. The framework should draw insights from **TERI's studies** and international standards, ensuring India remains competitive in adopting and regulating nanotechnology.

Leveraging Government Flagship Programs: The National Nanotechnology Mission can expand its funding focus to emerging applications like quantum computing and **UV LEDs**. **Programs like Make in India and Digital India** should support the domestic manufacturing of nanotechnology products, emphasizing sensors, IoT devices, and energy-efficient systems.

Collaboration with Global Institutions: Establishing international collaborations with leading countries like the US, Japan, and Germany will provide access to advanced tools and expertise. Participation in global forums will keep India aligned with cutting-edge developments, supported by schemes like **India's GIAN initiative (Global Initiative of Academic Networks)**.

Monitoring: A centralized body under MeitY or DST should oversee nanotechnology projects to ensure alignment with national priorities. Regular publication of reports on patents filed, commercialized innovations, and economic impact metrics can help measure progress and guide policy refinement.

CONCLUSION

India's journey toward becoming a global leader in nanotechnology requires consistent efforts in research, funding, skill development, and industry collaboration. By leveraging existing initiatives and addressing current

challenges, India can establish itself as a hub for nanotechnology innovation and drive its socio-economic transformation.

PRELIMS QUESTION:

Q. With reference to carbon nanotubes (CNTs), consider the following statements:

1. Single-walled carbon nanotubes (SWCNTs) can be idealized as cutouts from a two-dimensional graphene sheet rolled up to form a hollow cylinder.
2. Multi-walled carbon nanotubes (MWCNTs) consist of multiple layers of carbon atoms arranged in a nested, tube-in-tube structure.
3. Carbon nanotubes exhibit exceptional tensile strength due to the covalent sp^2 bonds formed between carbon atoms.

How many of the above-given statements are correct?

- A. Only one
- B. Only two
- C. All three
- D. None

ANSWER: C

MAINS QUESTION:

Q. Explain the role of government schemes and programs in promoting nanotechnology research and innovation in India. How do these initiatives help in bridging the gap between academia and industry?

(Answer in 250 words)

EMPOWERING YOUTH FOR A DEVELOPED INDIA: VIKSIT BHARAT YOUNG LEADERS DIALOGUE

WHY IN THE NEWS?

India's youth is the nation's greatest asset, representing a vibrant and dynamic generation that is pivotal to achieving the vision of a developed India by 2047. How-

ever, the journey towards this ambitious goal comes with its share of challenges. In line with the Prime Minister's call for increased youth participation in shaping the nation's future, the Ministry of Youth Affairs has reimagined the National Youth Festival into the Viksit Bharat Young Leaders Dialogue. This transformative initiative seeks to tap into the collective potential of India's youth, empowering them to make comprehensive contributions to the country's development.

"I and you, we should all encourage people for a Viksit Bharat. We should motivate especially young minds to realize this dream." ~ **Prime Minister Shri Narendra Modi**



DATA ON YOUTH IN INDIA:

India has one of the largest youth populations in the world, with over 600 million people under the age of 25, representing about 50% of the country's total population. This demographic presents a unique opportunity for the nation's growth and development. The youth of India are highly diverse, spread across urban and rural areas, with different levels of access to education, skills, and employment opportunities.

Key Statistics:

1. **Population:** In 2011, the youth population in India was 333.4 million, which was a 77 million increase from the previous census. The youth population is expected to decrease from 371.4 million in 2021 to 345.5 million by 2036.

2. **Education:** The unemployment rate is higher for those with higher levels of education. In 2022, the unemployment rate was 18.4% for those with secondary education or higher and 29.1% for graduates.
3. **Employment:** In 2022-23, 42.1% of India's youth (15-29 years old) were part of the labour force. The share was 61.6% for young men and 19.7% for young women.
4. **Skill level:** According to the Global Business Coalition for Education (GBC-Education), United Nations Children's Fund (UNICEF), and the Education Commission, more than 50% of Indian youth are not on track to have the education and skills necessary for employment by 2030.
5. **Gender:** In 2011, 52.7% of adolescents were male, and 47.3% were female.

GOVERNMENT INITIATIVES TO EMPOWER YOUTH:

1. **Skill India Mission:** Launched in 2015, this initiative focuses on providing youth with skill development opportunities across various sectors to make them more employable. It includes schemes like Pradhan Mantri Kaushal Vikas Yojana (PMKVY) to provide training and certification in various skills.
2. **Startup India:** This initiative promotes entrepreneurship among the youth by offering financial support and mentorship and reducing regulatory burdens for startups, making it easier for young entrepreneurs to establish businesses.
3. **Digital India:** Aimed at increasing digital literacy and access to technology, this initiative ensures that youth across India, including in rural areas, have access to digital tools, broadband connectivity, and online educational resources.
4. **Atal Innovation Mission (AIM):** This mission promotes a culture of innovation and entrepreneurship in young minds by supporting innovation hubs, startup incubation, and fostering partnerships between institutions and industries.
5. **National Youth Policy (NYP):** The NYP lays out a roadmap for youth development in India, focusing on education, employment, health, and leadership, while promoting the active participation of youth in national development.
6. **Yuva Sarkar:** Yuva Sarkar aims to involve 1 million youth leaders in policy-making by 2025, fostering

youth participation in governance and leadership roles.

7. **Internships:** Government schemes like the National Internship Scheme and PM Modi's Internship Scheme offer thousands of opportunities annually. Over 50,000 internships are provided each year in government sectors and private organizations, promoting skill development and employability.
8. **Skill Development (PMKVY):** Under the Pradhan Mantri Kaushal Vikas Yojana (PMKVY), over 13 million youth have been trained since 2015, with 2.8 million placements recorded by 2023. The scheme aims to train 10 million youth by 2025.
9. **National Education Policy (NEP) 2020:** The NEP 2020 aims to increase the Gross Enrollment Ratio (GER) in higher education to 50% by 2035. It also targets 50% of school students to receive vocational training by 2025, promoting skills alongside academic education. Additionally, 100 million learners are expected to benefit from digital learning platforms by 2024.

ISSUES THAT NEED TO BE ADDRESSED:

1. **Unemployment and Underemployment:** A significant number of youth, especially graduates, face difficulties in finding quality employment due to skill mismatches and limited job opportunities in key sectors.
2. **Educational Gaps:** While enrollment in schools has improved, the quality of education remains a concern, particularly in rural areas. Many young people lack practical skills that meet the demands of the modern job market.
3. **Mental Health Challenges:** The mental health of youth in India is often overlooked, with rising concerns about stress, anxiety, and depression, exacerbated by societal pressures and the uncertainties of the future.
4. **Gender Inequality:** Despite progress, women and girls in India still face barriers to education, employment, and leadership roles, limiting their ability to contribute equally to national development.
5. **Digital Divide:** Access to the internet, technology, and digital resources is still a major issue for rural and economically disadvantaged youth, hindering their opportunities for learning and innovation.

- 6. Social and Cultural Challenges:** Issues like caste-based discrimination, rural-urban divide, and lack of social inclusion limit opportunities for many young people in India, preventing them from realizing their full potential.
- 7. Skill gap:** The skill gap is a major issue, with a mismatch between educational outcomes and industry needs, leaving many youth unemployable. Practical training and soft skills like communication and problem-solving are often lacking, further limiting job readiness.
- 8. Rural-Urban Divide:** The rural-urban divide exacerbates disparities, with rural areas lacking infrastructure, education, and job opportunities, driving youth migration to cities. Limited digital access in rural regions also prevents youth from benefiting from online learning and skill development programs.

SOLUTIONS TO ADDRESS THESE ISSUES:

1. Skill Development and Vocational Training:

Expand skill development programs to align with industry needs and provide hands-on training in high-demand sectors such as technology, healthcare, and renewable energy.

Increase partnerships between educational institutions, industry players, and government bodies to ensure that students are equipped with relevant skills.

2. Improvement of Educational Quality:

Implement reforms to ensure that education systems focus on critical thinking, creativity, and practical skills, not just rote learning.

Increase investment in rural and underserved areas to improve infrastructure and access to quality teachers.

3. Promotion of Mental Health Awareness:

Launch nationwide awareness campaigns to destigmatize mental health issues and provide youth with access to counselling and support services.

Integrate mental health programs into schools and universities to offer proactive support for students.

4. Gender Equality Initiatives:

Strengthen policies to promote gender equality in education, employment, and leadership positions.

Create safe and inclusive spaces for women and girls, ensuring equal access to opportunities in all sectors.

5. Bridging the Digital Divide:

Improve internet connectivity in rural and remote areas and provide subsidized access to digital devices and tools for education.

Promote digital literacy programs that ensure youth from disadvantaged backgrounds can effectively participate in the digital economy.

6. Youth Leadership and Social Inclusion:

Provide platforms like the Viksit Bharat Young Leaders Dialogue for youth to engage in policy discussions, community projects, and leadership development.

Encourage youth-led organizations and grassroots movements that advocate for social change and inclusion.

7. Gender Budget: Gender-responsive budgeting (GRB) should prioritize women's empowerment in sectors like healthcare and education. Funding should focus on women's economic opportunities, childcare, and social programs. Gender-disaggregated data is essential for tracking policy impact. Involving women in budget planning and raising awareness ensures inclusive policymaking.

CONCLUSION:

The reimagining of the National Youth Festival into the Viksit Bharat Young Leaders Dialogue marks a significant step towards empowering India's youth to actively contribute to the nation's development. By promoting political engagement, encouraging merit-based involvement, and creating a platform for innovation and leadership, this initiative aligns with the Prime Minister's vision of a developed India. Through activities such as the Viksit Bharat Challenge, it offers young individuals a chance to present their ideas and share their visions on a national stage, positioning it as a crucial driver in shaping the future of the country.

PRELIMS QUESTION:

Q. With reference to the Viksit Bharat Young Leaders Dialogue, consider the following statements:

1. The Viksit Bharat Young Leaders Dialogue was created to replace the National Youth Festival with a focus on empowering youth through political engagement and leadership.

2. The initiative aims to provide a platform for youth to share their ideas and solutions for India's development, including through the Viksit Bharat Challenge.

3. The Viksit Bharat Young Leaders Dialogue primarily focuses on youth involvement in traditional cultural programs and celebrations.

How many of the above-given statements are correct?

- A. Only one
- B. Only two
- C. All three
- D. None

Answer: B

MAINS QUESTION:

Q. "Discuss the significance of merit-based participation in the Viksit Bharat Young Leaders Dialogue and its potential impact on India's youth."

(250 words, 15 marks)