Secure Synopsis compilation for November 2024

General Studies-3

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Indian Economy and issues relating to planning, mobilization, of resources, growth, development and employment.

Q. Discuss the potential economic benefits of increasing women's labour force participation by valuing and redistributing unpaid household work. How might this shift affect India's GDP. (10 M)

Introduction

Valuing and redistributing unpaid household work can significantly boost India's GDP by encouraging women's workforce participation, creating economic opportunities that foster gender equity and inclusive growth.

Body

Economic benefits of recognizing unpaid work

1. **Enhanced labour force participation**: Valuing unpaid work can motivate policies that facilitate women's entry into formal employment, directly increasing economic output.
    - **E.g.**: The **State Bank of India (2023)** highlighted that recognizing women's unpaid work could **increase GDP by up to 27%.**
2. **Increased household income and productivity**: Inclusion in paid work generates additional household income, which improves productivity and spending capacity.
    - **E.g.**: An **ILO report (2022)** found that countries with policies enabling higher **female workforce participation see a 10% rise** in GDP growth.
3. **Reduction in gender pay gap**: Assigning value to unpaid labor sets a foundation for fair wages, reducing the gender pay gap and contributing to economic equality.
    - **E.g.**: **Wage disparities narrowed by 3% in countries** implementing labor inclusion reforms (World Economic Forum, 2022).
4. **Boosts human capital investment**: When women participate in formal work, there is increased focus on skill development and education, improving national human capital.
    - **E.g.**: In countries like **Japan**, **increased female workforce training** has contributed to productivity gains (ILO, 2022).
5. **Reduced poverty and income inequality**: Employment stability resulting from workforce participation can lead to better income distribution and reduced poverty levels.
    - **E.g.**: According to **UN Women**, nations that recognize unpaid work see higher socio-economic mobility.
6. **Improved labour market balance**: Redistributing unpaid household duties allows for a more balanced labour market, filling skill gaps and improving economic output.
    - **E.g.**: In **Sweden**, policies promoting shared domestic work increased women's **labour force participation by 15%** (UNDP, 2023).

Impact on India's GDP

1. **Increased national output:** Enhanced female workforce participation has a multiplier effect on GDP growth through increased labour productivity and diversified economic activities.
    - **E.g.**: The **Economic Survey (2024)** projected that a **10% rise in women's** labour participation could add approximately 1.4% to India's GDP.

2. **Support for sustainable development goals (SDGs)**: Valuing unpaid work aligns with **SDG 5**, which emphasizes gender equality, enabling equitable economic development.
    - **E.g.**: **APEC (2022)** estimates that **unpaid work contributes up to 9% of GDP** in some economies, emphasizing its economic relevance.
3. **Strengthened economic resilience**: Female inclusion adds resilience to the economy, enabling households to withstand economic shocks through diversified income sources.
    - **E.g.**: The **McKinsey Global Institute** indicates that increased female participation could add **$770 billion** to India's GDP.
4. **Improved health and productivity outcomes**: Women's employment improves access to healthcare, boosting productivity and enhancing health outcomes for families.
    - **E.g.**: A **Lancet Study (2023)** found that increased economic participation among women enhances household health investments, reducing healthcare costs.
5. **Spurs innovation and economic diversification**: Women's unique perspectives contribute to innovation and support diversification across sectors.
    - **E.g.**: **Niti Aayog** reports that women entrepreneurs have been instrumental in 15% of India's MSME sector growth.
6. **Enhanced tax revenue**: Increased workforce participation by women broadens the tax base, generating revenue for public welfare programs and infrastructure.
    - **E.g.**: An additional **₹1.2 lakh crore** in **tax revenue** is estimated with a 10% rise in female workforce participation (Economic Survey, 2024).

Conclusion

Recognizing unpaid work and redistributing household responsibilities can unleash women's potential in India's labour market, **fostering sustainable economic growth and achieving a balanced**, inclusive society that values all contributions equally.

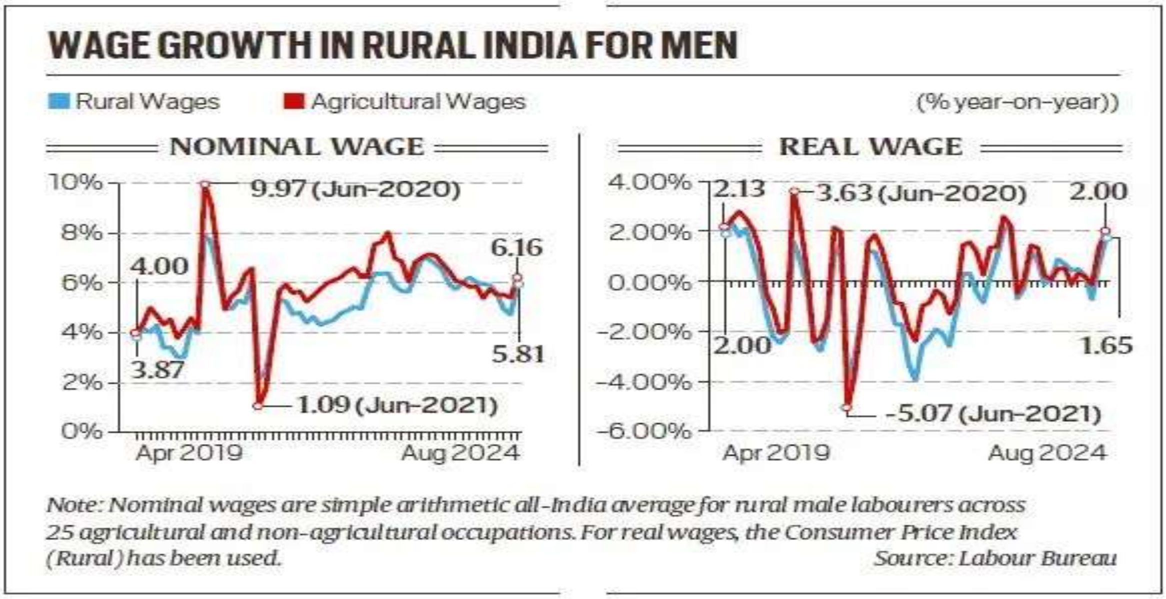
Q. Analyze the paradox of stagnant rural wages in India despite a buoyant GDP growth. Examine the factors driving this stagnation and suggest measures to enhance rural wage growth. (15 M)

Introduction

India has witnessed **buoyant GDP growth** in recent years, but **rural wages** have remained **stagnant in real terms**, raising concerns about the inclusiveness of economic development. This paradox reveals structural issues within the economy, particularly in rural labor markets.

Body

Paradox of stagnant rural wages amid buoyant GDP growth



1. **<u>Capital-intensive economic growth</u>:** Recent economic growth has favoured **capital-intensive sectors** like infrastructure, reducing the demand for labour in rural areas.
   - **E.g.: The construction sector's increased mechanization** has diminished the need for manual labour.
2. **<u>Agricultural sector's limited growth</u>:** Agriculture, which employs a large portion of the rural workforce, has seen **slower growth** compared to other sectors.
   - **E.g.**: Agriculture's contribution to GDP has declined from **18.2% in 2014-15 to 16.5% in 2022-23**.
3. **<u>Prevalence of informal employment</u>:** A significant portion of the rural workforce is engaged in **informal employment**, which lacks wage security and growth prospects.
   - **E.g.:** Over **80% of rural workers** are in informal employment, according to the **Periodic Labour Force Survey (PLFS) 2022-23**.
4. **<u>Regional disparities</u>: Economic growth** has been uneven, with **rural areas** lagging behind **urban centers**.
   - **E.g.:** States like **Bihar** and **Uttar Pradesh** have lower per capita incomes compared to **Maharashtra** and **Gujarat**.
5. **<u>Underemployment issues</u>:** Many rural workers face **underemployment**, working fewer hours than they desire, leading to stagnant incomes.
   - **E.g.:** The **PLFS 2022-23** reports a higher underemployment rate in rural areas compared to urban regions.

Factors driving stagnation in rural wages

1. **<u>Surplus labour supply</u>:** An increase in the rural labour force, particularly due to the rise in **female Labor Force Participation Rate (LFPR)**, has created downward pressure on wages.

    - **E.g.:** The **rural female LFPR** increased from **26.4% in 2018-19 to 47.6% in 2023-24**, according to the **PLFS**.
2. **<u>Inflationary pressures</u>: Rising inflation**, especially in essential goods, has eroded the **real wage** gains of rural workers.
    - **E.g.:** The **Consumer Price Index (Rural)** shows an **average inflation rate of 6.5%** over the past five years.
3. **<u>Limited access to credit</u>: Restricted access to affordable credit** limits rural entrepreneurship and income diversification, stifling wage growth.
    - **E.g.:** Only **15% of rural households** have access to formal credit, as reported by the **National Bank for Agriculture and Rural Development (NABARD)**.
4. **<u>Inadequate infrastructure</u>:** Poor **infrastructure** such as roads and electricity in rural areas limits economic activity and wage growth.
    - **E.g.: Many rural industries lack access to reliable infrastructure**, affecting productivity and employment opportunities.
5. **<u>Education and skill deficits</u>: Low education and skill levels** among rural workers restrict their employment opportunities and wage growth potential.
    - **E.g.:** The **literacy rate in rural India** is **73.5%, lower** than the urban rate of 87.7%, according to **Census 2011**.

<u>Measures to enhance rural wage growth</u>

1. **<u>Promotion of labour-intensive industries</u>:** Encouraging growth in **labour-intensive sectors** such as textiles, handicrafts, and agro-processing can create more employment opportunities in rural areas.
    - **E.g.:** The **Pradhan Mantri Kaushal Vikas Yojana (PMKVY)** aims to enhance skills in labour-intensive sectors.
2. **<u>Infrastructure development</u>:** Investing in **rural infrastructure** such as roads, electricity, and internet connectivity can boost economic activity and wage growth.
    - **E.g.:** The **Pradhan Mantri Gram Sadak Yojana (PMGSY)** focuses on improving rural road connectivity.
3. **<u>Access to affordable credit</u>:** Expanding **financial inclusion** and providing affordable credit will stimulate **rural entrepreneurship** and job creation.
    - **E.g.:** The **Pradhan Mantri Jan Dhan Yojana (PMJDY)** has significantly increased bank account penetration in rural areas.
4. **<u>Skill development programs</u>:** Implementing targeted **skill development programs** to enhance the employability of rural workers is crucial.
    - **E.g.:** The **Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY)** focuses on rural youth skill development.
5. **<u>Strengthening social security nets</u>:** Expanding social security schemes like **direct benefit transfers** can provide crucial income support in times of wage stagnation.
    - **E.g.:** The **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)** provides wage employment to rural households.

Conclusion

To resolve the issue of **stagnant rural wages**, a multifaceted approach focusing on **labor-intensive industries**, **skill development**, and **improved infrastructure** is essential. By ensuring that rural wage growth aligns with economic progress, India can promote inclusive and sustainable development.

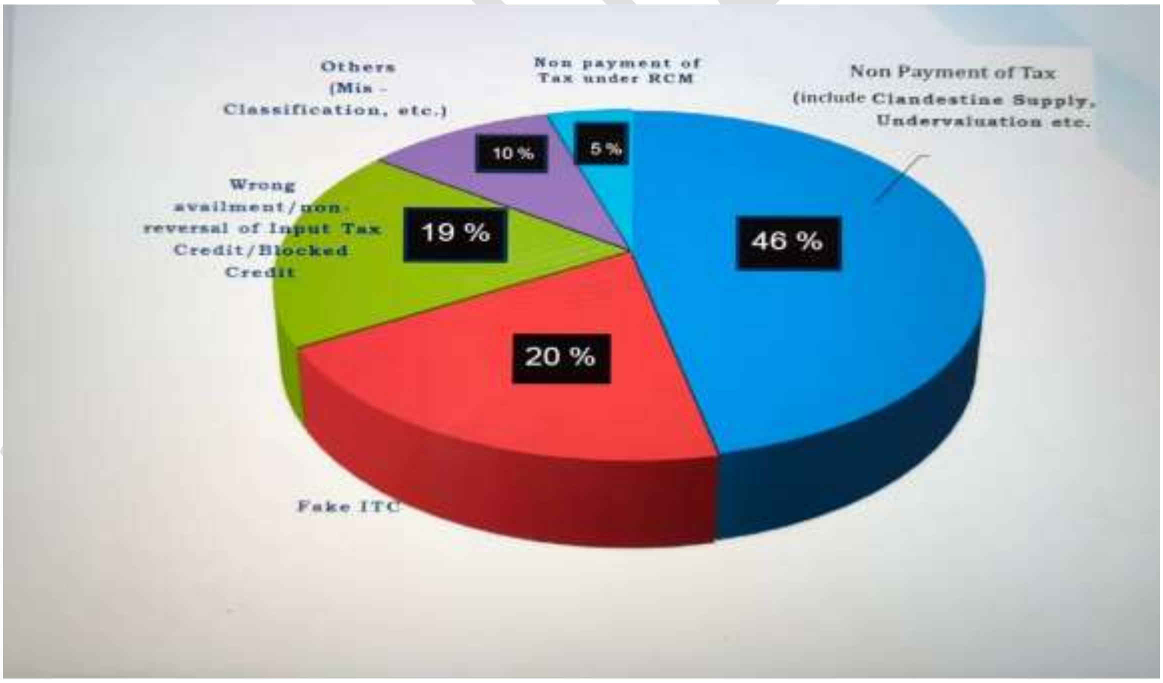
Q. "Tax evasion under the GST regime in India has seen evolving and complex trends, impacting both revenue and compliance". Examine these trends and suggest measures to strengthen enforcement and improve compliance. (10 M)

Introduction

Tax evasion under the GST regime has grown into a sophisticated issue, impacting **revenue collection** and **tax compliance**. Addressing these evolving trends is crucial for maintaining fiscal discipline and ensuring equitable taxation.

Body

Trends of tax evasion in India's GST regime



1. **Fake invoicing and input tax credit (ITC) fraud:** A major challenge is the misuse of **fake invoices** to claim **fraudulent ITC** without any real transactions.
    - **E.g.:** In FY 2023-24, the **DGGI detected Rs 2.01 lakh crore** in tax evasion, primarily linked to fake ITC claims (Source: DGGI).
2. **Identity theft and fake firms:** Scammers often use **stolen identities** to create **fake firms** and evade taxes through fraudulent GST registrations.

- **E.g.:** In Pune, a scam involving **246 fake GST firms** evaded taxes worth **Rs 5,000–Rs 8,000 crore**.

3. **Undervaluation of goods and services:** Businesses undervalue goods/services to **reduce GST liability** and minimize taxes.
   - **E.g.:** In Jaipur, plywood manufacturers were caught **undervaluing their goods by 60-70%**, evading **Rs 20 crore** in taxes.
4. **Non-payment on taxable services:** Some entities provide taxable services but **evade GST** by misclassifying services or failing to pay taxes.
   - **E.g.:** A **Mumbai brand licensing firm** avoided **Rs 382 crore** in GST until detected by authorities.
5. **Sector-specific evasion:** Certain sectors like **real money online gaming** and **iron scrap** are prone to high evasion due to complexities in tax structures.
   - **E.g.: The online gaming sector** alone accounted for **Rs 81,875 crore** in GST evasion in FY 2023-24.

Measures to improve enforcement and compliance

1. **Technological interventions:** Use of **AI, data analytics, and blockchain technology** can help monitor transactions in real-time and flag suspicious activities.
   - **E.g.:** The **Goods and Services Tax Network (GSTN)** uses AI to detect patterns in ITC claims and identify discrepancies.
2. **E-invoicing and real-time monitoring:** Mandatory **e-invoicing** for all businesses helps track transactions and curb **fake invoicing**.
   - **E.g.: E-invoicing became mandatory for businesses** with a turnover of over **Rs 10 crore** in **2022**.
3. **Inter-agency collaboration: Coordination between tax authorities, police, and financial intelligence units** is essential to detect and prevent complex frauds like identity theft.
   - **E.g.: The Noida case involving 2,660 fake firms** was solved through collaboration between the **DGGI and FIU**.
4. **Legal reforms and penalties:** Strengthening **legal frameworks** and ensuring **swift legal action** for offenders can deter evasion.
   - **E.g.:** The **Shyamala Gopinath Committee** has recommended **harsher penalties** for tax fraud and fake ITC claims.
5. **Capacity building and awareness campaigns:** Training programs for **tax officials** and raising awareness among businesses about **compliance requirements** can improve enforcement.
   - **E.g.:** The **CBIC** launched **campaigns to help MSMEs** understand GST compliance and avoid inadvertent evasion.

Conclusion

To address the evolving trends of **GST evasion**, India must rely on **technological solutions** and **stronger inter-agency cooperation**. A **proactive approach** will strengthen compliance and ensure the stability of the GST system for sustained fiscal health.

Q. "The gig economy in India provides flexible work opportunities but often at the cost of job security and fair wages." Discuss the challenges faced by gig workers in securing dignified employment. (10 M)

Introduction

The gig economy has seen rapid growth in India, offering flexible work options to millions. However, this flexibility often comes at the cost of job security, fair wages, and essential worker rights.

Body

Challenges faced by gig workers

1. **Job insecurity**: Gig work is typically project-based with no formal employment contracts, leading to uncertainty.
    - **E.g.:** As per the **NITI Aayog Report on the Gig Economy (2022)**, around 77% of gig workers lack any form of job security.
2. **Low and unpredictable wages**: Many gig platforms do not guarantee minimum wages, and earnings are subject to platform fees and cuts.
    - **E.g.:** The **Fairwork India Report 2021** found that over 80% of gig workers earn below minimum wage across major Indian states.
3. **High commission fees**: Gig workers lose a significant portion of their earnings to platform commissions and operational fees.
    - **E.g.: Delivery workers on platforms** like **Swiggy** pay up to 20% in commissions, affecting net income.
4. **Absence of social security:** Gig workers often lack health insurance, pension, and paid leave, affecting long-term security.
    - **E.g.:** Only 10% of gig workers in India have access to social security benefits, according to **ILO (2022)**.
5. **Algorithmic control and rating systems**: Platform algorithms assign work based on ratings, which can be arbitrary and lead to unfair job distribution.
    - **E.g.:** Companies like **Zomato** and **Uber** use algorithms that often penalize workers, affecting their access to future gigs.
6. **Lack of legal protection**: Gig workers are categorized as "independent contractors," leaving them outside the purview of labour laws.
    - **E.g.:** The **Code on Social Security 2020** has provisions for gig workers but is yet to be fully implemented.
7. **Gender-based disparities**: Women gig workers often face barriers, relegating them to lower-paying roles and affecting their economic independence.

- E.g.: **Women are largely concentrated in domestic work** and beautician services, limiting income potential.

8. **Limited collective bargaining power**: Gig workers have minimal bargaining power due to the informal nature of their contracts.
    - **E.g.:** Efforts by groups like the **Gig Workers Union** highlight the need for formal recognition of worker rights.
9. **Personal financial burdens**: Gig workers often bear the cost of transportation, maintenance of work tools, and platform fees, cutting into earnings.
    - **E.g.: Delivery agents frequently pay for fuel**, vehicle upkeep, and equipment maintenance, affecting take-home pay.
10. **Physical and mental strain**: Gig workers often work long hours without breaks to meet financial needs, impacting health.
    - **E.g.**: **Delivery workers face intense schedules during peak seasons**, which can lead to health issues.

Impact on dignified employment

1. **Economic instability**: Low wages and unpredictable income prevent workers from achieving financial stability.
2. **Erosion of worker rights**: Without formal legal protections, gig workers lack the ability to demand fair treatment.
3. **Compromised well-being**: Long hours and lack of health benefits impact the physical and mental health of gig workers.

Conclusion:

To ensure dignified employment for gig workers, **India must implement solution-oriented policies, such as enforcing minimum wage standards, expanding social security coverage, and enabling collective bargaining rights**. A balanced regulatory framework can protect gig workers' rights while preserving the flexibility that the gig economy offers.

Q. "Innovation in technical textiles is essential for achieving self-reliance in critical sectors". Analyze in the context of the National Technical Textiles Mission. (10 M)

Introduction

Technical textiles, as high-performance materials, are essential for self-reliance in sectors like defence, healthcare, and infrastructure by reducing dependency on imports and fostering indigenous capabilities.

Body

Role of innovation in technical textiles in achieving self-reliance

1. **Critical infrastructure development:** Technical textiles such as geotextiles are crucial for enhancing the durability and efficiency of infrastructure projects, especially in areas prone to natural disasters.
   - E.g.: **Geotextiles** are used in North-East India for stabilizing roads in flood-prone regions, reducing reliance on foreign solutions.
2. **Supporting high-security sectors:** Advanced textiles for defense and aerospace ensure that India meets its strategic requirements independently.
   - E.g.: Indigenous **aramid-based protective gear** developed by DRDO for military use, reducing reliance on costly imports.
3. **Reducing health sector vulnerabilities:** Medical textiles like surgical masks, PPE, and biodegradable medical fabrics ensure self-sufficiency in healthcare, crucial for emergency responses.
   - E.g.: During the COVID-19 pandemic, India scaled up domestic production of PPE kits, achieving self-sufficiency within months.
4. **Enhancing agrotech solutions for food security:** Technical textiles like agrotech fabrics improve agricultural productivity, supporting rural development and reducing reliance on imported agro-solutions.
   - E.g.: **Polyhouse covers and crop protection nets** boost yields by creating controlled environments for year-round farming.
5. **Boosting employment and rural economy:** Establishing technical textile units in rural areas can stimulate job creation, helping local economies grow and support sustainable livelihoods.
   - E.g.: Development of technical textile manufacturing in rural Maharashtra has provided direct and indirect employment to local communities.
6. **Reducing dependence on climate-sensitive imports:** As technical textiles reduce the need for import-dependent resources, they make India's economy less vulnerable to climate-driven global supply shocks.
   - E.g.: **Indigenous production of biodegradable textile materials** mitigates environmental impact and reduces import reliance.

Contribution of the national technical textiles mission

1. **Strategic r&d investments in cutting-edge textiles:** The Mission's funding of research in smart, sustainable, and composite textiles promotes innovations that can fulfil sector-specific needs domestically.
   - E.g.: **Research at IIT Delhi** on moisture-absorbing fabrics enhances protective gear for defence personnel.
2. **Enabling technology transfer to industry:** The Mission facilitates partnerships between research institutions and industry, promoting rapid commercialization of new technologies.
   - E.g.: **Technology transfers to SMEs** for the production of advanced medical textiles have bolstered the domestic supply chain.

3. **<u>Focus on export competitiveness</u>**: By improving standards and quality, the Mission enhances India's ability to export high-value technical textiles to global markets, supporting economic growth.
   - E.g.: India's **exports of technical textiles to Europe** have increased due to quality certifications supported by the Mission.
4. **<u>Infrastructure for testing and certification</u>**: Establishing dedicated testing labs ensures compliance with global standards, improving product credibility.
   - E.g.: **National Textile Testing Labs** in Delhi provide certifications that meet European standards, enhancing export potential.
5. **<u>Ipr facilitation and protection</u>**: New IPR guidelines encourage the development and protection of indigenous technologies, strengthening India's technical textile sector's intellectual property base.
   - E.g.: **IPR patents filed by institutions like IIT Madras** for smart textiles ensure proprietary technology stays within India.
6. **<u>Targeted skill development programs</u>**: Specialized training programs under the Mission enhance technical skills for advanced textile manufacturing, increasing productivity and innovation.
   - E.g.: **Collaboration with the Textile Sector Skill Council** has trained thousands in the technical textile industry.

Conclusion:

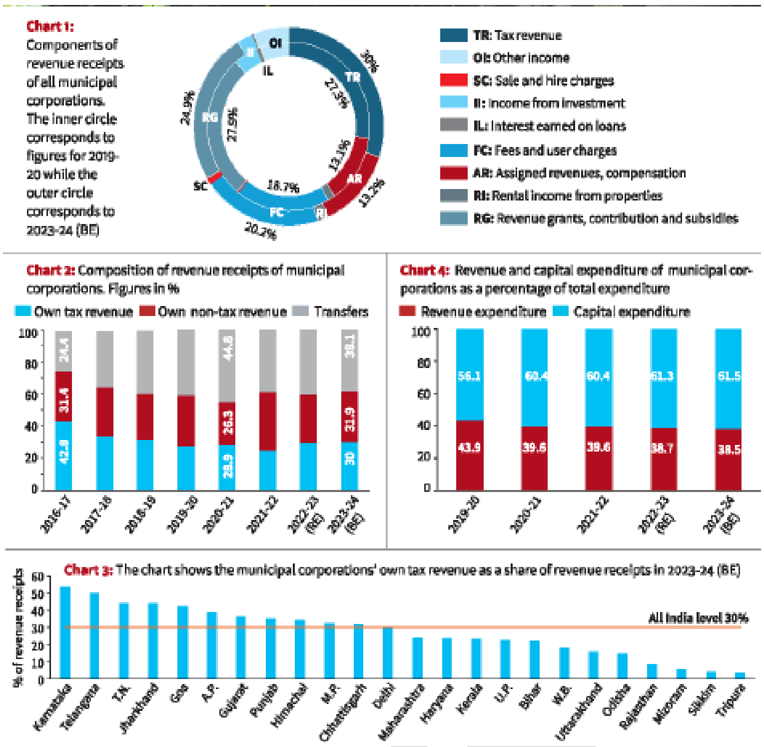
The National Technical Textiles Mission fosters innovation essential for self-reliance across critical sectors, enhancing India's resilience against import dependencies. **Continued investment in R&D and skill-building** under the Mission will further strengthen India's strategic autonomy in high-performance textiles.

Q. Examine the challenges and opportunities in enhancing the own-tax revenue of municipal corporations in India. What strategic measures can bolster their financial robustness while fostering efficient urban service delivery? (15 M)

Introduction

In a rapidly urbanizing India, **financial independence of municipal corporations** is essential for delivering quality urban services. While there are significant challenges in generating own-tax revenue, strategic reforms could strengthen municipal finances and support sustainable urban development.

Body



Challenges in enhancing own-tax revenue

1. **Limited taxing powers**: Municipal corporations have restricted powers to levy taxes, relying heavily on property tax, which often limits their revenue base.
    - E.g.: **The 74th Amendment grants taxation rights but leaves specifics to State discretion**, often restricting municipal autonomy (MoHUA Report, 2023).
2. **Low property tax collection efficiency**: Property taxes, a primary revenue source, suffer from outdated valuation systems, poor collection efficiency, and widespread evasion.
    - E.g**.: Property tax compliance in Delhi is just 37%** due to outdated records and collection inefficiencies (RBI Municipal Finance Report, 2023).
3. **High dependency on state transfers**: Reliance on grants and transfers from Central and State governments limits fiscal independence and hampers effective planning.
    - E.g.: **Municipal corporations in Rajasthan and Odisha derive over 50%** of **revenue from state transfers** (National Institute of Urban Affairs, 2022).
4. **Inadequate user charges**: Municipalities often fail to generate sufficient revenue from user fees, with low-cost recovery on utilities like water and waste management.
    - E.g**.: Urban water charges cover only about 20%** of service costs in many cities (Ministry of Urban Development, 2023).
5. **Weak institutional capacity**: Limited staff and technology resources hinder efficient tax collection and revenue management.

- E.g.: **Many smaller municipal corporations lack digital tools** for efficient tax collection, affecting revenue generation (Indian Institute for Human Settlements, 2022).

Opportunities for revenue enhancement

1. **Expanding the property tax base**: Updating property records and valuation methods offers significant potential for increasing property tax revenues.
   - E.g.: **Bengaluru implemented GIS-based property mapping**, increasing its property tax base by 15% (Bengaluru Municipal Corporation, 2022).
2. **Innovating with technology**: Digital tools, such as online tax portals and automated billing systems, streamline collection processes and improve compliance.
   - E.g.: The **Pune Municipal Corporation's digital payment portal** increased revenue collection by 10% (Pune Municipal Report, 2023).
3. **Enhancing public-private partnerships (PPPs)**: Collaborating with private players can help municipal corporations invest in better infrastructure and service delivery, indirectly increasing user charges.
   - E.g.: **Indore's waste-to-energy project** under a PPP model has improved revenue from waste collection fees (NITI Aayog, 2023).
4. **Leveraging land-based financing**: Revenues from land leasing and development rights offer potential for long-term revenue.
   - E.g.: **Gujarat's Town Planning Schemes** generate revenue by selling development rights, funding urban infrastructure (Gujarat Urban Development Report, 2023).
5. **Encouraging green taxes and environmental charges**: Municipalities can explore eco-taxes on pollution-generating entities to promote sustainable practices and increase revenue.
   - E.g.: **Delhi's Green Cess** on commercial vehicles has raised funds for air pollution control efforts (Delhi Government, 2023).

Strategic measures to bolster financial robustness

1. **Reforms in property taxation**: Implement regular property revaluations and Geographic Information System (GIS)-based mapping to improve accuracy and compliance.
   - E.g.: **Bhubaneswar used GIS mapping**, raising property tax compliance by 20% (Orissa State Urban Development Report, 2022).
2. **Implementing performance-based grants**: Link state transfers to revenue performance to incentivize higher own-revenue generation.
   - E.g.: The **14th Finance Commission recommended performance grants** to municipalities based on their tax collection efficiency (Finance Commission Report, 2015).
3. **Introducing dynamic user fees**: Adjust user charges for utilities and services based on cost recovery, ensuring quality and financial viability.

- E.g.: **Nagpur has implemented a model where water tariffs** are adjusted to cover costs, improving service quality and revenue (Urban Water Management Report, 2022).

4. **<u>Strengthening digital infrastructure</u>**: Invest in digital platforms for seamless tax collection and transparency, improving ease of payment and compliance.
   - E.g.: **Surat Municipal Corporation's online portal** increased tax compliance through automated reminders and online payments (Surat Urban Report, 2023).
5. **<u>Promoting fiscal autonomy through policy reforms</u>**: Advocate for constitutional amendments to enhance municipal taxation powers, allowing them greater financial control.
   - E.g.: The **74th Constitutional Amendment** review committee has suggested further decentralization to empower local bodies (MoHUA, 2023).

Conclusion

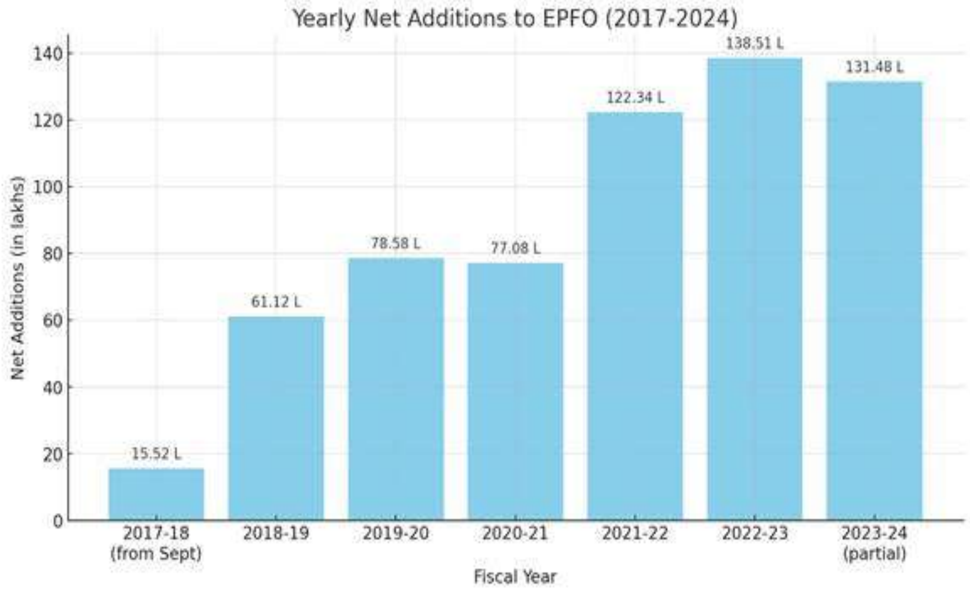
Enhancing the financial independence of municipal corporations through strategic reforms in revenue generation is essential for sustainable urban governance. **Empowering municipalities with the right tools and policies** can lead to stronger fiscal health and improved quality of urban services for India's rapidly growing cities.

Q. How does the formalization of jobs in India contribute to gender diversity and inclusivity in the workforce? (10 M)

Introduction

The formalization of jobs in India has been a **transformative force in promoting gender diversity and inclusivity**, providing a stable and supportive work environment that empowers women and marginalized groups.

Body



Increased access for women

1. **Job security and fixed income**: Formal jobs provide regulated wages, contracts, and legal protections, making them more appealing and secure for women.
   - **E.g.: Recent EPFO data (July 2024)** shows a rise in female registrations, reflecting an increase in women joining the formal workforce.
2. **Social security benefits**: Formal employment offers benefits such as maternity leave, provident fund, and insurance, creating a supportive work environment for women and minorities.
   - **E.g.: The Employees' Deposit Linked Insurance (EDLI)** scheme under EPFO ensures life insurance coverage for women and all registered workers, enhancing financial security.
3. **Equal opportunities through compliance**: Companies in the formal sector follow gender equity laws and workplace policies, supporting equal pay and career growth.
   - **E.g.: The Maternity Benefit (Amendment) Act, 2017**, mandates paid maternity leave in the formal sector, improving job retention among women.
4. **Access to skill development programs**: Formal jobs are often linked to employer-sponsored training, increasing women's skills and employability.
   - **E.g.: The Pradhan Mantri Kaushal Vikas Yojana (PMKVY)** provides skill certification for women, promoting job stability and career growth.
5. **Flexibility with part-time and remote work options**: Many formal sector companies offer flexible work hours, making employment more feasible for women.
   - **E.g.: Corporate policies in IT companies** have adopted hybrid and flexible work models, increasing female workforce retention and inclusivity.

Supportive environment for inclusivity

1. **Increased participation of marginalized groups**: Formalization offers protections and benefits that attract diverse groups, shifting workers from informal to formal sectors.
   - **E.g.: EPFO data** indicates an increase in first-time job seekers from rural and economically weaker backgrounds joining formal jobs.
2. **Digital access and financial inclusion**: Digital wage payments and accessible banking through formal employment promote financial inclusion for underrepresented groups.
   - **E.g.: RuPay Kisan Credit Cards**, available to rural cooperative members, have boosted financial inclusion in remote areas.
3. **Impact on gender diversity**: Increased formalization has led to greater female participation, contributing to a more balanced and diverse workforce.
   - **E.g.: Ministry of Labour and Employment (2023)** reports show that 37% of new formal workforce entrants were women, a significant increase over past years.
4. **Enhanced workplace protections**: The formal sector ensures legal safeguards against discrimination and harassment, making workplaces safer for all employees.
   - **E.g.: The Sexual Harassment of Women at Workplace Act, 2013**, mandates an Internal Complaints Committee in all formal organizations.
5. **Pension and retirement benefits**: Formalization provides pension and retirement savings options that improve long-term financial security, especially for marginalized groups.

Conclusion

As India advances toward a more formalized economy, enhancing inclusivity and diversity through **secure, equitable employment** is essential to sustainable and balanced growth.

Q. "Capital expenditure in India faces both structural and cyclical challenges". Examine the reasons behind the flagging capex and suggest measures to improve fiscal spending efficiency. (15 M)

Introduction

Capital expenditure (capex) is pivotal for **economic growth** as it builds productive assets and drives long-term development. However, the **flagging capex in H1 FY25** reflects deep-**rooted structural inefficiencies and cyclical challenges**, impacting fiscal targets and economic momentum.

Body

Structural challenges in capital expenditure

1. **Delays in project approvals**: Complex administrative procedures and weak institutional frameworks hinder timely project execution.

- **Eg. CMIE data (2024) shows a 53%** YoY decline in project completions in H1 FY25.

2. **Lack of capacity at state level**: States often face resource constraints and inadequate technical expertise for capex execution.
    - **Eg.** States achieved only **28% of their capex targets in H1 FY25** (CareEdge Ratings).
3. **Weak public-private collaboration**: Poor coordination limits private sector participation in infrastructure projects.
    - **Eg.** Only **45% of capex in FY25** was directed to the manufacturing sector despite its high growth potential.
4. **Inefficient fund utilization**: A mismatch between budgetary allocations and actual spending leads to unspent funds.
    - **Eg.** A**udit report highlighted** over **30% of allocated funds remained unused** in major central projects.

Cyclical challenges in capital expenditure

1. **Election-related disruptions**: General elections in early 2024 delayed fiscal planning and implementation.
    - **Eg. Centre's capex** contracted **35% in Q1 FY25** (India Ratings).
2. **Slow revenue growth**: Moderation in domestic consumption and inflationary pressures reduced revenue receipts, impacting fiscal space.
    - **Eg. Revenue receipts grew** only **7.3% in H1 FY25** against a budgeted 20% growth (ICRA).
3. **Global uncertainties**: Inflation, geopolitical tensions, and supply chain disruptions increased input costs and slowed capex.
    - **Eg. Oversupply from China** led to subdued demand for domestic manufacturing in FY25.
4. **Election-related restrictions**: Q1 FY25 saw lower investment announcements due to policy uncertainties.
    - **Eg.** Investment announcements fell **29.5% YoY** in H1 FY25 (CMIE data).

Measures to improve fiscal spending efficiency

1. **Streamline project execution**: Establish single-window clearances and strengthen institutional frameworks to expedite approvals.
    - **Eg**. Maharashtra's "War Room" initiative significantly reduced project delays.
2. **Enhance state-Centre coordination**: Regular consultations and better fund disbursal mechanisms can improve capex performance at state levels.
    - **Eg.** The **Centre's early tax devolution** in October 2024 boosted state fiscal capacity.
3. **Frontload expenditure**: Focus on spending in the first two quarters to avoid year-end bunching of funds.

- **Eg. States like Rajasthan improved** capex by allocating **42% of total expenditure to capital outlays in Q2 FY25**.

4. **Innovative financing mechanisms**: Use public-private partnerships (PPPs), green bonds, and sovereign funds to attract private investment.
    - **Eg.** Kerala's **Masala Bonds** effectively financed infrastructure projects.
5. **Strengthen monitoring systems**: Real-time monitoring and performance-based funding can ensure efficient utilization of allocated funds.
    - **Eg.** The **National Infrastructure Pipeline (NIP) dashboard** tracks project progress effectively.
6. **Boost revenue mobilization**: Rationalize GST structures, improve compliance, and widen the tax base to create fiscal space.
    - **Eg. Simplified GST returns in FY24** improved compliance, enhancing revenue receipts.
7. **Encourage sectoral focus:** Prioritize capex in high-growth sectors like manufacturing, infrastructure, and renewable energy.
    - **Eg. 25% of manufacturing capex** in FY25 targeted transport and chemicals sectors (CareEdge Ratings).

Conclusion

To overcome structural inefficiencies and cyclical disruptions, **timely execution, innovative financing, and revenue mobilization** are critical. A **sustained focus on efficient fiscal spending** will ensure capex delivers long-term growth and resilience to external shocks.

Q. How does the inflation targeting framework affect India's long-term economic growth and financial stability? Analyze its effectiveness. (10 M)

Introduction

India adopted the **inflation targeting framework** in 2016 to maintain inflation at **4% ± 2%**, ensuring price stability while fostering economic growth. It has largely controlled inflation but presents both opportunities and challenges for long-term growth and stability.

Body

Impact on long-term economic growth

1. **Promotes macroeconomic stability**: Controlling inflation reduces uncertainty, creating a favorable environment for investments and economic growth.
    - **Eg.**: After 2016, inflation volatility declined significantly, with average inflation at **3.9% between 2016-2020** (RBI).
2. **Improves purchasing power**: Stable inflation protects consumers' real incomes, sustaining demand in the economy.
    - **Eg.**: Retail inflation during **FY 2023 remained within 6%**, ensuring moderate household consumption.

3. **Supports long-term fiscal planning:** Lower inflation leads to reduced borrowing costs, aiding sustainable fiscal policies.
    - **Eg.**: The fiscal deficit narrowed to **5.9% of GDP in FY 2023.**

Impact on financial stability

1. **Strengthens financial resilience**: A predictable inflation trajectory reduces risks of asset price bubbles and non-performing assets (NPAs).
    - **Eg.**: NPAs in India declined from **7.5% in 2021 to 5.8% in 2023** (RBI Financial Stability Report, 2023).
2. **Enhances global investor confidence**: A stable inflation rate attracts foreign investments and promotes exchange rate stability.
    - **Eg.**: India witnessed **$83 billion in FDI inflows in FY 2023** (DPIIT).

Evaluation of effectiveness

Positive aspects

1. **Anchoring inflation expectations**: The framework has reduced inflation volatility and boosted credibility of monetary policy.
    - **Eg.**: Inflation expectations of households moderated post-2016 (RBI Consumer Confidence Survey, 2023).
2. **Promoting policy transparency**: The inflation targeting framework ensures accountability and clarity in monetary policy decisions.
    - **Eg.**: The Monetary Policy Committee (MPC) publishes bi-monthly reports explaining policy decisions.

Challenges

1. **Weak focus on growth**: A rigid inflation-centric approach can constrain growth, particularly in periods of demand slowdowns.
    - **Eg.**: India's **GDP growth slowed to 6.3% in Q2 FY 2024**, partially due to tight monetary policies.
2. **Inability to address supply shocks**: The framework struggles with supply-driven inflation from volatile food and energy prices.
    - **Eg.**: Vegetable inflation surged to **26% in August 2023**, unaffected by monetary interventions.
3. **Neglect of core inflation**: While headline inflation is controlled, core inflation remains persistently high, affecting long-term price stability.
    - **Eg.**: Core inflation averaged **6.1% in FY 2023**, indicating structural issues.

Conclusion

The inflation targeting framework has enhanced **macroeconomic stability** and financial credibility, but its rigidity must evolve to accommodate **growth concerns** and **supply-side**

challenges. A balanced, flexible approach is vital for fostering sustainable economic progress.

Q. How does the inclusion of informal sector activities pose challenges in the accurate measurement of national income in India? Suggest measures to improve the reliability of such estimates. (15 M)

Introduction

The **informal sector**, employing around **85% of India's workforce** (ILO, 2022), significantly contributes to GDP but remains elusive in formal estimates due to its unstructured nature. This creates challenges for policymakers in accurately assessing and leveraging economic potential.

Body

Challenges in measuring informal sector activities

1. **Lack of documentation**: Informal sector transactions are predominantly cash-based, lacking formal records, which limits data collection.
   - **Eg. Street vendors and small-scale artisans** rarely maintain financial books, as noted by the **Rangarajan Committee (2008)**.
2. **Absence of standardized valuation methods**: Valuing informal goods and services is complex due to non-uniform pricing mechanisms.
   - **Eg. Domestic workers or small-scale tailors** may receive payments that differ based on informal negotiations.
3. **High prevalence of subsistence activities**: Many informal workers engage in subsistence-level production, not reflected in market transactions.
   - **Eg. Small farmers consume a significant portion** of their harvest, as highlighted by the **Arjun Sengupta Report (2007)**.
4. **Underreporting to avoid taxation**: Fear of taxation or legal scrutiny leads many informal enterprises to underreport their earnings.
   - **Eg. Local electricians or roadside mechanics** often operate entirely off the books.
5. **Gender disparities in recognition**: Women's contributions to the informal sector, such as unpaid household work, are often excluded from GDP estimates.
   - **Eg.** The **NITI Aayog's Women's Work Study (2019)** estimated unpaid labor contributes over **$160 billion** annually to the economy.
6. **Regional and sectoral disparities**: Diverse informal sector dynamics across regions hinder uniform measurement.
   - **Eg. Urban Maharashtra's informal retail sector** is vastly different from rural Bihar's agricultural economy.

Measures to improve reliability of estimates

1. **Strengthen survey frameworks**: Expanding surveys like **Periodic Labour Force Survey (PLFS)** to better capture informal sector contributions.
   - **Eg.** Include unregistered enterprises and gig workers, as suggested by the **Rangarajan Committee (2008)**.
2. **Leverage digital technologies**: Employ digital tools like GIS mapping and blockchain to track informal activities.
   - **Eg.** The **e-SHRAM portal**, launched in 2021, has registered over **28 crore informal workers** to date.
3. **Promote formalization through incentives**: Schemes like **PM SVANidhi** can encourage informal businesses to register by providing credit access.
   - **Eg.** Over **50 lakh street vendors** were formalized under this scheme by 2023.
4. **Adopt time-use surveys**: Quantify unpaid and informal labor through periodic surveys focused on time allocation.
   - **Eg.** As recommended by the **Expert Group on Women's Work (2021)**, this method can better account for women's unpaid labor.
5. **Enhance local-level data collection**: Empower local bodies for micro-level data gathering on informal sector activities.
   - **Eg. Kerala's Kudumbashree Mission** effectively documents women-led informal enterprises at the Panchayat level.
6. **Adopt indirect estimation techniques**: Utilize proxy indicators like electricity consumption or transport data to estimate informal production.
   - **Eg. Input-output analysis is effectively used in South Africa** for such estimations.
7. **Implement capacity-building programs**: Train local officials and enumerators to improve the quality and accuracy of informal sector surveys.
   - **Eg.** Capacity-building initiatives under the **National Statistical Commission's guidelines** have shown positive results in state-level surveys.

Conclusion

Capturing informal sector activities accurately requires a blend of **technological innovation**, **policy interventions**, and **enhanced local governance frameworks**. By bridging the data gaps, India can unlock the full potential of its economy and ensure more **inclusive policy planning** for sustainable growth.

Q. Critically analyze the limitations of using GDP as a measure of national welfare. Provide alternative indices that address these limitations. (10 M)

Introduction

While **GDP** measures economic output, it often fails to capture dimensions of **national welfare** such as inequality, environmental health, and social well-being. This has sparked debates on its adequacy as a true indicator of societal progress.

Body

Limitations of GDP as a measure of national welfare

1. **Neglect of income inequality**: GDP growth does not reflect unequal income distribution, leading to distorted welfare analysis.
   - **Eg.** India's Gini coefficient was **0.47** in 2021 (World Bank), despite high GDP growth.
2. **Exclusion of environmental degradation**: GDP ignores the depletion of natural resources and environmental costs.
   - **Eg.** The cost of pollution in India was **5.4% of GDP** in 2020 (World Bank).
3. **Lack of social indicators**: GDP does not account for education, health, or happiness, which are critical welfare components.
   - **Eg.** India ranks **132 out of 191 countries** in the **Human Development Index (HDI) 2023**.
4. **Inclusion of non-welfare enhancing activities**: GDP includes activities like tobacco sales or resource-intensive mining, which may harm welfare.
   - **Eg.** Mining-related GDP contributions in **Jharkhand** have exacerbated local displacement and poverty.
5. **Undervaluation of unpaid work**: Contributions like household labor and caregiving remain unrecognized in GDP calculations.
   - **Eg.** Women's unpaid labor in India is estimated at **$160 billion annually** (NITI Aayog, 2019).

Alternative indices to address these limitations

1. **Human Development Index (HDI)**: Measures income, education, and life expectancy for a broader welfare perspective.
   - **Eg.** India improved its HDI from **0.645 in 2010 to 0.633 in 2023** (UNDP).
2. **Gross National Happiness (GNH)**: Captures holistic well-being, incorporating mental health and community vitality.
   - **Eg.** Bhutan uses GNH to guide policy decisions since 1972.
3. **Green GDP**: Adjusts GDP by accounting for environmental costs and resource depletion.
   - **Eg.** China's experimental **Green GDP** program tracks ecological losses alongside economic growth.
4. **Multidimensional Poverty Index (MPI)**: Considers health, education, and living standards beyond monetary poverty.
   - **Eg.** India lifted **415 million people** out of poverty between 2005 and 2021 (UNDP, 2023).
5. **Sustainable Development Goals (SDG) Index**: Tracks progress across 17 goals for sustainability and inclusivity.
   - **Eg.** India scored **66 out of 100** in the **SDG Index 2023**.

Conclusion

GDP, while valuable for economic analysis, requires **complementary indices** for a holistic view of national welfare. Integrating **environmental sustainability and social equity** metrics into policymaking will ensure a more inclusive and sustainable development trajectory.

Q. "Banking crises often result from systemic inefficiencies". Analyze the significance of Non-Performing Assets (NPAs) in understanding the challenges faced by Indian banks. (10 M)

Introduction

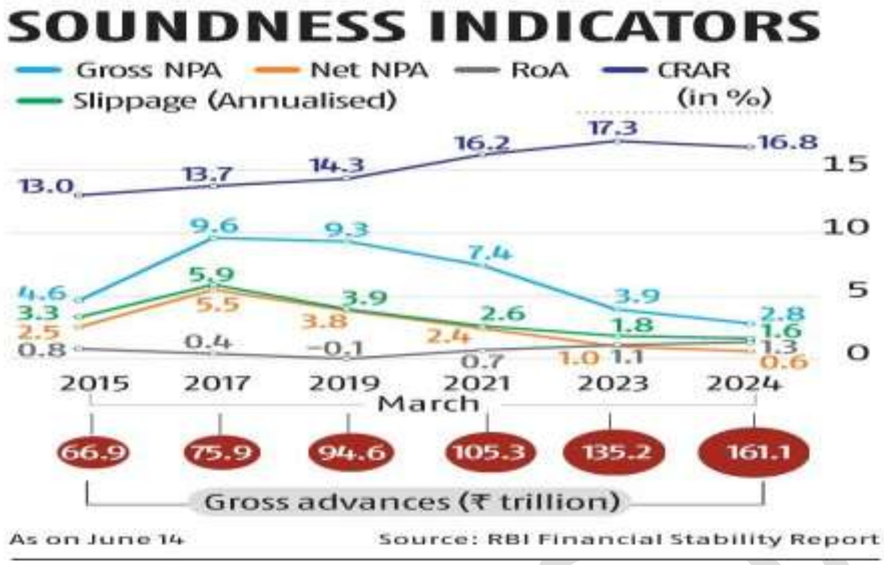
Banking crises are often triggered by **systemic inefficiencies** such as poor regulatory oversight, flawed credit mechanisms, and operational inefficiencies, with **Non-Performing Assets (NPAs)** being a critical indicator of underlying challenges.

Body

Banking crises often result from systemic inefficiencies

1. **Weak credit appraisal systems**: Inadequate assessment of borrower creditworthiness leads to higher loan defaults.
   - **Eg:** The **Infrastructure Leasing & Financial Services (IL&FS) default (2018)** highlighted weak appraisal and over-leveraging.
2. **Ineffective regulatory mechanisms**: Delays in identifying and addressing stressed assets exacerbate crises.
   - **Eg:** The **Global Financial Crisis (2008)** showcased the consequences of lax financial regulations.
3. **Inefficient governance in public sector banks**: Political interference and lack of autonomy often result in suboptimal lending decisions.
   - **Eg: PSU banks account for over 75% of NPAs in India** (RBI Financial Stability Report, 2023).
4. **Sectoral concentration risks**: Excessive exposure to vulnerable sectors like infrastructure or real estate creates systemic risks.
   - **Eg:** Stressed power sector loans contribute significantly to NPAs (IBA Report, 2022).
5. **Economic disruptions**: External shocks like the pandemic strain banking systems, exposing inefficiencies.
   - **Eg: Post-COVID moratoriums** led to increased stress in small business loans.

<u>Significance of Non-Performing Assets (NPAs) in understanding challenges faced by Indian banks</u>



1. **<u>Erosion of profitability</u>**: NPAs reduce banks' net interest income and profitability, affecting their ability to lend.
    - **Eg:** As per RBI, gross NPAs of Indian banks stood at **5.9% as of March 2023**, impacting financial stability.
2. **<u>Capital adequacy issues</u>**: Rising NPAs necessitate higher provisioning, straining capital adequacy ratios.
    - **Eg:** Many PSU banks required recapitalization under the **Indradhanush Plan (2015)**.
3. **<u>Credit crunch</u>**: High NPAs reduce banks' willingness to extend credit, hampering economic growth.
    - **Eg:** The **Twin Balance Sheet Problem** identified in the **Economic Survey 2017-18** highlighted this phenomenon.
4. **<u>Sectoral vulnerabilities</u>**: NPAs reveal stressed sectors, enabling targeted interventions.
    - **Eg:** Loans to sectors like **power, textiles**, and **aviation** have been major contributors to NPAs.
5. **<u>Investor confidence</u>**: NPAs signal risk to stakeholders, leading to reduced investments and weaker financial markets.
    - **Eg:** Low valuations of PSU banks due to persistent NPA problems.

<u>Way forward</u>

1. **<u>Strengthening credit appraisal and monitoring</u>**: Enhance due diligence mechanisms and adopt **AI-based risk management tools** for loan disbursal.
    - **Eg:** Private banks using AI-based algorithms show lower NPA ratios compared to PSUs.

2. **Resolution mechanisms**: Expand the scope of **IBC (2016)** and expedite insolvency resolutions to recover bad loans effectively.
    - **Eg:** The **Insolvency and Bankruptcy Code** resolved ₹7.3 lakh crore worth of NPAs (MCA data, 2023).
3. **Governance reforms in PSU banks**: Improve autonomy and accountability to reduce political interference and operational inefficiencies.
    - **Eg:** Recommendations by the **P.J. Nayak Committee (2014)** for governance reforms in PSBs.

Conclusion

Addressing **systemic inefficiencies** and reducing **NPAs** is essential for restoring the health of Indian banks and ensuring sustainable economic growth. **Leveraging technology**, **regulatory reforms**, and **efficient resolution frameworks** can pave the way for a more resilient banking system.

Q. Examine the factors influencing money supply in India and analyze its relationship with inflation and growth. (15 M)

Introduction

The **money supply**, which refers to the total stock of money available in an economy, plays a crucial role in influencing **inflation** and **economic growth**. Understanding its determinants and relationships is vital for effective monetary policy and macroeconomic stability.

Body

Factors influencing money supply in India

1. **Reserve Bank of India's monetary policy tools**: Instruments like **CRR (Cash Reserve Ratio)**, **SLR (Statutory Liquidity Ratio)**, and **repo rate** regulate liquidity and money supply in the economy.
    - **Eg:** The **repo rate hike in 2022** aimed to control inflation by reducing money supply.
2. **Credit creation by commercial banks**: Banks create money by issuing loans, which depends on their reserves and the demand for credit.
    - **Eg:** High **credit growth in FY2022-23** increased money supply as bank lending expanded.
3. **Government borrowings and deficit financing**: Increased government borrowing injects more money into the economy, affecting money supply.
    - **Eg: COVID-19 relief packages (2020)** led to higher deficit financing, expanding liquidity.
4. **Foreign exchange reserves and FDI flows**: Inflows from **FDI, FPI**, and **remittances** add to the money supply.

- **Eg:** Record **FDI inflows in FY2021-22 ($83.57 billion)** boosted India's money supply.

5. **Demonetization and cash circulation**: Policies like **demonetization** directly impact cash availability and money supply.
   - **Eg:** The 2016 **demonetization drive** initially contracted money supply due to reduced cash circulation.
6. **Velocity of money**: The rate at which money changes hands influences effective money supply.
7. **Digital transactions and payment systems**: The growth of digital payments reduces dependency on cash, impacting the money supply.
   - **Eg:** Increased **UPI transactions (₹12.8 lakh crore in October 2023)** contribute to circulating money efficiency.

Relationship between money supply and inflation

1. **Demand-pull inflation**: Excess money supply increases demand, outstripping supply, causing price levels to rise.
   - **Eg:** During the **pandemic recovery (2021-22)**, increased money supply contributed to inflationary pressures globally.
2. **Cost-push inflation control**: Restricted money supply can stabilize prices by reducing liquidity and cooling demand.
   - **Eg:** The RBI's **repo rate hikes in 2022** helped control **CPI inflation**, bringing it from 7% to 5.4% in mid-2023.
3. **Excess liquidity and asset price inflation**: Surplus money supply leads to inflation in asset markets like real estate and stocks.
   - **Eg: Post-2020 quantitative easing** globally fueled stock market booms.
4. **Hyperinflation risks**: Unregulated expansion of money supply may lead to hyperinflation, eroding currency value.
   - **Eg:** Historical instances like **Zimbabwe's hyperinflation (2008)** show the risks of excessive money supply.
5. **Food and energy price impact**: Money supply influences inflation indirectly by affecting consumer purchasing power and global commodity prices.

Relationship between money supply and growth

1. **Investment and production**: Increased money supply enhances credit availability, fostering investment and production growth.
   - **Eg:** RBI's **accommodative stance during COVID-19** ensured liquidity for businesses, aiding India's GDP recovery.
2. **Consumption-driven growth**: A higher money supply boosts disposable income, driving consumption and economic growth.
   - **Eg:** Post-pandemic growth in **consumer durables demand (2021)** was fueled by liquidity measures.

3. **<u>Credit support for MSMEs</u>**: Enhanced money supply enables targeted credit schemes for small businesses, a key growth driver in India.
   - **Eg:** The **Emergency Credit Line Guarantee Scheme (ECLGS)** during the pandemic sustained MSME growth.
4. **<u>Risk of stagflation</u>**: Excessive money supply without productive output growth can lead to stagflation, where inflation rises but growth stagnates.
   - **Eg: 1970s oil crisis** showcased this phenomenon globally.
5. **<u>Long-term economic resilience</u>**: A balanced money supply ensures sustainable growth by avoiding cyclical booms and busts.
   - **Eg:** RBI's **liquidity normalization measures (2023)** aim to align growth with inflation control.

Conclusion

The **money supply** significantly impacts **inflation** and **growth**, necessitating careful management to achieve macroeconomic stability. A **balanced monetary policy** that ensures adequate liquidity while curbing inflationary pressures is essential for sustainable economic development in India.

Q. Evaluate the role of money markets in ensuring short-term liquidity for financial institutions. How do they differ from capital markets in their objectives and instruments? (10 M)

Introduction

Money markets, integral to a nation's financial system, provide **short-term liquidity** to financial institutions, ensuring operational efficiency and stability in volatile economic conditions.

Body

<u>Role of money markets in ensuring short-term liquidity</u>

1. **<u>Facilitating short-term borrowing and lending</u>**: Money markets provide platforms for institutions to manage **cash flow mismatches** by borrowing or lending for short durations.
   - **Eg**: **Treasury Bills (T-bills)** issued by the Government of India are widely used by banks to manage liquidity.
2. **<u>Supporting monetary policy implementation</u>**: Central banks use money markets to regulate **liquidity** and implement **monetary policy**.
   - **Eg**: The **Reserve Bank of India (RBI)** conducts **repo and reverse repo operations** to manage liquidity in the banking system.
3. **<u>Enhancing liquidity for financial institutions</u>**: Instruments like **commercial papers (CPs)** and **certificates of deposit (CDs)** allow institutions to raise funds quickly at competitive rates.

- **Eg**: **HDFC Bank** recently raised funds through **CPs** for short-term needs.

4. **Reducing liquidity risk**: Money markets provide access to **immediate funding**, reducing the risk of liquidity shortages.
    - **Eg**: During the **COVID-19 pandemic**, the **RBI** infused liquidity through the **Targeted Long-Term Repo Operations (TLTRO)**.
5. **Interbank market operations**: Banks use the **call money market** for overnight borrowing and lending, ensuring smooth day-to-day operations.
    - **Eg**: The **Mumbai Interbank Offer Rate (MIBOR)** determines overnight lending rates in India.

Differences between money markets and capital markets

1. **Time horizon**: Money markets focus on **short-term instruments** (less than one year), while capital markets cater to **long-term investments**.
    - **Eg**: **T-bills** (money market) vs. **corporate bonds** (capital market).
2. **Purpose**: Money markets address **liquidity management**, while capital markets focus on **wealth creation** and **capital formation**.
    - **Eg**: **Equity markets** help companies raise long-term funds.
3. **Instruments**: Money markets use instruments like **repo agreements**, **call money**, and **CPs**, whereas capital markets involve **stocks**, **bonds**, and **mutual funds**.
    - **Eg**: **Government Securities (G-secs)** in the capital market vs. **Treasury Bills** in the money market.
4. **Participants**: Money markets primarily involve **financial institutions** and **governments**, while capital markets include **retail investors**, **corporations**, and institutions.
    - **Eg**: **Banks** and **NBFCs** dominate money markets; **individual investors** participate in stock markets.
5. **Risk profile**: Money markets have **low-risk, low-return instruments**; capital markets have **higher risks** with potential for higher returns.
    - **Eg**: **Commercial papers** (low risk) vs. **equities** (high risk).

Conclusion

The **money market** is crucial for ensuring **short-term liquidity**, enabling **financial stability**, and supporting **monetary policy**. Complementing this, the **capital market** drives **long-term investments** and **economic growth**. A balanced approach to developing both markets will enhance **India's financial resilience** and **economic progress**.

Q. How does the development of a robust corporate bond market support infrastructure financing in India? Highlight key challenges and reforms. (15 M)

Introduction

India's ambitious infrastructure development goals, essential for achieving a $5 trillion economy, require a **robust corporate bond market** as a sustainable financing avenue, reducing dependence on banks.

Body

Role of a corporate bond market in supporting infrastructure financing

1. **Access to long-term funding**: Corporate bonds provide **long-tenor financing**, which is crucial for large-scale infrastructure projects.
   - **Eg**: India's National Infrastructure Pipeline (NIP) requires an investment of **₹111 lakh crore** by 2025.
2. **Diversifying funding sources**: A corporate bond market reduces over-reliance on banks and mitigates the **Asset-Liability Mismatch (ALM)** issues.
   - **Eg**: The **IL&FS crisis (2018)** highlighted the need for alternative financing mechanisms.
3. **Attracting private and institutional investors**: Bonds attract domestic and global investors, ensuring a steady flow of funds.
   - **Eg**: **Masala Bonds** issued by NTPC helped tap international markets for infrastructure financing.
4. **Reducing public debt burden**: A developed bond market lessens the pressure on government resources, allowing public funds to focus on welfare schemes.
   - **Eg**: The **Centre's fiscal deficit of 6.4% (FY2023)** underlines the need for private capital.
5. **Improving project execution**: Long-term, predictable financing through bonds enhances the viability of infrastructure projects.
   - **Eg**: Bonds issued by **Indian Railway Finance Corporation (IRFC)** support railway development.

Key challenges in developing a corporate bond market

1. **Low liquidity**: Limited trading volumes in secondary markets deter investors from participating actively.
   - **Eg**: RBI's Financial Stability Report (2023) highlights low retail investor presence in bond markets.
2. **Lack of credit depth**: The dominance of high-rated instruments reduces market diversity, making it harder for smaller firms to raise funds.
   - **Eg**: Over **80% of bonds issued** in India are AAA-rated (CRISIL).
3. **Regulatory hurdles**: Fragmented oversight by SEBI, RBI, and IRDAI creates compliance burdens for issuers.
   - **Eg**: The **RBI-2020 Working Group on Financial Markets** called for streamlined regulations.
4. **High cost of issuance**: Compliance and operational costs deter smaller companies from issuing bonds.

- **Eg**: Comparatively higher transaction costs than equity markets.

5. **Investor awareness**: Limited knowledge about corporate bonds among retail investors hampers broader participation.
    - **Eg**: SEBI Investor Education Programs are trying to bridge this gap but have limited penetration.

Key reforms and initiatives to address challenges

1. **Improving market liquidity**: Measures like allowing **market-making activities** and deepening the secondary market.
    - **Eg**: SEBI introduced the **Electronic Book Provider Platform** for transparent bond issuance.
2. **Boosting investor participation**: Tax incentives and creating diversified products such as **Infrastructure Debt Funds (IDFs)**.
    - **Eg**: **NABARD Infrastructure Bonds** with tax benefits saw increased subscriptions.
3. **Strengthening credit markets**: Encouraging the growth of credit-rating alternatives and enhancing frameworks for distressed asset resolution.
    - **Eg**: **IBC reforms (2021)** expedited insolvency resolutions.
4. **Reducing regulatory overlap**: Establishing a unified regulatory framework for corporate bond markets.
    - **Eg**: Recommendations by the **U.K. Sinha Committee (2016)** on bond market development.
5. **Leveraging technology**: Digitizing bond issuance and trading to lower costs and enhance efficiency.
    - **Eg**: SEBI's use of **Blockchain technology** for bond settlement processes.

Conclusion

Developing a robust corporate bond market is essential to meet India's growing infrastructure financing needs, reduce banking sector vulnerabilities, and attract private capital. A **forward-looking, investor-friendly framework combined with proactive policy interventions** can unlock the true potential of this market, accelerating India's infrastructure growth.

Q. Discuss the concept of the inflationary gap and its role in the inflationary process in an emerging economy like India. (10 M)

Introduction

An **inflationary gap** occurs when **aggregate demand surpasses aggregate supply** at full employment, leading to rising price levels. In an emerging economy like **India**, understanding and managing this gap is critical to achieving **sustainable growth** without triggering inflationary pressures.

Body

<u>Concept of inflationary gap</u>

1. **<u>Definition and mechanism</u>**: The inflationary gap reflects the **excess of actual GDP over potential GDP**, creating an imbalance between demand and supply. This gap triggers **demand-pull inflation** as producers cannot meet rising demand.
    - **Eg**: Post-**COVID-19 recovery in 2021-2022**, where **pent-up demand** and **supply chain disruptions** contributed to inflationary pressures.
2. **<u>Keynesian perspective</u>**: **Keynes** explained the inflationary gap as a situation where **excessive aggregate demand** drives inflation, particularly in economies nearing **full employment**.
3. **<u>Connection to economic cycles</u>**: The gap is often cyclical, influenced by factors like **fiscal stimulus, monetary easing**, or **consumption spurts**.
    - **Eg**: Increased government spending during the **Atmanirbhar Bharat Package (2020)** boosted demand but strained supply.

<u>Role in the inflationary process in an emerging economy like India</u>

1. **<u>Demand-driven inflation</u>**: Rising **income levels, urbanization**, and changing **consumption patterns** lead to excess demand.
    - **Eg**: Festive seasons in India witness sharp spikes in consumer demand, fueling temporary inflation (**RBI Data, 2022**).
2. **<u>Supply-side bottlenecks</u>**: **Infrastructure deficiencies, logistical constraints**, and dependency on imports aggravate inflationary pressures.
    - **Eg**: Supply chain disruptions during the **Russia-Ukraine conflict (2022)** escalated **food and fuel prices**.
3. **<u>Global interconnectedness</u>**: Emerging economies like **India** are more vulnerable to **external shocks**, which can widen the inflationary gap.
    - **Eg**: Rising global **crude oil prices in 2023** increased India's import bills, contributing to inflation.
4. **<u>Impact on monetary policy</u>**: The inflationary gap forces central banks like the **RBI** to adopt **contractionary policies**, such as raising **interest rates**, to moderate demand.
    - **Eg**: The **repo rate hikes in 2023** aimed at curbing inflation caused by excess demand.
5. **<u>Widening socio-economic inequality</u>**: Inflation triggered by the gap affects **lower-income groups disproportionately**, reducing their **purchasing power**.
    - **Eg**: **CPI Inflation (2023)** showed higher **food price inflation** impacting rural households more than urban ones.
6. **<u>Reduced investment climate</u>**: Persistent inflation discourages **investment** due to **uncertainty** and rising input costs, hampering **long-term economic growth**.

Conclusion

To bridge the inflationary gap, India must focus on **stimulating supply-side capacities** and fostering **inclusive growth** through **infrastructure development** and **targeted monetary**

policies. These measures will ensure **price stability** while driving **long-term economic resilience** in the face of global and domestic challenges

Q. "Structural unemployment in India is a reflection of both technological advancements and inadequate workforce readiness". Discuss (15 M)

Introduction

Structural unemployment in India reflects a growing mismatch between the skills workers possess and the skills demanded by employers. It arises from **technological advancements** that disrupt traditional jobs and **inadequate workforce readiness** in adapting to these changes.

Body

Structural unemployment and technological advancements

1. **Automation and AI disruption**: Industries increasingly automate routine tasks, reducing the demand for low-skilled jobs.
   - **Eg**: Increased robotics in assembly lines at **Maruti Suzuki plants** has displaced manual workers.
2. **Sectoral shift in employment**: The transition from agriculture to services and high-tech manufacturing has left unskilled laborers unemployed.
   - **Eg**: Services contribute **55% of GDP**, but rural workers often lack skills to transition out of agriculture.
3. **Digital divide**: Limited digital access in rural areas prevents the workforce from adapting to tech-driven jobs.
   - **Eg**: Only **33% of rural households** have internet access (**NSO, 2022**).
4. **Lack of reskilling initiatives**: Companies often prioritize hiring skilled labor over reskilling existing employees.
   - **Eg**: Limited impact of **Infosys' Digital Skills Training Initiative**, which only covers a fraction of its workforce.

Inadequate workforce readiness

1. **Skill gap**: A significant portion of the workforce lacks employable skills.
   - **Eg**: The **World Economic Forum (2023)** reports **47% of Indian graduates** are unemployable.
2. **Weak vocational education**: Enrollment in vocational courses remains low, hindering employability.
   - **Eg**: Only **5.6% of India's workforce** has undergone formal training (**PLFS, 2021**).
3. **Outdated curriculum**: University programs are often misaligned with modern industry requirements.

- **Eg**: The **AICTE 2021 study** found that many engineering programs lack fields like AI and robotics.

4. **Low female workforce participation**: Cultural barriers and workplace exclusion restrict women's participation.
    - **Eg**: Female labour force participation in India is just **25%** (World Bank, 2023).
5. **Urban-rural disparity**: Rural youth face significant barriers to education and employment.
    - **Eg**: Rural unemployment is **7.3% (CMIE, 2023)** compared to **4.8% in urban areas**.

Possible solutions

1. **Strengthening skilling programs**: Expand initiatives like the **Skill India Mission** with stronger private sector collaboration to address skill gaps.
    - **Eg**: Programs like **NSDC-TCS iON collaboration** focus on digital skills training.
2. **Curriculum alignment with industry needs**: Update university syllabi to include emerging technologies such as AI, robotics, and blockchain.
    - **Eg**: **AICTE reforms (2023)** introduced industry-oriented courses in technical institutes.
3. **Bridging the digital divide**: Expand connectivity under **BharatNet** and provide affordable devices to underserved regions.
    - **Eg**: **PM Gati Shakti** integrates rural digitization with infrastructure development.
4. **Promoting lifelong learning**: Encourage mid-career reskilling through subsidized programs on platforms like **SWAYAM** and **FutureSkills Prime**.
    - **Eg**: **NASSCOM's FutureSkills Prime** offers free AI and machine learning courses.
5. **Localized skill development centers**: Establish region-specific vocational centers tailored to local employment needs.
    - **Eg**: **Kerala's ASAP program** trains youth for tourism and IT industries.

Conclusion

Structural unemployment in India demands a multi-pronged approach that integrates **education, skilling, and technology** with industry requirements while ensuring **equitable access** to opportunities. Prioritizing **human capital development** will enable India to transform its demographic dividend into a driver of **inclusive and sustainable growth**.

Q. “The success of fiscal policy depends on efficient public expenditure management and effective revenue generation”. Discuss (15M)

Introduction

Fiscal policy serves as a **critical tool for ensuring economic stability, equitable growth, and financial discipline**. Its effectiveness depends on prudent expenditure management and robust revenue mobilization to meet developmental and fiscal goals.

Body

Success of fiscal policy depends on efficient public expenditure management

1. **Optimal resource allocation**: Ensures funds are allocated to priority sectors like health, education, and infrastructure.
    - **Eg.**: **Increased spending** on **Ayushman Bharat** enhanced healthcare access for 50 crore people, noted in the **NITI Aayog Report (2021)**.
2. **Reduction of leakages**: Transparent systems minimize corruption and ensure efficient delivery of services.
    - **Eg.**: The **Direct Benefit Transfers (DBT)** in schemes like **PM-KISAN** saved over **₹2.2 lakh crore** by eliminating middlemen.
3. **Focus on capital expenditure**: Drives economic growth by building long-term productive assets.
    - **Eg.**: The **National Infrastructure Pipeline (2020-25)** targets investments worth **₹111 lakh crore** to boost infrastructure.
4. **Outcome-linked budgeting**: Connects spending with measurable results to enhance accountability.
    - **Eg.**: Outcome-based frameworks were adopted for schemes like **Samagra Shiksha Abhiyan** in recent Union Budgets.

Success of fiscal policy depends on effective revenue generation

1. **Tax buoyancy**: A higher tax-to-GDP ratio ensures fiscal capacity without overburdening citizens.
    - **Eg.**: **Implementation of GST streamlined** indirect taxation and boosted compliance.
2. **Expanding the tax base**: Inclusion of untaxed sectors reduces over-reliance on a narrow taxpayer base.
    - **Eg.**: **Measures like faceless tax assessments (2020)** encouraged voluntary compliance and reduced litigation.
3. **Maximizing non-tax revenue**: Revenues from dividends, fees, and public asset monetization enhance fiscal health.
    - **Eg.**: Disinvestment of **LIC shares** in FY 2022-23 generated **₹35,000 crore** for the exchequer.

4. **<u>Reducing tax evasion</u>**: Leveraging technology for better enforcement increases revenue realization.
   - **Eg.**: Use of **AI-based tax scrutiny systems** raised compliance as reported by the **CBDT Annual Report (2022)**.

<u>Challenges</u>

1. **<u>Budgetary rigidity</u>**: Pre-committed expenditures like interest payments and subsidies reduce fiscal flexibility.
   - **Eg.**: Over **50% of government spending** is pre-allocated, as highlighted in the **Economic Survey 2023**.
2. **<u>Low tax-to-GDP ratio</u>**: India's tax-to-GDP ratio of **11%** lags behind global peers, limiting revenue potential.
   - **Eg.**: **OECD countries average** a tax-to-GDP ratio of **34%**, showcasing India's gap.
3. **<u>Implementation bottlenecks</u>**: Poor coordination and delays in fund disbursement reduce efficiency.
   - **Eg.**: Delays in **PM Awas Yojana** execution have resulted in underutilization of allocated funds.
4. **<u>Dependence on short-term borrowings</u>**: Rising fiscal deficits compel reliance on borrowing, leading to higher interest obligations.
   - **Eg.**: Fiscal deficit in FY 2022-23 stood at **6.4% of GDP**, increasing public debt burden.

<u>Way forward</u>

1. **<u>Strengthening fiscal discipline</u>**: Enforce stricter adherence to **FRBM Act** targets to control deficits and debt.
   - **Eg.**: The **NK Singh Committee (2017)** recommended a medium-term roadmap for fiscal consolidation.
2. **<u>Improving tax compliance</u>**: Simplify processes and incentivize timely payments to enhance voluntary compliance.
   - **Eg.**: The **Vivad se Vishwas (2020)** scheme successfully resolved tax disputes and boosted collections.
3. **<u>Outcome-oriented expenditure management</u>**: Link public spending to measurable socio-economic outcomes.
   - **Eg.**: The **Aspirational Districts Program** focuses on achieving outcomes in health, education, and infrastructure.
4. **<u>Public-private partnerships</u> (PPPs)**: Leverage private sector expertise and funding for infrastructure development.
   - **Eg.**: PPP projects in metro rail systems like **Delhi Metro** have reduced fiscal strain while ensuring quality services.

Conclusion

The success of fiscal policy lies in balancing efficient public expenditure with sustainable revenue generation. **By adopting robust monitoring systems, fostering compliance, and emphasizing transparency, fiscal policy** can drive India toward inclusive and sustainable growth.

Inclusive growth and issues arising from it.

Q. "The cooperative sector is critical for achieving the goal of inclusive economic growth". Discuss. (15 M)

Introduction

The cooperative sector, as a people-centered model of economic growth, empowers communities and plays a crucial role in achieving inclusive growth, particularly in rural India.

Body

<u>Importance for inclusive growth</u>

1. **Financial inclusion**: Cooperatives increase credit access for underserved areas, especially for farmers and small businesses, enhancing economic participation.
    - **E.g.: According to NABARD (2024)**, over 8 lakh cooperatives across India serve 29 sectors, strengthening financial inclusion in rural regions.
2. **Rural employment and livelihoods**: By providing resources and creating self-sustaining local businesses, cooperatives reduce migration and support rural job creation.
    - **E.g.: AMUL**, a major cooperative, sustains livelihoods for 36 lakh milk producers, boosting rural employment and income stability.
3. **Empowerment of marginalized communities**: Cooperatives enable women, farmers, and artisans to gain collective bargaining power and market access.
    - **E.g.: Women-led SEWA Cooperative** in Gujarat empowers women by providing employment and financial resources to over 1.5 million members.
4. **Agricultural productivity**: Agricultural cooperatives support small farmers with inputs, credit, and market access, reducing dependency on middlemen.
    - **E.g.: PACS (Primary Agricultural Credit Societies)** provide input credit to over 13 crore farmers, enhancing productivity and income (NABARD, 2024).
5. **Affordable housing**: Housing cooperatives make affordable housing accessible to economically weaker sections by pooling resources for land and infrastructure.
    - **E.g.: Employees' Housing Cooperatives** have successfully provided homes to thousands of low-income families.

Challenges facing the cooperative sector

1. **Lack of professional management**: Many cooperatives face inefficiencies due to a lack of skilled management and expertise.
    - **E.g.: RBI Report (2021)** identified weak governance and management inefficiencies in several urban cooperative banks.
2. **Limited technological integration**: Digital infrastructure within cooperatives is often inadequate, limiting service delivery and outreach.
    - **E.g.: Only 15,783 PACS** out of 63,000 are computerized as of 2024, according to NABARD, affecting operational efficiency.
3. **Regulatory constraints**: Cooperatives face overlapping state and central regulations, limiting their autonomy and growth potential.
    - **E.g.: The MSCS Act, 2002** permits state intervention in Multi-State Cooperatives, causing operational delays.
4. **Inadequate financial resources**: Smaller cooperatives struggle to access sufficient capital for growth and diversification.
    - **E.g.: Micro-cooperatives often lack funds** to expand or invest in market-linked products, limiting their impact.
5. **Lack of transparency and accountability**: Issues such as politicization and limited member participation reduce trust and effectiveness.
    - **E.g.: The National Cooperative Development Corporation (NCDC)** has reported transparency issues in fund management within cooperatives.

Measures to strengthen the cooperative sector

1. **Capacity building and training**: Skill development programs and managerial training can enhance efficiency and leadership within cooperatives.
    - **E.g.: The Ministry of Cooperation's "Cooperative Capacity Building" program** focuses on leadership development for cooperative managers.
2. **Technological upgradation**: Digital transformation initiatives, such as PACS computerization, enhance transparency, efficiency, and member reach.
    - **E.g.: The Government's Rs. 2,516 crore project** aims to computerize 63,000 PACS by 2025, linking them with NABARD.
3. **Enhanced financial support**: Expanding credit facilities and grants can help cooperatives grow and diversify.
    - **E.g.: The Union Budget 2024-25** increased funding for cooperative modernization and digital transformation.
4. **Improved regulatory framework**: Simplifying laws can reduce regulatory overlap and empower cooperatives with greater autonomy.
    - **E.g.: MSCS Amendment Act 2023** aims to improve governance and transparency in Multi-State Cooperatives.
5. **Promoting inclusivity and member participation**: Strengthening member involvement and internal democracy can improve accountability and trust.
    - **E.g.: The Model Bye-Laws for PACS (2024)** promote inclusivity and transparency within cooperative management.

Conclusion

With sustained support and reforms, the cooperative sector has the potential to become a national model for broad-based economic growth**, empowering rural and marginalized communities** and driving India towards sustainable development.

Government Budgeting.

Q. Discuss the challenges of implementing outcome-based budgeting in India. Suggest measures to enhance its effectiveness. (10 M)

Introduction

Outcome-based budgeting (OBB) seeks to improve the efficiency and accountability of public spending by linking funds to tangible results. Despite its progressive intent, implementation in India faces systemic challenges.

Body

Challenges of implementing outcome-based budgeting in India

1. **Lack of clear objectives and indicators**: The absence of specific, measurable, and time-bound targets hampers meaningful monitoring.
    - **Eg.**: The **MGNREGA performance review (CAG 2019)** highlighted weak linkages between fund allocations and tangible outcomes.
2. **Fragmented data systems**: Siloed and non-standardized data collection by various ministries leads to inefficiencies in evaluation.
    - **Eg.**: The **Economic Survey 2021-22** reported delayed and inconsistent data sharing in sectors like agriculture and health.
3. **Inadequate capacity and expertise**: Limited technical know-how and human resources weaken OBB implementation at state and district levels.
    - **Eg.**: The **NITI Aayog's Governance Report (2018)** identified skill gaps in outcome-based policy evaluation frameworks.
4. **Resistance to accountability**: Resistance from bureaucrats and lack of political commitment dilute efforts to link expenditure with outcomes.
    - **Eg.**: Parliamentary Committee (2022) noted limited accountability in the **Smart Cities Mission**, resulting in unmeasured project impacts.
5. **Budgetary rigidity**: Rigid fund allocation frameworks restrict flexibility to adapt expenditures based on real-time results.
    - **Eg.**: Welfare schemes like **PM-KISAN** operate under strict spending norms, which limits dynamic reallocation.
6. **Inconsistent evaluation mechanisms**: Regular, independent assessments are often missing, leading to superficial or delayed evaluation reports.
    - **Eg.**: The **Economic Advisory Council to the Prime Minister (2020)** flagged irregularities in monitoring schemes like the **Mid-Day Meal Program**.

Measures to enhance effectiveness

1. **Capacity building and training**: Strengthen technical capacity and institutional expertise for OBB frameworks.
    - **Eg.**: The **Kerala Infrastructure Investment Fund Board (KIIFB)** demonstrates capacity-building initiatives for effective outcome monitoring.
2. **Integration of technology**: Use digital tools like **real-time dashboards** and **blockchain** to improve transparency and data analysis.
    - **Eg.**: **Aspirational Districts Program's dashboard** tracks performance metrics in real time, enabling targeted interventions.
3. **Setting clear goals and performance metrics**: Establish KPIs linked to schemes and national priorities like SDGs to track progress.
    - **Eg.**: Align **Samagra Shiksha Abhiyan** outcomes with **SDG 4 (Quality Education)** for systematic evaluation.
4. **Independent audits and evaluations**: Create third-party monitoring mechanisms to ensure unbiased evaluations.
    - **Eg.**: The **2nd ARC report on Accountability (2009)** recommended setting up independent bodies for performance audits.

5. **<u>Improving inter-ministerial coordination</u>**: Encourage better collaboration between ministries for integrated implementation and evaluation.
    - **Eg.**: The success of **NITI Aayog's Aspirational Districts Program** lies in its multi-ministerial coordination for achieving measurable outcomes.
6. **<u>Enhancing public participation</u>**: Involve citizens and civil society organizations in scheme evaluation to improve accountability.
    - **Eg.**: Participatory budgeting in the **Pune Municipal Corporation** has improved local governance transparency and accountability.

Conclusion

Outcome-based budgeting is a transformative fiscal tool for efficient governance. By **strengthening institutional frameworks, integrating technology, and fostering accountability**, India can institutionalize OBB to deliver measurable socio-economic progress.

Major crops-cropping patterns in various parts of the country, - different types of irrigation and irrigation systems storage, transport and marketing of agricultural produce and issues and related constraints; e-technology in the aid of farmers.

Q. "Technology-led agriculture is key to modernizing India's farming sector". Discuss how schemes like Namo Drone Didi can contribute to precision agriculture and resource optimization. (10 M)

Introduction

India's agricultural sector is on the cusp of transformation with the integration of **technology-led solutions**. Schemes like **Namo Drone Didi**, focusing on **drone technology**, offer the potential to modernize farming through **precision agriculture** and **resource optimization**, addressing key challenges in agriculture.

Body

<u>Contribution to precision agriculture</u>:

1. **<u>Targeted application of inputs</u>:** Drones enable precise application of **fertilizers** and **pesticides**, reducing wastage and ensuring even distribution.
    - **E.g.:** Drones under the **Namo Drone Didi** scheme ensure up to **30% reduction** in chemical usage.(**Ministry of Agriculture, 2024**)

2. **<u>Real-time crop monitoring</u>:** Drones allow real-time monitoring of crops, offering data on **crop health**, **soil condition**, and early disease detection for timely intervention.
    - **E.g.:** In **Andhra Pradesh**, drones helped **reduce crop loss** by **20%** due to timely detection of pest attacks.
3. **<u>Data-driven farming</u>:** Drones provide precise data on **crop growth patterns**, **soil health**, and **yield estimation**, improving farm management and decision-making.
    - **E.g.:** Drones deployed in **Maharashtra** enabled farmers to better predict yields, increasing **productivity**.
4. **<u>Precision in variable rate application</u>:** Drones allow **variable rate application** of inputs like nutrients, adjusting according to specific field needs, maximizing input efficiency.
    - **E.g.:** In **Uttar Pradesh**, drone-assisted farming enabled farmers to apply fertilizers precisely based on **soil fertility variations**, enhancing **nutrient use efficiency**.
5. **<u>Reduced human error</u>:** Automation in drone technology minimizes **human error** in tasks like spraying pesticides or fertilizers, leading to more effective operations.
    - **E.g.:** A pilot project in **Madhya Pradesh** showed reduced errors in pesticide spraying, improving **crop yield by 15%**.

<u>Contribution to resource optimization:</u>

1. **<u>Water efficiency</u>:** Drones help assess **moisture levels** in the soil, facilitating **precision irrigation**, which conserves water and ensures only the required areas are watered.
    - **E.g.: Drone-assisted irrigation** reduced water use by **15%** in **Gujarat's** water-scarce regions.
2. **<u>Reduction in input costs</u>:** With precise usage of inputs like **fertilizers** and **pesticides**, farmers save on costs, contributing to better resource management.
    - **E.g.:** SHGs in **Punjab** reported a **20% cost saving** on inputs using drones under the **Namo Drone Didi** scheme.
3. **<u>Reduced labor costs</u>:** Drones reduce the need for **manual labour** in tasks like spraying pesticides and fertilizers, helping farmers cut down on **labor costs** and improve operational efficiency.
    - **E.g.: Farmers in Haryana** experienced up to **25% reduction** in labour expenses after adopting drone services under **Namo Drone Didi**.
4. **<u>Time efficiency</u>:** Drone technology drastically reduces the time required for tasks like spraying and monitoring large fields, improving overall farm productivity.
    - **E.g.:** In **Rajasthan, drone-assisted pesticide** spraying reduced the time taken for operations from 7 days to **2 days**, significantly increasing productivity.
5. **<u>Sustainable pest management</u>:** Drones help in **precision pest management**, reducing the overuse of pesticides, which improves long-term soil and ecosystem health.

- E.g.: **Tamil Nadu** farmers reported a **10% improvement in crop quality** by using drone-assisted pest management systems.

Conclusion

The **Namo Drone Didi scheme** demonstrates the immense potential of **technology-led agriculture** in **modernizing farming**, enhancing **precision agriculture** and ensuring **optimal resource use**. With proper implementation and support, such initiatives can drive India's agriculture sector toward **sustainability** and increased productivity.

Q. "Export-oriented agriculture in India faces significant sustainability challenges". Discuss this statement with a focus on the environmental impact of high-demand crops. (10 M).

Introduction

India's export-oriented agriculture **contributes to economic growth but also raises sustainability concerns, especially in the cultivation of high-demand crops like tea and sugarcane**. Addressing these challenges is essential for ensuring long-term ecological stability alongside economic gains.

Body

Sustainability challenges

1. **Excessive water extraction**: Intensive irrigation practices for crops like sugarcane have led to critical groundwater depletion in many regions.
    - E.g.: **Sugarcane consumes about 1,500-2,000 litres of water per kg** produced, leading to severe water scarcity in states like Maharashtra (Central Ground Water Board, 2023).
2. **Habitat degradation and wildlife conflict**: Expansion of agricultural land into forested areas has increased human-wildlife conflicts, especially in tea plantation zones.
    - E.g.: **Tea plantations in Assam disrupt elephant corridors**, leading to frequent human-wildlife conflicts (Wildlife Trust of India, 2023).
3. **Labour exploitation**: Many workers in the tea and sugar industries face unsafe working conditions, low wages, and lack of labour rights.
    - E.g.: **Despite the Plantations Labour Act, poor working conditions** persist, affecting over 50% of female workers in tea estates (ILO Report, 2023).
4. **Increased carbon footprint**: The use of non-renewable energy sources for processing and transportation in export-oriented agriculture increases the carbon footprint.
    - E.g.: **Fossil fuel dependence in the sugar milling process** in Uttar Pradesh adds significantly to carbon emissions (International Institute for Environment and Development, 2023).

Environmental impact of high-demand crops

1. **High soil erosion rates**: The cultivation of crops like tea on sloped terrains accelerates soil erosion, leading to loss of fertile topsoil.
   - E.g.: **Tea plantations in Darjeeling have seen significant soil erosion**, affecting long-term productivity (Indian Soil Information System, 2023).
2. **Chemical residue accumulation**: High pesticide and fertilizer use in tea and sugarcane results in chemical residue accumulation in soil, affecting crop health and food safety.
   - E.g.: **Pesticide residues like DDT and Endosulfan** have been detected in export-quality tea, affecting global standards (Food Safety and Standards Authority of India, 2023).
3. **Water pollution from runoff**: Excessive agrochemical runoff contaminates nearby water bodies, impacting aquatic life and local water sources.
   - E.g.: **Fertilizer runoff from sugarcane farms in Maharashtra** has been linked to eutrophication in local lakes (Ministry of Environment, 2023).
4. **Deforestation for expansion**: The expansion of agricultural land for export crops has led to deforestation, impacting biodiversity and carbon sequestration.
   - E.g.: **Grasslands and forested areas in Karnataka** have been converted into sugarcane fields, contributing to biodiversity loss (Forest Survey of India, 2022).

Possible solutions

1. **Adopt rainwater harvesting**: Encourage rainwater harvesting systems in high water-consuming crop regions to reduce groundwater dependence.
   - E.g.: **Rainwater harvesting in sugarcane** regions in **Maharashtra** has shown promise in mitigating water stress (National Water Mission, 2023).
2. **Enforce agroforestry models**: Integrate agroforestry with export crops to restore ecological balance and enhance soil health.
   - E.g.**: Agroforestry models** in tea plantations in Assam have **successfully reduced soil erosion and improved biodiversity** (Indian Council of Agricultural Research, 2023).
3. **Promote fair labour practices**: Strengthen labor regulations and ensure fair wages, safer conditions, and benefits for agricultural workers.
   - E.g.: **Darjeeling tea estates adopting fair-trade practices show improved worker welfare** and sustainable production .
4. **Encourage crop rotation and organic practices**: Promote crop rotation and organic farming to improve soil quality and reduce chemical residues.
   - E.g.: **Crop rotation practices in sugarcane regions of Tamil Nadu have been successful** in maintaining soil fertility and reducing pest dependency (Tamil Nadu Agricultural University, 2022).

Conclusion

To ensure sustainable export-oriented agriculture, India must adopt diverse, **eco-friendly practices that conserve resources, improve labour standards, and promote long-term ecological health.** Balancing economic growth with environmental responsibility will secure a resilient agricultural future.

Issues related to direct and indirect farm subsidies and minimum support prices; Public Distribution System-objectives, functioning, limitations, revamping; issues of buffer stocks and food security; Technology missions; economics of animal-rearing.

Q. Examine the financial and operational constraints of the Food Corporation of India (FCI) in fulfilling its mandate. How can increased government investment and capacity expansion address these challenges effectively? (15 M)

Introduction

The **Food Corporation of India (FCI)** plays a critical role in ensuring **food security** and supporting **farmer welfare** in India. However, it faces significant **financial and operational constraints** that limit its efficiency, making **government investment and capacity expansion** essential for fulfilling its mandate effectively.

Body

Financial constraints

1. **High borrowing costs**: FCI relies heavily on **short-term borrowing** to manage funding gaps, leading to high interest costs.
    - **E.g.:** FCI's debt reached over **₹2 lakh crore by 2022**, with increasing interest burdens impacting its fiscal health (Ministry of Finance).
2. **Rising subsidy burden**: The FCI's role in the **Public Distribution System (PDS)** contributes significantly to India's food subsidy costs, stressing the central budget.
    - **E.g.:** Food subsidy allocation was approximately **₹2.1 lakh crore in the Union Budget 2023-24**.
3. **Delays in fund reimbursement**: Prolonged delays in subsidy reimbursements disrupt FCI's cash flow, limiting its ability to manage operational costs effectively.
    - **E.g.:** The **CAG 2021 report** highlighted that reimbursement delays impacted FCI's operational efficiency.

Operational constraints

1. **Limited storage capacity**: Insufficient storage infrastructure leads to crop wastage and reduces FCI's capacity to procure effectively.
    - **E.g.:** FCI incurs losses due to **wastage and deterioration**, with over **10% of grains damaged annually** (Agriculture Ministry, 2023).
2. **Inefficient procurement processes**: Delays in procurement, especially during peak harvest seasons, result in delayed payments to farmers.

   - **E.g.:** In **Punjab and Haryana**, delayed paddy procurement post-kharif season led to farmer protests in 2024.
3. **<u>Logistics and transportation issues</u>**: Dependence on outdated logistics results in delays, increasing operational costs and reducing efficiency.
   - **E.g.:** FCI's reliance on railways creates bottlenecks, especially during seasonal peaks (Food Ministry report, 2023).

<u>Role of government investment</u>

1. **<u>Reduction in borrowing needs</u>**: Increased capital infusion reduces dependence on high-interest borrowing, enhancing FCI's fiscal stability.
   - **E.g.:** The recent **equity infusion of ₹10,700 crore** in 2024 is expected to lower FCI's interest burden by **15%** (Economic Survey, 2024).
2. **<u>Sustained funding for modernization</u>**: Government investment allows FCI to adopt **modern storage and distribution infrastructure**, improving efficiency.
   - **E.g.:** The Integrated Storage Modernization Program received increased funding in 2023, enabling the construction of **silos and warehouses**.

<u>Impact of capacity expansion</u>

1. **<u>Improved storage infrastructure</u>**: Expanding warehousing capacities will minimize crop wastage and maintain grain quality.
   - **E.g.:** Construction of **steel silos** in states like **Madhya Pradesh** and **Maharashtra** has reduced grain losses by **30%**.
2. **<u>Streamlined procurement</u>**: Enhanced procurement capacity ensures timely payments to farmers, directly supporting their income.
   - **E.g.:** Capacity improvements reduced procurement delays in **Uttar Pradesh** in 2023, leading to more efficient paddy procurement.
3. **<u>Better distribution mechanisms</u>**: Investments in transportation logistics enable FCI to streamline food distribution, reducing supply chain delays.
   - **E.g.:** In 2022, **automated supply chains** in states like **Gujarat** improved food distribution through the PDS.

Conclusion

The **Shanta Kumar Committee** recommended restructuring and modernizing the FCI, emphasizing efficiency in storage and procurement processes. By addressing financial constraints through **targeted government investment** and **capacity expansion**, FCI can improve its operational efficacy and reduce food wastage. Moving forward, adopting **best practices in warehousing** and **logistics modernization** will be essential to strengthen India's food security framework.

Q. Discuss the economic viability and challenges of farm mechanization for small and medium-scale farmers in India. Suggest measures to make mechanization more inclusive and cost-effective. (15 M)

Introduction

Farm mechanization is a **critical driver of agricultural productivity and efficiency, especially in the face of labour shortages and rising costs**. However, for small and medium-scale farmers, the adoption of mechanization remains constrained by economic and infrastructural barriers.

Body

Economic viability of farm mechanization

1. **Higher productivity and cost savings**: Mechanization reduces time, labor costs, and post-harvest losses, improving net incomes.
    - Eg: **Sugarcane harvesters in Maharashtra increase efficiency**, cutting 20 tonnes per day compared to 2 tonnes by manual labor.
2. **Better resource utilization**: Mechanization enables precision farming, reducing wastage of seeds, fertilizers, and water.
    - Eg: **Use of laser levellers in Punjab** has improved water efficiency in wheat cultivation.
3. **Economies of scale challenge**: Mechanization often favors large-scale farms due to high capital costs, making it less viable for smallholders.
    - Eg: Only **4.9% of small and marginal farmers** own tractors (Agricultural Census, 2021).

Challenges for small and medium farmers

1. **High capital costs**: Machinery like combine harvesters and sugarcane harvesters remain unaffordable.
    - Eg: A combine harvester costs **₹25-30 lakh**, beyond the reach of most smallholders.
2. **Limited credit access**: Small farmers face difficulty in securing loans due to collateral requirements and high-interest rates.
    - Eg: Only **13% of agricultural credit** reaches marginal farmers (NABARD Report, 2023).
3. **Fragmented landholdings**: The average landholding size in India is **1.08 hectares**, limiting the operational efficiency of machinery.
    - Eg: Mechanized plows and seeders are underutilized on small plots.
4. **Lack of technical knowledge**: Farmers often lack training on operating and maintaining machinery, leading to underutilization.
    - Eg: **CHCs in Bihar report low adoption** due to poor farmer awareness.
5. **Environmental concerns**: Mechanized farming can degrade soil health and increase carbon emissions if not managed sustainably.
    - Eg: **Excessive tillage using tractors** has led to reduced soil fertility in regions like Haryana.

Measures to make mechanization inclusive and cost-effective

1. **Promote cooperative farming**: Encourage farmer producer organizations (FPOs) and cooperatives to share equipment and reduce costs.
   - Eg: **Mann Deshi Foundation** supports small farmers in Maharashtra through shared machinery models.
2. **Expand custom hiring centers (CHCs)**: Establish CHCs to provide affordable rental access to equipment.
   - Eg: **Sub-Mission on Agricultural Mechanization (SMAM)** has set up over 15,000 CHCs across India.
3. **Subsidies and financial schemes**: Provide targeted subsidies and zero-interest loans for mechanization.
   - Eg: **PM-Kisan Samman Nidhi** can be linked with mechanization loans to benefit marginal farmers.
4. **Develop low-cost machinery**: Encourage R&D for small, affordable machines tailored to fragmented landholdings.
   - Eg: **ICRISAT's development** of mini tillers for small farms in Andhra Pradesh.
5. **Skill development programs**: Train farmers in operating and maintaining machinery under programs like PMKVY (Pradhan Mantri Kaushal Vikas Yojana).
   - Eg: **Agricultural Skill Council of India (ASCI)** conducts workshops on mechanized farming techniques.
6. **Public-private partnerships (PPPs)**: Involve private players in leasing and financing schemes to reduce machinery costs.
   - Eg: **Mahindra & Mahindra's Krishi Samriddhi initiative** offers affordable tractor leasing services.

Conclusion

Mechanization is pivotal for enhancing productivity and addressing labour shortages in Indian agriculture. By **leveraging cooperative models, targeted subsidies, and skill-building initiatives**, India can ensure inclusive and cost-effective mechanization, empowering small and medium-scale farmers for sustainable growth.

Q. "The Blue Revolution is not just about increased fish production but also about sustainable practices". Discuss the progress and challenges in achieving a sustainable Blue Economy in India. (15 M)

Introduction

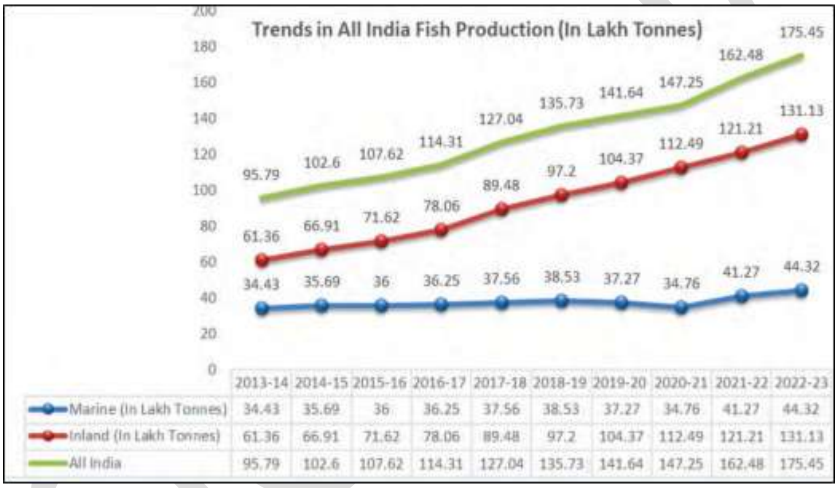
The **Blue Revolution**, introduced in the **5th Five-Year Plan (1980-85)**, focuses on enhancing fish production while ensuring ecological and economic sustainability. It aims to balance marine biodiversity conservation with the livelihood needs of millions dependent on the fisheries sector.

Body

Blue Revolution -about increased fish production and sustainable practices

1. **Focus on ecosystem-based management**: The Blue Revolution emphasizes maintaining ecological balance through sustainable fisheries management.
    - **Eg**: **National Policy on Marine Fisheries (2017)** aims at sustainability through stock assessment and conservation.
2. **Reduction in harmful fishing practices**: It promotes bans on unsustainable practices like trawling and overfishing to protect marine biodiversity.
    - **Eg**: Uniform **61-day fishing bans** in the Exclusive Economic Zone (EEZ).
3. **Empowerment of small-scale fishers**: Focus on inclusivity by ensuring equitable access to resources and market opportunities for small-scale fishers.
    - **Eg**: The **PMMSY** provides financial support and capacity building for fisherfolk.

Progress in achieving a sustainable blue economy in India



1. **Growth of inland aquaculture**: Inland fisheries contribute nearly **70%** of India's total fish production, reducing dependence on marine ecosystems.
    - **Eg**: Expansion of **culture-based fisheries** in Andhra Pradesh and West Bengal.
2. **Global leadership in shrimp exports**: India is the **world's largest shrimp producer**, adopting sustainability certifications to meet export standards.
    - **Eg**: **Eco-friendly shrimp farming practices** in Tamil Nadu.
3. **Enhanced investment in the sector**: Increased budgetary allocation of **₹2,584 crore (2024-25)** for infrastructure, technology, and climate-resilient practices.
    - **Eg**: Development of **integrated aquaparks** under the PMMSY.
4. **Promotion of saline aquaculture**: Transforming wastelands into productive zones for sustainable aquaculture.
    - **Eg**: Haryana's saline water aquaculture project for inland fish farming.
5. **Data-driven policymaking**: Launch of the **5th Marine Fisheries Census** for better resource assessment and sustainable planning.

- **Eg**: **Zoning of fishing areas to balance resource** use and conservation.

Challenges in achieving a sustainable blue economy in India

1. **Overfishing and depletion of resources**: Unsustainable fishing practices and illegal fishing reduce fish stock and biodiversity.
    - **Eg: IUU fishing** in the **Bay of Bengal** leads to resource overexploitation.
2. **Marine pollution**: Plastic and chemical waste threaten aquatic ecosystems and fish habitats.
    - **Eg**: **Mumbai's coastline** generates high marine plastic pollution levels.
3. **Climate change impacts**: Ocean acidification, rising temperatures, and habitat loss disrupt fish breeding and migration.
    - **Eg**: **Loss of mangrove forests** in **Sundarbans** affects marine life.
4. **Social inequality**: Marginalized fisherfolk lack access to modern technologies and infrastructure.
    - **Eg**: **Women in fishing communities face exclusion** from decision-making processes.
5. **Weak enforcement of policies**: Inadequate monitoring and regulation hinder effective implementation of sustainable practices.
    - **Eg**: **Delayed enforcement** of **gear-mesh size regulations** under the Marine Fishing Regulation Act.

Way forward

1. **Strengthen marine governance**: Establish integrated frameworks for effective zoning, resource management, and enforcement of sustainable fishing practices.
    - **Eg**: Implementation of the **Bay of Bengal-Regional Plan of Action** to combat IUU fishing.
2. **Promote climate-smart aquaculture**: Develop adaptive aquaculture systems and restore coastal ecosystems like mangroves and coral reefs.
    - **Eg**: **Mangrove restoration projects** along the Andhra Pradesh coast.
3. **Empower marginalized fisherfolk**: Provide equitable access to financial aid, markets, and technology for small-scale fishers and women.
    - **Eg**: **Skill-building programs** under the PMMSY for community empowerment.
4. **Combat marine pollution**: Launch nationwide campaigns for marine plastic reduction and better waste management systems.
    - **Eg**: Expansion of the **Swachh Sagar Abhiyan** to all coastal states.

Conclusion

India's **Blue Revolution** embodies a vision of productivity balanced with ecological and social sustainability. By addressing existing challenges and adopting innovative, inclusive strategies, India can lead the way toward a thriving and sustainable **Blue Economy** for the global good.

Food processing and related industries in India- scope' and significance, location, upstream and downstream requirements, supply chain management.

Land reforms in India.

Effects of liberalization on the economy, changes in industrial policy and their effects on industrial growth.

Infrastructure: Energy, Ports, Roads, Airports, Railways etc.

Q. Analyze the key challenges and opportunities in India's transition from fossil fuels to renewable energy. How have government schemes and fiscal reforms contributed to this transformation? (15 M)

Introduction

India is making a transformative shift from **fossil fuels to renewable energy** to meet its **net-zero target by 2070** and fulfill global climate commitments. This transition presents both **challenges and opportunities**, driven by **government schemes** and **fiscal reforms** aimed at building a sustainable energy future.

Body

Key challenges in India's transition:

1. **Infrastructure gaps:** India's existing energy grid needs significant upgrades to support the integration of **renewable energy** sources like wind and solar.
    - E.g.: **The Green Energy Corridor Project** aims to improve grid capacity, but infrastructure issues still persist.
2. **Investment shortfall:** India requires an estimated **$10 trillion** in clean energy investments by 2070, but current financial inflows are insufficient. (IEA estimates 2023).
3. **Technological barriers:** The **storage and intermittency** of renewable energy pose technical challenges, particularly for solar and wind energy, while **battery storage costs** remain high.

- E.g.: Lack of widespread **battery storage systems** hampers efficient energy use.

4. **Dependence on coal:** India's energy mix is still heavily reliant on **coal**, which contributes over **55%** of electricity generation.
5. **Social and employment impact:** The transition may lead to **job losses** in the fossil fuel sector, affecting coal-dependent regions like Jharkhand and Chhattisgarh. **Just transition frameworks** are needed.

Opportunities in India's transition:

1. **Renewable energy leadership:** India has the potential to become a global leader in **solar energy**, with a target of **500 GW of renewable capacity** by 2030.
    - India ranks **4th globally** in installed renewable capacity (IRENA, 2023).
2. **Job creation in clean energy:** The shift to renewables is expected to create millions of **green jobs** in sectors such as **solar, wind, and electric vehicles (EVs)**.
    - E.g.: **PM-KUSUM scheme** promotes **solar installations in rural India**, creating jobs for farmers.
3. **Energy security:** Renewable energy reduces dependence on **imported fossil fuels**, enhancing India's **energy security**.
    - E.g.: India's solar power generation is reducing oil import dependency, contributing to **$5 billion savings annually** in energy imports.
4. **Climate mitigation and sustainability:** The transition helps **reduce carbon emissions**, aligning with global climate goals, including **Paris Agreement commitments**.
    - E.g.: India's **solar parks have avoided over 35 million** tons of CO2 emissions annually.
5. **Global investments and partnerships:** India has attracted significant international funding, including the **$1 billion from the World Bank** for renewable energy projects.

Role of Government Schemes and Fiscal Reforms:

1. **Fossil Fuel Subsidy Reform:** The government has reduced fossil fuel subsidies by **85%** between 2014 and 2023, reallocating funds to clean energy.
2. **Taxation Measures:** The **coal cess** imposed from 2010 to 2017 generated funds for the **National Clean Energy Fund**, boosting renewable projects.
    - E.g.: The **Green Energy Corridor** project was partly financed by this cess, promoting solar and wind power integration.
3. **National Solar Mission:** Launched in 2010, this initiative aims to achieve enhcaed **solar capacity**, with incentives for **utility-scale solar projects**.
4. **PM-KUSUM Scheme:** Promotes the installation of solar pumps for irrigation, contributing to **sustainable agriculture** and rural electrification.
    - E.g.: The scheme has installed over **30,000 solar pumps** in rural areas by 2023.

5. **National Green Hydrogen Mission (2023):** Aims to make India a global hub for **green hydrogen production**, further reducing fossil fuel dependence.
    - E.g.: A target of **5 million tonnes of green hydrogen** production by 2030.
6. **Production-Linked Incentive (PLI) Schemes:** Provide incentives to manufacturers of **solar PV modules** and **electric vehicles**, fostering local production and reducing reliance on imports.
    - E.g.: The **PLI scheme for solar PV manufacturing** attracted investments of over **₹4,500 crores** by 2023.

Conclusion

India's transition from fossil fuels to renewable energy offers immense potential for **economic growth, sustainability**, and **global leadership**. Continued **investment in technology**, **policy support**, and a focus on **inclusive growth** are key to achieving long-term energy security and climate resilience.

Q. What are the challenges associated with developing a robust EV infrastructure in India, and how does the PM E-DRIVE Scheme aim to address them?

Introduction

The shift to **electric vehicles (EVs)** is critical for India's sustainable mobility goals, yet establishing a robust EV infrastructure faces numerous hurdles, from technical gaps to economic constraints.

Body

Challenges in developing EV infrastructure

1. **High initial setup costs**: Establishing charging stations and other infrastructure involves significant capital, often deterring private investment.
    - **E.g.: The cost of setting up a fast-charging station** can range between **Rs. 15–40 lakh** per unit (Ministry of Heavy Industries, 2023).
2. **Limited charging network**: A lack of adequate charging facilities creates "range anxiety," slowing EV adoption, particularly in non-urban areas.
    - **E.g.:** India had fewer than **2,000 public charging stations** in 2022, insufficient for growing EV numbers (CPCB Report, 2023).
3. **Technological and operational gaps**: Limited domestic capacity in **battery manufacturing** and inadequate testing facilities hinder scalability and reliability.
    - **E.g.: Dependence on imported lithium-ion batteries** raises both cost and environmental concerns (NITI Aayog, 2022).
4. **Inadequate power supply**: Expanding EV infrastructure requires a stable power supply, which poses a challenge, particularly in rural and remote areas.

- E.g.: **Power shortages** in states like **Bihar** and **Uttar Pradesh** affect the reliability of charging infrastructure (Ministry of Power, 2023).

5. **Policy and regulatory issues**: Complex policies and unclear regulations regarding land use for charging stations delay infrastructure development.
    - **E.g.: Zoning regulations** have slowed EV infrastructure growth in cities like **Mumbai** and **Delhi** (MoHUA Report, 2023).

PM E-drive scheme's solutions to address challenges

1. **Incentives for charging infrastructure**: The scheme allocates **Rs. 2,000 crore** to build a widespread network of public charging stations, with a focus on urban areas and highways.
    - **E.g.:** Plan includes **22,100 fast chargers for e-4Ws** and **48,400 for e-2Ws/e-3Ws** in major cities (Ministry of Heavy Industries).
2. **Subsidies and demand incentives**: Provides direct subsidies on e-vehicles, including e-2Ws, e-3Ws, and e-trucks, to make EVs more affordable and reduce dependence on imports.
    - **E.g.:** Demand incentives of **Rs. 5,000 per kWh** are offered for EVs registered in **FY 2024-25** (PIB, 2024).
3. **Encouraging domestic manufacturing**: Supports a **Phased Manufacturing Program (PMP)** to strengthen the EV supply chain and boost battery manufacturing.
    - **E.g.: Focus on indigenizing battery production** aligns with the **Aatmanirbhar Bharat** initiative (NITI Aayog).
4. **Upgradation of testing facilities**: Allocates **Rs. 780 crore** to modernize testing agencies under the **Ministry of Heavy Industries** to ensure EV quality and safety.
    - **E.g.: Upgraded testing will enhance battery standards** and overall vehicle safety (MHI Report, 2024).
5. **IEC and public awareness campaigns**: Implements Information, Education & Communication (IEC) initiatives to spread awareness and address range anxiety.
    - **E.g.: Nationwide awareness drives** to educate the public on EV benefits and available incentives (Ministry of Heavy Industries).

Conclusion

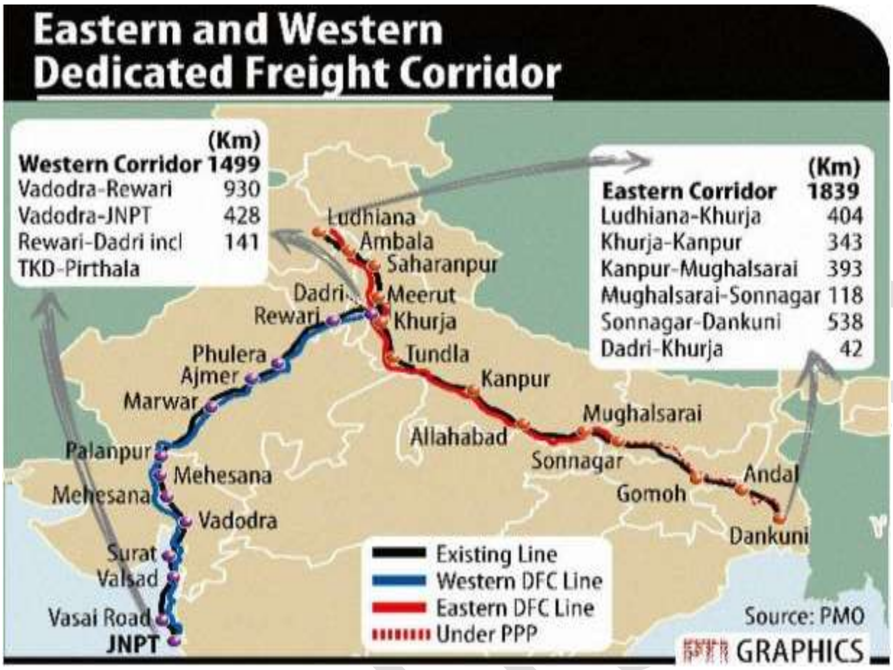
The PM E-DRIVE Scheme aims to systematically address India's EV infrastructure challenges through **subsidies, robust policy support, and enhanced domestic production**, moving the country closer to sustainable, self-reliant transportation.

Q. "The Dedicated Freight Corridors (DFCs) are enhancing India's GDP and boosting rail revenues." Analyze how the DFCs contribute to economic growth and the efficiency of the Indian Railways. (15 M)

Introduction

The **Dedicated Freight Corridors (DFCs)** are a transformative infrastructure project aimed at creating specialized freight-only routes to streamline logistics, reduce costs, and boost the efficiency of Indian Railways, ultimately contributing to India's GDP growth.

Body



Contribution to economic growth

1. **Reduction in logistics costs**: By offering a more efficient and cost-effective mode of freight transport, DFCs reduce logistics costs, enhancing the competitiveness of Indian goods globally.
    - E.g.: **World Bank** estimates suggest DFCs could help reduce India's logistics costs from **13-15% of GDP to around 8%,** which aligns with developed countries.
2. **Acceleration of industrial development**: Improved connectivity promotes the growth of industrial hubs along DFC routes, spurring local economies and attracting investments.
    - E.g.: The **Eastern DFC** has accelerated industrialization in regions like **Uttar Pradesh** and **Bihar**, creating employment and boosting regional GDP.
3. **Increase in export-import efficiency**: Faster and dedicated freight movement enables quicker movement of exports and imports, improving India's trade balance and supporting export-driven growth.
    - E.g.: The **Western DFC connects to major ports** like **JNPT**, reducing transit times and facilitating faster export-import cycles.
4. **Increased foreign investment**: Enhanced logistics attract foreign investments, as efficient supply chains are a critical factor for global companies.

- E.g.: **Foreign direct investments in logistics** have grown **by 20%** in DFC-adjacent regions (DPIIT).

5. **Boost to small and medium enterprises (SMEs)**: DFCs make logistics affordable for SMEs, enabling them to access distant markets and expand their reach.
    - E.g.: **SMEs in** states like **Rajasthan** and **Gujarat** benefit from reduced transportation costs due to the Western DFC.
6. **Support for agricultural exports**: Faster transportation reduces perishability risks for agri-products, supporting agribusiness and exports.
    - E.g.: **Fresh produce from Punjab and Haryana** reaches ports faster via DFCs, facilitating export to Middle Eastern markets.

Contribution to the efficiency of Indian railways

1. **Decongestion of passenger lines**: DFCs separate freight from passenger lines, reducing congestion on existing tracks, leading to increased punctuality and reliability of passenger services.
    - E.g.: The **Eastern DFC** has reduced congestion on the **Howrah-Delhi route**, benefiting passenger services significantly.
2. **Increased freight capacity**: With dedicated tracks, DFCs can accommodate longer and heavier freight trains, allowing Indian Railways to transport larger volumes of goods efficiently.
    - E.g.: The **Western DFC** supports double-stack container trains, significantly enhancing capacity.
3. **Improved transit speed**: DFCs are designed for faster freight movement, which minimizes delays and improves turnaround times for goods transportation.
    - E.g.: Average speed of **freight trains on DFCs is 60-70 km/h**, a significant increase over the 25 km/h on conventional tracks.
4. **Revenue boost for Indian railways**: By increasing freight volume and operational efficiency, DFCs contribute directly to revenue growth for Indian Railways.
    - E.g.: **Indian Railways** reported **a 2.94% increase in revenue attributable** to DFCs, as per 2023 data (Indian Railways Annual Report).
5. **Reduced carbon emissions**: Faster and efficient freight movement on DFCs reduces the dependency on road transport, lowering greenhouse gas emissions.
    - E.g.: Shift to rail freight over DFCs is expected to cut carbon emissions **by up to 40% by 2030** (Ministry of Environment).
6. **Advanced infrastructure and technology**: DFCs incorporate modern technologies like automated signalling and GPS-based tracking, enhancing operational efficiency.
    - E.g.: The **Western DFC uses GPS tracking for real-time** monitoring of freight, reducing turnaround time and improving reliability.
7. **Increased freight market share for railways**: By making rail freight more attractive and competitive, DFCs help Indian Railways capture a larger share of the freight market, which has traditionally been road-dominated.
    - E.g.: **Indian Railways aims to increase** its freight market share from **27% to 45% by 2030** through DFCs (National Rail Plan).

Way forward

1. **Completion of remaining DFC segments**: Fast-tracking the construction of remaining sections, such as the Pilkhani-Khurja section, will maximize the benefits of a fully operational DFC network.
2. **Integration with multimodal transport**: Develop multimodal logistics parks along DFC routes and link them to ports, highways, and inland waterways to create an integrated logistics ecosystem.
3. **Promote private investment in logistics hubs**: Encourage private sector investment in logistics parks and warehousing facilities along DFC corridors to enhance supply chain capabilities.
4. **Adoption of green technologies**: Implement solar-powered stations, automated control systems, and electrification along DFC routes to further reduce the environmental impact.
5. **Strengthening last-mile connectivity**: Improve last-mile connectivity between DFC terminals and local markets to fully leverage the freight capacity.

Conclusion

The Dedicated Freight Corridors represent a transformative step in India's logistics infrastructure, contributing significantly to economic growth and enhancing the operational efficiency of Indian Railways. **To fully realize the potential of DFCs, timely completion, integration with multimodal infrastructure, and sustainable practices** will be key to driving India's ambitions of becoming a global economic powerhouse.

Q. "India's wind energy sector has significant untapped potential, yet challenges persist in fully harnessing it". Examine the factors hindering optimal wind energy generation in India and suggest measures to overcome these challenges.(15 M)

Introduction:

India, with the **world's fourth-largest installed wind capacity**, holds vast potential for wind energy, crucial for its clean energy goals. Yet, only a fraction of this potential is currently harnessed.

Body

Untapped potential in India's wind sector

1. **High theoretical potential**: India's wind power potential is estimated at **1,163.86 GW** at 150 meters, yet only **6.5%** is currently utilized (Source: **National Institute of Wind Energy**).
2. **Favourable geographical conditions**: States like **Gujarat, Tamil Nadu, Maharashtra, and Karnataka** have high wind speeds suitable for energy generation.

3. **<u>Strategic role in renewable targets</u>**: Wind energy is integral to India's target of achieving **500 GW from renewable sources by 2030** as per its **COP26** commitments.

<u>Barriers to optimal wind energy utilization</u>

1. **<u>Aging technology</u>**: Many turbines are below **1 MW** capacity and over 15 years old, limiting their efficiency.
    - **E.g.: Nearly half of Tamil Nadu's 20,000 turbines** are of smaller capacities, reducing power generation.
2. **<u>Land and infrastructure constraints</u>**: High-capacity turbines require additional land and advanced infrastructure, which is limited in dense wind zones.
    - **E.g.:** In **Aralvaimozhi, Tamil Nadu**, newer turbines face challenges due to inadequate sub-stations.
3. **<u>Transmission and evacuation bottlenecks</u>**: Lack of grid infrastructure in high wind potential areas disrupts efficient power evacuation.
    - **E.g.: Central Electricity Authority (CEA)** reports grid congestion as a significant issue in wind-rich states.
4. **<u>Regulatory and financial challenges</u>**: High interest rates, absence of power purchase agreements (PPAs), and inconsistent policies make wind projects financially risky.
    - **E.g.:** In **Tamil Nadu, projects lack banking facilities since 2018,** impacting financial viability.
5. **<u>Environmental and social constraints</u>**: Large-scale wind installations face resistance from communities concerned with land use and environmental impacts.
6. **<u>Policy and permitting issues</u>**: Complex permitting processes and state-wise policy variations delay project approvals.
    - **E.g.:** The **Repowering Policy 2023** has met resistance due to insufficient on-ground support for implementation.

<u>Strategic solutions for boosting wind capacity</u>

1. **<u>Repowering and technological upgradation</u>**: Replace old turbines with high-capacity, efficient ones to maximize energy yield on existing wind farms.
    - **E.g.:** The **Repowering and Life Extension Policy 2023** by the MNRE targets turbines of less than **2 MW** capacity.
2. **<u>Enhanced infrastructure and grid connectivity</u>**: Strengthen grid infrastructure in high-potential states to improve energy evacuation.
    - **E.g.: High-capacity substations and transmission** lines planned for Tamil Nadu's **Aralvaimozhi** region.
3. **<u>Clear policy framework for banking and ppas</u>**: Implement consistent banking mechanisms and ensure long-term PPAs to attract investment.
    - **E.g**.: Restoring banking facilities for post-2018 installations in Tamil Nadu would support financial viability for investors.

4. **Incentivizing private investment and financial support**: Provide tax incentives, low-interest loans, and subsidies to encourage high-capacity turbine installations.
    - **E.g.: Gujarat** offers subsidies for large-scale wind projects, boosting private sector investment (Source: **Gujarat Energy Development Agency**).
5. **Streamlined permitting and uniform policies**: Simplify permitting processes and create uniform regulations across states for faster project execution.
    - **E.g.: An inter-state regulatory committee** could ensure consistency and reduce approval delays.
6. **Promoting research and development**: Encourage R&D in advanced wind technologies, like offshore and hybrid wind-solar systems.
    - **E.g.: NIWE is collaborating on offshore** wind research to tap into India's offshore potential.

Conclusion:

Unlocking **India's wind potential through targeted reforms will not only support sustainable energy** but also strengthen rural development and job creation, positioning India as a leader in renewable energy.

Q. Highlight the role of the Network Planning Group (NPG) in enhancing infrastructure planning. How does its approach contribute to integrated and efficient project implementation? (10 M)

Introduction

The **Network Planning Group (NPG)**, established under **PM GatiShakti National Master Plan (2021)**, plays a crucial role in India's infrastructure transformation. It ensures **integrated, multi-modal, and data-driven infrastructure planning** for efficient project execution.

Body

Role of NPG in enhancing infrastructure planning

1. **Integrated infrastructure vision**: Facilitates coordination between 44 central ministries and 36 states/UTs for holistic infrastructure planning.
    - **Eg**: NPG integrated **1685 data layers** to align projects with national priorities.
2. **Gap identification and resolution**: Identifies and resolves connectivity gaps, ensuring better resource utilization.
    - **Eg**: **Addressed last-mile connectivity** issues in **aspirational districts** like Dantewada.
3. **Data-driven decisions:** Utilizes geospatial tools to assess feasibility and optimize project alignment with social and economic nodes.
    - **Eg**: Mapping of **OFC networks and economic zones** to minimize overlaps.

4. **<u>Prioritization of projects</u>**: Evaluates projects worth over **₹15.89 lakh crore** for viability and long-term economic impact.
    - **Eg**: **Recent quadrupling of railway** lines like **Itarsi-Nagpur** for freight efficiency.
5. **<u>Multi-modal synergy</u>**: Aligns roads, railways, and ports to ensure seamless logistics and reduce transport costs.
    - **Eg**: **Enhanced intermodal connectivity** between **NH-137A and Kakching Road**.

<u>Contribution of NPG's approach to integrated and efficient project implementation</u>

1. **<u>Inter-ministerial coordination</u>**: Synchronizes project timelines and eliminates redundancies across sectors.
    - **Eg**: Harmonized projects of **MoRTH, MoR, and MoPSW** for freight corridors.
2. **<u>Cost and time efficiency</u>**: Streamlined approvals reduce delays and save costs through real-time collaboration.
    - **Eg**: Accelerated **Secunderabad-Wadi rail line** quadrupling through synchronized approvals.
3. **<u>Enhanced private sector participation</u>**: Encourages private investments by creating a predictable and transparent infrastructure environment.
    - **Eg**: Increased investments in **industrial corridors** under **NICDC**.
4. **<u>Environmental sustainability</u>**: Promotes eco-friendly infrastructure by factoring in environmental data layers in project planning.
    - **Eg**: Preservation of **mangrove ecosystems** in Mumbai coastal projects.
5. **<u>Boost to logistics sector</u>**: Aligns with **National Logistics Policy (2022)** to cut logistics costs from **14% to 8% of GDP**.
    - **Eg**: Development of **Logistics Data Bank** for tracking EXIM cargo efficiency.

Conclusion

The **NPG's collaborative framework** ensures seamless infrastructure planning, addressing connectivity gaps and driving cost-effective, sustainable growth. **By leveraging data and inter-ministerial coordination**, it strengthens India's journey toward **Viksit Bharat 2047** with a robust infrastructure backbone.

Investment models.

Science and Technology- developments and their applications and effects in everyday life.

Q. Discuss the potential applications of drone technology in the fisheries and aquaculture sector. (10 M)

Introduction

Drone technology is increasingly transforming the **fisheries and aquaculture sectors**, providing innovative solutions that boost productivity, enhance sustainability, and strengthen crisis response capabilities.

Body

Applications of drone technology in fisheries

1. **Monitoring and surveillance of fishing zones**: Drones enable real-time tracking of fish populations and **illegal fishing activities**, ensuring resource sustainability and compliance with regulations.
   - **E.g.**: The **Fishery Survey of India** uses drones to monitor marine fisheries, reducing illegal fishing along India's west coast.
2. **Disaster management and rescue operations**: Drones are used to drop **emergency supplies**, assess post-disaster damage, and aid in **rescue missions** for fishers stranded at sea.
   - **E.g.**: During **Cyclone Tauktae** (2021), drones were deployed in Gujarat's coastal regions for emergency aid and damage assessment.
3. **Mapping and environmental conservation**: Drones help **map fishing zones** and monitor coastal habitats, supporting sustainable fishing practices and **ecosystem conservation**.
   - **E.g.**: **ICAR-CIFT** employs drones to survey mangrove health along fisheries zones, contributing to coastal ecosystem preservation.
4. **Fish stock assessment**: Drones facilitate **stock estimation** and help prevent overfishing by accurately assessing fish populations and movements.
   - **E.g.**: **Japan** uses drones to monitor tuna fish stocks, helping to maintain sustainable fishing levels.
5. **Assistance in anti-poaching operations**: Drones help coastal authorities detect and prevent **poaching and unauthorized fishing** in restricted zones.
   - **E.g.**: Drones deployed in the **Andaman and Nicobar Islands** enhance patrolling efforts against poaching.

Applications of drone technology in aquaculture

1. **Feed management and stock assessment**: Drones allow **precise feed distribution** and regular stock assessment, optimizing feed usage, reducing costs, and ensuring sustainable growth.
    - **E.g.**: In **Tamil Nadu's aquaculture farms** (2022), drones have enhanced feed efficiency, leading to cost savings and improved stock health.
2. **Disease detection and health monitoring**: Equipped with **advanced sensors**, drones detect early signs of disease or stress in fish populations, allowing timely intervention to minimize stock loss.
    - **E.g.**: **Marine Products Export Development Authority (MPEDA)** uses drones in Kerala to monitor health indicators and prevent disease outbreaks in fish farms.
3. **Water quality monitoring**: Drones provide regular assessment of **water quality parameters** like temperature, pH, and oxygen levels, which are crucial for maintaining healthy aquaculture systems.
    - **E.g.**: **Andhra Pradesh** uses drones to monitor water quality in inland fish farms, helping improve farm productivity.
4. **Infrastructure and asset monitoring**: Drones inspect aquaculture facilities, tanks, and equipment for **maintenance needs**, improving operational efficiency.
    - **E.g.**: Fisheries in **Vietnam** employ drones to check for infrastructure integrity in offshore aquaculture installations.
5. **Behavioural monitoring of fish stocks**: Underwater drones observe **fish behaviour** and identify signs of stress or aggression, enabling optimized environmental conditions.
    - **E.g.**: **Norwegian aquaculture** uses underwater drones to study salmon behaviour, enhancing stock health and productivity.

Conclusion

Drone technology is revolutionizing both **fisheries and aquaculture** through enhanced monitoring, resource management, and operational efficiency. With continued innovation and **government support**, these advancements are poised to secure a sustainable and resilient future for **India's fisheries and aquaculture sectors**.

Achievements of Indians in science & technology; indigenization of technology and developing new technology.

Q. Discuss the significance of fostering a research and innovation ecosystem in India and analyze the potential impact of the Anusandhan National Research Foundation (ANRF) in achieving this goal. (10 M)

Introduction:

A robust **research and innovation ecosystem** is pivotal for driving **economic growth, global competitiveness, and societal well-being**. India's **Anusandhan National Research**

Foundation (ANRF), with an allocation of ₹1 lakh crore, aims to catalyze this transformation by fostering a culture of experimentation and innovation.

Body

Significance of fostering a research and innovation ecosystem

1. **Economic growth and competitiveness:** A strong R&D ecosystem fuels industrial growth and strengthens India's position in global value chains.
   - **Eg:** Countries like **South Korea** spend over 4% of their GDP on R&D, leading to tech giants like Samsung.
2. **Self-reliance in technology:** Indigenous research reduces dependency on imports and strengthens critical sectors like defence and semiconductors.
   - **Eg:** India's **Chandrayaan-3 success (2023)** demonstrated the potential of indigenous R&D.
3. **Job creation and skill development:** Innovation hubs generate employment, especially for skilled youth, and foster entrepreneurship.
   - **Eg:** The **Startup India program** has already incubated over 92,000 startups.
4. **Addressing societal challenges:** Research-driven solutions are vital for addressing issues like climate change, public health, and energy security.
   - **Eg:** India's **National Solar Mission** has leveraged innovation for clean energy expansion.
5. **Boosting exports:** R&D enhances product quality and innovation, crucial for export growth.
   - **Eg:** India's **pharmaceutical sector** accounts for 20% of global generic drug exports, backed by strong R&D investments.

Potential impact of ANRF in fostering innovation

1. **Increased funding for R&D:** The ₹1 lakh crore allocation ensures adequate financial support for long-term projects in both fundamental and applied research.
   - **Eg:** Prior underfunding limited India's R&D spending to **0.64% of GDP**, compared to 2.4% in China.
2. **Strengthening academia-industry collaboration:** ANRF promotes partnerships between academia, private sector, and government, aligning research with market needs.
   - **Eg: ISRO's collaboration with private startups** like Skyroot Aerospace underlines the success of such partnerships.
3. **Encouraging private sector participation:** ANRF incentivizes private players to invest in R&D, reducing over-reliance on government funding.
   - **Eg:** China's private sector accounts for nearly 76% of its R&D investments.
4. **Time-efficient, outcome-oriented research:** With clear guidelines and performance benchmarks, ANRF aims to deliver measurable results.

    - **Eg:** Focus on **climate-resilient agriculture** can directly benefit India's farmers.
5. **Nurturing young innovators:** ANRF will support early-stage research, fostering a mindset of innovation among the youth.
    - **Eg:** Schemes like **Atal Innovation Mission** have already demonstrated the potential of engaging young minds in problem-solving.

Conclusion

The ANRF has the potential to redefine India's **R&D landscape** by fostering innovation and enabling solutions for critical challenges. Leveraging this platform with **inclusive participation and measurable outcomes** will position India as a global leader in research and innovation.

Awareness in the fields of IT, Space, Computers, robotics, Nano-technology, bio-technology and issues relating to intellectual property rights.

Q. Discuss the potential of RNA editing in treating genetic disorders. How does it differ from DNA editing in terms of safety and efficacy? (10 M)

Introduction

RNA editing, a promising technology in gene therapy, allows temporary corrections to **mRNA**, making it a potential breakthrough in treating genetic disorders without permanently altering **DNA**.

Body

Potential of RNA editing in treating genetic disorders

1. **Targeted correction of genetic mutations**: RNA editing can correct **single-point mutations** in mRNA, potentially treating disorders caused by minor genetic errors.
    - **E.g.: Wave Life Sciences** used RNA editing to treat **alpha-1 antitrypsin deficiency (AATD)** by targeting specific mRNA errors (2024).
2. **Application in diverse diseases**: RNA editing is being explored for conditions like **Huntington's disease**, **Duchenne muscular dystrophy**, and certain cancers, which involve single or multiple gene mutations.
    - **E.g.: Shape Therapeutics** is developing RNA therapies for neurological conditions using **ADAR enzymes**.
3. **Precision in gene therapy**: RNA editing allows for **fine-tuned interventions**, adjusting single amino acids in proteins rather than larger gene sections, enhancing treatment accuracy.
    - **E.g.:** This precision is being applied in clinical trials by **ProQr Therapeutics** to treat **retinal diseases** without affecting surrounding genes.

4. **<u>Potential to address previously untreatable diseases</u>**: RNA editing can target complex diseases where DNA editing is challenging or risky, such as **liver diseases** and certain **neurological disorders**.
    - **E.g.: Ascidian Therapeutics** is testing RNA editing to treat **ABCA4 retinopathy**, a retinal disease where gene replacement is difficult due to the gene's large size.
5. **<u>Reversibility and control</u>**: Unlike DNA editing, RNA edits are **temporary**, allowing for controlled treatment and easy reversal if adverse effects occur.
    - **E.g.: RNA editing's temporary nature** ensures that treatment can be stopped if needed, enhancing safety.

<u>Differences between RNA and DNA editing in terms of safety and efficacy</u>

1. **<u>Safety – temporary vs. Permanent edits</u>**: RNA editing is **temporary and reversible**, reducing risks of permanent errors, whereas DNA editing permanently alters the genome, which can lead to unintended consequences.
    - **E.g.: CRISPR-Cas9** DNA editing has raised concerns due to potential **off-target effects** and irreversibility.
2. **<u>Immune response</u>**: RNA editing uses naturally occurring **ADAR enzymes**, which minimizes immune reactions compared to foreign proteins used in DNA editing (like **Cas9** from bacteria).
    - **E.g.: RNA editing's** use of **ADAR enzymes** lowers the risk of immune sensitivity, crucial for repeat treatments.
3. **<u>Lower risk of off-target effects</u>**: Since RNA editing only targets the **mRNA**, it's less likely to accidentally modify unintended genes, unlike DNA editing tools which can have broader off-target impacts.
    - **E.g.:** Research by **Korro Bio** on **RNA editing for liver diseases** has shown a high level of precision and minimal off-target activity.
4. **<u>Reduced ethical concerns</u>**: RNA editing's temporary nature reduces **ethical concerns** around permanent genetic modifications and inheritable changes, making it more widely acceptable for clinical use.
    - **E.g.:** Unlike DNA editing, **RNA editing does not alter the germline**, addressing ethical concerns around heritable modifications.
5. **<u>Efficacy in disease management</u>**: DNA editing is more suitable for **permanent cures** but poses risks in precision; RNA editing is ideal for temporary adjustments, especially in **chronic diseases** requiring frequent intervention.
    - **E.g.:** RNA editing shows potential in **diseases needing regular updates**, such as **cancer therapies** and **metabolic disorders**.

Conclusion

RNA editing offers a flexible and safer alternative to DNA editing, with significant potential in **precision medicine** for genetic disorders. Its temporary nature, high precision, and reduced ethical concerns make it a viable option for targeted, repeatable treatments. The future of gene therapy may see RNA editing as a complementary tool to DNA editing, particularly in managing complex and **chronic genetic conditions**.

Q. “The 'One Day One Genome' initiative has the potential to transform India’s approach to environmental sustainability, agriculture, and health”. Analyze its potential benefits and the challenges associated with its execution. (15 M)

Introduction

Microbial genomics holds immense potential to address global challenges in sustainability, agriculture, and health. India’s **'One Day One Genome' initiative**, launched in **November 2024** by the **Department of Biotechnology**, aims to sequence and annotate one bacterium daily, unlocking microbial capabilities to transform key sectors of the economy.

Body

Potential benefits

Environmental sustainability

1. **Waste management:** Genome sequencing helps identify microbes capable of degrading organic and toxic pollutants, reducing waste accumulation.
    - **Eg.**: Research on **plastic-degrading microbes** in Kerala has shown promising results (2023).
2. **Climate adaptation**: Methanotrophic microbes can reduce methane emissions, contributing to climate change mitigation.
    - **Eg.**: **Methane-oxidizing bacteria** identified in Indian wetlands are helping reduce greenhouse gas emissions.
3. **Soil restoration**: Sequenced microbes aid in nutrient cycling and reclaiming degraded soils.
    - **Eg.**: **Phosphate-solubilizing bacteria** have been successfully used in Rajasthan to enhance soil fertility (2024).

Agriculture

1. **Nitrogen fixation**: Genomic insights improve nitrogen-fixing microbes, reducing reliance on chemical fertilizers.
    - **Eg.**: Enhanced **Rhizobium strains** have boosted yields in pulses (ICAR, 2023).
2. **Pest and disease control**: Biopesticides developed using microbial genomics reduce crop losses while minimizing environmental harm.
    - **Eg.**: **Bacillus thuringiensis-based biopesticides** are widely used in cotton farming.
3. **Crop resilience**: Stress-tolerant microbes help crops adapt to drought, salinity, and heat, ensuring food security.
    - **Eg.**: **Salt-tolerant Azospirillum strains** are being used in coastal regions (DBT, 2024).

Health

1. **Combatting antimicrobial resistance (AMR)**: Identifying resistance genes helps develop targeted antibiotics and therapies.
   - **Eg.**: Studies on **Escherichia coli strains** in India have informed AMR management strategies (ICMR, 2023).
2. **Probiotic therapies**: Genomic insights into gut microbiota enable the development of probiotics for immunity and digestion.
   - **Eg.**: Research on **Lactobacillus rhamnosus** has led to probiotic supplements improving gut health.
3. **Disease surveillance and control**: Sequencing pathogenic microbes aids in early detection and prevention of infectious diseases.
   - **Eg.**: **Genomic tracking of Mycobacterium tuberculosis** has strengthened India's TB control programs.

Challenges

1. **Infrastructure limitations**: Genome sequencing requires advanced labs and skilled personnel, which are inadequate in rural and remote areas.
   - **Eg.**: Only **10% of Indian research institutions** have high-throughput sequencing facilities (DBT, 2023).
2. **High cost of research**: Sequencing and annotating genomes require substantial funding, which is currently limited.
   - **Eg.**: The **Union Budget 2024** allocated only **₹150 crore** for microbial genomics research.
3. **Data accessibility and misuse**: Ensuring equitable access to data while protecting intellectual property rights is challenging.
   - **Eg.**: Concerns over **biopiracy** of India's microbial diversity have been raised in international forums (2023).
4. **Public awareness**: Limited understanding of microbial genomics reduces acceptance and adoption of its applications.
   - **Eg.**: A **NABARD study (2022)** found that **65% of farmers** were unaware of microbial biofertilizers.
5. **Lack of collaboration**: Effective coordination between government, industry, and academia remains insufficient.
   - **Eg.**: Fragmented efforts in antimicrobial resistance research have slowed progress in this field.

Conclusion

The **'One Day One Genome' initiative** is a transformative step towards leveraging microbial genomics for sustainable development. By addressing challenges through targeted **policy interventions**, enhanced **infrastructure investment**, and fostering **public-private**

partnerships, India can unlock the full potential of this initiative and emerge as a global leader in **microbial innovation**.

Conservation, environmental pollution and degradation, environmental impact assessment.

Q. Examine the challenges and opportunities associated with India's carbon credit mechanism. How can India ensure that its Carbon Credit Trading Scheme (CCTS) aligns with international standards? (15 M)

Introduction

India's **Carbon Credit Trading Scheme (CCTS)** is essential for balancing **economic growth with climate goals**. However, its success hinges on effectively addressing challenges and ensuring alignment with **global standards**.

Body

Challenges in India's carbon credit mechanism

1. **Greenwashing risk:** Ensuring the **authenticity of carbon credits** is critical, as inadequate verification can lead to credits that do not represent genuine emission reductions.
    - **E.g.:** Investigations in global voluntary carbon markets revealed **inflated project claims**, particularly in forestry.
2. **Monitoring and verification issues:** Verification protocols must be rigorous to prevent **non-additional projects** from qualifying, which undermines emissions reduction.
    - **E.g.:** India's **Green Credit Programme** faced criticism for lacking science-based guidelines, risking credibility.
3. **Double counting and oversight:** Without strict oversight, there is a risk of **double-counting credits**, which diminishes emission reduction achievements.
    - **E.g.:** The **World Bank's report on Article 6 Mechanisms** highlights double-counting risks that weaken carbon market integrity.
4. **High compliance costs: Monitoring, Reporting, and Verification (MRV)** systems are costly, posing a barrier for smaller projects.
    - **E.g.:** The **Voluntary Carbon Markets Integrity Initiative (VCMI)** identifies MRV costs as a significant entry barrier for smaller entities.

Opportunities in India's carbon credit mechanism

1. **Climate finance potential:** CCTS could channel substantial **domestic and international investments** into low-carbon projects, boosting sustainability.
   - **E.g.:** The **International Energy Agency (IEA) reported a 20% growth** in global climate finance in 2023, showing ample funding potential.
2. **Alignment with national climate goals:** CCTS aligns with **India's Nationally Determined Contributions (NDCs)** to transition to a low-carbon economy.
   - **E.g.:** India's updated NDCs in 2022 target a **45% reduction in emissions intensity of GDP by 2030** from 2005 levels and aim for **50% cumulative electric power capacity from non-fossil fuel sources by 2030** (Source: PIB).
3. **Economic growth and job creation:** Scaling projects in **renewable energy and afforestation** can drive economic benefits and job creation.
   - **E.g.:** The **Ministry of New and Renewable Energy** projects that clean energy could create over **3 million jobs** by 2030.
4. **Global climate leadership:** A robust carbon credit market would position India as a **leader in global climate finance** and emissions reduction.
   - **E.g.:** India's role in **Paris Agreement Article 6** negotiations demonstrates its commitment to shaping global carbon standards.

Ensuring alignment with international standards

1. **Adoption of global best practices:** Integrate standards from bodies like **Gold Standard** and the **International Emissions Trading Association (IETA)** to ensure project credibility.
   - **E.g.:** The **Gold Standard requires independent third-party verification** for all carbon offset projects to maintain integrity.
2. **National carbon registry:** Implementing a centralized system to **track and monitor carbon credits** would prevent double-counting and boost transparency.
   - **E.g.:** The **Justice Verma Committee** emphasized the need for centralized tracking systems to improve compliance.
3. **Independent third-party verification:** Mandate regular audits by **certified third parties** to verify emission reductions and ensure project validity.
   - **E.g.:** The **Bureau of Energy Efficiency (BEE)** could accredit verifiers for standardized project assessments.
4. **Stringent additionality and permanence criteria:** Projects must show that emission reductions **exceed business-as-usual scenarios** for credits to be meaningful.
   - **E.g.:** The **Kyoto Protocol's Certified Emission Reductions (CERs)** emphasized additionality as a key project requirement.
5. **Transparent disclosure requirements:** Mandate public disclosure of project details, **emission reduction techniques**, and third-party verification results to foster accountability.
   - **E.g.:** The **Voluntary Carbon Markets Integrity Initiative (VCMI)** stresses transparent disclosures to validate offset claims.

6. **<u>Alignment with article 6 standards of the Paris agreement</u>:** India must prevent **double-counting** and comply with **Internationally Transferred Mitigation Outcomes (ITMOs)** to align with Article 6.
    - **E.g.:** The **Article 6 rulebook** established at COP26 provides a framework to meet compliance standards for international credibility.

Conclusion

By effectively addressing challenges and leveraging opportunities, India can create a **transparent and credible carbon credit system** that supports both national climate goals and global standards. Robust governance will enable India's CCTS to contribute meaningfully to **sustainable growth and climate leadership**.

Q. "The Global South bears a disproportionate burden of climate change". Examine the dual challenge of mitigation and loss and damage faced by developing countries like India. (10 M)

Introduction

The Global South, including countries like India, contributes minimally to global greenhouse gas emissions but faces severe climate impacts. These nations must tackle the dual challenges of **mitigation** to reduce emissions and **loss and damage** caused by climate-induced disasters, all while balancing developmental priorities.

Body

<u>Mitigation challenges</u>

1. **<u>High costs of clean energy transition</u>**: Transitioning to renewable energy and adopting green technologies requires significant financial resources.
    - Eg: India's **National Solar Mission** aims for 280 GW solar capacity by 2030 but requires over **$223 billion** in investments (IRENA, 2022).
2. **<u>Limited carbon space</u>**: Developed countries' historical emissions limit the carbon budget available for developing countries to achieve industrial growth.
    - Eg: **India's per capita emissions** are **2.4 tonnes**, far below the global average of **6.3 tonnes** (UNEP, 2023).
3. **<u>Dependence on fossil fuels</u>**: Transitioning from coal and oil to renewables is challenging given their significant share in energy supply and employment.
    - Eg: Over **50% of India's electricity** still comes from coal (CEA, 2023).
4. **<u>Lack of affordable technology</u>**: High costs and patents on renewable energy technologies hinder adoption in developing countries.
    - Eg: **Expensive lithium-ion batteries for electric vehicles** and grid storage slow down energy transitions in India.
5. **<u>Social resistance to green policies</u>**: Policies like carbon taxes and banning fossil fuels often face resistance due to economic disruptions.

- Eg: The **opposition to coal phase-outs** in coal-dependent states like Jharkhand and Odisha.

Loss and damage challenges

1. **Extreme weather events**: Climate change-induced disasters such as floods, droughts, and cyclones disrupt livelihoods and infrastructure.
   - Eg: **Cyclone Amphan (2020)** caused losses worth $13 billion in India and Bangladesh (World Bank).
2. **Agricultural vulnerability**: Erratic rainfall and rising temperatures threaten food security and rural incomes.
   - Eg: Indian farmers lost **$10 billion annually** from 1995-2020 due to climate extremes (ICAR).
3. **Impact on public health**: Rising temperatures and changing disease patterns increase health expenditures in developing countries.
   - Eg: **Heatwaves in India** caused over **24,000 deaths** between 1992 and 2022 (Lancet).
4. **Rising sea levels**: Coastal regions face severe challenges, including submergence and salinity intrusion.
   - Eg: **Sundarbans region in India** is losing significant landmass annually due to rising sea levels.
5. **Inadequate financial support**: Funds for loss and damage under international mechanisms like COP remain insufficient.
   - Eg: **Developing countries sought $100 billion** annually, but actual mobilization has fallen short (OECD, 2022).

Conclusion

Solving the dual challenges of mitigation and loss and damage requires a **global partnership** that ensures adequate funding, technology access, and policy flexibility for developing countries. Initiatives like scaling up **climate-resilient infrastructure**, integrating **local adaptation strategies**, and enhancing **public-private partnerships** can enable nations like India to address these challenges while fostering sustainable development.

Disaster and disaster management.

Q. Discuss the causes of increasing fire incidents in urban high-density areas and propose effective mitigation strategies to reduce casualties. (10 M)

Introduction

Urban high-density areas, **characterized by overcrowding and inadequate infrastructure, are increasingly prone to fire incidents,** posing severe risks to lives and property. The growing frequency of such incidents underscores the urgent need for robust preventive measures.

Body

Causes of fire incidents in urban high-density areas

1. **Overcrowding and unplanned urbanization**: Dense population clusters lead to congestion, increasing fire risks in residential and commercial spaces.
   - **Eg.** The **Jhansi NICU fire (2024)** occurred due to overcrowding and insufficient facilities.
2. **Non-compliance with fire safety norms**: Buildings often lack proper fire exits, sprinklers, and alarms due to negligence or regulatory lapses.
   - **Eg.** A 2023 audit found that **60% of high-rise buildings in Delhi** failed to comply with fire safety norms (NDMA).
3. **Aging electrical infrastructure**: Outdated and poorly maintained electrical systems frequently cause short circuits, a leading cause of urban fires.
   - **Eg.** A short-circuit triggered the **2022 Bhubaneswar hospital fire**, resulting in fatalities.
4. **Improper storage of inflammable materials**: Lack of proper storage standards for chemicals and LPG cylinders heightens risks in slums and informal markets.
   - **Eg.** The **Mumbai Crawford Market fire (2023)** was caused by improperly stored chemicals.
5. **Limited firefighting capacity**: Insufficient resources, outdated equipment, and delayed response times exacerbate the impact of urban fires.
   - **Eg.** India's average **response time for urban fires exceeds 20 minutes**, double the global best practice.

Mitigation strategies to reduce casualties

1. **Strengthening fire safety norms**: Enforce stringent building codes, conduct regular audits, and ensure compliance with National Building Code standards.
   - **Eg. Implementation of fire-resistant** materials in **Smart Cities** projects.
2. **Upgrading firefighting infrastructure**: Modernize firefighting equipment, enhance training, and deploy quick response vehicles in densely populated areas.
   - **Eg.** Mumbai introduced **drones for fire monitoring** in 2023 to improve response times.
3. **Promoting urban planning reforms**: Encourage planned development with adequate space for fire escapes and emergency access.
   - **Eg. Chandigarh's grid system** provides effective fire control access.
4. **Community awareness and drills**: Conduct regular fire safety awareness programs and evacuation drills to prepare residents for emergencies.

- Eg. NDMA's **National Fire Service Day (2024)** campaign reached over 2 lakh urban residents.

5. **Leveraging technology**: Use GIS-based mapping to identify fire-prone zones and install IoT-enabled fire detection systems.
    - **Eg.** Hyderabad's **Smart Fire Management System** reduced fire incident response times by 30%.
6. **Improving disaster management coordination**: Strengthen collaboration between municipal authorities, fire departments, and health services for effective crisis management.
    - **Eg.** Best practices from **Tokyo Fire Department** show effective inter-agency coordination.

Conclusion

Addressing fire risks in urban high-density areas requires a combination of **stringent safety regulations, technological advancements, and community participation.** A proactive approach will not only save lives but also ensure sustainable and resilient urban development.

Q. Examine how climate change has increased the frequency and intensity of forest fires globally. Discuss their impact and suggest strategies for prevention and mitigation. (15 M)

Introduction

The increasing frequency and intensity of forest fires **globally are closely linked to climate change, with rising temperatures, prolonged droughts, and erratic weather** creating conducive conditions. These fires, in turn, exacerbate climate change, creating a dangerous feedback loop.

Body

How climate change has increased forest fires

1. **Rising global temperatures:** Higher temperatures cause drier vegetation and soils, creating fuel for wildfires.
    - **Eg:** Europe witnessed its **hottest summer in 2023**, triggering large-scale wildfires in Greece and Portugal (Source: EU Joint Research Centre).
2. **Prolonged droughts:** Climate change-induced droughts increase the flammability of forests, making fires more likely.
    - **Eg:** Canada faced its **worst wildfire season in 2023**, burning over **15 million hectares** during record-breaking dry spells.
3. **Erratic weather patterns:** Increased wind speeds and changing precipitation cycles exacerbate fire spread and intensity.
    - **Eg:** Dry thunderstorms in Australia's **Black Summer Fires (2019-20)** were worsened by altered climate systems.

4. **<u>Extended fire seasons</u>:** Global warming has prolonged fire seasons, especially in traditionally temperate regions.
   - **Eg:** The fire season in the **Mediterranean region** now spans beyond summer months, with rising incidents in spring and autumn.
5. **<u>Melting permafrost and boreal forest fires:</u>** Climate change has triggered wildfires in previously unaffected regions, such as Siberian forests.
   - **Eg:** Siberia's **2021 wildfires** released a record amount of carbon emissions into the atmosphere (Source: Copernicus Atmospheric Monitoring Service).

<u>Impact of forest fires</u>

1. **<u>Health hazards</u>:** Forest fires release particulate matter and toxic gases, impacting air quality and human health.
   - **Eg:** In 2023, wildfire smoke from **Canada c**aused hazardous air quality levels in the US, affecting over **100 million people**.
2. **<u>Economic losses</u>:** Wildfires destroy infrastructure, crops, and forests, leading to significant financial losses.
   - **Eg:** California's **Camp Fire (2018)** resulted in over **$16.5 billion** in damages.
3. **<u>Loss of ecosystems and services</u>:** Fires destroy forests that act as carbon sinks, worsening global warming.
   - **Eg:** The **Amazon wildfires (2020)** reduced critical rainforest cover, with far-reaching climate impacts.
4. **<u>Displacement of populations</u>:** Wildfires force evacuations and disrupt livelihoods, particularly in rural and forest-dependent communities.
   - **Eg:** Over **70,000 people** were evacuated during Greece's wildfires in 2023.
5. **<u>Global carbon emissions</u>:** Wildfires release massive amounts of greenhouse gases, intensifying climate change.
   - **Eg:** Canada's wildfires in 2023 emitted **1.5 gigatonnes of CO_2**, equivalent to the annual emissions of Japan.

<u>Strategies for prevention and mitigation</u>

1. **<u>Early warning systems</u>:** Use advanced technologies like remote sensing, satellite imagery, and AI to predict and monitor fire risks.
   - **Eg:** NASA's **Fire Information for Resource Management System (FIRMS)** provides real-time fire alerts globally.
2. **<u>Community-based forest management</u>:** Involve local communities in fire prevention and control measures.
   - **Eg:** India's **Joint Forest Management (JFM)** model empowers local stakeholders to protect forests.
3. **<u>Fire-resistant infrastructure</u>:** Design fire-safe buildings and create buffer zones in high-risk areas.
   - **Eg:** Australia's **Bushfire-Resistant Design Standards** have been effective in reducing fire damage to properties.

4. **<u>Controlled burns and fuel management</u>:** Conduct prescribed burns to reduce excess vegetation and prevent large-scale fires.
    - **Eg:** The US Forest Service uses **prescribed burning** to manage fire risks effectively.
5. **<u>Legislation and international cooperation</u>:** Strengthen legal frameworks and enhance cross-border collaboration to address transboundary wildfire risks.
    - **Eg:** The EU's **RescEU Mechanism** coordinates firefighting resources among member states during emergencies.

Conclusion

Addressing forest fires requires an integrated approach combining **science, community participation, and international cooperation**. With climate change intensifying these disasters, investing in **resilience and sustainable forest management** is crucial to breaking this destructive cycle

Linkages between development and spread of extremism.

Role of external state and non-state actors in creating challenges to internal security.

Q. "Eradicating terrorism is essential for India's vision of becoming a developed nation by 2047". Discuss how a cohesive national counter-terrorism policy, with coordinated efforts between central and state agencies, can effectively address security challenges. (15 M)

Introduction

Terrorism undermines stability, economic growth, and social cohesion—key pillars required for India to achieve its vision of becoming a **developed nation by 2047**. A cohesive national **counter-terrorism policy, involving central and state collaboration**, is thus crucial for effectively addressing security challenges.

Body

<u>Why eradicating terrorism is essential for India's development vision</u>

1. **<u>Economic growth and investment</u>**: Terrorism discourages investments and impacts economic growth. A secure environment is vital to attract domestic and foreign investors, enabling sustainable development.
    - **E.g.**: **Jammu & Kashmir** has witnessed **a rise in investments as terror** incidents have declined, contributing to regional growth (Ministry of Home Affairs, 2023).
2. **<u>Social cohesion and public safety</u>**: Terrorism disrupts social unity and public safety, which are critical for inclusive growth and stability, aligning with India's 2047 vision.

- **E.g.**: Reduction in insurgency in **North-eastern states** has fostered greater social cohesion and economic integration (Home Ministry, 2024).

3. **<u>Human resource development</u>**: Terror-affected regions face limited access to **education, healthcare**, and employment, restricting human capital development.
    - **E.g.**: The decline in Naxal violence in **Bastar, Chhattisgarh** has allowed better access to education and healthcare, boosting human resource potential.
4. **<u>Strengthening national sovereignty and global standing</u>**: A strong anti-terror stance enhances India's **sovereignty and global reputation**, essential for a developed nation.
    - **E.g.**: India's **zero-tolerance policy on terrorism** has bolstered its international relations and counter-terror partnerships.
5. **<u>Reducing security expenditures</u>**: A stable, terror-free environment reduces the financial burden on security operations, enabling resources to be redirected toward developmental programs.
    - **E.g.**: Reduced security spending in the **Northeast** has allowed funds to be reallocated to infrastructure and social programs.

<u>Role of a cohesive national counter-terrorism policy in addressing security challenges</u>

1. **<u>Unified policy framework</u>**: A national policy ensures a standardized approach, enabling consistent counter-terrorism practices across states and promoting efficient resource allocation.
    - **E.g.**: The establishment of **Model Anti-Terrorism Squads (ATS) and Special Task Forces (STF)** provides a uniform structure for counter-terror operations.
2. **<u>Central-state collaboration</u>**: The policy emphasizes **intelligence-sharing and joint operations**, enabling central and state agencies to pool resources and respond swiftly to threats.
    - **E.g.**: **Multi-Agency Centre (MAC)** facilitates intelligence coordination between state and central agencies, improving response times.
3. **<u>Legal and operational tools</u>**: Policies like **Unlawful Activities (Prevention) Act (UAPA)** empower agencies to handle terror-related offenses consistently and effectively across states.
    - **E.g.**: The **NIA has achieved a 95% conviction rate using UAPA**, making it a robust legal tool in anti-terror efforts (NIA Report, 2024).
4. **<u>Advanced technology and training</u>**: The policy may aid in modernizing counter-terrorism with **advanced technology** and training young officers in intelligence, surveillance, and response.
    - **E.g.**: Central and state forces employ **drones and AI-based analytics** for real-time surveillance and monitoring of conflict-prone regions.
5. **<u>Addressing high-risk regions</u>**: The policy will prioritize **high-risk areas** like Jammu & Kashmir, Naxal regions, and the Northeast, enhancing targeted efforts to curb terrorism.

- E.g.: Joint state-central operations have reduced terrorist activity in **Jammu & Kashmir** by over **70% si**nce 2014.

6. **Capacity building and skill development**: Training programs for state and central law enforcement equip them with specialized skills to tackle evolving terror threats effectively.
    - **E.g.**: The **Central Academy for Police Training** offers skill-enhancement programs, boosting operational readiness in conflict zones.
7. **Increased accountability and transparency**: A cohesive policy clarify roles and responsibilities, ensuring **accountability** and minimizing duplication of efforts among agencies.
    - **E.g.**: **Joint operational reviews** by central and state agencies enhance transparency and efficiency in counter-terrorism measures.

Way forward

1. **Enhanced intelligence-sharing mechanisms**: Strengthen multi-agency centers and intelligence-sharing frameworks to provide real-time updates across central and state agencies.
    - **E.g.**: Expanding the **Multi-Agency Centre (MAC)** network can enhance real-time intelligence sharing between regions.
2. **Strengthening legal frameworks and judicial efficiency**: Amend counter-terror laws to improve the judicial process, ensuring faster trials and robust anti-terror prosecution.
    - **E.g.**: **Reforms in UAPA** to expedite trials can improve conviction rates and deterrence in terror cases.
3. **Increased investment in technology and research**: Invest in cutting-edge technology, such as **AI and cybersecurity**, to counter emerging threats and improve surveillance in high-risk regions.
    - **E.g.**: **Deploying AI-based analytics** in border areas can strengthen detection of illicit cross-border activities.

Conclusion

A **unified counter-terrorism policy** with strong central-state collaboration, modern technology, and community involvement provides a solid foundation for India's security. This cohesive approach is essential to secure a stable environment, driving India toward its goal of becoming a **developed nation by 2047**.

Q. Discuss the importance of securing space-based assets for India's defence and national security. How does 'Antariksha Abhyas – 2024' contribute to achieving this objective? (10 M)

Introduction

Space is increasingly seen as a critical domain in modern defence. **Securing space-based assets** is essential for India's **military strength and strategic autonomy**. India's first space defence exercise, **'Antariksha Abhyas – 2024,'** represents a significant step towards protecting these assets and integrating space capabilities into its defence framework.

Body

Importance of securing space-based assets

1. **Enhanced surveillance and intelligence:** Space assets enable **real-time intelligence** crucial for monitoring adversarial activities.
    - **E.g.: RISAT satellites** provide high-resolution imagery vital for border and maritime surveillance.
2. **Communication and connectivity:** Secure communication through satellites is essential for **coordinated military operations** across remote regions.
    - **E.g.: GSAT-7A** ensures encrypted communication for India's Air Force, enhancing coordination.
3. **Navigation and precision targeting:** Navigation systems ensure **accurate positioning and targeting**, which is critical in modern warfare.
    - **E.g.:** The **NavIC system** enhances the precision of military operations, especially in challenging terrains.
4. **Space debris management:** Managing **space debris risks** is necessary to protect operational satellites from potential collisions.
    - **E.g.:** With growing debris in Low Earth Orbit, India's space defence must incorporate **collision-avoidance strategies**.
5. **Cybersecurity of space assets: Cyber defences** are essential to secure satellite systems from hacking, which could disrupt critical communication and surveillance.
    - **E.g.:** Protecting satellite control systems from **cyber threats** ensures reliability in military operations.
6. **Protection from anti-satellite (ASAT) Weapons:** Securing assets against ASAT capabilities is crucial as **global powers** expand counter-space operations.
    - **E.g.:** China's ASAT tests underline the importance of ASAT preparedness for India.

Role of 'Antariksha Abhyas – 2024' in securing space-based assets

1. **Identifying vulnerabilities and strengthening resilience:** The exercise assesses **risks and response mechanisms** to protect space assets from potential attacks or disruptions.
    - **E.g.:** Examining **contingency plans** ensures operational continuity even in satellite denial scenarios.
2. **Enhancing inter-agency coordination:** It fosters **collaboration between defence, ISRO, DRDO, and the armed forces** for a cohesive space defence strategy.

    - **E.g.:** Collaboration with **DRDO** enables the development of **indigenous counter-space technologies**.
3. **<u>Promoting technological innovation</u>:** The exercise encourages **innovation** in space warfare technologies, focusing on satellite security and cybersecurity.
    - **E.g.:** Involvement of **academia** supports R&D in cutting-edge space defense technologies.
4. **<u>Building strategic space doctrine</u>: Antariksha Abhyas** contributes to developing a **national space security policy**, which is essential for long-term defense planning.
    - **E.g.:** Insights from this exercise can inform **India's National Space Security Policy** for addressing emerging space threats.
5. **<u>Global context and strategic relevance</u>:** The exercise prepares India to keep pace with **global powers like the U.S. and China**, who have advanced space commands.
    - **E.g.:** India's proactive stance through **Antariksha Abhyas** positions it competitively in the **space defence landscape**.

Conclusion

'Antariksha Abhyas – 2024' marks a vital step toward securing India's space-based assets, integrating space in defence, and enhancing resilience to future threats. Going forward, **strategic foresight and collaboration** will ensure that India remains prepared and competitive in the dynamic space defence arena.

Q. Discuss the concept of 'Adaptive Defence' and its significance for national security in an era of emerging and unpredictable threats. How can India's defence mechanisms evolve to address transnational security challenges? (15 M)

Introduction:

Adaptive Defence is a dynamic security strategy that anticipates and evolves to counter emerging threats, ensuring resilience against a wide spectrum of modern challenges from cyber warfare to AI-driven conflict.

Body

<u>Key elements of adaptive defence in India</u>

1. **<u>Situational awareness</u>:** Leveraging data and AI for accurate, real-time threat assessment and swift action.
2. **<u>Strategic flexibility</u>:** Ensuring that India's military can quickly adapt tactics based on evolving threat landscapes.
3. **<u>Agility in operations</u>:** Agile response mechanisms enable faster, localized responses to threats.
4. **<u>Integration with futuristic technologies</u>:** Emphasizing technologies like AI, quantum encryption, and robotics for long-term security enhancement.

<u>Significance of adaptive defence in national security</u>

1. **<u>Enhanced responsiveness to emerging threats</u>:** Adaptive Defence focuses on anticipating potential threats, enabling proactive preparedness rather than reactive responses.
    - E.g.: **Swarm drone attacks** and cyber threats are examples of emerging challenges requiring pre-emptive strategy (2024, Ministry of Defence).
2. **<u>Integration of technology and innovation</u>:** It relies heavily on cutting-edge technology, such as AI, quantum computing, and robotics, to counter highly sophisticated threats.
    - E.g.: **Defence AI Project** to advance autonomous systems in India (NITI Aayog, 2023).
3. **<u>Strategic and tactical flexibility</u>:** Adaptive Defence ensures flexibility at operational levels, essential in an unpredictable geopolitical landscape.
    - E.g.: Increased use of **Unmanned Aerial Vehicles (UAVs)** for versatile operational tactics in border regions.
4. **<u>Resilience against hybrid warfare</u>:** It builds resilience to hybrid threats, combining traditional military strategies with non-conventional threats like cyber-attacks and disinformation.
    - E.g.: **CERT-In collaboration** with the armed forces to counter cyber threats in hybrid warfare contexts.

<u>Evolving India's defence mechanisms to address transnational security challenges</u>

1. **<u>Collaborative defence partnerships</u>:** Engaging in joint training, intelligence-sharing, and defence alliances with countries facing similar security threats enhances readiness.
    - E.g.: India's **Quad Alliance** partnership supports security measures across the Indo-Pacific, addressing transnational challenges.
2. **<u>Advanced technological integration</u>:** Developing indigenous technologies in drones, AI, and cybersecurity to safeguard against cross-border cyber and digital warfare.
    - E.g.: India's ambition to become a **global drone hub** aligns with enhancing adaptive defence capabilities.
3. **<u>Strengthening cyber and information security</u>:** Establishing robust cyber defence frameworks to secure sensitive defence data and infrastructure from transnational cyber threats.
    - E.g.: **National Cyber Security Policy 2023** emphasizes building resilience against sophisticated cyber threats targeting critical infrastructure.
4. **<u>Intelligence modernization and surveillance</u>:** Improving intelligence and surveillance capabilities to detect and neutralize transnational threats early.
    - E.g.: **Integrated Intelligence Monitoring System** by Defence Intelligence Agency to improve real-time situational awareness.
5. **<u>Joint military operations and drills</u>:** Conducting joint military exercises with allies to strengthen interoperability and readiness for cross-border security challenges.
    - E.g.: Annual **Yudh Abhyas** exercises between India and the U.S. enhance operational preparedness in adaptive defence scenarios.

6. **<u>Policy focus on defence modernization</u>:** Policies such as Aatmanirbhar Bharat in Defence and increased defence R&D funding aim to make India self-reliant and responsive to shifting security dynamics.
    - E.g.: **Defence Production and Export Promotion Policy (DPEPP) 2020** emphasizes self-reliance in defence production.

Conclusion:

Adaptive Defence provides India with a **robust framework to stay ahead of unpredictable threats, making national security future-ready**. Leveraging this approach, India can safeguard its strategic interests effectively amidst an ever-evolving global security environment.

Challenges to internal security through communication networks, role of media and social networking sites in internal security challenges, basics of cyber security; money-laundering and its prevention.

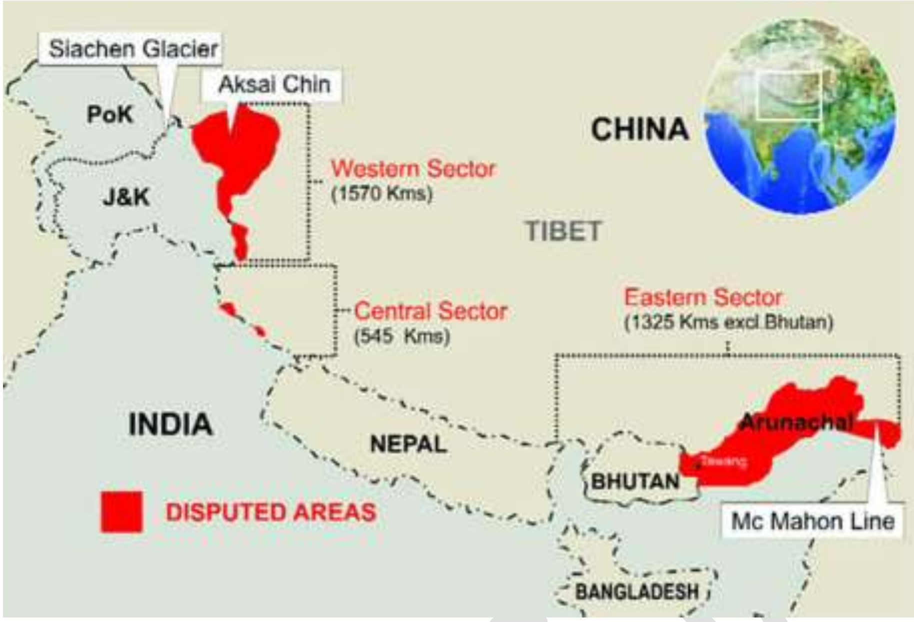
Security challenges and their management in border areas - linkages of organized crime with terrorism.

Q. Analyze the strategic implications of the recent India-China agreement on patrolling arrangements along the Line of Actual Control (LAC). How does this development influence regional security and bilateral relations. (15 M)

Introduction

The October 2024 India-China agreement on patrolling arrangements along the **Line of Actual Control (LAC)** marks a critical step toward de-escalating border tensions, reflecting both strategic recalibration and the pursuit of stability in a volatile region.

Body



<u>Key Aspects of the Agreement</u>

1. **<u>Structured Patrolling Protocol</u>**: The agreement establishes **defined patrolling limits** to avoid accidental confrontations and maintain peace.
    - **E.g.**: **Troops will avoid overlapping patrolling** points in Ladakh's contested zones.
2. **<u>Troop Disengagement Process</u>**: Initiated phased withdrawal in regions with heightened tensions to prevent standoffs.
    - **E.g**.: Gradual troop pullback from areas near Galwan and Pangong Tso since early October 2024.
3. **<u>Regular Communication Channels</u>**: Reinforces **bilateral dialogue frameworks** to resolve minor incidents quickly and effectively.
    - **E.g.**: **Weekly hotline conversations** between local commanders.
4. **<u>Confidence-Building Measures (CBMs)</u>**: Prioritizes transparent, confidence-enhancing protocols for sustained peace along the LAC.
    - **E.g.**: **Both nations committed to respecting no-build zones** at specific areas near the LAC.

<u>Strategic Implications for India's Security</u>

1. **<u>Reduced border tensions</u>**: Decreases the risk of escalation in disputed areas, allowing India to allocate resources elsewhere.

- E.g.: Ministry of Defence reports (October 2024) indicate reduced deployment intensity at key points in Ladakh.

2. **Enhanced regional influence**: The agreement underscores India's **diplomatic resolve**, strengthening its role as a peace stabilizer in South Asia.
   - **E.g.**: **India's dialogue-centric approach** is now a regional model for conflict de-escalation.
3. **Resource optimization**: Enables India to redirect defence expenditure from high-alert LAC deployment to **modernization of armed forces**.
   - **E.g.**: **Emphasis on indigenous weapon development** under the **Make in India** initiative for enhanced self-reliance.
4. **Focus on Indo-Pacific strategy**: The easing of border tensions enhances India's **maritime focus** in the Indo-Pacific, crucial for countering broader regional challenges.
   - **E.g.**: **Increased naval collaboration** with the Quad (2024).
5. **Bolstered surveillance capabilities**: Promotes investment in **surveillance and early-warning technologies** along the LAC to prevent future confrontations.
   - **E.g.**: **Deployment of advanced drones** by DRDO along border zones.

Influence on regional security

1. **Strengthens peace in south asia**: The pact promotes **regional stability**, mitigating concerns among neighboring nations about potential conflict escalation.
   - **E.g.**: **Statements from SAARC members** commend India-China engagement as a regional peace-building model.
2. **Enhances strategic partnerships**: India's commitment to peaceful resolution strengthens ties with partners who value regional stability, such as the US and ASEAN.
   - **E.g.**: **ASEAN leaders have expressed appreciation** for India-China diplomatic efforts at the October 2024 summit.
3. **Boosts confidence in multilateral platforms**: The agreement reflects positively on forums like **BRICS** and **SCO**, reinforcing trust in peaceful dispute resolution frameworks.
   - **E.g.**: China reaffirmed commitment to BRICS peace mechanisms, strengthening multilateral trust.
4. **Contributes to global security goals**: By stabilizing a nuclear flashpoint, the agreement aligns with global **non-proliferation and peace goals**.

- **E.g.**: **UN Secretary-General** lauded the development as a critical step toward regional and global peace.

Impact on bilateral relations

1. **Improved diplomatic channels**: Establishes smoother communication pathways, improving **trust and crisis management** between India and China.
    - **E.g.**: **Enhanced hotline arrangements** and faster issue resolution timelines since the agreement.
2. **Economic and trade prospects**: Reducing border tension fosters a conducive environment for trade negotiations, especially in non-strategic sectors.
    - **E.g.**: Talks on resuming **rare earth mineral trade** have reopened, a key to tech manufacturing.
3. **Balancing strategic competition**: Maintains a **competitive yet stable** relationship, allowing India to address other pressing foreign policy areas.
    - **E.g.**: India can better focus on **Indo-Pacific initiatives with ASEAN and Quad** members.
4. **Resilience against proxy challenges**: Allows India to strategize effectively against possible non-border challenges, like **cybersecurity threats** or proxy conflicts.
    - **E.g.**: **India-China dialogue on cyber security** began in October 2024.

Conclusion

The agreement is a landmark in **ensuring border stability and strengthening diplomatic resilience**. Moving forward, sustained dialogue and robust confidence-building mechanisms will be essential for transforming strategic de-escalation into a pathway for lasting peace.

Various Security forces and agencies and their mandate.