GPS ENTRANCE EXAM-2025

For civil service preparation

ABSTRACT

This entrance examination is for admission to the academic courses conducted by the institute. The exam will be descriptive in nature and will consist of 12 questions. Candidates must prepare according to the syllabus. Qualifying this examination is mandatory. The exam will be conducted offline at the GPS campus, Jodhpur, on July 7th 2025.

Exam information:

Exam Date: 7th June 2025
Reporting Time: 8:30AM- 9:00AM
Exam time: 9:30AM
An orientation session will be held after the examination.

India's Push for Natural Farming

What is Natural Farming?

- **About**: **Natural farming** is a **sustainable agricultural method** that **avoids chemical fertilizers, pesticides, and intensive tillage,** relying on ecological processes and indigenous resources for soil fertility and crop growth.
- **Key Principles**
  - **No Chemical Inputs**: Avoids synthetic fertilizers and pesticides.
  - **Use of Bio-Inputs**: Utilizes **Jeevamrut, Beejamrut, and Panchagavya for soil enrichment.**
  - **Minimal Soil Disturbance**: No plowing or tilling to maintain soil biodiversity.
  - **Intercropping & Crop Rotation**: Enhances soil fertility and pest control.
  - **Mulching & Cover Cropping**: Retains soil moisture and prevents erosion.

What are the Key Benefits of Natural Farming for India?

- **Enhances Soil Health and Reduces Land Degradation:** Natural farming eliminates synthetic fertilizers and pesticides, promoting **microbial activity, improving soil structure, and enhancing nutrient availability.**
  - It prevents land degradation, which is critical as **30% of India's land is already degraded** due to intensive chemical use.
  - By restoring organic matter, natural farming ensures **long-term soil fertility**, reducing dependence on external inputs.
  - **For instance, Andhra Pradesh Community-Managed Natural Farming (APCNF)** has shown **improvement in soil organic carbon** in just 3-5 years.
- **Reduces Water Consumption and Enhances Drought Resilience:** By promoting techniques like **mulching, cover cropping, and microbial soil conditioning**, natural farming reduces irrigation needs and enhances water retention.
  - Given **India's over-extraction of groundwater (25% of global groundwater usage)**, water-efficient farming is crucial for sustainability.
  - Rainfed farmers practicing **Pre-Monsoon Dry Sowing (PMDS) in Andhra Pradesh** reported **significant reduction in irrigation needs**
  - According to the **Central Groundwater Board (2023)**, groundwater levels are critical in **256 out of 700 districts**, making water-efficient farming urgent.
- **Lowers Cost of Cultivation and Improves Farmers' Profitability:** Natural farming significantly reduces input costs as farmers rely on on-farm resources like **Jeevamrit, Beejamrit, and mulching** instead of expensive chemical fertilizers and pesticides.
  - This is crucial for small and marginal farmers, who make up **86% of India's farming population** and struggle with rising input costs.
  - For instance**, Zero Budget Natural Farming** processes require **50–60% less water and less electricity (than non-ZBNF) for all the selected crops.**

- **Enhances Climate Resilience and Reduces Greenhouse Gas Emissions:** Natural farming minimizes methane and nitrous oxide emissions by maintaining **aerobic soil conditions** and avoiding synthetic fertilizers.
    - Also, they are significant for climate adaptation. For instance, **in Andhra Pradesh, during the Pethai and Titli cyclones in 2018,** the crops cultivated through natural farming showed greater resilience to heavy winds than conventional crops.
    - At the **Indian Agricultural Research Institute site in New Delhi,** SRI methods were found to reduce CHy emissions by **62%.**
- **Promotes Food and Nutritional Security with Diverse Cropping:** Unlike monoculture-based chemical farming, natural farming encourages **multi-cropping, agroforestry, and intercropping**, enhancing food diversity and nutritional security.
    - This is crucial as the **FAO report** finds **74.1%** of Indians unable to afford a healthy diet; **16.6% of population undernourished.**
    - By 2025 the **Indian Organic food** business is likely to be Rs 75,000 crores, a manyfold growth from the current level.
        - Additionally, **e-commerce** platforms like **Amazon and BigBasket** have started dedicated natural farming sections, expanding market access for farmers.
- **Strengthens Rural Livelihoods and Generates Employment:** Natural farming is **knowledge- and labor-intensive**, requiring farmers to engage in techniques like composting, mulching, and crop rotation, generating rural employment.
    - As farm mechanization grows, leading to **job losses for agricultural laborers (casual farm labour shrinks by 40% since 2011-12, total job loss nearly 3 crore: NSSO)**, NF offers an alternative livelihood.
    - The **National Mission on Natural Farming (2023)** is deploying **30,000 Krishi Sakhis** to train rural women farmers, creating **direct employment opportunities**.

What are the Key Issues Associated with Natural Farming in India?

- **Lack of Scientific Validation and Long-Term Studies:** Despite its environmental benefits, NF lacks **large-scale, long-term scientific studies** proving its sustainability across different agro-climatic zones.
    - Most studies focus on small-scale pilots, creating skepticism about its viability for **large-scale food production**.
    - Without rigorous research, NF remains an **alternative practice rather than a mainstream solution**.
    - The **Food and Land Use Coalition (FOLU, 2023)** highlights that only **5 out of 16 Sustainable Agriculture Practices (SAPs)** have scaled beyond **5% of India's net sown area**.
        - The **Indian Council of Agricultural Research** has urged for **more empirical research** before large-scale promotion.
- **Uncertainty in Crop Yields and Productivity Risks:** Natural farming often faces **initial yield declines**, especially in **high-input crops like rice, wheat, and sugarcane**, leading to lower short-term returns for farmers.

- Unlike conventional farming, which ensures higher output with chemical inputs, NF depends on **biological soil enhancement**, which takes time to show results.
- This uncertainty discourages farmers from transitioning, particularly in **food security-dependent regions**.

- **Absence of Well-Defined Certification Standards:** Unlike organic farming, which has **clear certification mechanisms (PGS-India, NPOP)**, NF lacks standardized certification, making it difficult to differentiate NF produce in the market.
  - This limits farmers' access to **premium pricing** and consumer trust in naturally grown food.
  - Without proper labeling, NF products often compete with **chemically grown produce** without any price advantage.
    - Himachal Pradesh's **CETARA-NF certification model (2023)** offers a possible self-certification framework, **but it is yet to be adopted nationally.**
- **Limited Market Linkages and Value Chain Development:** NF lacks **organized value chains**, making it difficult for farmers to sell their produce at fair prices.
  - The prices of organic food are the real price reflecting the **true cost without subsidies,** which **farmers struggle to sell in the market.**
  - A recent report also raised concerns about high commissions on organic products, suggesting that reducing margins to normal levels could lower prices **by 25-30% or more.**
- **High Labor Requirements and Limited Mechanization:** Natural farming is **labor-intensive**, requiring manual weed removal, compost preparation, and mulching, which increases workload and costs for farmers.
  - Mechanized solutions for large-scale NF are **still underdeveloped**, making it **less attractive for medium and large farmers.**
  - This discourages adoption, especially as rural labor availability declines due to **urban migration**.
  - A recent report stated that **labor costs were significantly higher (7–13%) with organic farming practices.**
- **Climate Sensitivity and Regional Suitability Issues:** NF's success depends heavily on **local agro-climatic conditions**, making it unsuitable for certain regions with extreme weather variability or fragile ecosystems.
  - Farmers in **low-rainfall areas** may struggle with compost-based soil improvement, while **humid regions** face pest and disease challenges without chemical interventions.
  - While natural farming offers benefits, it can be less effective in semi-arid regions due to water scarcity, unreliable rainfall, and other climate-related challenges.
  - In contrast, **Himachal Pradesh's NF** project under **Prakritik Kheti Khushhal Kisan Yojana** showed an **increase in farm incomes**, **highlighting regional disparities.**

What Measures can India Adopt to Integrate Natural Farming into India's Agricultural Landscape?

- **Strengthening Research and Evidence-Based Scaling:** India must invest in **long-term, multi-location trials** to establish the economic, environmental, and yield impacts of natural farming across diverse agro-climatic zones.

- **ICAR and Krishi Vigyan Kendras (KVKs)** should collaborate with farmers to document real-world results and create **location-specific NF models**.
- Integrating **geo-spatial mapping and AI-driven soil health monitoring** can optimize practices for different regions.
- Encouraging **agroecology-based universities** to specialize in natural farming research will ensure scientific validation.

- **Reforming Agricultural Subsidies to Support NF Adoption:** The existing **₹71,309 crore fertilizer subsidy** needs gradual reallocation towards **bio-input production, soil health enhancement, and NF extension services**.
  - A **Direct Benefit Transfer (DBT) model** can provide farmers with financial incentives for **Jeevamrit, Beejamrit, and compost production** instead of subsidizing chemical inputs.
  - The **National Mission on Natural Farming (NMNF)** should be linked with the **Soil Health Card Scheme** to track improvements and incentivize farmers accordingly.
    - Transition funds, in the form of **interest-free credit lines**, can help small farmers overcome initial yield fluctuations.
- **Developing Market Linkages and Certification Framework:** A **national-level Natural Farming Certification System (NFCS)** should be established to differentiate NF produce in domestic and global markets.
  - **E-NAM and Agri-Export Promotion Schemes** should introduce dedicated NF categories to integrate farmers into high-value supply chains.
  - Public-private partnerships (PPPs) can help set up **Farmer Producer Organizations (FPOs) specializing in NF**, ensuring collective bargaining power.
  - Encouraging **contract farming models** with retail giants and online platforms can create assured demand for NF produce.
    - Dedicated **farm-to-fork channels**, **including NF-exclusive mandis and organic bazaars,** can improve accessibility.
- **Strengthening Farmer Training and Capacity Building:** A structured **Farmer-to-Farmer Learning Model (F2F-LM)** should be developed, where trained farmers act as **Natural Farming Ambassadors** in their communities.
  - **Bio-Resource Centers** under NMNF should serve as hands-on learning hubs for composting, mulching, and microbial soil enhancement.
  - Leveraging **Krishi Sakhis under Deendayal Antyodaya Yojana (DAY-NRLM)** can ensure women farmers actively participate in NF adoption.
    - Expanding **mobile-based advisory services**, such as through the **Kisan Suvidha App**, will provide real-time guidance on NF techniques.
- **Integrating Natural Farming with Watershed and Agroforestry Programs:** To improve resilience, NF should be blended with **Watershed Management Programs like PMKSY** to enhance soil moisture retention.
  - Promoting **Silvo-Pastoral and Agroforestry Systems** under **National Agroforestry Policy** will diversify farmer incomes while ensuring soil regeneration.

- **Catchment-based rainwater harvesting models** can be integrated with NF to mitigate irrigation risks in water-scarce regions.
- Linking **Jal Shakti Abhiyan** with NF adoption in rainfed areas can ensure better resource efficiency.
    - Encouraging plantation of **Nitrogen-fixing trees (e.g., Gliricidia, Subabul)** within NF plots can naturally replenish soil fertility.

- **Promoting Mechanization and Technology for NF Practices:** Given the labor-intensive nature of NF, **customized mechanization** solutions like **low-cost weeders, microbial sprayers, and bio-fertilizer applicators** should be developed.
    - **Startup incubators under the Agri-Tech Innovation Fund** can support innovations for NF-specific mechanization tools.
    - The **Sub-Mission on Agricultural Mechanization (SMAM)** should be expanded to include NF-friendly implements, ensuring accessibility for small and marginal farmers.
        - Leveraging **AI and IoT-based soil health monitoring** will further optimize input use in NF systems.
- **Enhancing Institutional Support through State-Level Policies:** States should develop **region-specific NF policies**, similar to **Himachal Pradesh's PK3Y and Andhra Pradesh's APCNF**, ensuring localized adoption strategies.
    - Strengthening **Gram Panchayat-level NF committees** will create decentralized decision-making and farmer participation.
    - Incentivizing **Panchayats to allocate land for community composting and bio-resource centers** will build local self-sufficiency in NF inputs.
        - Aligning state procurement policies to source NF-grown produce for **mid-day meals and PDS** can provide institutional market support.

Conclusion:

Natural farming presents a sustainable alternative to chemical-intensive agriculture, offering benefits such as improved soil health, reduced input costs, and climate resilience. Strengthening research, policy support, and farmer incentives will be crucial in making natural farming economically viable. A balanced approach **integrating scientific validation and institutional backing can ensure its long-term success in India's agricultural landscape.**

Revamping Indian Railways

How the Indian Railway Contributes to the Indian Economy?

- **Backbone of National Transportation:** Indian Railways is the **lifeline of the country, providing affordable and reliable transport** to millions daily.
    - It facilitates the movement of both passengers and goods across vast distances, playing a crucial role in economic integration.
    - Indian Railways transports over **8 billion passengers annually,** making it one of the busiest railway networks globally.
        - During the **Covid-19 pandemic**, Indian Railways operated **"Oxygen Express"** trains to deliver medical oxygen across states, showcasing its **logistical strength.**
- **Economic Growth and Industrial Development:** Railways serve as a crucial driver of economic growth by facilitating **trade, commerce, and industrialization across the country.**
    - The transportation of raw materials like **coal, iron ore, cement, and agricultural produce** ensures the smooth functioning of industries.
        - Efficient rail logistics reduce supply chain costs, enhancing the competitiveness of Indian manufacturing and exports.
        - Mega infrastructure projects such as the **Dedicated Freight Corridors (DFCs)** aim to boost efficiency and economic productivity.
    - **CAG (2021-22)** highlighted that coal alone accounts for **nearly 50% of railway freight earnings**, making industrial supply chains highly dependent on rail connectivity.
- **Employment Generation and Livelihood Support:** Indian Railways is one of the **largest employers in the world**, directly employing millions and indirectly supporting many more in ancillary industries.
    - It employs over 1.2 million people, **making it the world's ninth-largest employer.**
        - It provides **stable employment across various skill levels,** from engineers and technicians to station managers and track maintenance workers.
    - The expansion of railway infrastructure, station redevelopment, and manufacturing of new rolling stock create additional employment opportunities.
        - **Privatization and PPP models** in railways are expected to generate further job prospects in operations and logistics
- **Rural Connectivity and Regional Development:** Railways play a pivotal role in connecting remote and rural areas, integrating them with urban centers and markets.
    - **Improved railway infrastructure in underdeveloped regions** enhances accessibility to education, healthcare, and employment opportunities.
        - Special railway corridors such as the North-East Connectivity Project aim to boost regional development and national integration.
    - In FY 2023-24, the railways have decided to redevelop 1,275 railway stations under the **Amrit Bharat Station scheme**

- The **Vande Bharata Express expansion to Tier-2 and Tier-3 cities** is a step toward improving accessibility and regional economic development.

- **Catalyst for Sustainable Development and Green Mobility:** Railways offer an **environmentally sustainable alternative to road and air transport by reducing carbon emissions** and fuel consumption.
  - The transition to **full electrification and renewable energy integration** aims to make **Indian Railways carbon-neutral by 2030.**
    - **14 States/UTs** have been 100% electrified by Indian Railways as of July 2023.
  - Energy-efficient locomotives, electrified routes, and green initiatives such as **bio-toilets** are improving the railway sector's sustainability footprint.
    - **Rail freight emits nearly 80% less greenhouse gas** per ton-kilometer than road transport, making it a key player in India's sustainable mobility strategy.
- **Strengthening National Security and Strategic Mobility:** Railways play a crucial role in national security by **ensuring rapid troop movement and defense logistics in border areas.**
  - Dedicated railway lines and freight corridors aid in the **quick mobilization of military supplies, vehicles, and personnel during emergencies.**
    - The construction of **strategic railway lines in border regions, particularly in the Northeast and Ladakh,** enhances defense preparedness.
  - The **Arunachal Frontier Highway** is a landmark infrastructure project, connecting **12 districts along the LAC with China.**
- **Urban Mobility and Decongestion of Road Networks:** The expansion of **metro rail and suburban rail systems in major cities** is reducing congestion and improving urban mobility.
  - Efficient mass transit options help reduce **travel time, pollution, and road accidents in densely populated areas.**
    - The integration of m**etro, suburban, and regional rapid transit systems** is fostering seamless multimodal transport networks.
  - India achieved over 1,000 km of operational metro rail network, becoming the **world's third-largest metro system after China and the US.**
    - The **Rapid Transit System between Delhi and Meerut, set to open in 2025,** will significantly cut travel time between the two cities.
- **Boost to Tourism and Cultural Integration:** Railways enable affordable and convenient travel to India's diverse cultural, historical, and religious sites, promoting tourism.
  - Special trains such as **Bharat Gaurav Trains and luxury services like the Palace on Wheels** attract both domestic and international tourists.
    - Enhanced railway connectivity to **pilgrimage sites, heritage locations, and ecotourism** destinations boosts local economies.

What are the Key Issues Associated with Indian Railways?

- **Deteriorating Financial Health:** Indian Railways is facing severe financial stress due to a declining revenue surplus, increasing **reliance on extra-budgetary resources (EBR),** and **unsustainable operating costs.**
    - The growing gap between **expenditure and revenue has led to reduced internal resource generation,** affecting long-term sustainability.
        - Additionally, **heavy cross-subsidization of passenger fares through freight earnings** has distorted pricing mechanisms, making freight transportation less competitive.
    - **CAG (2021-22) reported the worst-ever Operating Ratio of 107.39%**, meaning **Railways spent ₹107.39 to earn ₹100,** which would have been **109.36%** if pension and asset renewal expenses were included.
- **Infrastructural Deficiencies:** Frequent **derailments, stampedes, and collisions point to gaps** in infrastructure maintenance and safety oversight.
    - **Poor track renewal, outdated signaling systems, and overcrowded stations** increase the likelihood of accidents.
    - The huge backlog in asset replacement further exacerbates safety concerns, raising risks for millions of daily passengers.
    - **CAG (2021-22) flagged a ₹34,318.79 crore backlog in over-aged asset renewal.**
        - The **Odisha Balasore triple train accident (June 2023)** highlighted critical gaps in railway safety and signaling systems.
    - The **'Kavach' anti-collision system,** designed to prevent crashes, has seen slow implementation, with coverage limited to select routes
- **Poor Crowd Management and Station Infrastructure:** Overcrowding at major railway stations, **lack of adequate holding areas, and ineffective crowd control measures** pose serious risks, especially during festivals or special events.
    - The **absence of proper barricading, unidirectional movement planning**, and emergency response mechanisms increases the likelihood of stampedes.
    - The **February 2025 New Delhi railway station stampede,** triggered by a last-minute train announcement, resulted in multiple casualties.
- **Freight Revenue Stagnation and Market Competition:** Freight operations, which subsidize passenger losses, **face increasing competition from road and air transport due to inefficiencies and high tariffs.**
    - Rail freight remains slow, lacks last-mile connectivity, and is heavily dependent on bulk commodities like **coal, limiting revenue diversification**.
        - The shift towards **renewable energy could reduce coal transportation** demand, impacting freight earnings further.
    - Govt records show that the rail share in freight transport has declined steadily from 8**5% in 1951, to 60% in 1991, and in 2022 it was only 27%.**
- **Environmental and Sustainability Challenges:** Despite electrification efforts, Indian Railways continues to rely on diesel locomotives in several regions, contributing to air pollution and carbon emissions.

- The **push for 100% electrification is slow,** with delays in infrastructure development and power procurement.
    - **Waste management at stations and inside trains remains inadequate,** affecting cleanliness and sustainability goals.
- India's transport sector contributes to **12%** of the country's greenhouse gas emissions with the railways accounting for about **4%.**

- **Lagging High-Speed Rail and Bullet Train Projects:** The ambitious **Mumbai-Ahmedabad bullet train project** has faced land acquisition hurdles, funding delays, and political opposition, setting back **India's high-speed rail plans.**
    - Slow execution of **semi-high-speed corridors (like Vande Bharat)** and **inadequate track upgrades** further limit speed improvements across conventional routes.
    - The bullet train project connecting Mumbai to Ahmedabad will be ready by 2022, a decade later it is only 30% complete, and the **revised deadline is now 2028.**
- **Mismanagement of Railway PSUs and Financial Viability Issues:** Several Railway PSUs face declining **profitability, mismanagement, and inefficiencies**, affecting their ability to contribute to Indian Railways' growth.
    - While **some PSUs in financing and tourism have performed well,** others in construction and logistics have seen declining returns.
        - The **falling return on equity and rising dependence on loans** highlight deeper structural issues.
    - CAG (2021-22) reported that return on equity for railway PSUs declined from 9.17% in 2017-18 to **7.53% in 2019-20.**

What Measures can be Adopted to Revitalise Indian Railways?

- **Financial Sustainability and Revenue Optimization:** Indian Railways **must shift towards a sustainable financial model** by reducing dependency on extra-budgetary borrowings.
    - **Dynamic fare pricing, monetization of railway land assets,** and increased private sector participation (as per **Bibek Debroy Committee**) in station development can enhance revenue streams.
    - **Freight tariff rationalization** and **last-mile connectivity solutions** will make rail cargo more competitive.
        - **Strengthening Public-Private Partnerships (PPPs) in infrastructure** projects can reduce fiscal burdens.
- **Safety Enhancement and Infrastructure Modernization:** Railways must prioritize **track renewal, bridge strengthening, and station decongestion** to minimize accidents and improve operational efficiency.
    - The **widespread implementation of automatic train control systems** like **Kavach** and centralized traffic control can significantly reduce human errors.
    - Upgrading **signaling infrastructure with AI-based predictive maintenance** will enhance real-time monitoring.
    - Comprehensive crowd management strategies, including better station design, holding areas, and **automated entry-exit points,** must be implemented.

- **Technological Advancements and Digitalization:** Implementing **AI-driven predictive maintenance, IoT-based asset monitoring,** and blockchain-enabled freight tracking can boost efficiency and reliability.
    - Expanding the **reach of real-time passenger information systems, smart ticketing solutions,** and integrated mobility apps will improve customer experience.
    - Upgrading railway workshops with automation and robotics will optimize rolling stock maintenance.
        - The **full integration of financial and operational data** under a unified digital platform will streamline railway administration.
- **Freight Sector Reforms and Multimodal Logistics Integration:** Indian Railways must diversify its freight basket beyond coal by **tapping into containerized cargo, automobile logistics, and express freight services.**
    - **Dedicated Freight Corridors (DFCs)** must be expanded with seamless connectivity to ports, highways, and inland waterways.
    - **Rationalizing freight tariffs and reducing terminal handling times** will make rail transport cost-effective for industries.
    - A **National Logistics Grid under PM Gati Shakti** integrating rail, road, and ports must be fast tracked to facilitate end-to-end cargo movement.
- **High-Speed Rail and Semi-High-Speed Expansion:** The **Mumbai-Ahmedabad bullet train project** must be expedited while planning additional high-speed corridors along high-demand routes, building upon **Rakesh Mohan Committee (2010).**
    - **Track upgradation projects**, including dedicated high-speed freight lines, should be prioritized.
    - Indigenous manufacturing of high-speed rolling stock will reduce procurement costs and **boost Make in India efforts.**
    - **Land acquisition, financing models, and technology transfer agreements** should be streamlined for faster implementation of high-speed rail projects.
- **Railway Station Modernization and Urban Mobility Integration:** Stations must be transformed into **multimodal transit hubs with seamless connectivity to metro networks, bus terminals, and airports.**
    - Infrastructure upgrades such as **elevated concourses, automated ticketing, and congestion-free passenger movement areas** are essential.
    - Expansion of suburban and regional rail networks will decongest metros and provide faster commuting options.
    - The **Indian Railway Station Development Corporation (IRSDC)** must be strengthened to accelerate station redevelopment projects.
- **Sustainable and Green Railways Initiative:** Achieving **100% electrification with renewable energy integration** will reduce dependency on fossil fuels and lower carbon emissions.
    - Expanding **solar and wind power installations** across railway stations, workshops, and vacant land areas will enhance energy sustainability.

- **Hydrogen-powered and battery-operated locomotives** should be piloted as alternatives to diesel engines.
- Strengthening **carbon credit mechanisms and green financing** will support long-term sustainability goals..

- **Increased Private Sector Participation:** Following the recommendations of the **Bibek Debroy Committee**, Indian Railways should open more avenues for private sector participation.
  - Private investments in rolling stock procurement, railway catering, and logistics parks will enhance service quality and efficiency.
  - **Competitive bidding for high-demand routes** can improve financial viability while reducing operational burdens on the government.

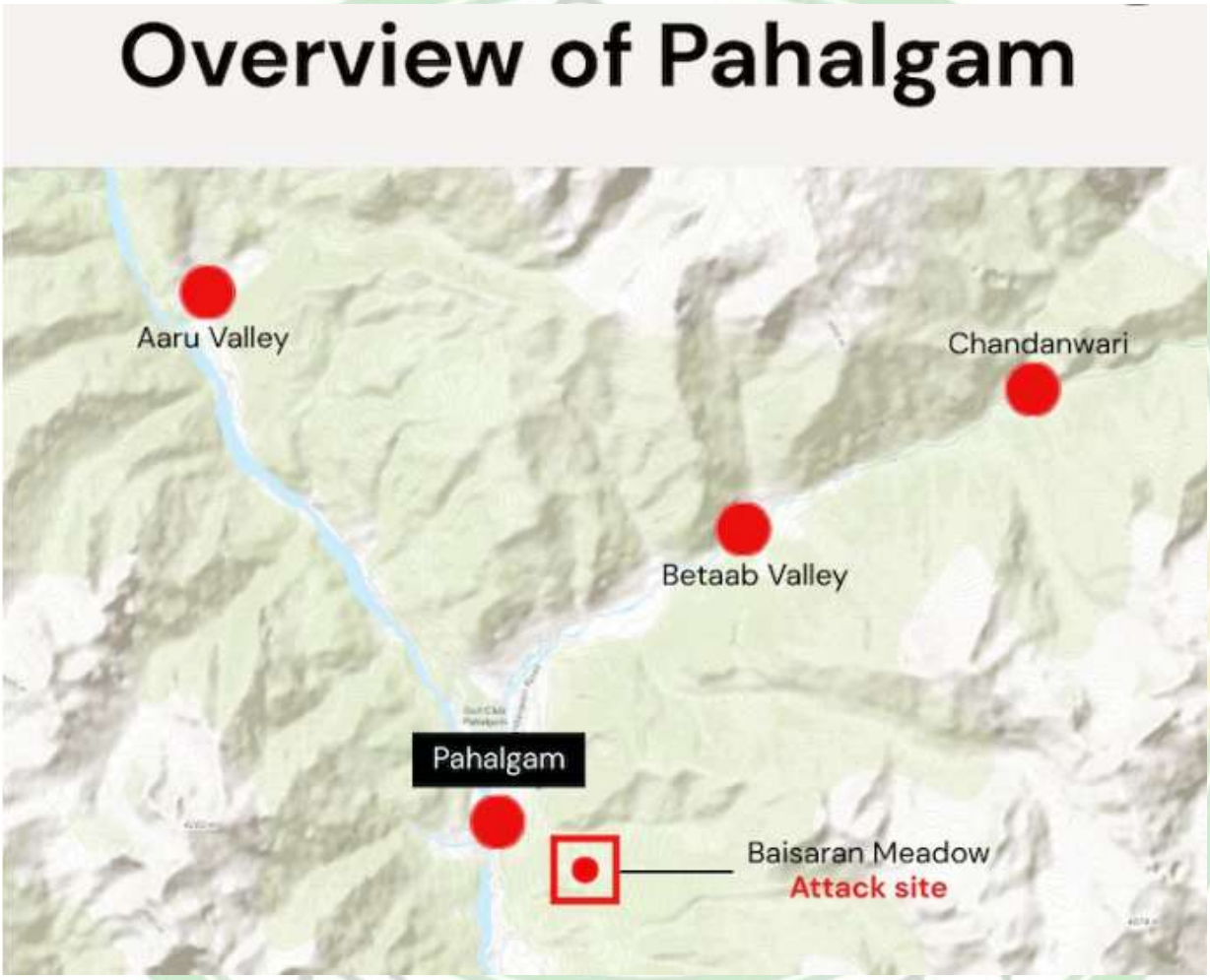
Conclusion:

Indian Railways remains the backbone of India's transportation and economic infrastructure, but **systemic inefficiencies, financial strain, and safety lapses continue to hinder its full potential.** Addressing infrastructure deficits, enhancing crowd management, and prioritizing financial sustainability are crucial for long-term resilience. Leveraging technology, strengthening freight operations, and promoting green mobility can transform railways into a modern and efficient entity

Terrorism and India's Security Landscape

How does Terrorism Continue to Challenge India's Internal Security and Geopolitical Interests?

- **Cross-Border Terrorism (Pakistan-Sponsored):** India faces the **constant threat of cross-border terrorism from Pakistan,** with militants infiltrating through Kashmir and other border areas. These groups are often backed by Pakistan's intelligence agencies.
    - The **2019 Pulwama attack and the recent Pahalgam massacre,** which targeted tourists based on their religion, illustrate the persistence and brutality of these attacks.



- **Radicalization of Local Populations:** The radicalization of local populations, particularly in conflict zones like **Kashmir,** remains a significant concern.
    - Youth in these regions, disillusioned with the state or manipulated by extremist ideologies, are increasingly joining terrorist groups.
    - The **rise of online radicalization and social media platforms like Telegram** as tools for spreading extremist propaganda further exacerbates this issue, making it harder to contain terrorism from within.
- **Cyber Terrorism:** Cyber terrorism has emerged as a modern form of threat, where terrorist groups utilize the internet for recruitment, propaganda, and **even launching attacks on critical infrastructure.**

- Cyber-attacks targeting government websites, financial institutions, and power grids are on the rise.
- India emerged as the **second most targeted nation in terms of cyber attacks** in the world as **95 Indian entities came under data theft attacks in 2024.**

- **Left-Wing Extremism (Naxalism):** Left-wing extremism, continues to be a significant internal terrorism issue in central and eastern India. These groups, primarily operating in **tribal areas, employ guerilla tactics** to challenge the state and propagate their revolutionary ideologies.
  - For instance, i**n 2019, several commandos lost their lives in Maharashtra** due to a bomb blast attributed to Maoist insurgents.
  - Despite a decline in attacks, these groups continue to **disrupt governance and development in affected regions.**
- **Insurgency in Northeastern States:** The insurgency in India's northeastern states**,** particularly in **Manipur and Nagaland,** has seen increasing links with larger terror networks.
  - For instance, the Kuki-Meitei conflict in Manipur**,** particularly intensified in 2023 and 2024, has escalated into significant violence, **with deep ethnic and political undertone**
    - The insurgents' ability to exploit the **porous border with Myanmar and access arms from external sources like China** complicates efforts to address the issue
  - The weak governance in remote areas allows these groups to thrive, complicating counter-terrorism efforts.
- **Persistence of Organized Crime Networks:** Organized crime has become intertwined with terrorism in India, especially in urban centers.
  - Criminal syndicates, involved in activities such as **smuggling, extortion, and drug trafficking,** often collaborate with terrorist organizations to fund their operations.
    - For instance, **in January 2025**, the **Punjab Police** announced the dismantling of a cross-border drug and weapon smuggling cartel.
  - The nexus between crime and terrorism has been responsible for several high-profile bombings and terror attacks in major cities like **Delhi and Mumbai,** complicating efforts to curb terrorism.

What is the Current Security Architecture in Place to Combat Terrorism in India?

- **National-Level Counter-Terrorism Agencies**
  - National Investigation Agency **(NIA)**: Primary agency for investigating and prosecuting terrorism-related cases, particularly those involving cross-border terrorism and organized terror networks
    - Handles high-profile terror cases, conducts operations, and ensures national security by coordinating with other agencies.
  - **Research and Analysis Wing (R&AW)**: India's external intelligence agency responsible for countering cross-border terrorism, particularly from Pakistan-based groups.
- **Legislative Framework**

- Unlawful Activities (Prevention) Act (UAPA), 1967: Provides the legal foundation for prosecuting terrorism-related offenses and allows for the designation of terrorist organizations.
    - Empowers law enforcement agencies to conduct surveillance, freeze assets, and detain suspects without charge for extended periods.
- National Security Act (NSA), 1980**:** A preventive detention law that allows authorities to detain individuals involved in terrorism-related activities for a specified period without formal charges.
    - Used to curb terror-related activities by detaining suspected terrorists and preventing their release on bail.

- **Security Forces and Specialized Units**
    - Central Armed Police Forces **(CAPFs)**: Agencies like the CRPF, BSF, ITBP, and SSB are crucial for counter-terrorism operations, especially in border and conflict regions.
        - Deploy in sensitive areas to prevent infiltration, maintain public order, and support anti-terrorism operations.
    - National Security Guard **(NSG)**: An elite special forces unit specializing in counter-terrorism operations, especially for high-risk situations like hostage rescues.
        - Handles situations involving large-scale terrorist attacks, such as Mumbai-style attacks or terrorist sieges.
- **Technological and Intelligence Infrastructure**
    - National Intelligence Grid (NatGrid): Integrated intelligence framework that combines data from multiple agencies to provide real-time threat analysis.
        - Monitors terrorist activities across various sectors (banking, immigration, phone records) to detect patterns.

What Measures can India Adopt to enhance its Counter-terrorism Efforts?

- **Strengthening Intelligence Sharing and Integration:** India must further enhance the integration of intelligence across different agencies like the **NIA, IB, RAW, and state police force**s to create a seamless flow of actionable information.
    - There is a **need for swift identification of terror cells and their activities,** and help in early intervention, re**ducing response times during critical situations.**
    - Promoting collaboration with international intelligence agencies will further improve the accuracy and timeliness of counter-terrorism operations.
- **Implementation of Advanced Surveillance and AI-Driven Monitoring Systems:** Adopting AI-driven technologies for surveillance can significantly improve India's counter-terrorism efforts.
    - **Deploying advanced facial recognition systems, predictive analytics,** and data mining tools can assist in identifying potential terrorist threats and networks before they can strike.
    - These technologies can help detect unusual patterns in financial transactions, communications, and social media activity that often precede terrorist activities.
- **Enhanced Border Security through Smart Fencing and Drones:** To curb cross-border infiltration by terror groups, India should invest in **"smart fencing"** along sensitive borders, incorporating sensors,

surveillance cameras, and **unmanned aerial vehicles (UAVs**) to create a comprehensive and responsive monitoring system.

- The use of drones to patrol borders and track movement in real-time will make it harder for infiltrators to cross undetected.
- This initiative, **when coupled with better communication and coordination between the BSF and other local security forces**, will significantly reduce cross-border terrorism and smuggling.

- **Community Engagement and Counter-Radicalization Programs:** India must focus on robust counter-radicalization strategies at the grassroots level. By engaging local communities, particularly in conflict zones like **Jammu & Kashmir and the Northeast,** authorities can build trust and prevent the spread of extremist ideologies.
  - Implementing **educational programs, vocational training, and social integration initiatives** for vulnerable youth will help divert potential recruits away from terrorist groups.
- **Revising and Strengthening Terrorism-Related Legislation:** India should consider revising its **counter-terrorism laws to make them more effective in the face of emerging threats like cyber terrorism and hybrid warfare.**
  - Strengthening provisions under the UAPA and NSA to address newer forms of terrorism, such as **lone wolf attacks** and radicalized individuals operating independently, will help the government respond more proactively.
- **Comprehensive Counter-Terrorism Cybersecurity Infrastructure:** As cyber warfare becomes a **crucial aspect of modern terrorism**, India must establish a specialized cybersecurity division focused on countering terror-related cyber threats.
  - This **division should work closely with the NIA** and other law enforcement agencies to detect and prevent cyber attacks targeting critical infrastructure, financial institutions, and communication systems.
  - Building resilience through **public-private partnerships will enable better defense against digital terrorism,** and a nationwide effort to protect critical data infrastructure will reduce vulnerabilities.
- **Public Awareness and Intelligence-Driven Citizen Participation:** Encouraging public participation in counter-terrorism efforts in prone areas through awareness campaigns and community vigilance programs can act as a force multiplier.
  - Citizens must be educated on identifying suspicious activities and reporting them **without fear of reprisal.** This can be done through **regular workshops, media campaigns, and outreach programs** aimed at creating a vigilant society.
  - In this regard, reviving and strengthening **Village Defence Guards (initiated in the mid-1990s in Jammu and Kashmir**) can further bolster grassroots security efforts.
- **Use of Economic and Diplomatic Leverage to Combat Terrorism:** India should expand the use of **economic and diplomatic leverage** as part of its broader counter-terrorism strategy, targeting nations that harbor or sponsor terrorist groups.

- A recent example of this is India's **suspension of the Indus Water Treaty (IWT)** with Pakistan in **April 2025**, which was seen as a direct response to Pakistan's continued support for cross-border terrorism.
- It is essential, however, that India articulates such measures as **targeted and proportionate responses to the policies and actions of the Pakistani state apparatus**, especially its military-intelligence establishment.
    - This ensures the **distinction between the government and the people of Pakistan is maintained,** reinforcing India's commitment to **principled statecraft and responsible diplomacy.**

Conclusion:

The persistence of terrorism, **as highlighted by the Pahalgam attack,** underscores the evolving and multifaceted nature of threats to India's internal security. India must continue enhancing intelligence cooperation, technological vigilance, and community engagement. As reaffirmed in the **Delhi Declaration on countering the use of new and emerging technologies for terrorist purposes,** a zero-tolerance approach and international collaboration are imperative to dismantle terror networks and uphold peace.

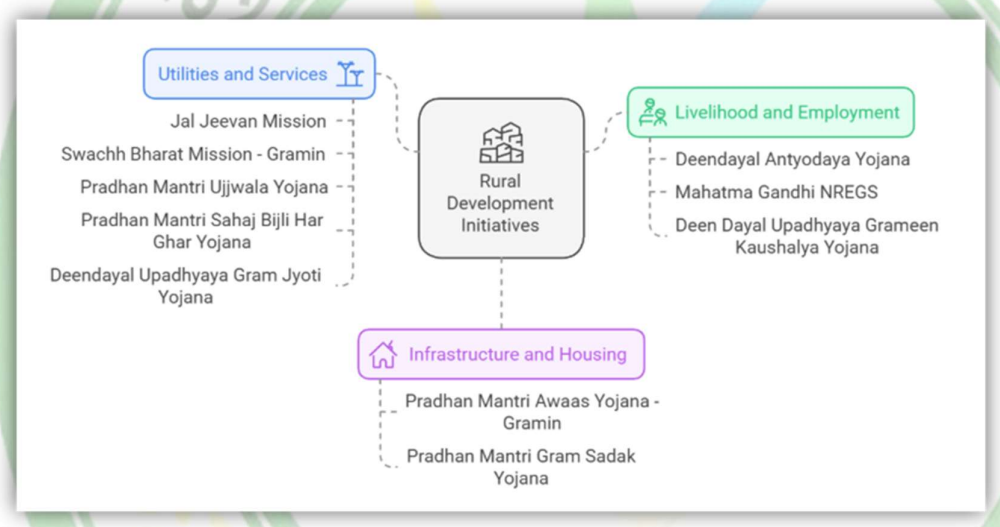
Rural Resilience and Development

What are the Key Factors Driving Rural Growth in India?

- **Infrastructure Development:** The expansion of rural infrastructure through flagship programs like the PM Gram Sadak Yojana **(PMGSY) and** Jal Jeevan Mission has significantly enhanced connectivity and basic amenities.
    - Improved infrastructure facilitates market access, boosts local enterprises, and reduces regional disparities.
    - In the last 21 years, **more than 7 lakh kms of rural roads** have been constructed under the PMGSY. These initiatives are crucial for socio-economic upliftment in rural areas.
- **Digital Inclusion and FinTech Penetration:** Rising smartphone penetration and the success of platforms like **Unified Payments Interface and Aadhaar-enabled payment systems (AEPS)** are transforming rural economies by fostering financial inclusion and e-commerce.
    - Unified Payments Interface (UPI) transactions at retail stores in rural and semi-urban India **rose 118% in 2023** due to affordable internet access via **BharatNet and low-cost smartphones.**
- **Agricultural Reforms and Allied Activities:** Support for agribusiness and allied sectors like fisheries and horticulture under schemes such as **PM-KISAN and the National Livestock Mission** has diversified rural incomes.
    - The **National Agriculture Market (eNAM)** enabled farmers to access better prices for their produce, increasing farm-to-market efficiency.
    - As of **January 2024**, the total credit disbursed to agriculture amounted to **₹22.84 Lakh Crore**, reflecting enhanced investment.
- **Rise of Rural MSMEs and Start-ups:** Policy support through the **Startup India Rural Program and** MUDRA Yojana has driven the growth of micro, small, and medium enterprises (MSMEs) in rural areas.
    - These initiatives provide credit and skill training, enabling entrepreneurship. As per **National Sample Survey (NSS) 73rd Round**, 31% of total MSMEs are engaged in the manufacturing sector with more than **50% in the rural sector,** creating sustainable livelihoods.
- **Decentralized Renewable Energy Initiatives:** The push for **decentralized solar power and clean energy under schemes like PM-KUSUM** has reduced rural energy costs and dependency on traditional fuels.
    - India's renewable energy installed capacity witnessed remarkable growth, increasing by **24.2 GW (13.5%)** to reach 203.18 GW as of **October 2024** and PM-KUSUM benefited **2.46 lakh farmers by ensuring access to solar pumps,** reducing input costs, and increasing agricultural sustainability.
- **Health and Social Welfare Expansion:** Programs like **Ayushman Bharat (recent extension to Senior Citizens above 70) and the Pradhan Mantri Matru Vandana Yojana (PMMVY)** have improved health outcomes and social security in rural areas.
    - Affordable healthcare and insurance for the poor have reduced out-of-pocket expenses, increasing disposable income.

- In May 2023, the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY) reached a significant milestone, recording **5 crore hospital admissions** with a total expenditure of ₹61,501 crore under the scheme.

- **Rural Tourism and Cultural Heritage:** Rural tourism, promoted under the **Dekho Apna Desh initiative,** is creating new revenue streams by leveraging India's diverse cultural heritage and especially through GI Tags associated with rural small scale industries.
  - States like **Rajasthan and Kerala have developed eco-tourism circuits,** attracting both domestic and international tourists.
- **Women Empowerment and SHGs: Women's Self-Help Groups (SHGs) under the National Rural Livelihood Mission (NRLM)** have transformed rural societies by enhancing women's participation in economic activities.
  - **Over 8.7 crore women are now part of SHGs,** with total SHGs crossing **81 lakhs.**
  - This empowerment leads to better **decision-making, improved family welfare,** and higher rural household incomes.



What are the Key Issues Related to India's Rural Landscape?

- **Agrarian Distress and Low Income Levels**: India's rural economy is heavily reliant on agriculture, yet the sector faces issues like **fragmented landholdings, low productivity, and erratic weather patterns** due to climate change.
  - Farmers continue to struggle with falling incomes despite government support schemes.
  - The **NABARD report** revealed that in 2021-22, the average monthly income of a farming household from all sources stood at just **₹13,661**.
  - Also, the contribution of agriculture to India's GDP dropped to **15% in 2022, compared to 35% in 1990-91.**

- **Inadequate Health Infrastructure**: Rural areas face a critical shortage of healthcare facilities, trained professionals, and awareness, leading to poor health outcomes.
  - Even flagship programs like **Ayushman Bharat** struggle to address infrastructure gaps in remote areas.

- A survey stated that **only 25% of the semi-rural and rural population in India** have access to modern healthcare within their localities.
- Approximately **75% of health infrastructure and resources are concentrated in urban areas**, where only **27% of the population resides**, leaving rural populations underserved.

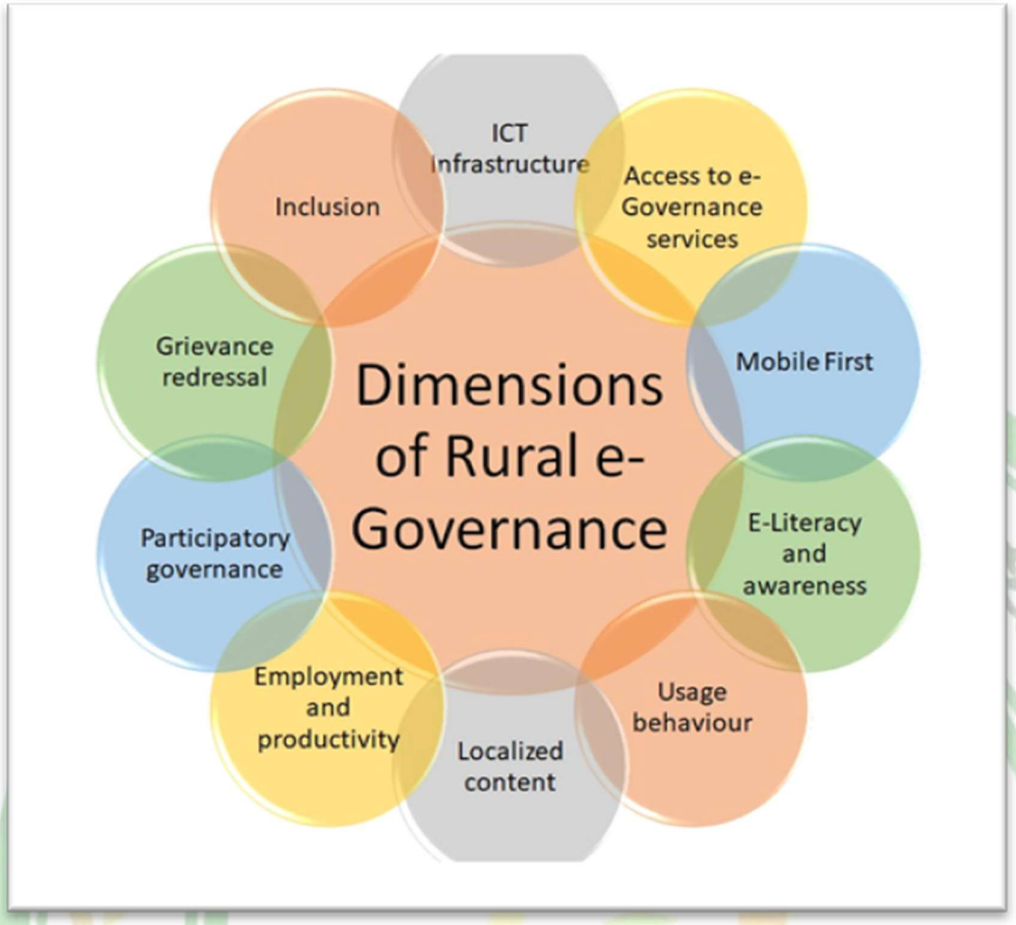
- **Educational Inequality and Digital Divide**: While school enrollment has improved under schemes like **Samagra Shiksha Abhiyan**, rural education still suffers from **inadequate infrastructure, teacher shortages, and poor digital access.**
  - A report by the **Pratham Foundation** reveals that **nearly 43% of children aged 14-18 struggle to read sentences in English.**
    - Additionally, the ASER survey highlights that **25% of rural children face difficulty reading a Class 2-level text** in their regional language.
  - And lack of consistent internet penetration limits access to online education.
- **Unemployment and Underemployment**: Despite schemes like **MGNREGA**, rural areas face high unemployment and disguised underemployment, particularly among youth.
  - Seasonal agricultural work fails to provide consistent income, pushing migration to urban areas.
  - **Rural unemployment rate** rose to 9.3% in June 2024 (CMIE), while **a larger chunk of rural workforce remains under disguised employment**.
- **Lack of Access to Safe Drinking Water and Sanitation**: Despite progress under the **Jal Jeevan Mission**, many rural households still lack **consistent access to clean drinking water and proper sanitation facilities.**
  - Open defecation persists in some areas due to behavioral and infrastructural gaps.
  - As of September 2023, over **67% of rural households have access to clean water at the flick of a tap**. Also, **12 Indian states have uranium levels** beyond permissible limits in their groundwater
- **Climate Change and Environmental Degradation**: Rural livelihoods are vulnerable to climate change, which **exacerbates droughts, floods, and soil degradation**, threatening agriculture and allied activities.
  - Poor waste management and deforestation add to the environmental crisis.
  - Recent years have seen a **threefold increase in widespread extreme rainfall events** over central India, leading to a steady rise in flash floods with significant socio economic losses especially in rural areas.
- **Social Inequalities and Gender Disparities**: Caste-based discrimination, gender inequality, and lack of opportunities for marginalized communities remain pervasive in rural India.
  - Women often face limited access to **education, healthcare, and employment.**
  - The **WEF Global Gender Gap Report 2017** states that on an average **66% of women's work in India is unpaid,** most of them reside in rural areas, highlighting financial exclusion.
- **Financial Exclusion and Credit Constraints**: Access to formal credit remains a challenge, as rural households often rely on informal moneylenders who charge exorbitant interest rates.

- Despite initiatives like **MUDRA Yojana**, small and marginal farmers lack sufficient institutional credit support.
- A 2020 report stated that among small and marginal farmers (SMFs) who availed credit, **59% (or 36 million) turned to formal sources,** while **41% still depended on informal channels.**

- **Weak Local Governance and Bureaucratic Inefficiency**: **Panchayati Raj Institutions (PRIs) often lack the funds, capacity, and autonomy** to effectively implement rural development programs.
  - Corruption and bureaucratic inefficiencies delay the benefits of schemes.
  - In the **Public Distribution System (PDS)**, cases of corruption and inefficiencies in local governance have resulted in food grains meant for rural households **being diverted or sold in the black market.**
    - For instance, in **Uttar Pradesh**, investigations revealed a scam where local officials colluded with ration shop owners to deprive intended beneficiaries of their entitlements.

What Measures can be Adopted to Promote Rural Growth and Resilience?

- **Expanding Climate-Smart Agriculture (CSA)**: Promote widespread adoption of CSA practices like crop diversification, agroforestry, and precision farming to reduce vulnerability to climate change.
  - Integrate schemes like **PM-KUSUM** with localized irrigation solutions and renewable energy.
  - For example, farmers in Gujarat's **Banaskantha district** are using solar-powered irrigation, reducing water wastage, while improving crop yields.
- **Integrating Technology in Rural Governance**: Leverage technology to improve the efficiency of rural governance through platforms like **e-Gram Swaraj** for transparent fund allocation and monitoring.
  - Linking **Digital India** initiatives with Panchayati Raj can enhance accountability and service delivery.
  - The Ministry of Panchayati Raj is implementing **e-Panchayat Mission Mode Project (MMP)** with the aim of making Panchayats more transparent, accountable is a significant step.



- **Strengthening Public-Private Partnerships (PPPs)**: Encourage private-sector involvement in skill development, infrastructure, and healthcare by creating rural-centric PPP models.
    - Partnering companies under **CSR initiatives** can amplify the impact of government schemes.
    - For instance, **ITC's e-Choupal** connects **farmers with markets,** benefiting **farmers** by providing real-time market information and quality inputs.
- **Promoting Integrated Rural Entrepreneurship**: Support diversified rural entrepreneurship by creating rural hubs for agri-processing, handicrafts, and eco-tourism.
    - Linking **MUDRA loans** with capacity-building initiatives can amplify the outcomes.
    - The **Dastkar initiative in Rajasthan**, which empowers rural artisans by connecting them to national markets, **increased their household incomes.**
- **Enhancing Local Water Governance**: Empower **Gram Panchayats and SHGs** to implement water conservation projects like **watershed management, rainwater harvesting**, and decentralized water distribution systems.
    - Scale successful projects like the **Jalyukt Shivar Abhiyan** in Maharashtra, which rejuvenated **11,000 villages**, increasing groundwater levels and reducing crop failures.
- **Mainstreaming Renewable Energy in Rural Development**: Implement solar micro-grids, biogas plants, and wind energy projects in rural areas to meet power demands sustainably.
    - Expand schemes like **PM-KUSUM** and provide incentives for renewable energy adoption.

- Villages like **Dharnai in Bihar**, powered entirely by solar energy, are models of **self-sufficiency,** with energy reliability driving entrepreneurship and education.

- **Reforming Agricultural Marketing Systems**: Strengthen the **eNAM platform** by enhancing digital literacy and expanding physical market infrastructure for farmers.
  - Promote direct farmer-to-consumer sales models through farmer producer organizations (FPOs).
  - The success of **Sahyadri Farms** in Maharashtra, which eliminated middlemen and provided farmers higher incomes, illustrates the potential of robust rural marketing reforms.
- **Transforming Rural Transport and Connectivity**: Expand rural road infrastructure under **PM Gram Sadak Yojana (PMGSY)** and develop multimodal transport systems for better market access.
  - Complement this with digital infrastructure like **BharatNet** for seamless e-commerce integration.
  - The **Bhagalpur silk hub in Bihar**, now accessible via improved roads, has seen a rise **in exports**, demonstrating the impact of connectivity on livelihoods.
- **Developing Sustainable Rural Housing**: Introduce disaster-resilient housing technologies, combining local materials with modern methods under **PM Awas Yojana (Gramin)**.
  - Promote **green housing designs** to reduce energy costs and environmental impacts.
  - Villages rebuilt in **Kashmir post-2014 floods**, using **eco-friendly reinforced concrete,** are now resistant to future climate shocks, proving cost-effective and sustainable.
- **Building Grassroots Disaster Management Systems**:Equip rural communities with training, early warning systems, and evacuation plans tailored to local vulnerabilities.
  - Expand **State Disaster Response Forces (SDRF)** into rural areas.
  - **Odisha's cyclone shelters network**, combined with community training, saved thousands of lives **during Cyclone Fani in 2019**, proving the efficacy of proactive disaster management.
- **Revitalizing Cooperative Institutions**: Strengthen cooperatives to address credit, marketing, and procurement gaps in rural areas.
  - Streamline their functioning with digitized operations and skill enhancement programs.
  - **Amul model-Cooperative societies** have created **self-reliant rural economies** in the dairy sector, ensuring consistent farmer incomes.
- **Fostering Knowledge-Based Agriculture**: Set up knowledge hubs in villages to train farmers in modern techniques like **hydroponics, organic farming, and digital tools.**
  - Link these hubs with **Krishi Vigyan Kendras (KVKs)** for research-backed solutions.
  - For instance, villages **experimenting with precision farming** have reduced fertilizer usage, ensuring cost savings and environmental benefits.
- **Empowering Youth with Digital and Green Skills**: Introduce rural youth to green jobs and digital economy opportunities through specialized training under **Skill India Mission**.
  - Partner with private players for certifications in renewable energy, IT, and logistics.
- **Focusing on Inclusive Social Welfare**: Integrate health, nutrition, and gender-focused programs like **POSHAN Abhiyaan** and **Mission Shakti** for comprehensive rural welfare. Ensure last-mile delivery through real-time tracking and local accountability.

- The **Kerala Kudumbashree model**, which integrates social and economic welfare through women's collectives, has successfully reduced poverty and malnutrition rates in the state.

- **Strengthening Rural Healthcare Systems**: Investments in healthcare infrastructure, mobile health units, and telemedicine can improve access to rural healthcare.
  - Expanding **Ayushman Bharat Health and Wellness Centers (HWCs)** to include diagnostics and specialist consultations will address gaps.
  - The success of **Karuna Trust's telemedicine model in Karnataka**, demonstrates that technology-driven healthcare is a scalable solution for rural resilience.
- **Strengthening Rural Governance**: Empowering **Panchayati Raj Institutions (PRIs) with greater autonomy** and resources can drive better implementation of schemes. Capacity-building programs for PRI members, coupled with transparency mechanisms, can improve accountability.
  - The **Participatory Governance Model** in **Pune**, has demonstrated how inclusive governance strengthens rural development outcomes.

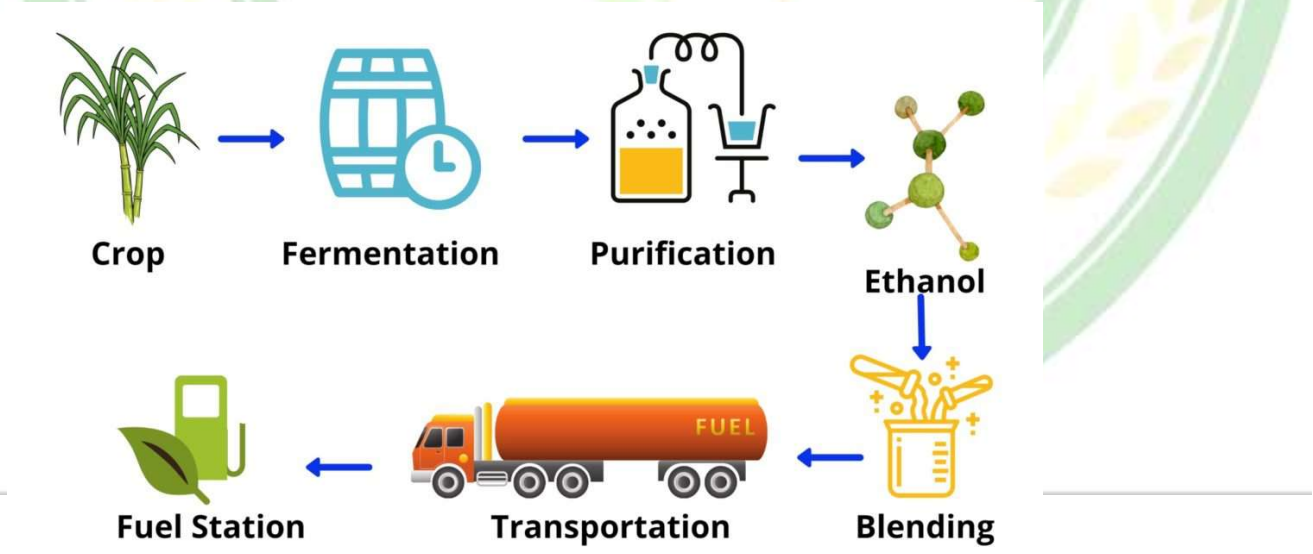
Conclusion

Building rural resilience in India is **pivotal for the nation's future.** It requires a holistic approach that integrates **infrastructure development, technological advancements, and socio-economic empowerment.** While challenges like agrarian distress and health infrastructure gaps persist, **India's rural growth trajectory offers hope through innovative solutions and policy support.** The synergy between government schemes, private-sector participation, and community-driven initiatives can unlock immense potential.

Ethanol Blending for Sustainable India

What is Ethanol Blending?

- **About: Ethanol blending** refers to the process of mixing ethanol, a biofuel derived from plant-based sources, with petrol to create a more sustainable and cleaner-burning fuel.
  - This reduces dependence on fossil fuels, lowers carbon emissions, and enhances energy security.
  - Ethanol is primarily produced from **sugarcane molasses, maize, rice, and other biomass sources** in India.
  - The Government of India launched the **Ethanol Blended Petrol (EBP) Programme** in **2003** to promote ethanol use in transportation fuel.
- **Government Initiatives for Ethanol Blending:**
  - **PM-JI-VAN Yojana** – Supports second-generation ethanol production from agricultural waste.
  - **National Bio-Energy Programme**– Promotes ethanol and other biofuels for sustainable energy.
  - **Interest Subvention Scheme** – Provides financial support for setting up ethanol plants.
  - **GST Reduction** – Ethanol for EBP programme taxed at **5% (reduced from 18%)** to encourage adoption.
- **Current Status & Future Roadmap:** The initial target of **10% blending by 2022** was achieved ahead of schedule, leading to an ambitious goal of **20% ethanol blending (E20) by 2025**.
  - Currently, ethanol blending stands at **15% as of 2024**. Expansion of **ethanol-dedicated fuel stations** and **E20-compatible vehicles** will play a key role in accelerating implementation.



What are the Key Benefits of Ethanol Blending for India?

- **Energy Security and Reduced Import Dependence:** India imports over **87% of its crude oil needs**, making it vulnerable to price volatility and geopolitical risks.

- **Ethanol blending reduces this dependence** by substituting imported petrol with domestically produced **biofuel, enhancing self-reliance in energy.**
- The **Ethanol Blended Petrol (EBP) Programme** has already **saved ₹1.1 trillion in foreign exchange** over the last decade.
  - Additionally, ethanol blending helped replace **181 lakh metric tonnes of crude oil** between **2014 and 2024.**

- **Reduction in Carbon Emissions and Pollution: Vehicular emissions** are a major contributor to **urban air pollution and climate change,** increasing respiratory diseases and environmental degradation.
  - Ethanol has **oxygen molecules** that enable more complete combustion, reducing carbon monoxide and particulate matter emissions.
  - The **National Bio-Energy Mission** promotes ethanol as a cleaner alternative to fossil fuels, aligning with India's **Net-Zero 2070** target.
    - Since 2014, the ethanol program has **cut CO_2 emissions by 544 lakh metric tonnes**, significantly improving air quality.
- **Economic Growth and Rural Employment:** Ethanol production boosts the rural economy by providing farmers with additional income streams through **sugarcane, maize, and other biofuel crops.**
  - Increased ethanol demand encourages investment in distilleries and agro-processing industries, creating jobs and reducing distress migration.
  - The **PM-JI-VAN Yojana** incentivizes second-generation ethanol production, further strengthening the rural economy.
  - Ethanol blending has led to **₹87,558 crore disbursed to farmers** and **₹1,45,930 crore paid to distillers**, stimulating rural employment and agro-industrial growth.
- **Diversification of Cropping Patterns and Waste Utilization:** Ethanol production encourages a shift from **water-intensive crops like rice and wheat** to alternative feedstocks like maize and sorghum, promoting sustainable agriculture.
  - The government has allowed **Food Corporation of India (FCI) rice and maize** for ethanol production, ensuring stable farmer incomes.
  - The **price of ethanol from maize is ₹51.55/litre**, and from FCI rice, it is **₹56.87/litre**, making surplus grain utilization economically feasible.
    - The **interest subvention scheme** has attracted investment in **grain-based distilleries**, boosting ethanol supply.
- **Foreign Investment and Industrial Growth:** India's ethanol push has created a lucrative market for private investment in biofuel infrastructure, attracting both domestic and foreign capital.
  - Policies like the **Long-Term Ethanol Procurement Policy** provide revenue visibility, encouraging large-scale investment in distilleries and supply chains.
  - The **Global Biofuels Alliance (GBA)** launched at the **G20 Summit 2023** positions India as a global leader in ethanol trade and technology.
  - The ethanol industry's rapid expansion has seen **₹40,000 crore in new investments**, enhancing India's manufacturing and export potential.

- **Strengthening of Automobile and Fuel Infrastructure:** Higher ethanol blending requires advancements in vehicle technology and fuel distribution networks, fostering innovation in India's auto sector.
    - Automakers are developing **E20-compliant engines**, ensuring efficiency and durability in ethanol-petrol blends.
    - As of April, 2024, **E20 petrol is available at 13,569 PSU outlets.**This marks a significant step towards expanding ethanol blending across India.
    - This transformation supports the **National Green Mobility Strategy**, integrating ethanol with EVs and hydrogen fuel for a multi-fuel future.

What are the Key Issues Associated with Ethanol Blending in India?

- **Water-Intensive Nature of Ethanol Production:** Ethanol production in India is **heavily dependent on sugarcane,** which requires enormous water resources, exacerbating water stress in already drought-prone regions.
    - This raises concerns about unsustainable agricultural practices and groundwater depletion, particularly in states like **Maharashtra and Uttar Pradesh.**
    - Alternative **feedstocks like maize and sorghum** are being promoted, but their adoption remains limited due to lower ethanol yields and farmer preferences.
    - According to **NITI Aayog,** sugarcane and paddy combined use 70% of irrigation water of the country, posing risks for long-term sustainability of ethanol.
- **Impact on Food Security and Inflation:** As ethanol demand increases, more food grains like **rice and maize** are diverted for fuel, potentially driving up food prices and affecting food security.
    - The use of **FCI rice and maize** for ethanol production may **reduce surplus buffer stocks**, limiting government capacity to stabilize food prices during shortages.
        - This raises ethical concerns about using edible grains for energy when malnutrition remains a challenge in India.
    - **FAO 2023 report** warned that **biofuel expansion could tighten global food supply chains**, impacting vulnerable populations.
- **Limited Ethanol Production Capacity and Supply Chain Bottlenecks:** Despite rapid growth, India's ethanol production and distribution infrastructure remain inadequate to meet the **20% blending target by 2025**.
    - Supply chain inefficiencies, including transport challenges and storage constraints, make uniform ethanol availability difficult across all regions.
    - **Many states lack sufficient distilleries and blending facilities**, making them dependent on ethanol imports from other states.
- **Technological and Vehicle Compatibility Challenges:** India's vehicle fleet is largely designed for **E10 fuel**, and transitioning to **E20 and beyond** requires modifications in engine design and fuel systems.
    - Higher ethanol content can cause **corrosion and reduced fuel efficiency**, leading to long-term maintenance challenges for consumers.

- Automobile manufacturers are working on **E20-compatible engines**, but existing vehicles may face performance issues unless retrofitted.

- **Financial Viability and Price Volatility:** Ethanol production is subject to **price fluctuations** due to variable sugarcane and grain output, **impacting industry profitability and investment stability.**
  - Distilleries depend on government-fixed procurement prices, which may not always align with market dynamics, creating uncertainty for investors.
  - The **energy content of ethanol is lower than that of gasoline**, requiring more fuel for the same mileage, which can offset cost benefits for consumers.
- **Environmental Concerns in Ethanol Production:** While ethanol reduces carbon emissions in vehicles, its production process—**especially from sugarcane and molasses**—leads to **high water usage, deforestation, and industrial waste discharge**.
  - Ethanol distilleries generate large amounts of waste water. This wastewater, known as **vinasse**, contains high concentrations of organic matter, residual sugars, and other pollutants.
    - If not properly treated, **it can pose significant environmental risks,** including water pollution and depletion of oxygen in aquatic ecosystems.
- **Heavy Dependence on Government Subsidies:** Ethanol production in India is **heavily reliant on government incentives**, including **interest subvention schemes, differential pricing, and tax exemptions**.
  - Any policy reversal or reduction in financial support could make **ethanol production economically unviable** for distillers and farmers.
  - The **Pradhan Mantri JI-VAN Yojana** has been extended until 2028-29 to boost second-generation ethanol, but adoption remains slow due to **high capital costs**.
  - Policy fluctuations in ethanol blending targets, **such as the shift from 2030 to 2025**, create implementation challenges for industry stakeholders.

What Measures to Strengthen Ethanol Blending and Accelerate Implementation?

- **Expanding Feedstock Diversification Beyond Sugarcane:** Dependence on sugarcane for ethanol is unsustainable; India must promote **maize, sorghum, bamboo, and agricultural waste** as alternative feedstocks.
  - Strengthening the **Pradhan Mantri JI-VAN Yojana** with better R&D funding can accelerate second-generation ethanol production.
  - The government should also integrate **PM-KISAN** to provide financial incentives for farmers shifting to biofuel crops.
  - Expanding ethanol production from **damaged food grains and municipal waste** can further enhance availability.
    - A structured **minimum support price (MSP) framework** for ethanol-linked crops can ensure stable raw material supply.
- **Strengthening Rural Distilleries and Decentralized Production:** A decentralized ethanol production model with **small-scale distilleries in rural areas** can improve supply-chain efficiency and reduce transportation costs.

- Linking ethanol units with **FPOs (Farmer Producer Organizations)** can empower local farmers and enhance direct procurement of feedstock.
- The government should provide **low-interest loans under Mudra Yojana** for small entrepreneurs to set up ethanol plants.
- Establishing **bio-refinery clusters** in grain-producing states will balance regional ethanol availability.

- **Enhancing Vehicle Compatibility and Fuel Infrastructure:** Mandating **E20-compatible vehicles** by 2025 must be complemented by **incentives for retrofitting older vehicles** to avoid consumer backlash.
  - Collaborating with **automobile manufacturers and IITs** to develop cost-effective engine modifications can ease the transition.
  - Expanding **ethanol-dedicated fuel pumps** across India, especially in non-sugarcane-producing states, will ensure uniform accessibility.
  - Public transport systems should be mandated to use **ethanol-blended fuels**, integrating **Faster Adoption and Manufacturing of Electric Vehicles (FAME) with biofuel policies** for hybrid solutions.
- **Improving Pricing Stability and Market-Linked Procurement:** A dynamic **Ethanol Price Stabilization Fund** should be created to insulate ethanol producers from raw material price fluctuations.
  - Moving towards a **market-driven ethanol procurement mechanism**, similar to the power sector's **Renewable Energy Certificates (REC)**, can encourage private sector participation.
  - A **carbon credit system linked to ethanol production** can provide financial incentives for industries adopting green fuel.
  - Flexible pricing mechanisms based on **seasonal variations in crop yield and crude oil prices** can make ethanol production more predictable.
- **Addressing Water Sustainability in Ethanol Production:** Shifting towards **water-efficient biofuel crops** through incentives under **PM Krishi Sinchayee Yojana** can reduce excessive water consumption in ethanol production.
  - Promoting **drip irrigation and micro-irrigation systems** for ethanol-linked crops will enhance sustainability.
  - Encouraging ethanol plants to implement **zero-liquid discharge (ZLD) systems** can reduce industrial water pollution.
  - Integrating ethanol plants with **wastewater treatment facilities** under **Namami Gange** can ensure responsible water usage.
- **Accelerating Investment and Private Sector Participation:** A dedicated **Ethanol Infrastructure Development Fund (EIDF)** with tax incentives can attract private investments in ethanol plants.
  - Linking ethanol production with **Make in India** can encourage domestic manufacturing of distillery equipment and fuel additives.
  - **Viability gap funding (VGF)** should be extended to private ethanol plants in non-traditional biofuel states.
  - Expanding **FDI opportunities in biofuel research and development** will bring in global expertise and capital.

- Enabling **public-private partnerships (PPPs) in ethanol logistics and distribution** will enhance nationwide supply efficiency.

- **Strengthening Policy Coordination and Governance Framework:** State governments should be encouraged to launch **ethanol-specific industrial policies** to attract investments.
  - Strengthening **interstate ethanol transport regulations** will prevent logistical disruptions and price disparities.
  - A **single-window clearance system for ethanol plant approvals** will reduce bureaucratic delays.
  - Linking **Ethanol Blended Petrol (EBP) Programme with National Green Hydrogen Mission** can create a long-term clean fuel roadmap.

Conclusion

India's ethanol-blending initiative holds immense potential for **enhancing energy security, reducing carbon emissions, and boosting rural economies**. However, overcoming challenges such as **feedstock shortages, water usage, and infrastructure limitations is critical to achieving the 20% blending target by 2025.** Strengthening policy support, expanding decentralized production, and improving vehicle compatibility will accelerate progress.

Essay Topics

1. मनुष्य होने और मानव बनने के बीच का लम्बा सफर ही जीवन है

   Life is long journey between human being and being humane

2. विचारपरक संकल्प स्वयं के शांतचित्त रहने का उत्प्रेरक है

   Mindful manifesto is the catalyst to a tranquil self

3. जहाज अपने चारों तरफ के पानी के वजह से नहीं डूबा करते, जहाज पानी के अंदर समा जाने की वजह से डूबते हैं

   Ships do not sink because of water around them, ships sink because of water that gets into them

4. सरलता चरम परिष्करण है

   Simplicity is the ultimate sophistication

5. जो हम हैं, वह संस्कार; जो हमारे पास है, वह सभ्यता

   Culture is what we are, civilization is what we have

6. बिना आर्थिक समृद्धि के सामाजिक न्याय नहीं हो सकता, किन्तु बिना सामाजिक न्याय के आर्थिक समृद्धि निरर्थक है

   There can be no social justice without economic prosperity but economic prosperity without social justice is meaningless

7. पितृ-सत्ता की व्यवस्था नजर में बहुत कम आने के बावजूद सामाजिक विषमता की सबसे प्रभावी संरचना है

   Patriarchy is the least noticed yet the most significant structure of social inequality

8. अंतर्राष्ट्रीय संबंधों में मौन कारक के रूप में प्रौद्योगिकी

   Technology as the silent factor in international relations