IASBABA'S SANKALP/TLP GS-3 (S&T/ INTERNAL SECURITY) SYNOPSIS – DAY 51

Q.1) "Discuss the applications of nanotechnology in agriculture and healthcare. Highlight the key challenges in its widespread adoption in India." (150 words, 10 marks)

Introduction

Nanotechnology refers to the manipulation of matter at the atomic and molecular scale, typically below **100 nanometers**. It offers transformative applications in sectors like agriculture and healthcare, promising higher efficiency and smarter solutions.

Body

Applications in Agriculture

1. **Nano-fertilizers:** Increase nutrient use efficiency and reduce wastage. Example: **ICAR**-developed **zinc nano-fertilizers** enhance crop yield with minimal environmental impact.
2. **Nano-pesticides:** Enable **targeted delivery** and reduce chemical load on soil. Example: **IIT-Kharagpur** created **nano-formulations** to combat fungal infections in crops.
3. **Soil Health Monitoring:** Nano-sensors detect nutrient deficiencies and pH levels in real time. Example: **Portable nano-sensors** help farmers make timely soil amendment decisions.
4. **Food Packaging and Preservation:** Nano-coatings prevent microbial contamination and extend shelf life. Example: **Nano-silver** embedded packaging materials preserve perishable items.
5. **Water Purification for Irrigation:** Nano-filters remove toxins and heavy metals from irrigation water. Example: **Nano-iron particles** used to clean arsenic-contaminated water in Bengal.

Applications in Healthcare

1. **Targeted Drug Delivery:** Nanoparticles deliver drugs directly to affected cells, minimizing side effects. Example: **Liposomal doxorubicin** used in breast cancer therapy.
2. **Early Disease Diagnosis:** Nano-biosensors detect diseases at molecular levels. Example: **Gold nanoparticle**-based kits for TB and cancer screening.
3. **Nano-imaging and Theranostics:** Combines diagnostics and therapy in a single nanodevice. Example: **Quantum dots** used in imaging cancer cells.
4. **Antimicrobial Coatings:** Nano-silver and copper coatings reduce hospital-acquired infections. Example: AIIMS used **nano-coatings** on medical instruments during COVID-19.
5. **Regenerative Medicine:** Nanomaterials aid tissue repair and wound healing. Example: **Nano-hydroxyapatite scaffolds** in bone regeneration.

Challenges in Widespread Adoption in India

1. **High Cost and Limited Access:** Nanotech products are expensive and unaffordable for small farmers and rural clinics. Example: Nano-fertilizers cost significantly more than conventional ones.
2. **Regulatory Gaps and Safety Concerns:** Lack of standardized safety protocols for nanomaterials. Example: No comprehensive Indian regulation for nano-pesticide residue limits.

3. **Limited R&D Infrastructure:** Few dedicated nanotech labs for agriculture or public healthcare. Example: Most innovations limited to premier institutes like IITs and CSIR labs.
4. **Low Awareness and Skill Deficit:** Farmers and healthcare workers lack training in nanotech applications. Example: Few extension programs include nano-based agricultural solutions.

Way Forward

1. **Dedicated National Mission:** Implement a comprehensive National Mission on Nano-Bio Applications in Agriculture and Health under the Department of Science & Technology.
2. **Regulatory Framework:** Strengthen the guidelines under the **Food Safety and Standards Authority of India (FSSAI)** and Central Insecticides Board to cover nanomaterials.
3. **Capacity Building:** Expand training and outreach through **Krishi Vigyan Kendras** and Ayushman Bharat to raise awareness and build local capacity.
4. **Government Incentives:** Promote startups and public-private partnerships through schemes like the **National Nanotechnology Mission** and Make in India.

Conclusion

Nanotechnology holds immense potential for revolutionizing agriculture and healthcare in India. Overcoming infrastructural, regulatory, and financial hurdles is crucial to realize its benefits and ensure inclusive, safe, and sustainable deployment across the nation.

Q.2) Balancing the protection of intellectual property rights with the larger public interest remains a key policy challenge in developing countries. Examine in the Indian context. (150 words, 10 marks)

Introduction

Intellectual Property Rights (IPRs) incentivize innovation, yet excessive protection can hinder public access. In a developing country like India, balancing **innovation and social equity** remains a persistent and nuanced policy challenge.

Body

Importance of Balancing IPR and Public Interest in India

1. **Access to Affordable Medicines:** Excessive patent protection can limit access to life-saving drugs. Example: India allowed **Natco** to produce a low-cost generic version of **Nexavar** in 2012.
2. **Encouraging Indigenous Innovation:** Strong but flexible IPR regime supports local R&D without stifling competition. Example: Startup India helps new firms with IP filings and awareness.
3. **Agricultural Sustainability:** Over-patenting of seeds can hurt farmers' rights and food security. Example: **PPVFR Act** lets farmers reuse and share seeds legally.
4. **Educational and Research Access:** Strict copyright laws can hinder academic sharing in resource-poor settings. Example: **DU photocopy case** highlighted fair use in education.

5. **Traditional Knowledge Protection:** Global patents on indigenous knowledge can lead to biopiracy. Example: **TKDL** prevents misappropriation of Ayurveda formulations.
6. **Digital Innovation vs. Monopoly:** Tech patents can restrict the growth of startups in AI and software. Example: India excludes software patents to support open innovation.

Challenges in Striking the Balance

1. **International Pressure:** Trade agreements push India to adopt stricter patent regimes. Example: India is targeted in the **U.S. Special 301 Report**.
2. **Judicial Ambiguity:** Courts vary in interpreting the scope of compulsory licenses and public interest. Example: Inconsistent rulings create legal uncertainty.
3. **Enforcement Issues:** Weak IPR enforcement deters foreign investment and local innovators alike. Example: India ranks low on the Global Innovation Index.
4. **Lack of Public Awareness:** Many startups and grassroots innovators remain unaware of IPR protections. Example: **MSMEs** underuse patent filing schemes.

Way Forward

1. **Strengthen Legal Clarity:** Streamline judicial guidelines for interpreting public interest in IPR cases.
2. **Expand Compulsory Licensing:** Use it judiciously in health, agriculture, and environmental sectors.
3. **Boost IP Literacy:** Integrate IPR awareness in higher education, R&D institutions, and startup incubators.

Conclusion

India's IPR policy seeks to balance innovation incentives with inclusive access. **The National IPR Policy 2016** promotes this balance through legal reform, education, and traditional knowledge protection—key to ensuring both development and equity.

Q.3) Despite a visible decline in Left-Wing Extremist violence in recent years, the underlying issues of underdevelopment and alienation persist in affected regions. Analyse in the context of recent developments. (150 words, 10 marks)

Introduction

Left-Wing Extremism (LWE), rooted in Maoist ideology, began in **Naxalbari in 1967** as a peasant revolt. Though violence has declined recently, core issues like tribal alienation and underdevelopment still persist in affected regions.

Body

Indicators of Declining Violence

1. **Decline in Violence:** Security operations and development efforts have reduced LWE-related incidents. Example: MHA data shows a **77% drop** in LWE violence between **2010 and 2023**.
2. **Enhanced Security Infrastructure:** More Forward Operating Bases (FOBs) and road projects have improved force mobility. Example: Over **500 km of roads** built under the Road Requirement Plan-I in affected districts.
3. **Surrender and Rehabilitation:** Many extremists have surrendered due to pressure and incentives. Example: **Jharkhand and Chhattisgarh** report hundreds of surrenders in recent years.

Persistent Issues of Alienation and Underdevelopment

1. **Lack of Basic Services:** Many LWE-affected areas still lack health, education, and clean drinking water. Example: Several districts in **Odisha and Jharkhand** have poor access to PHCs and schools.
2. **Weak Local Governance:** Shortage of officers and weak panchayats limit development and trust in state institutions. Example: Administrative posts remain vacant in parts of **Chhattisgarh and Bihar**.
3. **Land and Forest Disputes:** Delay in recognising tribal land rights continues to fuel anger and unrest. Example: Poor implementation of **Forest Rights Act** leaves many without legal land ownership.
4. **Poor Execution of Welfare Schemes:** Leakages and corruption reduce the impact of government programmes. Example: **MGNREGA payments** are often delayed or siphoned off in remote villages.
5. **Digital and Financial Exclusion:** Many people in LWE zones lack internet access or bank accounts. Example: **DBT** benefits often don't reach remote areas in Maharashtra and Andhra Pradesh.
6. **Fear and Mistrust:** People fear both security forces and extremists, making cooperation difficult. Example: Civilians avoid reporting Maoist activity due to fear of retaliation.

Way Forward

1. **Inclusive Governance:** Strengthen local administration through the **Aspirational Districts Programme and Mission Karmayogi** to improve delivery and capacity.
2. **Land and Forest Rights Implementation:** Speed up implementation of **FRA and PESA Acts** with support from schemes like **Van Dhan Yojana**.
3. **Skill and Employment Generation:** Promote livelihoods through schemes like RSETI, NRLM, and PM Vishwakarma Yojana in tribal belts.
4. **Build Trust Through Dialogue:** Use Jan Samvad campaigns and community policing initiatives like **"Aastha" in Chhattisgarh** to build confidence and reduce fear.
5. **Use of Integrated Strategy:** Effectively apply the **SAMADHAN strategy** that combines leadership, technology, intelligence, and development efforts to tackle extremism from all angles.

Conclusion

Despite operational success, sustainable peace demands addressing structural causes of LWE. Recent moves like the **Aspirational Districts Programme** and revamped surrender policies must be complemented by deeper reforms to ensure inclusive and lasting development.

Q.4) Biotechnology is playing an increasingly important role in Indian agriculture. Discuss its major applications and examine the environmental and regulatory concerns associated with its use. Suggest measures to ensure its safe and sustainable deployment. (250 words, 15 marks)

Introduction

Biotechnology uses biological processes and organisms to develop useful products. In Indian agriculture, it is increasingly applied to improve crop yield, nutrition, and sustainability—making it vital to food security and climate resilience.

Body

Major Applications of Agricultural Biotechnology in India

1. **Genetically Modified (GM) Crops:** Enhance yield, pest resistance, and reduce pesticide usage. Example: **Bt cotton** led to a sharp decline in pesticide use and improved farmer incomes.
2. **Biofertilizers and Biopesticides:** Promote soil health and reduce chemical input dependence. Example: **Use of Rhizobium and Azotobacter** as nitrogen-fixing biofertilizers in legume farming.
3. **Tissue Culture:** Enables mass propagation of disease-free, high-yielding plant varieties. Example: **Banana and sugarcane** are widely propagated through tissue culture in Maharashtra and Tamil Nadu.
4. **Molecular Breeding:** Speeds up development of stress-resistant crop varieties using gene markers. Example: Development of **drought-resistant rice** under the ICAR's marker-assisted selection programs.
5. **Genetic Diagnostics:** Helps detect plant pathogens early to prevent spread. Example: **PCR-based tools** are used to detect viruses in **chillies and tomato crops**.
6. **Animal Biotechnology:** Improves livestock health and productivity through vaccines and diagnostics. Example: Development of FMD **(Foot-and-Mouth Disease) vaccines** for cattle.

Environmental and Regulatory Concerns

1. **Biodiversity Loss:** GM crops may impact natural genetic diversity by crossbreeding with wild relatives. Example: Concerns raised about **Bt cotton**'s impact on non-target insects and local varieties.
2. **Emergence of Superweeds/Pests:** Prolonged use may lead to resistance among pests or weeds. Example: **Bollworm resistance to Bt toxins** has been reported in some regions of Gujarat.
3. **Soil and Water Health:** Over-reliance on biotech inputs might affect soil microbial life and groundwater. Example: Intensive Bt cotton cultivation linked with falling soil fertility in parts of Punjab.

4. **Biosafety Risks:** Lack of comprehensive field trials and impact assessments can pose risks. Example: Controversy over **GM mustard** due to concerns over long-term ecological impacts.
5. **Weak Regulatory Oversight:** Gaps in coordination between agencies and lack of public engagement. Example: **GEAC** decisions often face criticism for inadequate transparency.

Measures for Safe and Sustainable Deployment

1. **Strengthen Regulatory Framework:** Make GEAC more transparent, autonomous, and inclusive of public feedback. Example: Include civil society and farmers' representatives in decision-making processes.
2. **Encourage Non-GM Biotech Alternatives:** Promote molecular breeding and bio-inputs over GM crops where feasible.
3. **Conduct Long-Term Environmental Assessments:** Ensure thorough field testing, ecological studies, and post-release monitoring.
4. **Promote Farmer Awareness and Training:** Equip farmers with knowledge about safe use, risks, and benefits.
5. **Develop Region-Specific Strategies:** Tailor biotech applications to agro-climatic zones and cropping patterns to prevent overuse.
6. **Strengthen IP and Benefit-Sharing Mechanisms:** Protect farmers' rights under the Protection of Plant Varieties and Farmers' Rights **(PPVFR) Act**.

Conclusion

Biotechnology can boost Indian agriculture if used responsibly. A strong **Biotechnology Regulatory Authority** is needed, along with the **National Biotechnology Development Strategy**, to ensure safety, farmer welfare, and environmental sustainability in its future adoption.

Q.5) In light of the recent Pahalgam terror attack on pilgrims in Jammu & Kashmir, examine the evolving nature of terrorism in the region. How can India strengthen its intelligence, coordination, and preventive response to such targeted civilian attacks? (250 words, 15 marks)

Introduction

The recent Pahalgam terror attack on pilgrims highlights the changing face of terrorism in Jammu & Kashmir, where civilians and soft targets are increasingly in focus. It raises urgent concerns about security preparedness and coordination.

Body

Evolving Nature of Terrorism in J&K

1. **Shift to Soft Targets:** Terror groups now focus more on unarmed civilians, tourists, and pilgrims to instill fear and attract media attention. Example: The attack on **Amarnath pilgrims in 2017** and the recent Pahalgam incident.

2. **Proxy and Hybrid Militancy:** Locals with minimal training are recruited for single operations, blurring the line between civilians and terrorists. Example: **Lone-wolf** or part-time militants with no known terror background.
3. **Use of Technology:** Encrypted communication, drones for arms delivery, and digital propaganda are rising. Example: **Drone-dropped weapons** recovered near border districts in Jammu region.
4. **Cross-border Support:** Despite tighter borders, Pakistan-backed groups continue infiltration and support via sleeper cells and logistics. Example: Recovery of arms caches with Pakistani markings.

Strengthening India's Response

1. **Intelligence Fusion:** Establish real-time coordination through Multi-Agency Centres and use AI to track movement patterns. Example: Integration of IB, RAW, and local police inputs through **NATGRID.**
2. **Tech-Enabled Surveillance:** Expand drone monitoring, facial recognition, and CCTV coverage across highways and religious sites. Example: Drone surveillance successfully foiled a terror attempt in Samba (2022).
3. **Community Policing & Early Warning:** Empower locals to report suspicious activity using mobile apps and reward systems. Example: Jammu Police's community informant network has helped track potential threats early.
4. **Pilgrim Protection Protocols:** Upgrade SOPs for Yatra routes with RFID tracking, quick response teams, and air surveillance. Example: The Amarnath Yatra security grid post-2017 includes RFID tags and 24/7 monitoring.
5. **Counter-Radicalisation Measures:** Run targeted de-radicalisation programs, online monitoring, and educational outreach in vulnerable communities. Example: **J&K Police's "Taameer" initiative** for youth engagement in Pulwama and Shopian.
6. **Crisis Response Drills:** Conduct regular mock drills and inter-agency coordination exercises for high-risk events and locations. Example: Annual mock evacuation drills conducted along the **Amarnath Yatra route**.

Steps Already Taken by India

1. **Revocation of Article 370:** Enabled better central control and coordination of security operations in J&K.
2. **Modernisation of Police Forces:** Under the MPF Scheme, J&K police have been equipped with bulletproof vehicles, body cameras, and surveillance tools.
3. **Increased Border Security:** Deployment of anti-drone systems and underground detection sensors along the Line of Control (LoC).
4. **Intelligence Infrastructure Expansion:** Strengthening **NATGRID** and establishing more Intelligence Fusion Centres in border areas.
5. **Operation Sindoor:** Launched after the **Pahalgam attack** to secure pilgrimage routes and neutralize terror threats through area domination and aerial surveillance.

Conclusion

The nature of terrorism in J&K is evolving, demanding **proactive adaptation** in **India's counter-terror strategy**. Enhanced coordination, tech integration, and community involvement will be key to preventing future attacks and securing civilian lives.