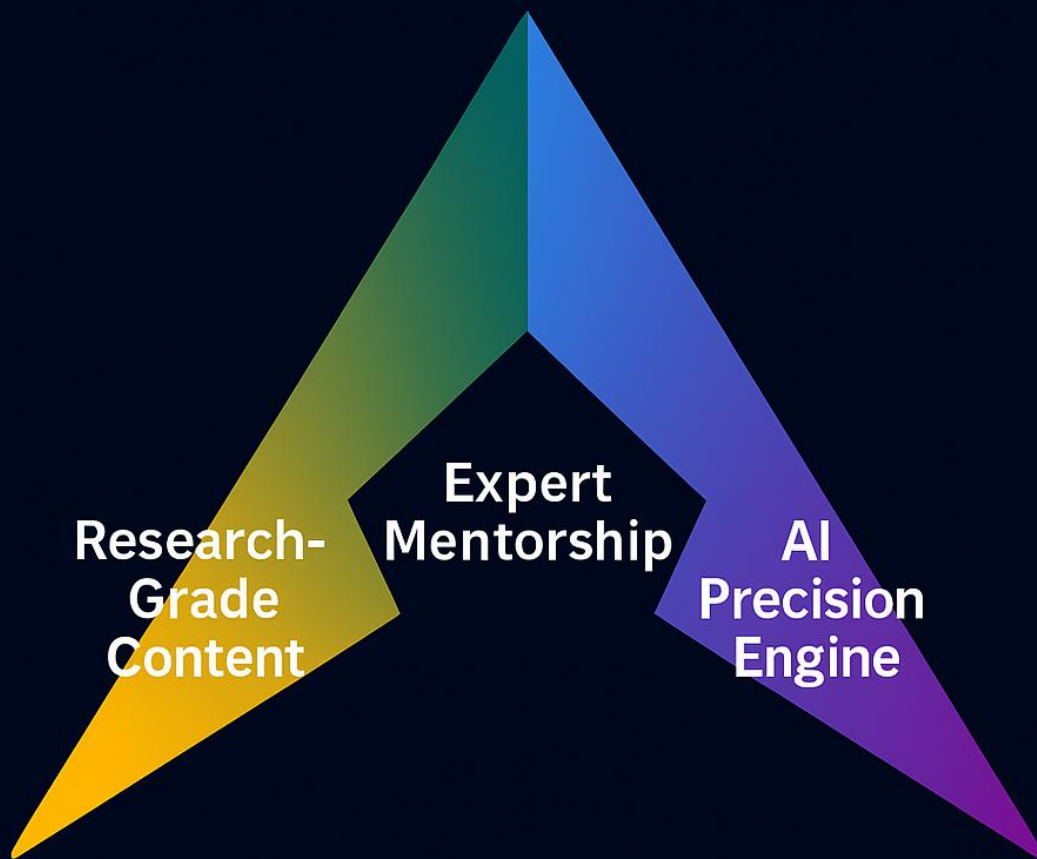


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GS Paper III: Security

1. Drones and Border Security

a. Introduction

For centuries, border security was built around physical barriers and human surveillance. States relied on fences, walls, border outposts, patrols, observation towers and soldiers to prevent infiltration, smuggling and hostile movement across territorial boundaries.

The emergence of drones, also known as Unmanned Aerial Vehicles, has fundamentally changed this traditional model. Threats no longer move only through land routes; they can now arrive through the air, carrying weapons, explosives, narcotics, communication equipment or surveillance devices. In some cases, drones themselves may be used as offensive weapons.

As a result, border management is shifting from a mainly human-centric system to a technology-driven security architecture. Drones have therefore become a major issue in internal security, border management, modern warfare and science and technology.

b. Understanding Drones

Meaning of Drones

- **Unmanned Aircraft:** A drone is an aircraft that operates without a pilot onboard.
- **Remote or Autonomous Operation:** It may be controlled remotely by an operator or function autonomously through software, sensors and navigation systems.
- **Flying Robot:** In simple terms, a drone may be understood as a flying robot capable of carrying cameras, sensors, weapons, explosives or small cargo.

Types and Uses of Drones

- **Surveillance Drones:** Used for intelligence gathering, reconnaissance and monitoring of sensitive areas.
- **Cargo Drones:** Used to transport supplies, but can also be misused for smuggling weapons or narcotics.
- **Armed Drones:** Carry missiles, explosives or other payloads for offensive operations.
- **Loitering Drones:** Remain airborne until a target is identified and then destroy it by crashing into it.
- **Swarm Drones:** Operate in coordinated groups and can overwhelm conventional defence systems.

Thus, drones are dual-use technologies: they can strengthen security, but can also create serious threats when used by hostile actors.

c. Why Drones Matter in Border Security

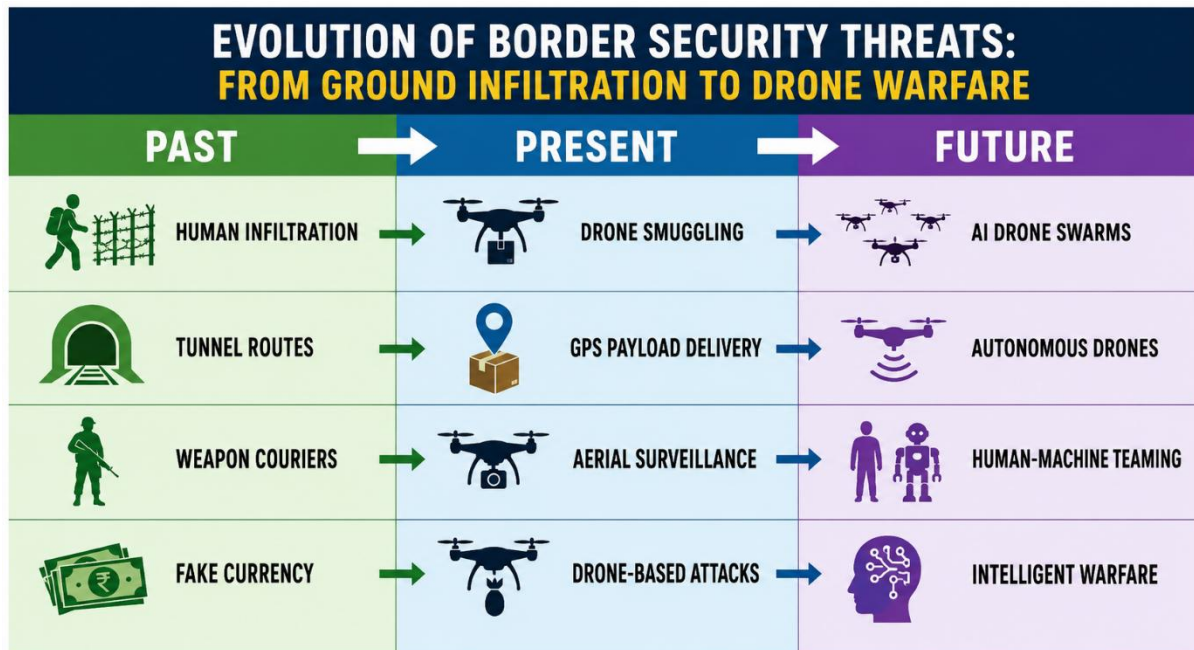
Shift from Ground Threats to Aerial Threats

- **Traditional Infiltration:** Earlier, infiltrators had to physically cross borders by cutting fences, using tunnels or avoiding patrols.
- **Drone-Based Infiltration:** Now, weapons, ammunition, narcotics or communication devices can be sent across borders without the operator physically entering Indian territory.
- **New Security Challenge:** Border violations are no longer limited to movement of persons. They now include movement of objects, data and weapons through unmanned aerial systems.

Strategic Significance

- Drones reduce the risk for hostile actors because the person operating the drone can remain safely across the border. This makes drones attractive for terrorist groups, smugglers, organised criminal networks and hostile state-backed actors.

This transition shows that border security must now protect not only the ground but also the low-altitude airspace above the border.



d. Evolution of Border Threats

Earlier Threat Model

- **Human Infiltration:** Terrorists or smugglers physically crossed borders.
- **Tunnels and Couriers:** Weapons, drugs and fake currency were moved through underground tunnels or human carriers.
- **Hawala Financing:** Illegal finance networks supported terrorism and organised crime.

Modern Drone-Based Threat Model

- **Remote Smuggling:** Weapons and narcotics can be dropped from the air.
- **Real-Time Surveillance:** Enemy operators can observe troop movement and vulnerable points.
- **Precision Delivery:** GPS-based navigation allows accurate delivery at selected locations.
- **Offensive Use:** Explosive-laden drones can target military installations, infrastructure and civilian areas.

Thus, the threat has shifted from ground-based infiltration to aerial infiltration supported by technology.

e. Use of Drones against Border Security

- **Weapons Delivery:** Drones can carry pistols, grenades, ammunition, explosives and small arms. Once dropped inside Indian territory, these consignments may be recovered by terrorists or criminal networks.
- **Narcotics Smuggling:** Drones are increasingly used to transport heroin, methamphetamine and synthetic drugs. Profits from narcotics can finance terrorism, strengthening the nexus among terrorism, organised crime and drug trafficking.
- **Intelligence Gathering:** Drones equipped with cameras and sensors can monitor security installations, patrol patterns and weak points in border defences.

- **Guidance to Infiltrators:** Drones can observe troop movement, identify safe routes and provide real-time updates to infiltrators.
- **Direct Attack:** Drones may carry improvised explosive devices, mortar rounds or explosive payloads to attack military assets, strategic infrastructure or civilian targets.

The use of drones therefore converts the border from a two-dimensional ground line into a three-dimensional security space.

f. Why Drones Are Difficult to Detect

- **Small Size:** Many drones are small and difficult for traditional radar systems to detect.
- **Low-Altitude Flight:** They often fly at low altitude, allowing them to avoid radar coverage and blend with ground clutter.
- **Night Operations:** Drones can operate at night when visibility is poor.
- **Autonomous Navigation:** Some drones can complete missions even if communication links are disrupted.
- **Swarm Capability:** Multiple drones can be launched together, overwhelming detection and response systems.

Thus, drones create a threat that is low-cost, flexible, mobile and difficult to neutralise.

g. Transformation of Border Management

Earlier Model

- The earlier model depended on soldiers, physical patrols, observation posts, fencing and human vigilance.

New Model

Modern border management requires a multi-layered security architecture involving:

- Smart sensors
- Thermal imaging
- Ground surveillance radars
- Fibre-optic sensors
- Artificial intelligence
- Surveillance drones
- Counter-drone systems

Wider Meaning

- Border management is no longer limited to guarding a line on the map. It requires control over land, airspace, data flows and electronic signals.

This shows the growing fusion of internal security with technology and modern warfare.

h. Counter-Drone Technologies

Detection Technologies

- **Radar Systems:** Track aerial objects entering protected zones.
- **Electro-Optical Sensors:** Use cameras and imaging systems to identify drones.
- **Thermal Sensors:** Detect drones during low-light or night conditions.
- **Acoustic Sensors:** Identify drones through sound signatures.

Neutralisation Technologies

- **Jammers:** Disrupt communication between drones and their operators.
- **GPS Spoofing:** Misleads drones by sending false navigation signals.
- **Directed Energy Weapons:** Use concentrated energy beams to disable drones.
- **Laser Systems:** Destroy drones using high-energy beams.
- **Drone-Kill Systems:** Physically intercept or neutralise hostile drones.

The effectiveness of counter-drone systems depends on rapid detection, identification, tracking and neutralisation.

i. Drones and the Future of Warfare

Changing Nature of War

- Recent conflicts, including the Russia-Ukraine War and conflicts in West Asia, show that drones are becoming central to modern warfare.

Comparison with Tanks

- Many analysts compare drones today with tanks during the First World War. Just as tanks transformed land warfare, drones are transforming surveillance, targeting, logistics and battlefield decision-making.

Emerging Trends

- **Drone Swarms:** Large numbers of drones may operate together.
- **AI-Enabled Drones:** Artificial intelligence may allow drones to identify and track targets more autonomously.
- **Loitering Munitions:** These remain airborne until a target is detected.
- **Human-Machine Teaming:** Soldiers may increasingly operate alongside autonomous systems.

Future warfare will therefore be shaped by the integration of humans, machines, sensors and artificial intelligence.

j. Challenges for India

- **Long and Diverse Borders:** India has long borders with Pakistan, China, Bangladesh and Myanmar. These include deserts, rivers, mountains, forests and populated areas, making surveillance difficult.
- **Rapid Technological Change:** Drone technology evolves faster than conventional regulation, procurement and training systems.
- **Cost Asymmetry:** A low-cost hostile drone may force the defender to use an expensive interception system.
- **Indigenous Capability Gap:** India must build domestic capacity in drones, sensors, electronic warfare, artificial intelligence and counter-drone systems.
- **Inter-Agency Coordination:** Drone threats overlap with terrorism, narcotics, organised crime and cyber operations. Therefore, a silo-based approach is inadequate.

These challenges make drone defence a long-term national security priority.

k. India's Response

- **Indigenous Drone Manufacturing:** India is promoting domestic drone production under the broader Make in India framework.
- **Anti-Drone Systems:** Counter-drone systems are being developed to detect and neutralise hostile unmanned aerial platforms.

- **Smart Border Management:** Sensors, artificial intelligence, surveillance networks and drones are being integrated into border management.
- **Training of Security Forces:** Security personnel are being trained in drone operations, electronic warfare and counter-drone tactics.
- **Integrated Ecosystem:** The objective is not merely to acquire equipment but to build a complete security ecosystem capable of responding to fast-changing aerial threats.

1. Significance for Internal Security

- **Border Management:** Drones affect both surveillance and hostile infiltration.
- **Counter-Terrorism:** They change the logistics of terrorist groups by enabling remote delivery of weapons.
- **Counter-Narcotics:** Drugs can now be moved across borders without human couriers.
- **Intelligence Gathering:** Drones improve situational awareness and real-time monitoring.
- **Military Preparedness:** Future conflicts will increasingly involve unmanned systems.

Therefore, drones are no longer only technological tools. They are central components of national security.

m. Way Forward

- **National Counter-Drone Grid:** India needs an integrated counter-drone grid across sensitive border areas, combining radars, sensors, artificial intelligence, electronic warfare tools and rapid response units.
- **Indigenous Technology Development:** Domestic research, public-private partnerships and defence innovation must be strengthened in drones, anti-drone systems, secure communication and AI-based threat detection.
- **Inter-Agency Coordination:** The Armed Forces, Border Security Force, intelligence agencies, State police and cyber units must share information and coordinate responses.
- **Adaptive Modernisation:** Since drone threats evolve rapidly, procurement, training and research must remain continuous and flexible.
- **Legal and Regulatory Clarity:** India must maintain clear rules for drone use, counter-drone action, airspace monitoring and accountability.

A successful drone-security framework must combine technology, training, intelligence and legal clarity.

Conclusion

Drones have revolutionised border security by adding an aerial dimension to traditional threats. Modern borders can no longer be secured only through fences, patrols and observation posts. They require an integrated architecture combining human intelligence, advanced sensors, artificial intelligence, surveillance drones and counter-drone technologies.

For India, the challenge is especially serious because of long borders, hostile neighbourhood conditions, terrorism threats and narcotics networks. The future of internal security will depend not only on controlling the ground but also on dominating the skies above the border.

A secure border in the drone age must therefore be intelligent, adaptive, technology-driven and institutionally coordinated.

GS Paper III: Security

2. Agni Missile with MIRV Capability

a. Introduction

India's successful test of an advanced Agni missile with Multiple Independently Targetable Re-entry Vehicle capability marks an important milestone in the country's strategic missile programme. It strengthens India's nuclear deterrence, improves long-range strike capability and reflects steady progress in indigenous defence technology.

The significance of MIRV lies not merely in technological sophistication. It strengthens India's ability to maintain credible deterrence in a changing regional security environment while remaining within the framework of responsible nuclear restraint.

b. The Agni Missile System

Meaning and Role

- **Nuclear-Capable Ballistic Missile System:** The Agni series is India's family of nuclear-capable ballistic missiles developed by the Defence Research and Development Organisation.
- **Strategic Deterrent:** These missiles form a central part of India's strategic missile programme and are designed to deliver nuclear warheads over long distances.
- **Graduated Deterrence:** The Agni family provides India with different ranges of deterrent capability for different threat scenarios.

Major Variants

- **Agni-I:** Agni-I provides short-range regional deterrence, with a range of about 700 to 900 kilometres.
- **Agni-II:** Agni-II extends the range beyond 2,000 kilometres and supports medium-range deterrence.
- **Agni-III:** Agni-III has a range of more than 3,000 kilometres, giving India deeper strategic reach.
- **Agni-IV:** Agni-IV extends capability to around 4,000 kilometres.
- **Agni-V:** Agni-V, with a range of more than 5,000 kilometres, gives India a long-range strategic deterrent.

Together, these missiles create a layered strategic capability suited to India's security needs.

c. Understanding MIRV Technology

Meaning of MIRV

- **Multiple Warheads:** Multiple Independently Targetable Re-entry Vehicle technology allows a single missile to carry multiple warheads.
- **Independent Targeting:** Each warhead can be directed towards a separate target.
- **Difference from Conventional Missile:** In a normal ballistic missile, one missile generally carries one warhead for one target. In a MIRV-equipped missile, one missile can strike multiple targets.

Why MIRV Is Important

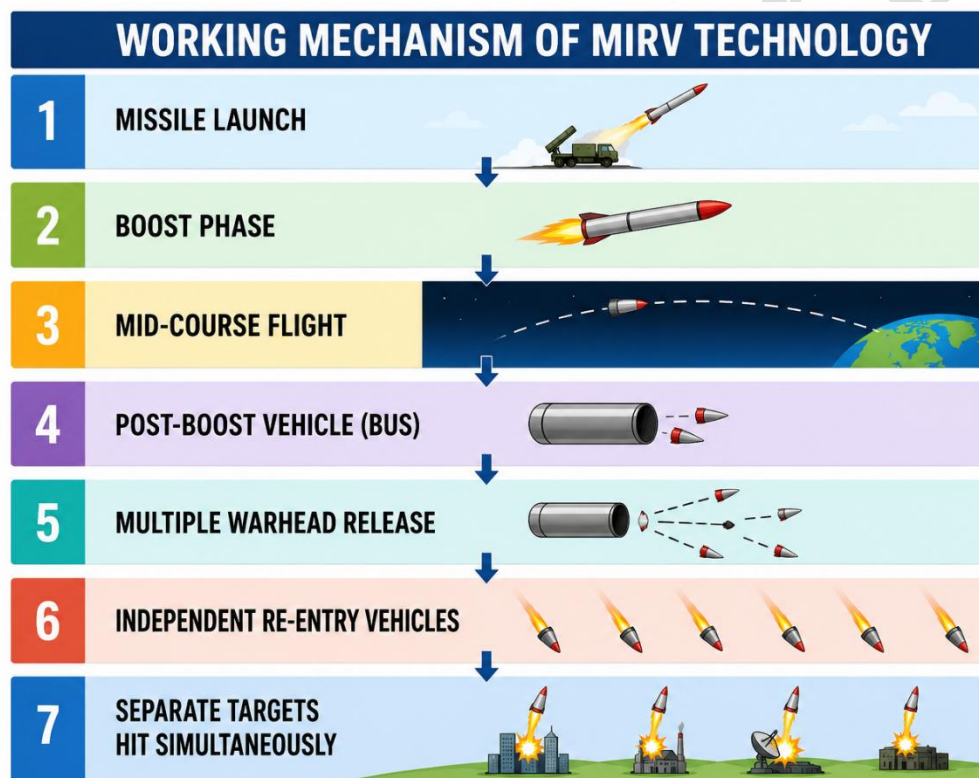
- **Greater Strike Efficiency:** It increases the effectiveness of a missile without requiring a larger number of missiles.
- **Difficult to Intercept:** A single missile can release multiple warheads, making interception harder for enemy missile defence systems.
- **Stronger Deterrence:** It increases the credibility of retaliation by improving the survivability and effectiveness of India's nuclear response.

Thus, MIRV is not merely a missile upgrade; it is a major enhancement in strategic deterrence.

d. How MIRV Works

- **Launch Phase:** The missile is launched like a normal ballistic missile and travels along its trajectory.
- **Mid-Course Phase:** After reaching the upper atmosphere or space-like trajectory, the missile carries a post-boost vehicle, often called a bus.
- **Warhead Release:** The bus releases multiple re-entry vehicles, each carrying a warhead.
- **Independent Targeting:** Each re-entry vehicle follows its own trajectory and re-enters the atmosphere separately before striking its assigned target.
- **Technological Complexity:** MIRV requires mastery over:
 - Warhead miniaturisation
 - Precision guidance
 - Heat-shield technology
 - Re-entry vehicle design
 - Advanced navigation
 - Telemetry and tracking

This makes MIRV one of the most sophisticated missile technologies.



e. Strategic Importance of MIRV Capability

Strengthening Nuclear Deterrence

- **Credible Retaliation:** MIRV increases India's ability to impose unacceptable damage in case of nuclear aggression.
- **Deterrence Value:** An adversary is less likely to attempt nuclear coercion if India's retaliatory capability is credible and survivable.

Strengthening Second-Strike Capability

- **Link with No First Use:** India follows a No First Use doctrine. Therefore, it must be able to retaliate effectively after absorbing a nuclear attack.
- **Multiple Targets with Fewer Missiles:** A MIRV-equipped missile allows even a limited number of surviving missiles to strike multiple targets.

- **Survivable Deterrence:** This strengthens the credibility of India's second-strike capability.

Complicating Enemy Missile Defence

- **Multiple Incoming Warheads:** A MIRV missile releases several warheads, forcing the adversary to detect, track and intercept many targets simultaneously.
- **Defence Saturation:** This can overwhelm missile defence systems.
- **Strategic Advantage:** It improves the chance that some warheads will penetrate enemy defences.

Enhancing Strategic Reach

- Long-range Agni missiles with MIRV capability can cover major strategic targets in India's neighbourhood, especially in the context of China's growing missile and nuclear modernisation.

Thus, MIRV gives India greater deterrent value without necessarily expanding missile numbers excessively.

f. MIRV and India's Nuclear Doctrine

India's Nuclear Doctrine

India's nuclear doctrine is based on:

- Credible minimum deterrence
- No First Use
- Massive retaliation
- Civilian political control

Fit within Doctrine

- **Credibility of Retaliation:** MIRV strengthens the ability to retaliate effectively after a nuclear attack.
- **Limited but Effective Arsenal:** It allows India to maintain a smaller but more effective nuclear force.
- **Defensive Posture:** MIRV does not necessarily imply aggressive nuclear posturing. It can be understood as a technological upgrade to preserve deterrence.

Therefore, MIRV capability fits within India's doctrine of credible minimum deterrence if managed with restraint.

g. Strategic Significance for India

China Factor

- **Advanced Chinese Capabilities:** China possesses advanced missile, nuclear, space and hypersonic capabilities.
- **Long-Range Deterrence:** MIRV strengthens India's ability to deter China by improving long-range strike credibility.
- **Strategic Balance:** It helps India respond to China's growing strategic modernisation.

Pakistan Factor

- **Nuclear and Tactical Systems:** Pakistan has developed tactical nuclear weapons and diverse delivery systems.
- **Deterrent Signal:** India's MIRV capability signals that any nuclear escalation would invite severe consequences.

Indian Ocean Region

- **Wider Strategic Reach:** The test also reflects India's ability to project strategic capability across wider maritime spaces.
- **Regional Security Role:** It reinforces India's role as a major security actor in the Indian Ocean Region.

h. Technological Significance

- **Advanced Missile Technology:** MIRV requires mastery over long-range propulsion, accuracy, navigation and payload management.
- **Warhead Miniaturisation:** Multiple warheads can be carried only when warhead design becomes compact and technologically advanced.
- **Re-Entry Technology:** Each warhead must survive extreme heat and pressure while re-entering the atmosphere.
- **Precision Targeting:** Each re-entry vehicle must reach its target independently and accurately.
- **Indigenous Capability:** Successful MIRV development shows that India is moving from basic missile capability towards more sophisticated strategic systems.

This reflects the growing maturity of India's defence technology ecosystem.

i. Role of DRDO and Defence Indigenisation

- **DRDO's Role:** The Agni missile system has been developed by DRDO laboratories with support from Indian industries.
- **Public-Private Collaboration:** Such technologies require collaboration among research institutions, public sector units, private industry and specialised suppliers.
- **Atmanirbhar Bharat in Defence:** MIRV capability strengthens the objective of Atmanirbhar Bharat by reducing dependence on foreign suppliers.
- **Strategic Autonomy:** Indigenous missile technology gives India greater freedom in defence planning and strategic decision-making.

Thus, MIRV capability is both a strategic achievement and an indigenisation milestone.

j. Concerns and Challenges

- **Risk of Regional Arms Race:** China and Pakistan may respond with further missile and nuclear modernisation, increasing strategic competition in Asia.
- **Crisis Instability:** MIRV missiles are high-value strategic assets. During a crisis, their presence may generate suspicion or pressure for early escalation.
- **Command and Control Complexity:** Multiple-warhead systems require reliable communication, authorisation, targeting and safety mechanisms.
- **Cost Factor:** MIRV-equipped missiles require advanced technology, secure deployment, testing and maintenance.
- **Misinterpretation of Strategic Signalling:** Missile tests are meant to demonstrate capability, but adversaries may interpret them as aggressive posturing.

Therefore, MIRV capability must be accompanied by mature doctrine, disciplined communication and stable command systems.

k. India's Balancing Approach

- **Security Requirement:** India must maintain credible deterrence against nuclear-armed neighbours.

- **Strategic Restraint:** At the same time, India must avoid unnecessary arms racing and preserve its image as a responsible nuclear power.
- **Defensive Doctrine:** India's approach should remain defensive, credible and restrained rather than expansionist or provocative.
- **Political Control:** Civilian political control over nuclear weapons must remain central to India's nuclear posture.

This balance is essential for combining security preparedness with strategic responsibility.

1. Way Forward

Strengthen Credible Minimum Deterrence

- India should maintain a survivable, reliable and modern nuclear force without excessive weaponisation.

Improve Second-Strike Capability

Second-strike credibility should be strengthened through:

- Nuclear submarines
- Mobile missile systems
- Hardened command structures
- Secure communication networks

Promote Indigenous R&D

- India should continue investing in DRDO, private industry, start-ups and academic institutions for missile technology, sensors, guidance systems and strategic platforms.

Maintain Strategic Restraint

- India should continue presenting itself as a responsible nuclear power committed to defensive deterrence.

Strengthen Command and Control

- Robust nuclear command mechanisms are essential to prevent accidental escalation, unauthorised use and strategic miscalculation.

A strong deterrent must be technologically capable, doctrinally restrained and politically controlled.

Conclusion

The successful test of an Agni missile with MIRV capability marks a major step in India's strategic missile programme. It enhances nuclear deterrence, strengthens second-strike capability and demonstrates India's growing competence in indigenous defence technology.

However, such capability must be managed carefully. India's long-term security lies not merely in possessing advanced weapons, but in integrating them within a responsible doctrine of credible minimum deterrence, No First Use, strategic restraint and stable command and control.

In a complex regional security environment, MIRV capability strengthens India's deterrence. Its true value, however, will depend on disciplined deployment, technological reliability and mature strategic signalling.

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