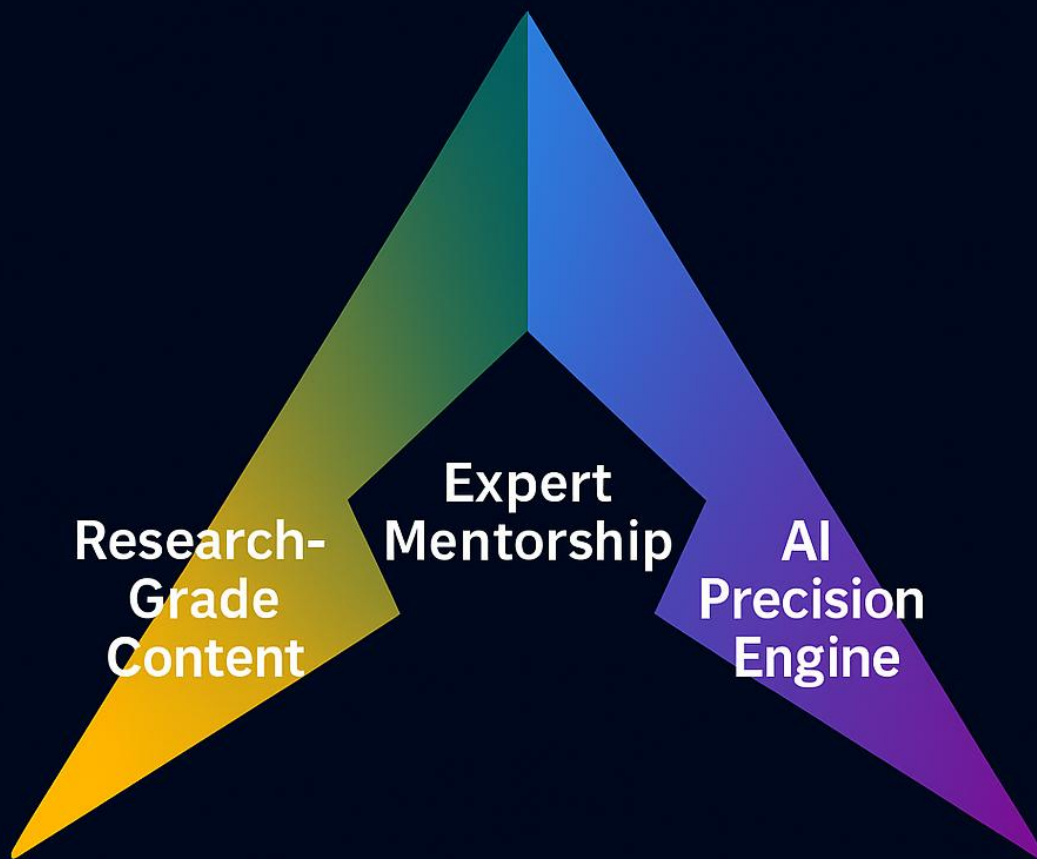


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GS Paper II: Current Affairs

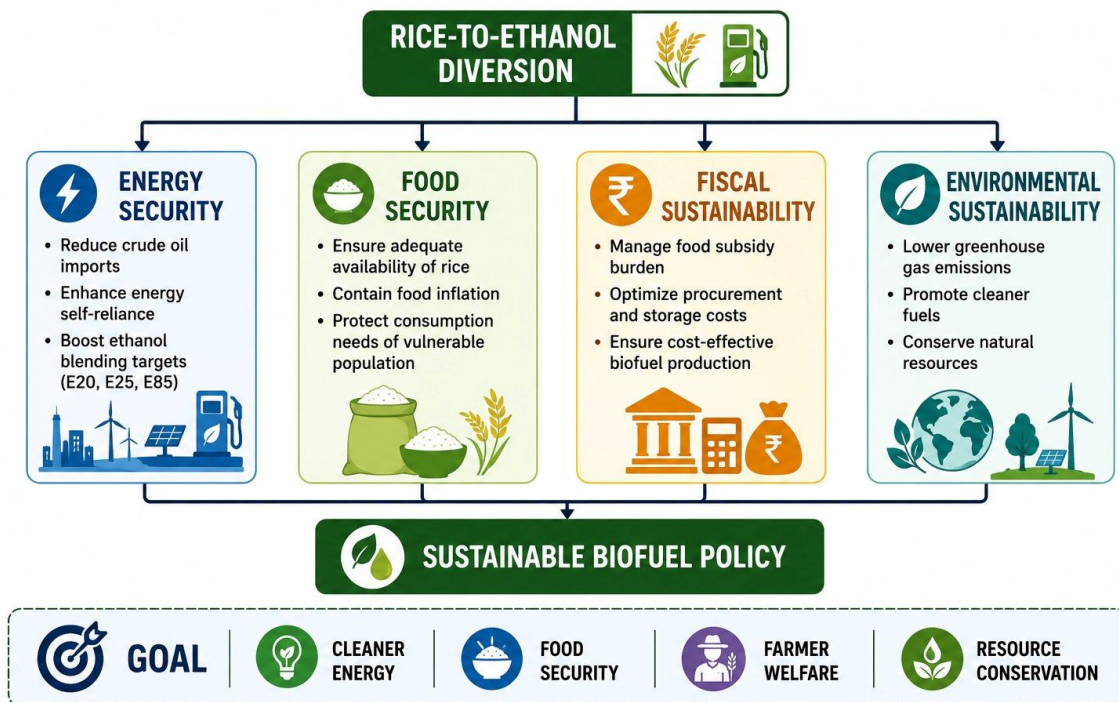
1. Rice-to-Ethanol Diversion: Balancing Energy Security with Food and Environmental Sustainability

a. Introduction

India's transition towards cleaner fuels has made ethanol blending a key component of its energy security strategy. The Ethanol Blended Petrol (EBP) Programme seeks to reduce dependence on imported crude oil, lower greenhouse gas emissions and provide an additional market for agricultural produce. However, the diversion of Food Corporation of India (FCI)-procured rice for ethanol production has revived an important policy debate regarding the balance between energy security, food security, fiscal sustainability and environmental conservation.

The issue illustrates the complex trade-offs involved in designing biofuel policies in a country where agriculture simultaneously supports livelihoods, food security and industrial development.

RICE-TO-ETHANOL DIVERSION: BALANCING NATIONAL PRIORITIES



b. Background Context

India has diverted nearly 5 million tonnes of FCI-procured rice for ethanol production to support the expansion of ethanol blending in petrol. The policy aims to utilise surplus foodgrain stocks more productively while strengthening domestic energy security.

However, the use of foodgrains for fuel production has generated concerns regarding the efficient utilisation of scarce natural resources, fiscal costs and the long-term sustainability of India's agricultural support system.

While ethanol blending offers important strategic advantages, its economic and environmental implications require careful evaluation.

c. Significance of Ethanol Blending

Energy Security

- Reduces dependence on imported crude oil.
- Diversifies India's energy basket.
- Enhances resilience against global oil price volatility.

Climate Benefits

- Promotes renewable transport fuels.
- Contributes to lower greenhouse gas emissions from the transport sector.
- Supports India's climate commitments.

Farmer Income

- Creates an additional market for agricultural produce.
- Encourages investment in the domestic biofuel industry.
- Diversifies income opportunities for farmers.

Circular Bioeconomy

- Converts agricultural biomass into productive energy.
- Encourages better utilisation of surplus feedstocks.

Despite these advantages, the diversion of foodgrains for ethanol production raises important economic concerns.

d. Economic Concerns

Rising Fiscal Burden

- FCI procures rice at Minimum Support Price (MSP) and incurs expenditure on procurement, storage and distribution.
- Sale of subsidised rice for ethanol production increases the government's fiscal burden.

Distorted Cropping Incentives

- Open-ended procurement under the MSP system encourages continued paddy cultivation even in ecologically unsuitable regions.
- This contributes to the accumulation of surplus foodgrain stocks.

Resource Misallocation

Agricultural subsidies relating to:

- Electricity.
- Fertilisers.
- Irrigation.
- Procurement.

often encourage water-intensive crops irrespective of local agro-climatic conditions.

Opportunity Cost

Using foodgrains for fuel raises questions regarding whether scarce public resources could be deployed more efficiently for food security or agricultural diversification.

The economic concerns are closely linked with significant environmental implications.

e. Environmental Concerns

High Water Consumption

- Paddy cultivation is among the most water-intensive agricultural activities.
- Intensive rice cultivation places severe pressure on groundwater resources, particularly in north-western India.

Groundwater Depletion

- Continued dependence on flood irrigation accelerates groundwater extraction.
- Long-term agricultural sustainability is adversely affected.

Greenhouse Gas Emissions

- Paddy cultivation generates substantial methane (CH₄) emissions.
- Excessive application of nitrogen fertilisers contributes to nitrous oxide (N₂O) emissions.
- Both gases have high global warming potential.

Unsustainable Cropping Patterns

Persistent policy incentives favour paddy cultivation, discouraging the adoption of:

- Less water-intensive crops.
- Climate-resilient farming systems.

These environmental challenges highlight the need for better coordination among agriculture, food and energy policies.

f. Governance Challenges

Feedstock Selection

- Excessive dependence on foodgrains limits flexibility in the biofuel programme.
- Diversified feedstocks improve long-term sustainability.

Policy Coordination

Effective biofuel policy requires convergence among:

- Agricultural policy.
- Food security policy.
- Energy policy.
- Water management.
- Climate policy.

Weak coordination may create unintended inefficiencies across sectors.

Balancing Multiple Objectives

Government policy must simultaneously ensure:

- Farmer welfare.
- Energy security.
- Food security.
- Environmental sustainability.
- Fiscal prudence.

Addressing these governance challenges requires a diversified and sustainable biofuel strategy.

g. Way Forward

Diversify Biofuel Feedstocks

- Increase reliance on:
 - Maize.
 - Agricultural residues.
 - Second-generation (2G) biofuels.
 - Other non-food biomass.
- Reduce dependence on foodgrains.

Promote Crop Diversification

- Encourage cultivation of less water-intensive crops in water-stressed regions.
- Provide:
 - Market support.
 - Extension services.
 - Appropriate incentives.

Rationalise Agricultural Subsidies

- Gradually reform input subsidies.
- Strengthen direct income support mechanisms that improve farmer welfare without encouraging environmentally unsustainable production.

Improve Procurement Policies

- Periodically review procurement requirements.
- Prevent excessive stock accumulation.
- Improve fiscal sustainability of the food management system.

Strengthen Sustainable Biofuel Policy

Align ethanol production with:

- Food security.
- Water availability.
- Climate objectives.
- Long-term resource sustainability.

Conclusion

India's ethanol programme represents an important step towards cleaner energy and reduced import dependence, but its long-term success will depend on maintaining an appropriate balance between energy security, food security, fiscal prudence and environmental sustainability. A diversified biofuel strategy based on non-food feedstocks, efficient water use, crop diversification and second-generation biofuels will enable India to advance its energy transition while safeguarding agricultural sustainability and natural resources.

GS Paper III: Economics

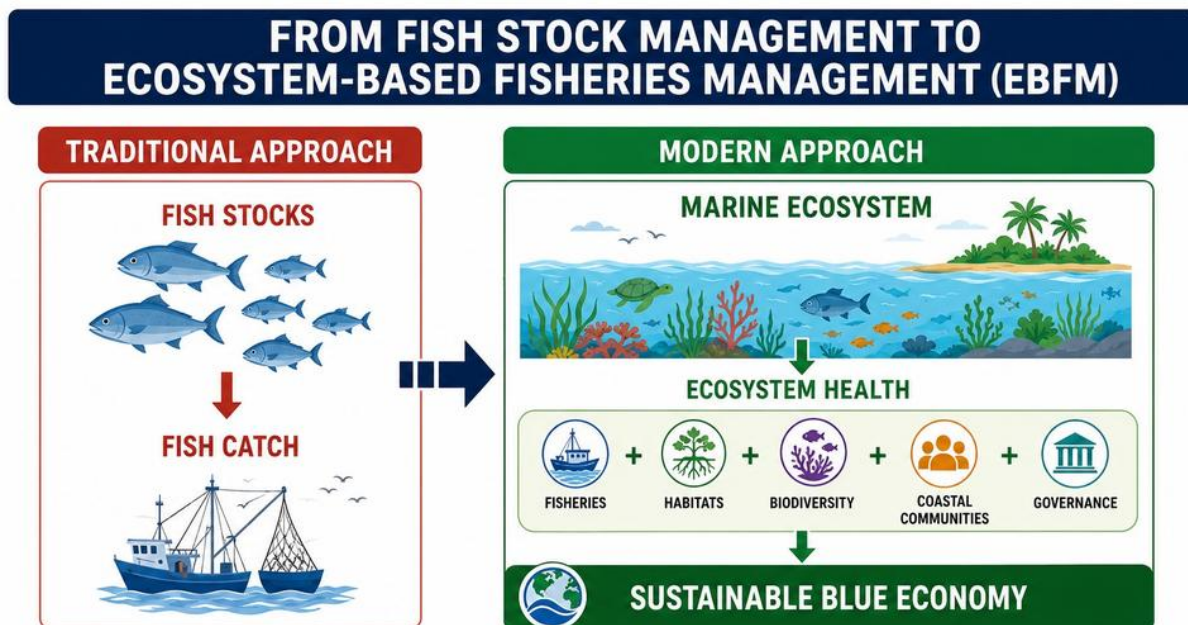
2. Sustainable Marine Fisheries: Beyond Fish Stocks to Ecosystem Governance

a. Introduction

Marine fisheries constitute a vital pillar of India's Blue Economy, supporting food security, livelihoods, exports and coastal development. India is among the world's leading marine fish producers, and millions of fishers and fish workers depend directly or indirectly on marine resources for their

livelihoods. However, the sustainability of fisheries depends not only on the abundance of fish stocks but also on the health of marine ecosystems that sustain them.

The Government of India has stated that over 90% of the assessed marine fish stocks are sustainable. At the same time, experts and international organisations have raised concerns regarding the degradation of India's inshore marine ecosystems, highlighting the need to move from a stock-centric approach towards ecosystem-based fisheries management.



b. Background Context

India possesses a coastline of more than 7,500 km, an Exclusive Economic Zone (EEZ) of over 2 million sq. km, and rich marine biodiversity that supports fisheries and other ocean-based economic activities.

Marine fisheries contribute significantly to:

- Food and nutritional security.
- Livelihoods of coastal communities.
- Export earnings.
- Employment generation.
- Blue Economy development.

However, increasing fishing intensity, mechanisation, habitat degradation and climate change have raised concerns regarding the long-term sustainability of marine ecosystems. While official assessments indicate that most assessed fish stocks remain sustainable, the Food and Agriculture Organization (FAO) notes that many commercially important marine fisheries are already fully exploited, leaving limited scope for expanding marine capture fisheries.

These developments underline the need to evaluate fisheries not merely through fish landings but through the overall health of marine ecosystems.

c. Key Issues

Ecological Stress in Inshore Waters

- Productive coastal fishing grounds are experiencing increasing environmental stress.
- Habitat degradation is reducing ecosystem resilience.

Expansion of Mechanised Trawling

- Rapid mechanisation has intensified fishing pressure.
- Bottom trawling has significantly affected near-shore ecosystems.
- Competition for marine resources has increased.

Limited Scientific Assessment

- Fisheries assessments largely rely on:
 - Landing statistics.
 - Catch data.
- Comprehensive ecosystem-based assessments remain relatively limited.
- Long-term sustainability therefore remains a subject of scientific debate.

These structural issues have resulted in multiple ecological, economic and governance challenges.

d. Major Challenges

Coastal Ecosystem Degradation

- Bottom trawling disturbs seabed habitats.
- Damages benthic ecosystems.
- Destroys breeding and nursery grounds.
- Weakens long-term fish stock regeneration.

Excess Fishing Capacity

- Larger mechanised fleets.
- Higher engine power.
- Improved fishing efficiency.

These developments have increased pressure on marine resources in several coastal regions.

Livelihood Conflicts

- Mechanised vessels increasingly compete with traditional fishers.
- Near-shore fishing grounds become less productive.
- Economic insecurity among artisanal fishing communities increases.

Weak Enforcement

- Coastal fishing regulations are not uniformly enforced.
- Limited surveillance and monitoring reduce regulatory effectiveness.

Climate and Environmental Pressures

Marine ecosystems are increasingly affected by:

- Coastal pollution.
- Mangrove destruction.
- Seagrass degradation.
- Altered river flows.
- Habitat loss.
- Climate change.

These factors reduce marine productivity and ecosystem resilience.

These challenges demonstrate that healthy ecosystems are indispensable for sustainable fisheries.

e. Why Sustainable Fisheries Matter

Food and Nutritional Security

- Fish provide an important source of affordable animal protein.
- Coastal populations are particularly dependent upon fisheries for nutrition.

Livelihood Security

- Fisheries support millions of:
 - Fishers.
 - Fish workers.
 - Processing industries.
 - Ancillary occupations.
- Sustainable fisheries strengthen rural employment and coastal economies.

Blue Economy

Healthy marine ecosystems support:

- Fisheries.
- Tourism.
- Coastal shipping.
- Marine biotechnology.
- Ocean-based industries.

They therefore form the ecological foundation of India's Blue Economy.

Biodiversity Conservation

Sustainable fisheries:

- Protect marine biodiversity.
- Preserve ecosystem services.
- Improve climate resilience.
- Support intergenerational equity.

Achieving these objectives requires a transition towards ecosystem-based governance rather than focusing exclusively on fish harvests.

f. Way Forward

Adopt Ecosystem-Based Fisheries Management (EBFM)

- Manage fisheries together with marine ecosystems.
- Protect habitats alongside fish populations.
- Integrate ecological, economic and social considerations.

Strengthen Scientific Monitoring

- Expand:
 - Marine stock assessments.
 - Ecosystem surveys.
 - Ocean observation systems.
- Complement catch-based assessments with ecological indicators.

Regulate Mechanised Fishing

- Enforce coastal fishing zones.
- Limit unsustainable fishing effort.

- Promote responsible fishing practices.

Restore Coastal Ecosystems

Prioritise conservation of:

- Mangroves.
- Estuaries.
- Seagrass beds.
- Coral reefs.

These habitats are critical breeding and nursery grounds for marine species.

Empower Coastal Communities

- Promote:
 - Community-based fisheries management.
 - Sustainable fishing technologies.
 - Livelihood diversification.
- Reduce pressure on marine resources while improving resilience.

Strengthen Cooperative Governance

- Improve coordination between:
 - Union Government.
 - State Governments.
 - Scientific institutions.
 - Coastal communities.
- Enhance surveillance, monitoring and enforcement capacity.

Conclusion

The long-term sustainability of India's marine fisheries depends on protecting the ecosystems that sustain fish populations, rather than focusing exclusively on fish harvests. An integrated approach combining scientific stock assessment, ecosystem conservation, sustainable fishing practices, community participation and effective governance will enable India to strengthen its Blue Economy while safeguarding marine biodiversity, coastal livelihoods and food security for future generations.

GS Paper III: Security

3. Artificial Intelligence, Autonomy and Algorithmic Warfare: Transforming Modern Military Operations

a. Introduction

Artificial Intelligence (AI) is rapidly transforming the character of warfare. Modern battlefields increasingly rely on AI-enabled decision support, autonomous platforms, cyber capabilities, electronic warfare, satellite networks and real-time data fusion rather than conventional firepower alone. Recent conflicts in Ukraine, Iran and Venezuela illustrate how technological superiority is becoming as decisive as numerical military strength.

These developments indicate that future military advantage will depend on the ability to collect, process, analyse and act upon information faster than the adversary. Consequently, military modernisation is shifting from platform-centric warfare towards data-centric and algorithm-driven operations, making Artificial Intelligence a strategic enabler of national security.

b. Background Context

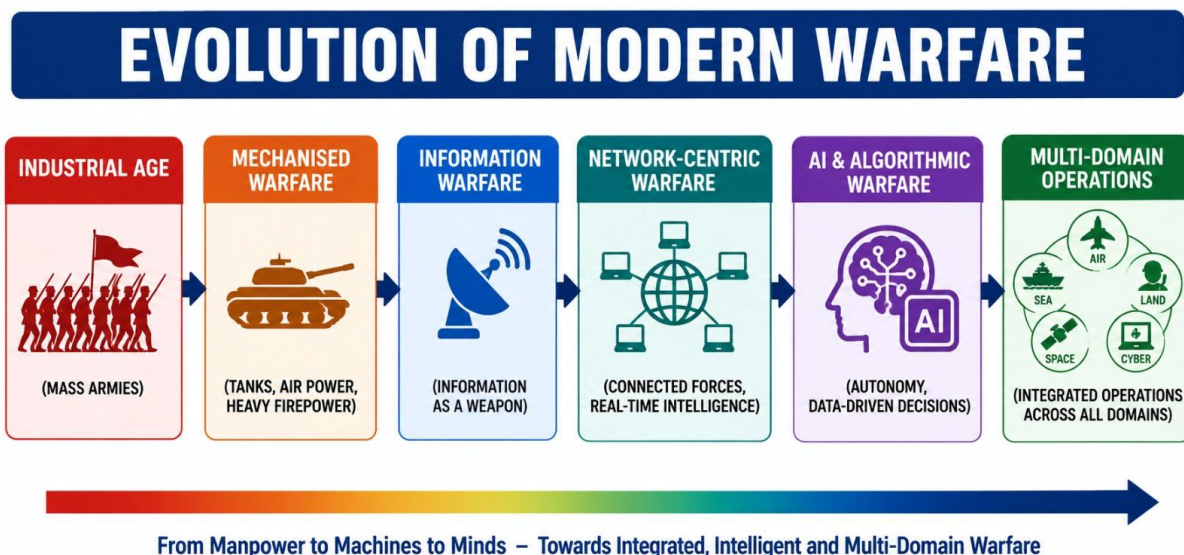
The evolution of warfare has moved from industrial-age mass mobilisation to information-age precision warfare. Artificial Intelligence, autonomous systems, satellite constellations, cloud computing, secure communications and advanced sensors are increasingly integrated with conventional military platforms.

Rather than replacing traditional weapons, these technologies are redefining how armed forces:

- Collect intelligence.
- Analyse battlefield information.
- Coordinate operations.
- Allocate resources.
- Execute precision strikes.
- Sustain operational superiority.

Military effectiveness therefore depends not only on weapon systems but also on the ability to integrate multiple technologies into a unified operational framework.

This technological transformation is reflected in several emerging trends that are reshaping military operations across the world.



c. Emerging Trends in Modern Warfare

AI-Enabled Battlefield Management

- Artificial Intelligence integrates information from:
 - Satellites.
 - Drones.
 - Radars.
 - Electronic sensors.
 - Intelligence platforms.
- Improves real-time situational awareness and operational decision-making.

Autonomous and Semi-Autonomous Systems

- Drones increasingly perform:
 - Surveillance.
 - Reconnaissance.
 - Logistics.
 - Electronic warfare.
 - Precision strike missions.

- Reduce risks to military personnel while expanding operational reach.

Algorithmic Warfare

- Artificial Intelligence assists commanders by:
 - Processing large datasets.
 - Identifying targets.
 - Prioritising threats.
 - Allocating resources.
 - Supporting mission planning.
- Improves the speed and quality of operational decisions.

Software-Defined Military Capabilities

- Modern military effectiveness increasingly depends upon:
 - Software.
 - Secure communication networks.
 - Data processing.
 - Cloud-enabled command systems.
- Hardware superiority alone is no longer sufficient.

These developments significantly enhance military capability but also redefine the strategic significance of Artificial Intelligence in warfare.

d. Strategic Significance

Accelerated Decision-Making

- AI rapidly processes vast quantities of battlefield information.
- Shortens the sensor-to-shooter cycle.
- Enables faster operational response.

Force Multiplication

- Autonomous systems undertake repetitive and hazardous missions.
- Improve operational efficiency while reducing human risk.
- Expand surveillance and reconnaissance capabilities.

Greater Precision

- AI improves target identification.
- Supports precision engagement.
- Helps reduce unintended collateral damage.

Network-Centric Warfare

Artificial Intelligence strengthens integration among:

- Sensors.
- Intelligence platforms.
- Communication systems.
- Command centres.
- Weapon systems.

This enhances joint operational effectiveness across all domains.

Multi-Domain Operations

Modern military operations increasingly integrate:

- Land.
- Air.

- Maritime.
- Cyber.
- Space.
- Electromagnetic spectrum.

Artificial Intelligence serves as the coordinating backbone across these domains.

While these technologies create strategic advantages, they also present significant challenges for India's defence preparedness.

e. Challenges for India

Technological Dependence

- Continued dependence on imported:
 - Advanced semiconductors.
 - AI processors.
 - High-performance computing hardware.
- Creates strategic vulnerabilities.

Limited Indigenous AI Ecosystem

India requires stronger domestic capabilities in:

- Defence AI models.
- Secure defence software.
- Trusted computing infrastructure.
- Military datasets.

Cyber and Electronic Warfare Risks

Increasing military connectivity expands vulnerability to:

- Cyberattacks.
- Electronic warfare.
- GPS spoofing.
- AI-enabled misinformation.
- Communication disruption.

Ethical and Legal Issues

Growing autonomy raises questions regarding:

- Meaningful human control.
- Accountability.
- Compliance with International Humanitarian Law.
- Responsibility for lethal decisions.

Doctrinal Transformation

Rapid technological change requires continuous adaptation of:

- Military doctrine.
- Procurement systems.
- Force structures.
- Training methodologies.

Addressing these challenges requires sustained investment in indigenous capability development and institutional reforms.

f. Way Forward

Accelerate Indigenous AI Development

- Strengthen Atmanirbhar Bharat in defence.
- Promote indigenous AI-enabled military technologies.
- Reduce strategic dependence on external suppliers.

Strengthen Defence Innovation Ecosystem

Enhance collaboration among:

- Armed Forces.
- Defence Research and Development Organisation (DRDO).
- Startups.
- Academic institutions.
- Private industry.

Build Sovereign AI Infrastructure

Develop:

- Defence-specific datasets.
- Trusted computing platforms.
- Secure AI models.
- Indigenous cloud infrastructure.

to support military applications.

Strengthen Counter-Technologies

Prioritise investment in:

- Counter-drone systems.
- Electronic warfare.
- Cyber defence.
- Secure communications.
- Space-based surveillance.

Ensure Human Oversight

Adopt a Human-in-the-Loop (HITL) approach for all critical decisions involving the use of lethal force.

Maintain meaningful human judgement and accountability.

Modernise Military Doctrine

Integrate Artificial Intelligence into:

- Multi-domain operations.
- Joint operational planning.
- Military education.
- Procurement strategies.

Conclusion

Artificial Intelligence is not replacing conventional military power; it is multiplying its effectiveness by enabling faster decisions, greater precision and integrated multi-domain operations. For India, the challenge is to build indigenous, secure and trustworthy AI capabilities while maintaining meaningful human control over critical military decisions. A balanced strategy combining AI innovation, cyber resilience, indigenous technology development and doctrinal transformation will be essential for strengthening India's defence preparedness in the era of algorithmic warfare.

Reader's Note — About This Current Affairs Compilation

Dear Aspirant,

This document is part of the PrepAlpine Current Affairs Series — designed to bring clarity, structure, and precision to your daily UPSC learning.

While every effort has been made to balance depth with brevity, please keep the following in mind:

1. Orientation & Purpose

This compilation is curated primarily from the UPSC Mains perspective — with emphasis on conceptual clarity, analytical depth, and interlinkages across GS papers.

However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

2. Content Length

Some sections may feel shorter or longer depending on topic relevance and news density. To fit your personal preference, you may freely resize or summarize sections using any LLM tool (ChatGPT, Gemini, Claude, etc.) at your convenience.

3. Format Flexibility

The formatting combines:

- paragraphs
- lists
- tables
- visual cues

—all optimised for retention.

If you prefer a specific style (lists → paras, paras → tables, etc.), feel free to convert using any free LLM.

4. Monthly Current Affairs Release

The complete Monthly Current Affairs Module will be released soon, optimized to a compact 100–150 pages — comprehensive yet concise, exam-ready, and revision-efficient.

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