2. India's Reach & Innovation - Science &Technology

India's Leap in Research and Innovation. India has launched the ₹1 lakh crore Research Development and Innovation (RDI) Scheme, managed under the Anusandhan National Research Foundation (ANRF), to boost private sector R&D in deep-tech sectors like AI and biotech. The scheme provides low-cost financing to address India's stagnant R&D spending (0.6-0.7% of GDP) and aims to achieve the "Viksit Bharat @ 2047" vision.

ESTIC 2025 and RDI Scheme Launch

The Research, Development and Innovation (RDI) Scheme was launched at the Emerging Science, Technology and Innovation Conclave (ESTIC) 2025 in New Delhi. The conclave brought together over 3,000 global experts. The theme was "Viksit Bharat 2047 – Pioneering Sustainable Innovation".

About the Research Development and Innovation (RDI) Scheme

Approval - Approved by the Union Cabinet, chaired by the Prime Minister.
Corpus - A significant fund of ₹1 lakh crore.
Aim - To strengthen India's research ecosystem by getting the private sector more involved in innovation.
Method - Providing long-term financing at low or zero interest rates.

Core Objectives

Private Sector R&D - Encourage private companies to increase R&D in strategic sectors like AI, biotechnology, and space technology to promote self-reliance.
Finance Big Projects - Support high-risk, high-impact projects that are close to market-ready (at advanced Technology Readiness Levels or TRLs).
Acquire Technology - Help India access strategic technologies needed for national growth.
Deep-Tech Fund of Funds (FoF) - Create a dedicated fund to support and grow deep-tech start-ups.

Institutional Framework

Governing Board of ANRF - Chaired by the Prime Minister; provides strategic guidance.
Executive Council (EC) of ANRF - Approves scheme guidelines and recommends fund managers.
Empowered Group of Secretaries (EGoS) - Led by the Cabinet Secretary; approves scheme changes, defines eligible sectors, and monitors performance.
Nodal Department - The Department of Science and Technology (DST) will be the implementing agency.

Two-Tier Funding Framework

Special Purpose Fund (SPF) - Set up within the Anusandhan National Research Foundation (ANRF), this fund holds the ₹1 lakh crore and allocates it.
Second-Level Fund Managers - These entities receive money from the SPF and provide long-term concessional loans or equity financing, especially to startups and deep-tech companies.

Expected Impact

Stimulates Private R&D - Fills funding gaps and provides risk capital for industry-led innovation.
Advances Self-Reliance - Reduces India's dependence on imported technologies.
Drives Tech Leadership - Promotes cutting-edge innovation in AI, biotech, etc.
Enhances Global Competitiveness - Strengthens India's position as a global innovation hub.
Supports Viksit Bharat @ 2047 - Paves the way for a self-reliant, innovation-driven economy by recognizing the private sector's key role in research.

Analytical Insights - India's Research & Innovation Ecosystem

Key Challenges & Reforms

Challenge	Reform
Financial Risk Aversion (Private R&D investment is low, around 36%)	The ₹1 lakh crore RDI Scheme offers long-term, low-interest financing for high-risk projects (AI, biotech, space).

Low R&D Translation (Research is slow to become market-ready products)	Focus on enhancing Technology Readiness Levels (TRLs) to bridge the research-to-commercialization gap.
Fragmented Funding (Dispersed R&D funding weakens coordination)	The ANRF's two-tier funding system ensures streamlined resource allocation through second-level fund managers.

Implementation Watchpoints

Bureaucratic Coordination - Decision-making must be simplified across the ANRF Board, EC, and EGoS to ensure efficiency.

Selection Bias - Must guard against conventional bias and promote deep-tech innovation through independent evaluation.

Fiscal Sustainability - The ₹1 lakh crore corpus must be maintained through private co-funding and global partnerships.

Deep-Tech Fund of Funds (FoF) - Strategic Catalyst

Purpose - To support deep-tech startups and innovation-driven enterprises.

Approach - Uses private sector expertise in equity/debt to finance high-growth, high-risk ventures.

Outcome - Strengthens India's deep-tech ecosystem while minimizing government micro-management.

India's R&D Expenditure and Growth Trends

Gross Expenditure on R&D (GERD) - Increased from ₹60,196.75 crore (2010–11) to ₹1,27,380.96 crore (2020–21).

GERD as % of GDP - Remained stagnant at 0.6–0.7%, which is below the global average of 2–3%.

GDP Context - India's GDP grew 2.5 times in the same period, which is why the GERD ratio remained low even as spending increased.

Sectoral Contribution -

Government - ~64% of R&D spending.

Private Sector - ~36% of R&D spending.

This is the opposite of major economies (China, South Korea, USA) where the private sector contributes over 70%.

Per Capita R&D Spending - Increased from PPP$ 29.2 (2007–08) to PPP$ 42.0 (2020–21).

Human Capital - India ranks 3rd globally in doctorates awarded (40,813 in 2018–19), with 60% in Science and Technology.

Innovation Growth - Patents filed rose sharply from 24,326 (2020–21) to 68,176 (2024–25).

Institutional and Policy Framework for Innovation in India

Anusandhan National Research Foundation (ANRF) - Established by the ANRF Act, 2023 (operational from Feb 2024). Aims to mobilize ₹50,000 crore (2023–28), with ₹14,000 crore from the government and the rest from industry. Focuses on linking academia and industry.

National Geospatial Policy, 2022 -Aims to make India a global leader in the geospatial sector by 2035. Liberalizes access to geospatial data. Targets a high-resolution topographical survey by 2030.

Indian Space Policy, 2023 - Provides a unified framework for the space sector. Enables private sector participation. Establishes IN-SPACe as the nodal agency to authorize private space activities.

BioE3 Policy, 2024 (Biotechnology for Economy, Environment and Employment) - Approved in August 2024. Focuses on biomanufacturing, Bio-AI, and a circular bioeconomy. Addresses challenges like climate change and food security.

Atal Innovation Mission (AIM) 2.0 - Launched in 2016 under NITI Aayog, continued until March 2028. A flagship initiative for innovation and entrepreneurship. Includes Atal Tinkering Labs (ATLs) in schools and Atal Incubation Centres (AICs) in universities.

Research and Infrastructure Strengthening Schemes

1. **FIST -** Strengthens S&T infrastructure in universities.
2. **SAIF & SATHI -** Provide access to advanced analytical facilities.
3. **CURIE -** Builds research capacity in women's universities.
4. **PURSE -** Supports high-quality university research.

5. **PAIR -** ANRF-led "hub-and-spoke" model pairing new and established institutions.
6. **DBT-BUILDER -** Enhances interdisciplinary life science research.
7. **Vigyan Dhara Scheme -** Central Sector Scheme to promote S&T capacity building.

Outcome - Together, these initiatives aim to create an inclusive, innovative ecosystem for self-reliance and sustainable growth.

National Research and Innovation Frameworks

Key Missions

National Quantum Mission (NQM) - (2023, ₹6,000 crore) Aims to develop 50–1,000 qubit quantum computers and secure quantum communications.

National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) - (2018, ₹3,660 crore) Promotes AI, robotics, and IoT through 25 Technology Innovation Hubs (TIHs).

National Supercomputing Mission (NSM) - (Jointly by DST & MeitY) Establishes a network of 70+ high-performance computing (HPC) facilities for AI research, weather modeling, etc.

National Deep Tech Startup Policy (NDTSP) - (Proposed) To foster startups in frontier tech like semiconductors and quantum.

India Semiconductor Mission (ISM) - (2021, ₹76,000 crore) To develop a semiconductor and display manufacturing ecosystem.

Digital Open Manufacturing (DOM) Initiative - Helps SMEs and startups access digital manufacturing platforms (Industry 4.0).

IndiaAI Mission - (2024, ₹10,371.92 crore) To build a national AI ecosystem, including compute platforms and startup financing.

National Mission on Advanced Materials - (Proposed 2024) R&D in novel materials (graphene, nanomaterials) for defence, space, and energy.

Digital Public Infrastructure (DPI)

Unified Payments Interface (UPI) - (2016) Facilitates instant payments, with over 12 billion monthly transactions (2025).

Co-WIN Platform - Managed COVID-19 vaccination (over 2 billion doses).

DigiLocker - Cloud-based repository for secure digital documents.

Aadhaar-enabled eKYC and Direct Benefit Transfer (DBT) - Ensures transparent welfare delivery, saving over ₹2.7 lakh crore.

India Stack and DEPA - The backbone for secure, consent-based data sharing; this model is now being adopted by other countries via the India–UNDP Global DPI Partnership.

Summary - The National Missions and DPI are the "twin engines" of India's innovation-led growth.

Challenges in India's Research and Innovation Ecosystem

Private Sector Investment Deficit - Private R&D investment remains low at ~36%.

Fragmented Infrastructure - Low-tech adoption and inconsistent data systems (especially in agriculture) hinder new tech like AI.

Financial Constraints - Limited access to financing and risk aversion from the private sector.

Low R&D Intensity - India's R&D spend (0.6-0.7% of GDP) is below the global average, with weak academia-industry collaboration.

Talent and Institutional Barriers - Research careers are seen as unattractive, and bureaucracy stifles innovation.

Innovation Depth - Lack of domestic ownership and commercialization of patents limits global competitiveness.

Way Forward

Increase R&D Intensity - Raise GERD to 2% of GDP or higher through stable, multi-year grants.

Encourage Private Sector Engagement - Expand the RDI corpus, offer tax credits for business R&D (BERD), and use co-funded challenge grants.

Enhance Technology Translation - Create IP acceleration funds, Technology Transfer Offices, and "sandboxed regulation" to test new solutions.

Strengthen Talent Development - Attract top talent through tenure-track hiring, global fellowships, and performance-based autonomy.

Globalization of Research Labs - Forge "big-science" partnerships in AI, quantum, and 6G, and lead in creating international standards.

Conclusion

India's innovation ecosystem is set to grow through the ₹1 lakh crore RDI Scheme, ANRF, and national missions. Strong policy and R&D investment are key to driving the Viksit Bharat @ 2047 vision.

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