



RESEARCH ECOSYSTEM IN INDIA - GS III MAINS

Q. India's research and development sector is still in the nascent stage. in this context, critically analyze the major challenges the sector is facing. (15 marks, 250 words)

News: *India's R&D funding, breaking down the numbers*

what's in the news?

- the announcement in the interim budget for 2024-25, of a corpus of ₹1 lakh crore to bolster the research and innovation ecosystem within the country, has sparked enthusiasm within the scientific and research communities.

Status of India's R&D:

1. gross expenditure on research and development:

- india's r&d is witnessing significant growth, with a notable increase in gerd from ₹6,01,968 million in 2010-11 to ₹12,73,810 million in 2020-21.
- however, with research and development investment as a percentage of gdp standing at 0.64%, india falls behind major developed and emerging economies such as china (2.4%), germany (3.1%), south korea (4.8%) and the united states (3.5%).

Comparison of research productivity and innovation metrics in selected countries (2021-22)

Country	Researchers per million inhabitants (2021) (FTE)	PhDs produced annually (2021) (Rank)	Publication output (2022) (Rank)	Top 1% most cited articles (% share)	Patents granted (2022) (Rank)
India	262	40,813 (3)	3,06,800 (3)	0.7	30,490 (6)
The U.S.	4,452	69,525 (1)	15,06,000 (1)	1.88	3,23,410 (2)
The U.K.	4,491	27,366 (5)	2,87,200 (4)	2.35	10,578 (15)
China	1,687	53,778 (2)	9,78,100 (2)	1.12	7,98,347 (1)
S. Korea	9,082	13,882 (11)	1,09,200 (16)	1.02	1,35,180 (4)
Japan	5,638	15,804 (10)	1,71,000 (9)	0.88	2,01,420 (3)

Source: Publications data has been extracted from OpenAlex on February 7, 2024.

2. academic talent:

- despite the comparatively lower share of gdp dedicated to r&d, india has emerged as a powerhouse in producing academic talent.



- annually, india generates an impressive 40,813 phds and is in third place after the united states and china.

3. research output:

- india's research output remains substantial, ranking third globally, with over 3,00,000 publications in 2022, highlighting the nation's robust research ecosystem and its commitment to advancing knowledge across diverse fields.

4. innovation:

- india also demonstrates commendable performance in patent grants, securing the sixth position globally with 30,490 patents granted in 2022.
- while this figure is lower compared to the u.s. and china, it underscores india's evolving innovation landscape and its potential for further growth in intellectual property creation.

5. major sponsors:

- in india, gerd is primarily driven by the government sector, including the central government (43.7%), state governments (6.7%), higher education institutions (heis) (8.8%), and the public sector industry (4.4%), with the private sector industry contributing only 36.4% during 2020–21.

6. investment in r&d:

- according to the r&d statistics (2022-23) of the department of science and technology, india's total investment in r&d reached \$17.2 billion in 2020-21.
- within this sum, 54% (\$9.4 billion) is allocated to the government sector and predominantly utilised by four key scientific agencies - the drdo (30.7%), the department of space (18.4%), icar (12.4%), and the department of atomic energy (11.4%).

major challenges in india's r&d:

1. private sector inertia:

- the contribution of private industries lags behind that of many other economies.
- at approximately \$6.2 billion, indian businesses represent 37% of the country's gerd, in contrast to the global trend, where business enterprises typically contribute over 65% of r&d.

2. low participation by higher education institutions (heis):

- heis play a comparatively minor role in the overall r&d investment, contributing 8.8% (\$1.5 billion).

3. brain drain:

- talented researchers often migrate to countries with better research infrastructure and funding opportunities.

4. inadequate education and training:



- the education system may not be fully equipping students with the necessary skills and knowledge to thrive in r&d.

5. bureaucratic hurdles:

- complex procedures and red tape can slow down research initiatives and discourage potential investors.

6. limited collaboration with academia:

- there's a gap between academic research and industry needs, hindering the transfer of knowledge and technology.

government measures:

1. change in approach:

- the decision to rebrand the slogan, 'jai jawan jai kisan' (by lal bahadur shastri) to 'jai jawan, jai kisan, jai vigyan' (a.b. vajpayee) to now 'jai jawan, jai kisan, jai vigyan, jai anusandhan' (by the prime minister) is intended to reinforce the foundation of research and innovation for development.

2. anusandhan national research foundation (anrf) act:

- the act aims to bridge india's persistent r&d investment gap while nurturing a robust research culture within heis.

3. national deep tech startup policy (ndtsp):

- ndtsp aims to support and nurture the unique requirements of deep tech startups in india, thereby enhancing the private sector's role in india's r&d ecosystem.

4. impacting research innovation & technology (imprint):

- it aims at providing solutions to the most relevant engineering challenges and translating knowledge into viable technology in 10 selected technology domains.

5. research parks:

- research parks at iit delhi, iit guwahati, iit kharagpur, iit kanpur, iit chennai, have been established which provide an interface between entrepreneurship and industry to establish their r&d units in collaboration with students & faculty members of the iits.

6. uchhatar avishkaryojana (uay):

- it promotes innovation of a higher order that directly impacts the needs of the industry and thereby improves the competitive edge of indian manufacturing.
- the project envisages collaboration between academia and industry – within or outside india.

measures needs to be taken:

1. collaborative approach:



- collaboration between the government, business enterprises and heis is essential to maximise the positive impact of science, technology, and innovation on economic growth and technological advancement.

2. promoting public-private partnerships:

- collaboration between academia and industry can bridge the gap between research and commercialization.

3. resource channelization:

- allocating resources to safeguard intellectual property and tackle technical obstacles can unlock untapped markets.

4. government subsidies to incentivise the private sector:

- government initiatives like tax breaks and grants can incentivize r&d spending in the private sector.
- india's r&d ecosystem could benefit more from strong private enterprises involvement and stronger industry-academia collaboration, facilitating knowledge transfer and fostering innovation.

5. focus on skill development:

- educational reforms emphasizing critical thinking, problem-solving, and research skills are crucial.

6. streamlining bureaucracy:

- simplifying procedures and regulations can expedite research projects and attract investments.

7. incentivizing innovation:

- government schemes and awards can recognize and reward innovative research endeavors.

india's technological and manufacturing aspirations hinge on a transformative shift in its r&d landscape. a multi-pronged approach involving diverse stakeholders is necessary to address the challenges and unlock the potential of r&d for india's economic growth and competitiveness.