Profit-Oriented Research and R&D Challenges in India

For Prelims: **Global Innovation Index 2024**, **Large language models**, **Chat GPT**, **World Intellectual Property Indicators 2024**, **Green hydrogen**, **National Quantum Mission**, **5G Technology**, **Vigyan Dhara Scheme**, **Rashtriya Vigyan Puraskar (RVP)**

For Mains: Challenges in India's R&D Ecosystem, Commercialization of Scientific Research,Status of Research and Development in India

Source: TH

Why in News?

In May 2024, **Google DeepMind** released **AlphaFold 3,** an **Artificial Intelligence (AI)** tool for **predicting protein structures.** Unlike its previous **open-source versions,** AlphaFold 3's full code was withheld, preventing scientists from fully understanding its workings or replicating its results.

- This decision has sparked discussions about the **growing influence of for-profit funding(**investors seeking profit**) in scientific research,** creating tensions between **transparency and intellectual property protection**, and highlighting challenges in India's research and development ecosystem.

How Does Commercialisation Influence Scientific Research?

- **Positive Impacts:**
  - **Funding and Resources:** For-Profit Companies fund research, providing access to advanced facilities and driving innovation, as seen in pharmaceutical trials like **Bharat Biotech's intranasal vaccine**.
  - **Faster Development:** Commercial incentives speed up technology development, with academia-industry collaboration driving breakthroughs in gene editing technologies like **CRISPR** advancing medicine and agriculture.
  - **Practical Applications:** Research with commercial backing often focuses on real-world applications, leading to **tangible benefits** such as medical breakthroughs or developments of new **large language models (LLM)** like **Chat GPT.**
- **Negative Impacts:**
  - **Global Inequality in Research Access**: Wealthier institutions have a **competitive edge,** while underfunded researchers **face innovation barriers.**
    - Limited open-source tools hinder access in low-resource settings.
  - **Blurred Lines Between Academia and Industry**: Increasing collaborations between corporations and universities **challenge traditional academic norms of openness and independence.**
    - Companies often use academic platforms to legitimize restricted discoveries, raising concerns about fairness and ethical practices.
  - **Trust and Scientific Integrity**: Open sharing of methodologies ensures robust testing and trust in scientific outputs, while withholding details creates a **"black box,"** which may

compromise the reliability and adoption of scientific advances.
- **Ethical Concerns:** Commercial pressures can sometimes lead to unethical practices, such as **exploiting Intellectual property (IP) patents, prioritizing profit over public good**, or compromising research integrity.

What Can be Done to Balance Transparency with Commercial Interests?

- **Open-Source Models with Enterprise Versions**: Researchers can share **foundational discoveries openly** while commercializing advanced applications for industry use (e.g., algorithms shared openly but bundled with proprietary tools).
  - Encouraging **public-private partnerships** enables researchers to maintain transparency while leveraging industry resources, with companies providing unrestricted funding for **broader research and reserving IP protections for specific commercial projects.**
- **Public Funding as a Catalyst**: Increased government funding reduces reliance on private sponsors, allowing more open research.
- **IP Laws and Secrecy:** Reform IP laws to balance commercial protection with scientific openness, enabling both innovation and public access.
  - Subsidies for essential commercial products (e.g., **Covid-19 vaccines**) can also ensure affordability while maintaining IP protection.
  - Policymakers should **establish guidelines to balance openness** with IP rights, promoting fair citation and transparency in funded research.
- **Rewards for Open Science:** Scientists prioritizing transparency should receive institutional support, funding, and recognition.

What is the Current Scenario of Research & Development(R&D) in India?

- **Global Innovation Index (GII)**: India's secured rank of 39th in the **GII 2024** among 133 economies underscores the country's increasing focus on R&D across sectors like biotechnology, space exploration, quantum technology, and renewable energy.
- **World Intellectual Property Indicators (WIPI):** According to the **WIPI 2024,** India holds the **6th position** in patents filed, demonstrating progress in innovation.
- **Scientific Publications:** As of 2022, India ranks **3rd globally in scientific publications** and scholarly output (**India's research output surged by 54% from 2017 to 2022),** highlighting its growing presence in global research.
- **Biotechnology**: India demonstrated its R&D prowess during the Covid-19 pandemic with the development of indigenous vaccines like **Covaxin.**
- **Renewable Energy**: India has made remarkable progress in renewable energy, especially **solar** and **green hydrogen** technologies, with record-low solar power costs and pioneering projects like the **Kayamkulam Floating Solar Power Plant.**
- **Quantum and Supercomputing Technologies**: India is also making strides in quantum technologies and supercomputing, with initiatives like the **National Quantum Mission** and the development of the **PARAM Siddhi-AI supercomputer.**
- **Telecommunications: India's Own 5G Technology(5Gi)** and **Bharat 6G Project**, are positioning India as a leader in telecommunications research.

What are the Challenges in India's R&D Ecosystem?

- **Low Budget Allocation**: India spends **less than 1% of its Gross Domestic Product (GDP) on R&D,** far below global averages like the US (2.8%), and China (2.1%). This hampers research infrastructure development and restricts high-impact research capacity.
- **Inclusivity Issues**: Socio-cultural barriers and **gender disparities** have led to a lack of inclusivity in India's R&D activities.
  - **Women, for example, are underrepresented in Science, Technology, Engineering and Mathematics (STEM)** fields and face hurdles in accessing research opportunities.
    - This not only limits the talent pool but also hinders diversity in research perspectives, which is crucial for fostering innovation.
- **Education System**: India's educational system faces challenges for R&D growth, **with low Ph.D.**

enrollment, and insufficient monitoring of research projects.
  - The focus on **rote learning and a disconnect between academics** and **industry needs** hinder the development of research skills.
- **Quality vs. Quantity:** India publishes many research papers, but their quality is a concern due to low citation rates.
- **Brain Drain**: India faces a significant **"brain drain," with top researchers migrating abroad for better opportunities.**
  - India has 216.2 researchers per million people, far behind China (1200) and the US (4300), due to low salaries, limited funding, and inadequate infrastructure, hindering R&D competitiveness.
- **Translating Research into Technology**: India struggles to **convert basic research into successful technologies due** to a focus on fundamental research, weak industry-academia ties, and inefficient technology transfer systems.

India's Initiatives Related to Research and Development

- **Vigyan Dhara Scheme**
- **Rashtriya Vigyan Puraskar (RVP)**
- **Science, Technology, and Innovation Policy 2020**
- **VAIBHAV Fellowship**
- **National Research Foundation**
- **AICTE - Research Promotion Scheme (RPS):** Introduced by **All India Council for Technical Education (AICTE)** in order to promote research in identified thrust areas of technical education.

Way Forward

- **Financial Support:** Encourage **sustainable funding for research** in educational institutions through private sector investments, public-private partnerships (PPPs), tax incentives, and the establishment of innovation clusters.
- **Address Brain Drain**: Implement "Reverse Brain Drain" initiatives and offer competitive salaries to retain top talent.
- **Education:** Reallocating government funds to increase investment in basic and applied research, along with proper implementation of the **National Education Policy, 2020,** will foster a conducive ecosystem for research and innovation in higher education.
- **Improve IPR and Innovation Culture:** India's patents are underutilized due to weak industry-academia links.
  - Enhancing IPR, fostering research in universities, and strengthening collaboration can bridge the gap between research and practical applications.
- **Promote Gender Inclusivity**: Launch programs and policies like **Vigyan Jyoti Scheme,** and **Knowledge Involvement Research Advancement through Nurturing (KIRAN)** to encourage women's participation in STEM.

> *Drishti Mains Question:*
>
> In the context of India's progress in R&D, discuss the challenges and opportunities in aligning commercial interests with the public good in scientific research.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims:

Q.1 Which of the following statements is/are correct regarding National Innovation Foundation-India (NIF)? (2015)

1. NIF is an autonomous body of the Department of Science and Technology under the Central Government.
2. NIF is an initiative to strengthen the highly advanced scientific research in India's premier scientific institutions in collaboration with highly advanced foreign scientific institutions.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Ans: (a)

Q.2 For outstanding contribution to which one of the following fields is Shanti Swarup Bhatnagar Prize given? (2009)

(a) Literature

(b) Performing Arts

(c) Science

(d) Social Service

Ans: (c)