

## ECONOMIC GROWTH AND SURVEY: SPOTLIGHTING ON PHARMACEUTICAL SCIENCES

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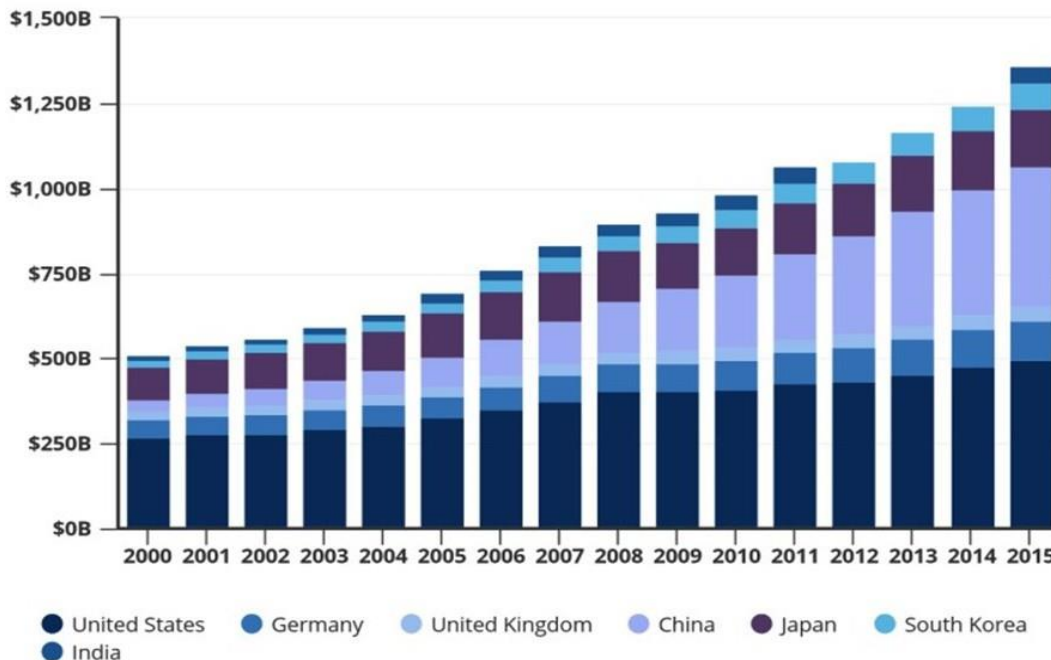
### ABSTRACT

Research and Innovation drive economic growth by fostering the development of new industrial, technologies, and products. It helps in new business establishment, attracting investments, generating employment opportunities, and enhancing productivity. In recent years R&D are rapidly increasing in various areas like advancements in Healthcare, Technology, Communication, Transportation, Education, Agriculture, Business, Entertainment industries, etc. Innovation is one of a driving force for a long term economic growth of country. Indian economy is one of the fastest growing economies in world. Innovation is very important to achieve long-term sustainable growth. The main aim of this paper is to analysis the role of R&D in the economic growth of India. Research and innovation helps the development of environmentally friendly technologies, promoting resource efficiency, and addressing climate change challenges. By investing in Research and Innovation, India can move towards a more sustainable and resilient future, ensuring long-term development and reducing negative environmental impacts. The GDP is the measurement of a countries economic growth. To increase the GDP, there are two ways: 1) Increase in investment on research and development 2) increase in patenting. After COVID -19 pharmaceutical sciences has gained importance, this article includes research work related to pharmacy field also. Pharmaceutical sciences combine a broad range of scientific disciplines that are involved with the design, action, delivery, disposition and use of drugs. This field draws on numerous regions of the essential and connected sciences, for example, science, science, the study of disease transmission, measurements, chemo metrics, arithmetic, material science and compound building and applies their standards to the investigation of medications.

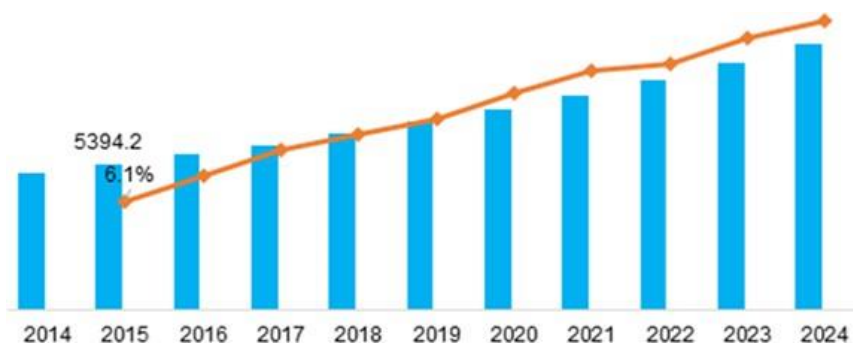
**KEYWORDS:** Research & Innovation, Economic Growth, R&D Investment, Pharmaceutical Sciences.

**INTRODUCTION**

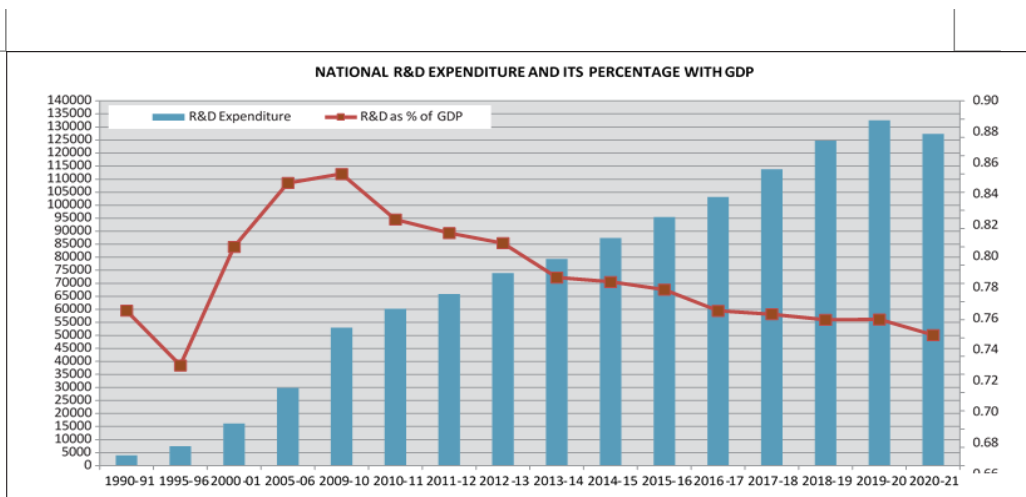
Research and Development in India, the starting point of this piece was the interest in Indian R&D evinced by foreign investors. The most commonly cited reason for this interest is the inherent ingenuity of research in India. However, Indians’ natural proclivity for ‘jugaad’ (problem solving using limited resources in an innovative way) aside, there have been concerted efforts to encourage investment in research. This is evidenced by the fact that patent filings by Indians have more than doubled in the last decade.



The global pharmaceutical excipients market is projected to reach USD 8.1 Billion in 2021 at a CAGR of 6.1% in the forecast period 2016 to 2024. The rising demand for new drug delivery systems, greater understanding of the functional benefits of excipients, growing pharmaceutical industry, and patent expiries of several blockbuster drugs are positively impacting the overall growth of the market.



The Gross Expenditure on R&D (GERD) in the country has been consistently increasing over the years and has more than doubled from Rs. 60,196.75 crore in 2010–11 to Rs. 127,380.96 crore in 2020–21.

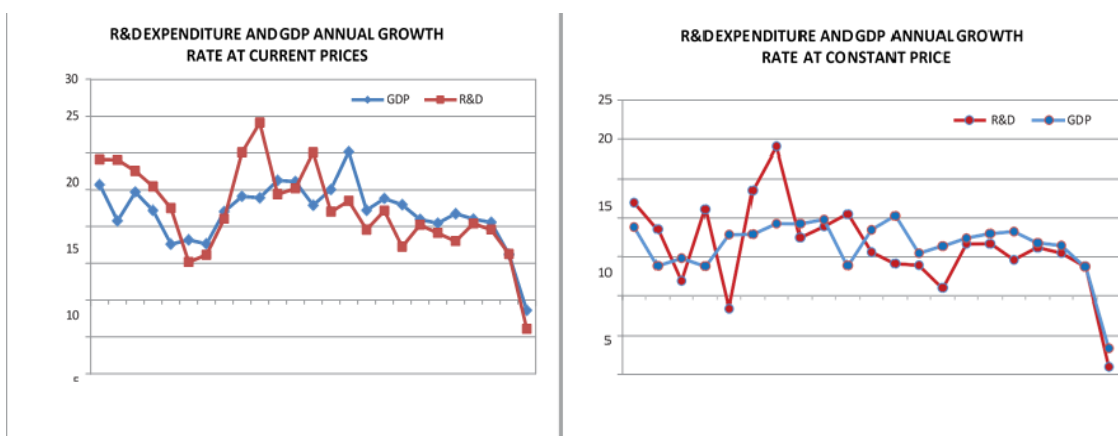


India's GERD as percentage of GDP remained at 0.66% and 0.64% during the years 2019–20 and 2020–21, respectively.

India's per capita R&D expenditure has increased to current PPP\$ 42.0 in 2020–21 from current PPP\$ 29.2 in 2007–08. GDP since 2009–10 to 2017–18 (both at current and constant prices) has surpassed the annual rate of growth of R&D. One of the reasons could be the revision of the GDP series with a new base year.

2011–12 involving a comprehensive coverage of industrial and service sectors, thus leading to higher GDP and its growth rate. From 2017–18 onwards, the annual growth rate of GDP R&D expenditure almost remained the same

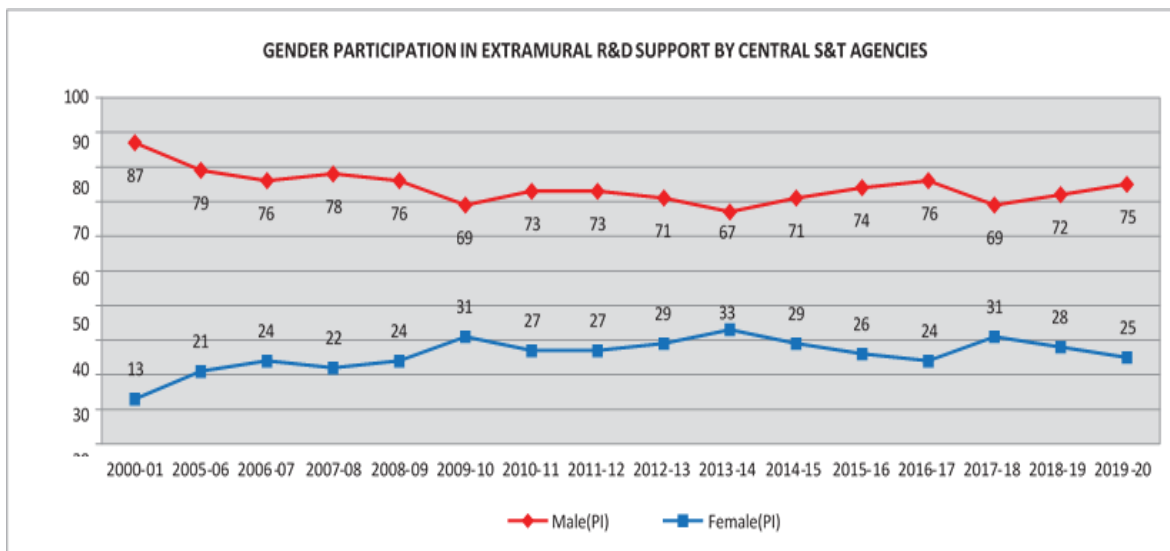
India's GERD increased to 57.9 billion current PPP\$ in 2020–21 from 50.3 billion current PPP\$ in 2014–15.



As per UNESCO Science Report 2021, India accounted for 3.1% of world GERD in 2018.

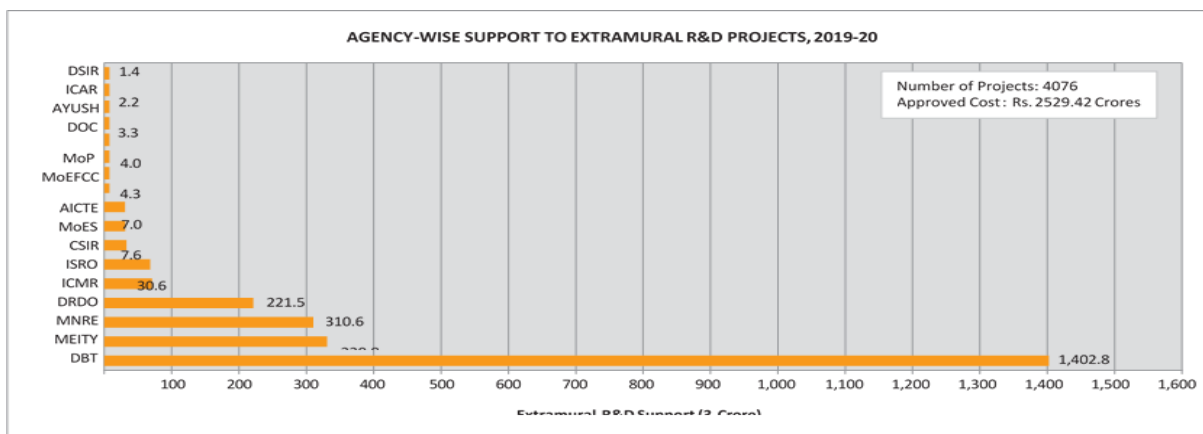
World GERD increased to 2232.57 billion current PPP\$ in 2018 from 1859.13 billion current PPP\$ in 2014. GERD is mainly driven by the Government sector comprising Central Government (43.7%), State Government (6.7%), Higher Education (8.8%) and Public Sector Industry (4.4%) with Private Sector Industry contributing 36.4% during 2020–21. Business Enterprise (Industrial) sector participation in GERD has been around 40% during the last 5 years.

Public sector R&D units spent 0.30% of their sales turnover on R&D as compared to 1.46% by Private sector in 2020–21.



Women participation in extramural R&D projects has increased significantly to 25% in 2019–20 from 13% in 2000–01 due to various initiatives undertaken by the Government in S&T sector. In absolute terms, 848 women Principal Investigator (PIs) during 2019–20 availed extramural R&D support as against 232 in 2000–01. As on 1st April 2021, nearly 5.55 lakh personnel were employed in the R&D establishments in the country including in-house R&D units of public and private sector industries. Out of which, 3.62 lakh (65.3%) were performing R&D activities while 0.95 lakh (17.1%) and 0.98 lakh (17.6%) personnel were engaged in auxiliary and administrative/non-technical support activities respectively.

As on 1st April 2021, there were 67,441 (18.6%) women out of total 3.62 lakh R&D personnel directly engaged in R&D activities.



Extramural R&D support by Central Government Agencies increased to Rs. 2529.42 crore in 2019–20 from Rs. 2454.02 crore in 2016–17. Its share in the national GERD was 1.9% during 2019–20.

The Department of Science and Technology (DST) and Department of Biotechnology (DBT) were the two major players contributing 55% and 13% respectively of the total extramural R&D support in the country during 2019–20. Academic sector received 70% of the total extramural R&D support during the year 2019–20.

India’s scientific publication output has shown a rising trend during the last decade. India has grown faster than many developed and developing countries such as USA, UK, Germany, France, Japan, South Korea, Brazil, etc.

India’s research output in publication has increased by 2.5 times from 60,555 in 2010 to 149,213 in 2020 as per NSF database, USA.

India’s growth rate of scientific publication was 9.4% as against the world average of 4.3% during 2010–20 as per the NSF database.

India’s share in global research publication output has increased over the years from 3.1% in 2010 to 5.1% in 2020 as reflected in NSF database.

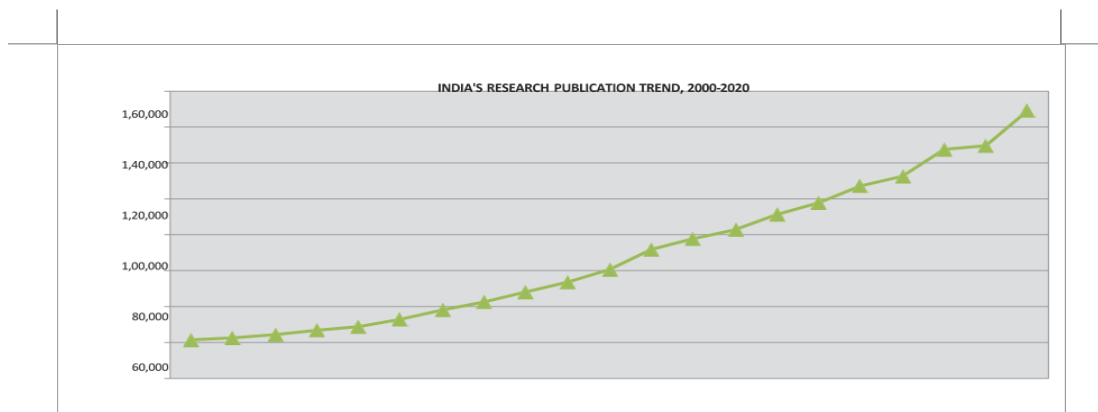
Patent applications filed in India are dominated by disciplines like Computer/Electronics, Mechanical, Communication and Bio-medical.

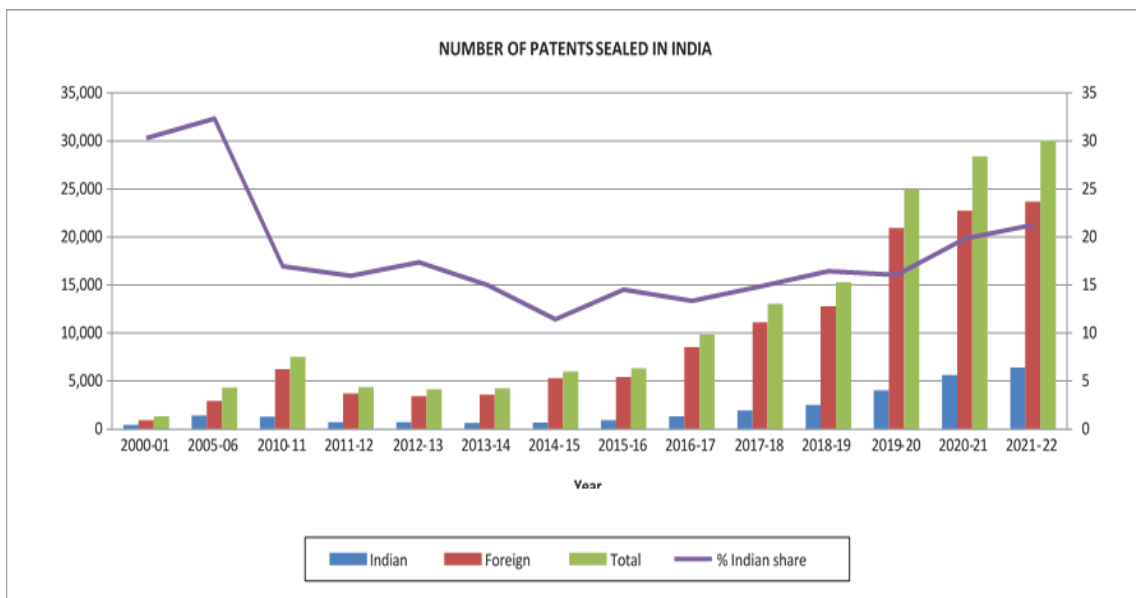
During 2020, India was ranked at 3rd in scientific publication output as per the NSF database. India is ranked ahead of many developed and developing countries including BRICS except China.

During 2020, India’s largest publication output were in Computer & Information Science (18%) followed by Engineering (17%), Health Sciences (16%), Biological & Biomedical Sciences (12%), Physics (11%) and Chemistry (8%) as per Science & Engineering Indicators 2022, NSF, USA.

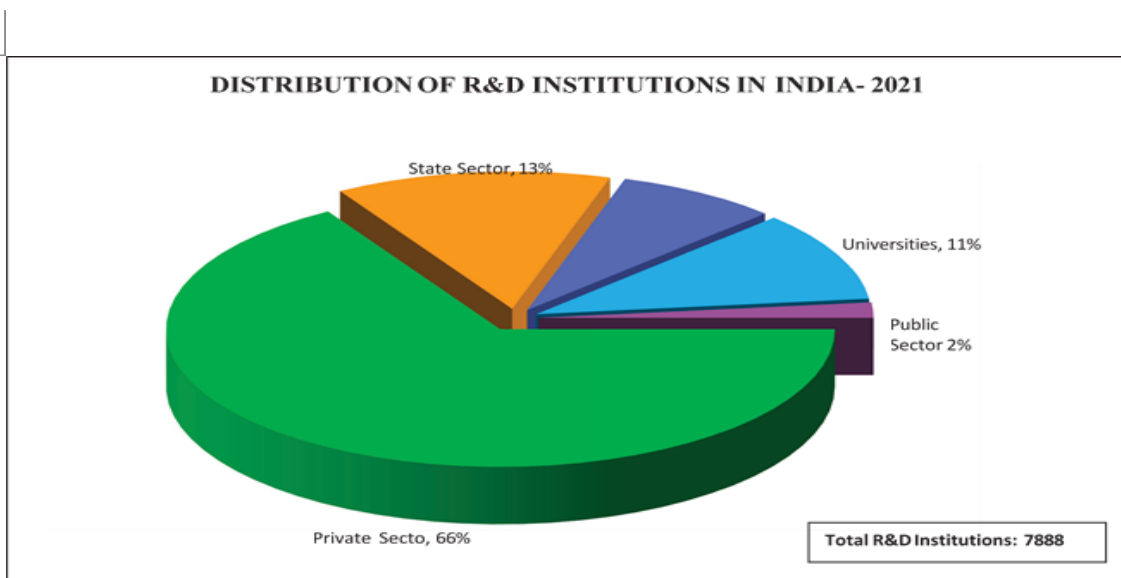
During 2021–22 a total of 66,440 patents were filed in India. Out of which, 29,508 (44%) patents were filed by Indian residents.

As per WIPO Report 2022, India is ranked at 7th position in terms of Resident Patent Filing activity in the world.





As per Directory of R&D Institutions, 2021, there were 7888 R&D institutions in the country, out of which 66% were in private sector.



World Bank data as the primary source of this research paper. To measure the growth of India, primary variables are in this study are GDP growth rate and Per capita GDP growth rate. R&D spending and number of patents application filed and the effect of that on economic growth of India

**Table No. 1: The variables used in Analysis.**

Variables	Description
Patents	It provides protection for the invention to the owner of the patent for a limited period.(For 20 years)
R&D Expenditure:	Expenditures for R&D are current and capital expenditures.
GDP Per Capita Growth:	Annual percentage growth rate of GDP per capita based on constant local currency.
GDP Growth:	Annual percentage growth rate of GDP based on constant local currency.

The GDP growth rate is dependent variable for this analysis whereas the others variables are independent variables  
With reference to Indian context some factors that affect Economic growth in India are as follows:

### **Population Growth**

Population growth is the major problem facing the world today. India is home to 1.3 billion people where the country accounts for a fifth of the world's youth population. Population growth is affected by decreasing the research productivity which directly related to income per capita and population growth.

### **Research and development (R&D)**

R&D has played a significant role in the growth of developed countries. In India, R&D investment has been relatively low. In the year 2008-09 R&D investment in the country has declined from 0.8 percent of the GDP to 0.7 percent in 2017-18. This is lower than the other BRICS nations such as Brazil spends about 1.2 percent, with the world average being about 1.8 percent.

### **Demographic dividend**

India's biggest asset is its young population. Currently, more than 60 percent of India's population is in the working age group (18–60). Here is need to properly channelized this age group's energy and potential towards innovation. Indian youth migrate to other countries for better opportunities.

### **Size of Company**

In India companies are peculiarly structured, with either very small sized companies where employees are less than 50 or very large-sized companies where employees are more than 500. So middle sized companies are very less. This structure causes problem like difference in productivity, whereby the large-sized companies are 10 times more productive than the small- sized companies. It is also reflects in innovation.

### **Labor market**

Sometimes adopting new and innovative technologies would displace labor from the market. India has massive labor force that affects the Innovation. Most of the time labor refuses to adopt innovation as they afraid of loss of jobs.

### **Economic Growth**

Research and Innovation drive economic growth by fostering the development of new industries, technologies, and products. It helps in new business establishments, attracting investments, generating employment opportunities, and enhancing productivity. Ultimately, the ability to innovate may lead to increased competitiveness in the global market and contribute to sustained economic development.

### **Technological Advancement**

Continuous Research and Innovation are essential for technological advancements. It helps in addressing social challenges and improving the quality of life. Evolution in areas like information technology, healthcare, agriculture, renewable energy, and infrastructure can significantly impact various sectors of the economy. Further to this, it enhances the well-being of a population.



### **Solving Societal Challenges**

India faces numerous challenges, including poverty, healthcare, education, infrastructure, environmental issues, and sustainable development. Further, Research and Innovation in these fields provide opportunities to develop solutions and strategies to address these challenges.

Investment in research and Innovation helps India find innovative approaches to poverty alleviation, healthcare delivery, education reform, sustainable agriculture practices, clean energy solutions, and urban development.

### **Human Resource Development**

Research and Innovation contribute to human resource development by fostering a culture of learning, creativity, and critical thinking. Additionally, it provides opportunities for students, scientists, and researchers to engage in cutting-edge research, gain valuable knowledge and skills, and contribute to the nation's development. Boon is in attracting and retaining talent within the country.

### **Global Competitiveness**

In an increasingly interconnected and competitive world, nations must keep Research and Innovation at the forefront to maintain a competitive edge. By investing in it, India can position itself as a global leader in various sectors, attract foreign investments, and foster collaborations with international partners. It results in trade opportunities, technology transfer, and overall global competitiveness.

### **Sustainable Development**

Research and Innovation are essential for achieving sustainable development goals. It helps the development of environmentally friendly technologies, promoting resource efficiency, and addressing climate change challenges. By investing in Research and Innovation, India can move towards a more sustainable and resilient future, ensuring long-term development and reducing negative environmental impacts.

The Indian government has identified the importance of Research and Innovation and has initiated several policies, programs, and funding mechanisms to support research and development activities. Institutes, such as the Department of Science and Technology, the Indian Council of Scientific and Industrial Research (ICSI), and various academic institutions and research organizations, are actively involved in research and innovation promotion in the country.





## PHARMACEUTICALS

India's pharmaceutical sector has emerged as a global leader in research and innovation, driven by a combination of a robust scientific and technological base, growing government support, a strong domestic market, and cost-competitive manufacturing.

The sector contributed nearly 1.32% of the Gross Value Added to the Indian Economy in 2020-21. The total annual turnover of Pharmaceuticals in the fiscal year 2021-22 was \$42.34 Bn. Major segments of the Indian Pharmaceutical Industry include generic drugs, OTC medicines, bulk drugs, vaccines, contract research & manufacturing, biosimilars and biologics.

The Economic Survey 2022-23 mentions that India is ranked 3rd worldwide in the production of pharma products by volume and 14th by value. India is the largest provider of generic medicines globally, occupying a 20% share in global supply by volume, and is also the leading vaccine manufacturer globally with a market share of 60%, contributing 40 to 70% of the WHO demand for Diphtheria, Tetanus and Pertussis (DPT) and Bacillus Calmette–Guerin (BCG) vaccines and 90% of the WHO demand for the measles vaccine. There are 500 API manufacturers contributing about 8% of the global API Industry. India is the largest supplier of generic medicines. It manufactures about 60,000 different generic brands across 60 therapeutic categories and accounts for 20% of the global supply of generics. Access to affordable HIV treatment from India is one of the greatest success stories in medicine. Because of the low price and high quality, Indian medicines are preferred worldwide, making it the pharmacy of the world.

From FY18 to FY22, the Indian pharmaceutical industry logged an average growth rate of 9.47% to \$42.34 Bn, primarily driven by an increase in exports and a rise in the domestic market. It is expected that the Pharma sector is likely to reach \$65 Bn industry by 2024 and \$120 Bn by 2030. To sustain growth in the sector, the government has taken many steps to further research and innovation.

The Indian pharmaceuticals market is supported by the following Production Linked Incentive Schemes to boost domestic manufacturing capacity, including high-value products across the global supply chain.

### **National Pharmaceutical Policy (2023)**

Aligned with Vision 2047, the policy is being drafted to serve as a comprehensive framework to address the challenges faced by Indian Pharmaceutical industries and provide definitive policy interventions to enhance the collective ecosystem. The draft policy encompasses five key pillars: Fostering Global Pharmaceutical Leadership, Promoting Self-Reliance, Advancing Health Equity and accessibility, Enhancing Regulatory Efficiency in the Indian Pharmaceutical Sector and Attracting investments.

### **Liberalized Foreign Direct Investment (FDI) Limit**

The Government has allowed up to 100% FDI through the automatic route for Greenfield investments and up to 74% for Brownfield investments. As a result of these policies, the sector has attracted 3% of the total FDI equity inflow, worth over \$21.5 Bn since April 2000.

### **Scheme for Strengthening of Pharmaceuticals Industry (2022)**

The scheme, launched with a total financial outlay of INR 500 Cr until FY 2025-26, to strengthen the existing pharmaceutical clusters' capacity by creating common facilities; to facilitate MSMEs of a proven track record to meet

regulatory standards; and to facilitate growth and development of Pharmaceutical and Medical Devices Sectors.

**Scheme for Promotion of Bulk Drug Parks (2020):** The scheme boosts domestic manufacturing of identified KSMs, Drug Intermediates and APIs by attracting large investments in the sector. Financial assistance, up to INR 1000 Cr, will be provided for the creation of common infrastructure facilities in three Bulk Drug Parks selected in Gujarat, Himachal Pradesh, and Andhra Pradesh.

**Scheme for Human Resource Development in the Medical Device Sector (2023):** The scheme was launched with a vision to bridge the gap between industry and academia, provide a skilled workforce to the industry and help in developing a research & development ecosystem for the medical device sector by training around 5,400 students over a period of 3 years. The scheme aims to fulfil the objectives of the Medical Device Policy, which include reaching a \$50 Bn market size by 2030 and reducing India's dependence on imported high-end medical devices.

**Scheme for Promotion of Research and Innovation in Pharma MedTech Sector (PRIP):** The scheme, launched in 2023 with a financial outlay of INR 5000 Cr until FY 2027-28, aims to transform the Indian Pharma MedTech sector from cost-based to innovation-based growth by promoting industry-academia linkage for R&D in priority areas. The scheme envisages the establishment of specialized Centres of Excellence at all seven National Institute of Pharmaceutical Education & Research (NIPERs) and the provision of funding for R&D in six priority areas.

#### **Production Linked Incentive (PLI) schemes**

To revive the country's manufacturing sector during the COVID-19 pandemic, the Government launched Production Linked Incentive Schemes, with an outlay of INR 1.97 Lakh Cr, targeting 14 critical sectors. These schemes were aimed towards making domestic manufacturing globally competitive and creating domestic leaders in manufacturing. The PLI schemes relevant to pharma sector are as follows:

#### **PLI for Pharmaceuticals**

The scheme was launched, with an outlay of INR 15,000 Cr until FY 2027-28, to boost India's manufacturing capabilities by increasing investment and production in the sector and contributing to product diversification to high-value goods. The scheme provisions rate of incentives between 3% to 10% on incremental sales (over the base year of FY 2019-20) of pharmaceutical goods covered. So far, 55 companies have been approved under the scheme.

#### **PLI for Promoting Domestic Manufacturing of Medical Devices**

The scheme, with an outlay of INR 3420 Cr till FY 2027-28, is being provided for the creation of common testing and laboratory facilities/centres in four Medical Device Parks. This initiative, providing financial incentives at the rate of 5% of incremental sales, will reduce manufacturing costs significantly and will help create a robust ecosystem for medical device manufacturing in the country. The scheme targets:

- Cancer care/Radiotherapy medical devices
- Radiology & Imaging medical devices and Nuclear Imaging Devices
- Anaesthetics and cardio-respiratory medical devices, including Catheters of Cardio-respiratory Category and renal Care Medical Devices
- All Implants, including implantable electronic devices
- In total, 21 applicants have been approved under the scheme.

Production Linked Incentive (PLI) Scheme for Promotion of Domestic Manufacturing of Critical Key Starting Materials (KSMs)/ Drug Intermediates and Active Pharmaceutical Ingredients (APIs) in the Country: The scheme, with an outlay of INR 6,940 Cr for six years until FY 2029-30, was formulated to provide financial incentives of 5% to 20% over base year. The scheme is aimed at attaining self-reliance and reducing import dependence in 53 critical KSMs/Dis/APIs. So far, 48 companies have been selected under the scheme.

Due to the PLI scheme, the sector witnessed a 46% increase in FDI inflows from FY 2021-22 to FY 2022-23 and a significant reduction in imports of raw materials in the pharma sector.

PLI Scheme for Key Starting Materials (KSMs)/Drug Intermediates (DIs) and Active Pharmaceutical Ingredients (APIs) (PLI 1.0) - Under the PLI scheme for Bulk Drugs, the objective is to boost domestic production of 41 select critical bulk drugs in the country. 51 projects have been selected for the 34 notified bulk drugs. Out of this, 22 projects have been commissioned till 31st Jan 2023. An investment of INR 2019 Cr have been reported while employing 1900 persons in the same period.

Production-Linked Incentive (PLI) Scheme for Pharmaceuticals d (PLI 2.0) - Under the PLI scheme for Pharmaceuticals, 55 applicants have been selected, including 20 Micro, Small & Medium Enterprises (MSMEs). As of 31st Jan 2023, sales of about INR 36,000 Cr have been reported by the select applicants. The scheme has garnered an investment of INR 16,199 Cr by these applicants in the first year of implementation while employing 23,000 persons in the same period.

### **Other Initiatives**

Biotechnology Industry Research Assistance Council (BIRAC), a Section-8 company of the Department of Biotechnology, has facilitated the implementation of R&D projects for drug discovery in the areas of TB, Anti-Microbial Resistance (AMR), Diabetes, Cancer, Rare Diseases, etc., through various schemes like Biotechnology Ignition Grant, Small Business Innovation Research Initiative, Biotechnology Industry Partnership Programme etc. It also supports bio- incubation centres in the pharmaceutical sector through BioNEST and EYUVA schemes. Over the past five years, 17 pharmaceutical products or technologies have been developed, transferred, or commercialized under these schemes.

CSIR- Central Drug Research Institute: A premier drug research centre, the institute primarily works in the area of malaria, leishmaniasis, AMR and bone health.

### **Future Prospects or Challenges**

Science and innovation are fundamental to economic growth, with research and development a big determinant of total factor productivity, especially when researchers are well connected with consumers.

Many technological advances have been made in the last 20 years, including a digital communications revolution driven by exponential increases in computer power. By 2035, scientific developments and innovation will have again reshaped the technologies which help deliver economic productivity.

The science of information and data is perhaps the most fundamental research topic of the century advances in technologies to analyses information and data will hasten progress in physics, chemistry, biology, social science and

economics current trends point to the advent of a suite of new digital technologies, such as machine learning, optimization, artificial intelligence, robotics and distributed ledgers<sup>109</sup> imperative to meet global challenges such as climate change and water scarcity will also set the direction of scientific endeavor.

Communications technologies and globalization will continue to offer greater opportunity for collaboration in scientific research but also more competition in commercial development. For many economics, intellectual property is already the greatest economic resource.

Against this backdrop, knowledge-intensive companies that innovate and export will remain the most profitable, competitive and productive.

One of the major research hub is pharmaceutical industry, it is expected to reach \$65 Bn by 2024 and to \$130 Bn by 2030 in India.

The pharmaceutical industry in India is currently valued at \$50 Bn, India is a major exporter of Pharmaceuticals, with over 200+ countries served by Indian pharma exports. India supplies over 50% of Africa's requirement for generics, ~40% of generic demand in the US and ~25% of all medicine in the UK.

India also accounts for ~60% of global vaccine demand, and is a leading supplier of DPT, BCG and Measles vaccines. 70% of WHO's vaccines (as per the essential Immunization schedule) are sourced from India.

### **Government Schemes**

By the year 2047, the Government aims to accomplish the following goals:

Make India a global leader in the manufacturing of affordable, innovative & quality pharmaceuticals & medical devices for the goal of Vasudhaiva Kutumbakam.

Vishwaguru in innovation & Research for delivering health care products to future generations in a sustainable manner, introducing natural products.

Ensure accessibility & affordability of patient-centric products for better healthcare outcomes for universal health coverage by building upon partnerships across industry, science and governments.

Contribute to the Health System to attain a union of equity, efficacy, and efficiency towards developing a holistic products profile with a focus on NCDs, AMR, and rare & neglected diseases.

Create equilibrium between social, economic, & governance aspects through facilitative, balanced & progressive policy and regulatory framework.

Reduce India's carbon footprint in Pharma-MedTech to align with Hon'ble PM's vision of Panchamrita.

Identifying critical suppliers, de-risking & decarbonizing the supply chain, and promoting local sourcing.

Medical Devices to be an integral part of global supply chains for raw materials, components, spare parts, assemblies/subassemblies, etc.

Digitization and technology up gradation in the delivery of services & products under Jan Aushadhi Pariyojana.

### **CONCLUSION**

The objective of this paper was to find relationship between R&D efforts and their innovation and between innovation and growth rate per capita income. Our results show that there is a strong positive relationship between innovation (R&D) and per capita in India with reference to pharma industry.

The results shows that the average growth rates of per capita R&D and patents of India are positively associated with the growth rate of R&D expenditure and growth rate of patents. However, we still observe a positive relationship between the growth rates of per capita R&D and patents. Most of the developed countries spent more than 2% of their Gross Domestic Product (GDP) on R&D.

India's pharmaceutical sector is well-positioned to continue to be a leader in research and innovation in the years to come. The country's strong scientific and technological base, growing government support, and large domestic market will continue to drive innovation. In addition, India's cost-competitive manufacturing capabilities will make it an attractive location for global pharmaceutical companies to conduct R&D.

Results conclude that the effectiveness of innovation in the economic growth of India but there are some limitations of this study. The conclusion is that the R&D and economic growth are related to each other. Developing Countries like India, the reasons behind the low spending on R&D are bigger issues such as hunger, disease control, growing population and raising the quality of life. Due to these factors resources are often diverted towards tackling them.

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