

## RESEARCH AND DEVELOPMENT EXPENDITURE: ROLE OF INSTITUTIONAL AND INDUSTRIAL SECTOR

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### ABSTRACT

*Our Honorable Prime Minister Narendra Modi's dream policy is 'Make in India'. Research and Development is playing a vital role to achieve Make in India goal. India is a destination for Multinational companies for IT and IT enabled services, Engineering, etc.. Companies are moving their main R&D operations to India not only for low cost but also having skilled human resources. Our Indians are leading many global firms like Google, Microsoft, Adobe, etc.. More than 150 international companies are doing R&D in India. Indian companies also need to invest in R&D to compete with global firms. Recently we experience the Barat Biotech spent crores of rupees to develop a vaccine for Covid 19 and succeeded. This is possible only because of Research and Development. This study is focused to analyse the Distribution of Research and Development expenditure by various states during the study period, Examine the Share of world Research and Development Expenditure by Continents during 2000 -01 to 2017 -18 and also examine the Expenditure on Research and Development by Objectives during the study period. Observed from the study is Compound Annual Growth Rate (CAGR) of Institutional Sector R&D Expenditure is i.e 6.66 percent is more than the Industry Sector rate i.e. 5.18 percent. At the same time institutions under Central Government are spending more than 45 percent of total national R&D expenditure. Gujarat, Tamil Nadu, and Punjab are in the top position among all the states in India in R&D expenditure. Bihar was recorded the highest negative CAGR i.e -26.05 percent. In the continents, Asia has recorded 9.10 percent CAGR. Central Government spent on R&D about 29 percent of total R&D expenditure on Defence as Central Government is giving priority to the security of the nation and public sector is also spending 51.37 percent of total R&D expenditure of public sector on Defence only. The Private sector has spent about 37 percent on health in total R&D expenditure of private sector. The next priority of private sector is Transport & Telecommunication.*

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**Keywords:** *Research and Development, Industrial Sector, DST, Ministry of Science & Technology.*

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### Introduction

Our Honorable Prime Minister Narendra Modi's dream policy is 'Make in India'. Research and Development are playing a vital role to achieve Make in India goal. India is a destination to the Multinational companies for IT and IT enabled services, Engineering, etc.. Companies are moving their main R&D operations to India not only for low cost but also having skilled human resources. Our Indians are leading many global firms like Google, Microsoft, Adobe, etc.. More than 150 international companies are doing R&D in India. Indian companies also need to invest in R&D to compete with global firms. Recently we experience Barat Biotech spent crores of rupees to develop vaccine for Covid 19 and succeeded. This is possible only because of Research and Development.

Government and the Corporates need to wakeup to the urgency of stepping up the Indian R&D centres to make in India to compete globally. Both public and private sectors are concentrating only on few areas while investing on Research and Development. The Private sector is focusing on pharma, Telecommunication and electronics and the Public sector is on Defence, Atomic energy, Space, etc...

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The Research and Development expenditure leads to long term economic growth of the county. The R&D is a backbone to registration of patents in India and world. R&D contributes not only to the business to mobilize the profits and also helps to the society in terms of providing better living facilities, reducing pollution, surgical equipment to the needy people. Institutional R&D enhances the knowledge in different field and Industrial R&D commercializes the innovations and provides the services to society and Government. We observed that, during the recent pandemic situation, Defence Research and Development Organisation (DRDO) has developed many safety equipment which will protect from Covid 19 within a short a span of period. Many state Governments are establishing separate hubs to promote the innovations of start-up companies. The importance of R&D in India was increasingly felt provided with the adoption of the Scientific Policy Resolution during 1958. The policy aimed at promoting pure, applied and Industrial Scientific Research. The ultimate aim of any research is to increase the profit by upgrading existing products or methods, reducing cost, standardization of products, find the solutions to problems faced by the public etc...

Research is original and planned investigation and 'Development' is the transformation of research into a plan or design for the production of new substantially improved products, processes, before the commencement of the commercial production. The Government has initiated several measures to promote industrial and institutional research to meet the requirements of society from time to time. Tax incentives are one of the measure to establish their own in-house R&D units.

### Review of Literature

**MilutinJesicet al.<sup>1</sup> (2020)** analysed the relation between institutional features and R&D in business enterprise sector and consequently on sustainable economic growth. They found that Government effectiveness and control of corruption in particular are very important in supporting the R&D. This study was used contemporary methods for testing the underlying problem.

**Martina Halskovaet al.<sup>2</sup> (2020)** studied about the R&D efficiency in public & private sectors. The result of the study presents a decrease in total R&D productivity in public and private sectors for an average of European Countries. The study's results also provide a valuable platform for creators of national strategic and innovative investment and educational plans and creators of relevant policies and create a platform for national and international benchmarking indicators.

**Reji K. Joseph et al.<sup>3</sup> (2019)** were analysed FDI in R&D in India in recent period as part of the working paper developed by Institute for Studies in Industrial Development. In an era of R&D in networks, the possibility of direct technology transfer to host countries is very limited. The policy needs to reflect recognition of the comparative advantage of India in R&D networks and propose concrete measures to take advantage of the comparative advantage.

**Akshata Nayak & Lokesh H<sup>4</sup> (2019)** are studied trends in agricultural research and development in India and they focused on unorganized sector unemployment. The survey concluded that the actual expenditure of the Department of agricultural research and ICAR has increased from Rs. 5,393 cr. to Rs. 6,800 cr. in 7 years.

**Rita Freimane & Signe Balina<sup>5</sup> (2016)** were investigated the empirical relationship between R&D expenditures and economic growth in the European Union member states in the period of 2000 - 2013. They found that, impact of R&D expenditures on the economic growth in the European Union countries is statistically significant.

**Anil Nair, Star Fanshmidt & Amir Pezesh kan<sup>6</sup>(2015)** concluded that India does not have a proper innovation infrastructure. To improve the innovative potential, India needs to focus on legal, physical, scientific, technological, and medical infrastructure. Thus more research is needed to develop not only on the outcomes associated with infrastructure investment, in turn, it leads to innovation.

**Vikas Kumar & Kunal Sinha<sup>7</sup> (2014)** evidenced Private sector needs to be attracted by framing proper policies and attractive market opportunities. This is essential for enhancing research intensity and making the system more demand-driven.

**Silaghiet al.<sup>8</sup> (2014)** analysed business and private R&D expenditures in central and eastern European Countries (CEECs). They concluded that, a dynamic panel estimation results showed a statistically significant impact of business R&D on economic growth in new European Member states. Public R&D was found to be with neutral effect did not stimulate growth, but also did not crowd out private R&D. They also reported that total R&D in CEECs did not appear to be statistically significant in any specification.

**S R Sheeja<sup>9</sup> (2014)** analysed the Resource, Development and Innovation in the Indian Industry. R&D has a major role in economic development. While developed countries give much importance to research and innovation, these remain as relatively unexplored areas in less developed countries. The study reveals that low priority attached to R&D in India is a matter of concern.

#### Objectives of the Study

This study is focused on the following objectives:

- To examine the trends and growth of Research and Development expenditure in India by Institutional and Industrial Sectors during the study period.
- To analyse the Distribution of Research and Development expenditure by various states during the study period.
- To Examine the Share of world Research and Development Expenditure by Continents during 2000 -01 to 2017 -18.
- To examine the Expenditure on Research and Development by Objectives during the study period.

#### Scope of the Study

This study is proposed to cover countrywide Research and Development Trends for the last 3 years from 2015-16 to 2017-18. It also covers the share of World R&D expenditure by Continents and State Governments expenditure on R&D.

#### Methodology

This study is based on secondary data. The data has been collected from DST, Ministry of Science & Technology, Government of India. It is a census study. Statistical tools like percentages and Compound Annual Growth Rates are used for the analysis of the data.

#### Limitations of the Study

The study period is covered three years i.e 2015-16 to 2017-18 however share of world R&D expenditure by continents has covered 200-01 to 2017-18. Our Indian Government was opened gates to FDI in many areas after 2000. Therefore, researcher feels that, free flow of funds was taken place in the institutional and industrial sector in terms of innovations after 2000 only. Hence, this period provides better insight towards world share.

#### Data Analysis & Interpretation

**Table 1: National Expenditure on R & D by Institutional and Industrial Sectors**

(Rs. In Crore)

S. No.	Sector	2015 - 16	% of Total	2016 - 17	% of Total	2017 - 18	% of Total	CAGR
<b>A</b>	<b>Institutional Sector</b>							
1	Institutions under Central Government	42433.33	44.45	45513.2	44.1	51666.82	45.39	6.78
2	Institutions under State Government	6447.94	6.76	6866.96	6.66	7264.81	6.38	4.05
3	Higher Education	6095.18	6.39	6888.17	6.68	7784.33	6.84	8.49
	<b>Total (A)</b>	<b>54976.45</b>	<b>57.60</b>	<b>59268.33</b>	<b>57.48</b>	<b>66715.96</b>	<b>58.61</b>	<b>6.66</b>
<b>B</b>	<b>Industry Sector</b>							
4	Industry (Public)	4453.84	4.67	4706.22	4.56	5253.20	4.61	5.65
5	Industry (Private)	31709.04	33.22	34522.99	33.50	36873.49	32.4	5.15
6	Scientific and Industrial Research Organization (SIRO)	4313.11	4.51	4601.72	4.46	4982.39	4.38	4.92
	<b>Total (B)</b>	<b>40475.99</b>	<b>42.40</b>	<b>43830.93</b>	<b>42.52</b>	<b>47109.08</b>	<b>41.39</b>	<b>5.18</b>
	<b>Grand Total (A+B)</b>	<b>95452.44</b>	<b>100.00</b>	<b>103099.26</b>	<b>100.00</b>	<b>113825.03</b>	<b>100</b>	<b>6.04</b>

Source: Compiled from Reports of DST, GOI

Table 1 shows that the trend of Research and Development expenditure from 2015-16 to 2017-18 by Institutional sector and Industry sector. The Institutional sector comprises the three types of institutions viz., Institutions under Central Government, Institutions under State Government, and higher education. Research and Development expenditure under industry sector categorized into the public sector, private sector and Scientific & Industrial Research Organisations (SIRO). The Compound Annual Growth Rate of the Institutional Sector and Industry Sector is almost the same i.e 6.66 percent & 6.04

percent respectively. Share of Institutional Sector in R&D expenditure is higher (58.61 percent) than the Industry Sector i.e 41.39 percent. This trend is continued in all the years during the study period. During 2017-18 total Institutional Sector has spent Rs. 66715.96 crores whereas Industry Sector spent Rs. 47109.08 crores only. The compound Annual Growth Rate of Higher education is 8.49 percent, which is the highest CAGR among all the sectors. Central Government institutions have more percent of R&D expenditure among all the institutions. Its share is almost 45 percent of total National R&D expenditure. Total Rs. 47109.08 cr. Spent by 2607 R&D units. Out of these 103 units are belong to the public sector and 2504 relate to the private sector. In R&D expenditure by Institutions sector, Central Government played a major role whereas Industrial R&D expenditure private sector played a major role.

**Table 2: Distribution of Research & Development Expenditure by Various States**

S. No.	States	2015-16	% of Total	2016-17	% of Total	2017-18	% of Total	CAGR
1	Andhra Pradesh	493.69	7.66	533.43	7.77	543.49	7.48	3.25
2	Assam	276.59	4.29	289.58	4.22	455.13	6.26	18.05
3	Bihar	132.79	2.06	129.71	1.89	53.68	0.74	-26.05
4	Chhattisgarh	169.99	2.64	208.57	3.04	257.99	3.55	14.91
5	Gujarat	728.01	11.29	755.44	11	789.52	10.87	2.74
6	Haryana	285.62	4.43	313.30	4.56	374.58	5.16	9.45
7	Himachal Pradesh	140.16	2.17	141.15	2.06	158.97	2.19	4.28
8	Jammu & Kashmir	238.17	3.69	260.58	3.79	290.68	4	6.86
9	Jharkhand	70.88	1.1	106.20	1.55	91.54	1.26	8.9
10	Karnataka	369.17	5.73	344.57	5.02	373.48	5.14	0.38
11	Kerala	138.90	2.15	123.82	1.8	160.41	2.21	4.91
12	Madhya Pradesh	417.93	6.48	466.98	6.8	488.51	6.72	5.33
13	Maharashtra	190.09	2.95	234.10	3.41	221.77	3.05	5.27
14	Manipur	200.19	3.1	113.19	1.65	102.00	1.4	-20.12
15	Meghalaya	8.76	0.14	8.58	0.12	9.01	0.12	0.94
16	Odisha	130.97	2.03	147.26	2.14	154.85	2.13	5.74
17	Punjab	513.68	7.97	534.38	7.78	551.44	7.59	2.39
18	Rajasthan	203.55	3.16	233.11	3.39	192.56	2.65	-1.83
19	Tamil Nadu	589.14	9.14	670.51	9.76	688.34	9.47	5.32
20	Telangana	269.89	4.19	284.07	4.14	276.02	3.8	0.75
21	Uttar Pradesh	371.87	5.77	448.39	6.53	471.02	6.48	8.19
22	Uttarakhand	255.53	3.96	253.98	3.7	281.41	3.87	3.26
23	West Bengal	252.36	3.91	266.10	3.88	278.41	3.83	1.78
	<b>Total</b>	<b>6447.93</b>	<b>100</b>	<b>6867.00</b>	<b>100</b>	<b>7264.81</b>	<b>100</b>	<b>4.05</b>

Source: Compiled from Reports of DST, GOI

**Figure 1: Distribution of Research & Development Expenditure by the Various States**

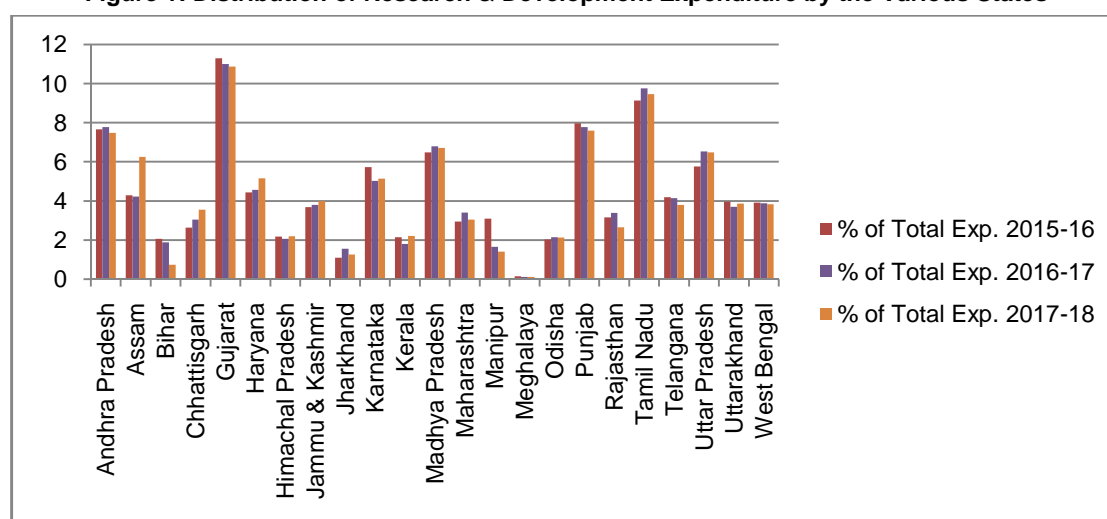


Table 2 reveals the R&D expenditure spent by various states in India. Gujarat, Tamil Nadu, Punjab, Andhra Pradesh, and Madhya Pradesh are in the first five places throughout the study period. Jharkhand, Bihar and Meghalaya are playing the least role in R&D expenditure as they are occupied in the last three ranks in R&D expenditure. Bihar has recorded the highest negative growth rate i.e -26.05 percent within three years. Assam, Chhattisgarh, Haryana, Jharkhand have accounted top four states among all states in terms of CAGR within three years. Assam reached 18.05 percent CAGR during the study period. Andhra Pradesh, Gujarat, Punjab having CAGR less than the CAGR of aggregate R&D expenditure at the same time these five states are in the top 5 states list in investment in R&D during the study period. Some new states are spending more on R&D activities than old states. Few states have a major share of the total R&D expenditure of the state sector as a whole. More than 55 percent of the total R&D expenditure of the states was accounted for by five states viz., Gujarat, Tamil Nadu, Punjab, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, and Assam. Some big states need to play a vital role in R&D activities at state levels. These states have to increase their investment in Research and Development.

**Table 3: Share of World R&D Expenditure by Continents**

Continent	2000-01	% of Total	2010-11	% of Total	2015-16	% of Total	2017-18	% of Total	CAGR
Africa	7.2	0.97	18.06	1.26	27.32	1.4	30.03	1.37	8.25
Asia	207.5	28.01	545.03	37.96	850.88	43.68	995.45	45.41	9.10
Europe	205.99	27.81	362.83	25.27	453.23	23.27	503.28	22.96	5.08
Latin America and the Caribbean	25.01	3.38	52.69	3.67	70.92	3.64	67.07	3.06	5.63
Northern America	286.26	38.64	434.99	30.29	522.11	26.81	570.42	26.02	3.90
Oceania/ Australia	8.81	1.19	22.29	1.55	23.3	1.2	26.12	1.18	6.22
Total	740.78	100	1435.89	100	1947.77	100	2192.38	100	6.21

Source: Compiled from Reports of DST, GOI

**Figure 2: Share of R&D Expenditure by Continent**

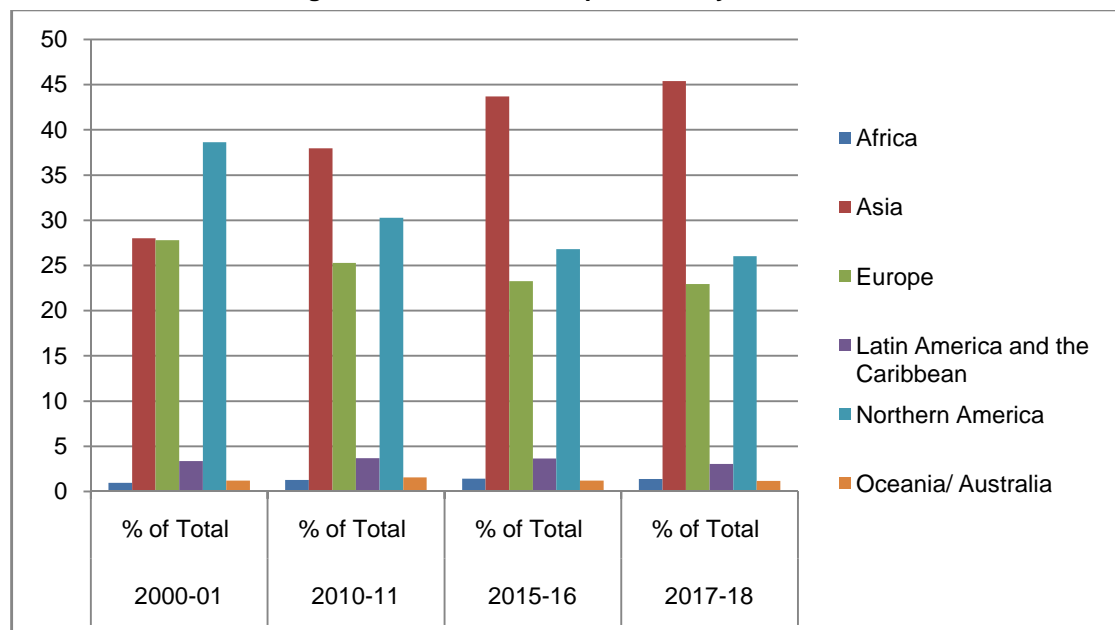


Table 3 shows the share of world R&D expenditure by continents. During the last two decades, more than 94 per cent of the world R &D expenditure has been concentrated in three continents only. Viz., Asia, Europe, and North America. There is a significant increase i.e. 17 by Asia continent expenditure in Research and Development, it has increased from 28.01 percent to 45.41 percent whereas it was decreased both Europe from 27.8 percent to 22.96 percent and North America from 38.64 percent to 26.02 percent during 2000-01 to 2017-18. Australia Continent share is constant for the last two decades and Latin America also is investing constantly @ 3 percent. World Research and Development expenditure has increased from \$ 740.78 billion in 2000-01 to \$ 2192.38 billion in 2017-18.

**Table 4: Expenditure on R&D by Objective**

S.No.	Objective	Central Government	State Government	Private Sector	Public Sector	Total
		% of Total	% of Total	% of Total	% of Total	% of Total
1	Defence	29.41		0.55	51.37	17.15
2	Development of Agriculture, Forestry and Fishing	10.43	88.03	3.65	0.19	12.60
3	Education	1.23	11.13	1.58		1.99
4	Energy	7.05		6.48	27.38	7.35
5	Environment	0.71		0.44	0.03	0.52
6	Exploration and Exploitation of Space	18.08		0		8.84
7	Exploration and Exploitation of the Earth	2.34		0.09	12.93	1.82
8	General Advancement of Knowledge	13.64		1.4	0.02	7.22
9	Health	8.6	0.15	36.58	0.19	18.59
10	Industrial Production and Technology	3.38		20.22	3.81	9.78
11	Political & Social Systems, Structures & Processes (including socio-economic services)		0.42	0.02		0.04
12	Transport, Telecommunication and other Infrastructures	1.16	0.08	20.24	2.71	8.65
13	Other Aims	3.96	0.19	8.74	1.37	5.45
	<b>Total</b>	100	100	100	100	100

Source: Compiled from Reports of DST, GOI

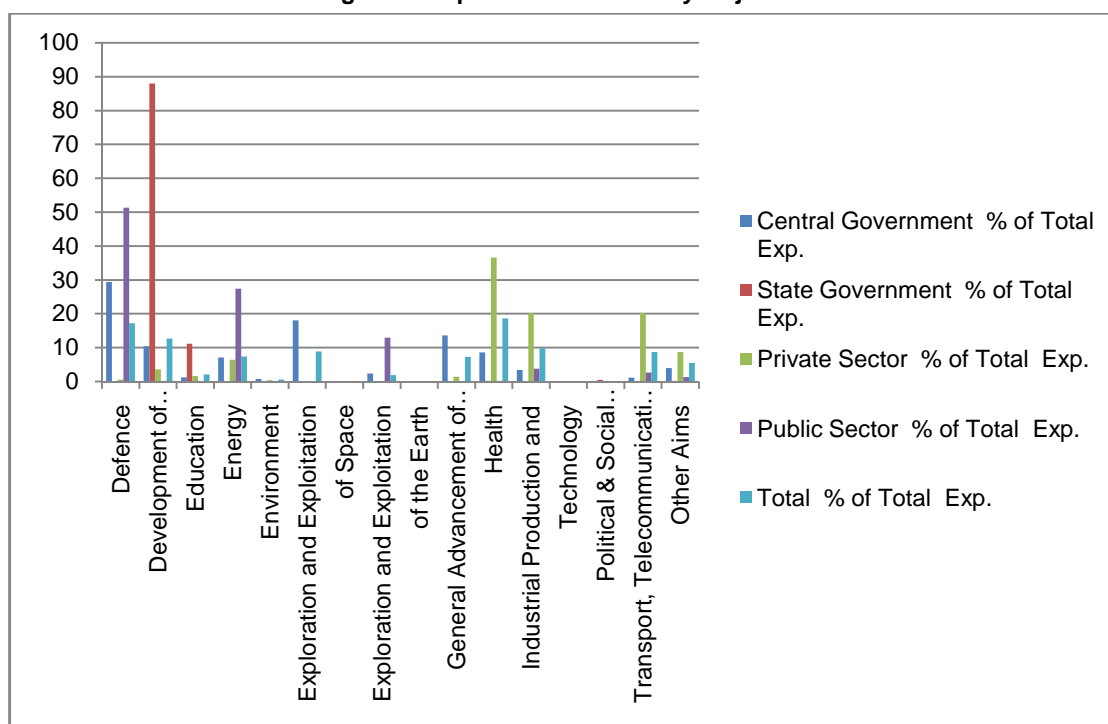
**Figure 3: Expenditure on R&D by Objective**

Table 4 shows the trend of R&D expenditure based on the objective. Further, it is classified as R&D expenditure spent by Central Government, State Government, Private Sector, and Public Sector. As per the report of the Department of Science and Technology, Government of India, the total objectives of India regarding Research & development Expenditure are categorized into 13 objectives. Viz., Defence, Exploration and Exploitation of space, General Advancement of Knowledge, Development of Agriculture,

Forestry & Fishing etc.. During 2017-18, Central Government spent on R&D about 29 percent of total R&D expenditure on Defence as Central Government is giving priority to the security of the nation and the public sector is also spending 51.37 percent of the total R&D expenditure of the public sector on Defence only. The Private sector has spent about 37 percent on health in total R&D expenditure of the private sector. The next priority of the private sector is Transport & Telecommunication. More than 75 percent of total private sector R&D expenditure is investing on Health transport & Telecommunications and other infrastructure and Industrial Production and Technology. State Government spent 88 percent of its R&D expenditure on Development of Agriculture, Forestry and Fishing as agriculture is in the state sector as per the constitution. This table reveals that, Investment in R&D by the respective sectors based on their priority.

Central Government is giving priority to Defence as national security, state are giving importance to Agriculture related activities, Private sector is giving importance to commercial goods like Health products, Transport & Telecommunication, and Industrial production. During 2017-18, Central Government has spent Rs. 51666.83 crores on Research & Development, States Government spent Rs. 7264.82 crores, Private sector Rs. 41,483.03 crores and Public sector Rs. 5253.21 crores on Research & Development.

### Conclusion

Government and the Corporates need to wakeup to the urgency of stepping up the Indian R&D centres to make in India compete globally. Both public and private sectors are concentrating only on few areas while investing on Research and Development. The Private sector is focusing on pharma, Telecommunication and electronics, and the Public sector is on Defence, Atomic energy, Space etc. Observed from the study is Compound Annual Growth Rate of Institutional Sector R&D Expenditure is i.e 6.66 percent as more than the Industry Sector rate i.e. 5.18 percent. At the same time institutions under Central Government are spending more than 45 percent of total national R&D expenditure. Gujarat, Tamil Nadu, and Punjab are in the top position among all the states in India in R&D expenditure. Bihar was recorded the highest negative CAGR i.e -26.05 per cent. In the continents, Asia has recorded 9.10 per cent CAGR. Central Government spent on R&D about 29 percent of total R&D expenditure on Defence as Central Government is giving priority to the security of the nation and public sector is also spending 51.37 percent of total R&D expenditure of public sector on Defence only. The Private sector has spent about 37 percent on health in total R&D expenditure of the private sector. The next priority of the private sector is Transport & Telecommunication.

More than 75 percent of total private sector R&D expenditure is investing in Health transport & Telecommunications and other infrastructure and Industrial Production and Technology. It is concluded, year after year, Government and Corporates have recognized the importance of Research and Development and increase spending on Research & Development.

### Recommendations

The following suggestions/ recommendations to improve the innovations in India:

- Government may initiate the policy to encourage the Private sector higher educational institutions to spend more on Research and Development. Because higher educational institutions are spending only 6.4 percent in total National R&D Expenditure.
- Some states have recorded less than 3 percent in total R&D expenditure by the states, States Governments must focus on increasing the R&D budget to satisfy the needs of the public.
- Some of the important sectors like Health, Transport and other infrastructures, Energy, Environment etc. are neglected by State Governments as they are not investing any amount on R&D in these areas. State governments may focus on those areas, which are necessary for public to lead the normal life.

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