

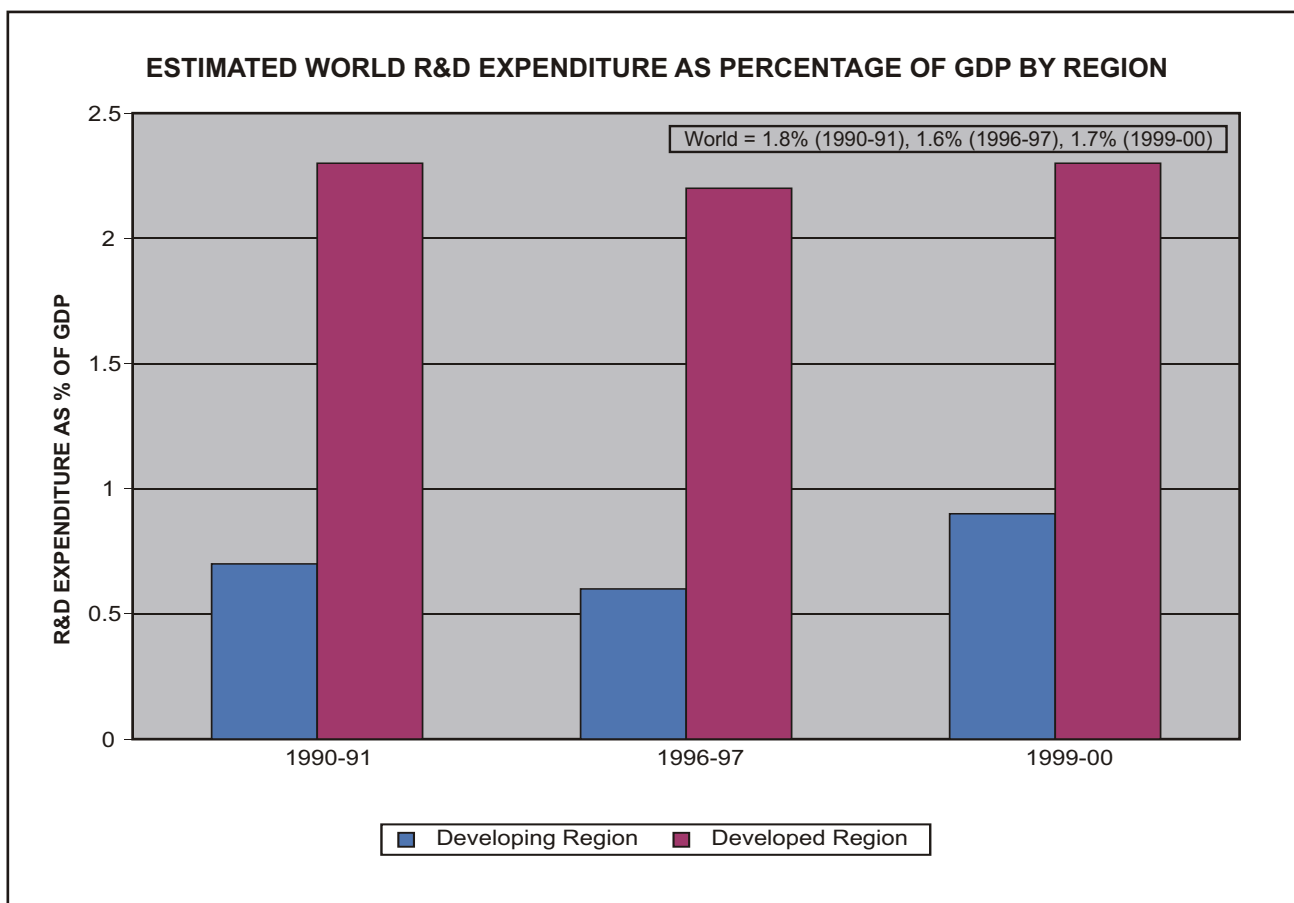
## CHAPTER VIII

# INTERNATIONAL COMPARISON OF RESEARCH AND DEVELOPMENT

In the preceding chapters, an analysis has been attempted on the total research and development efforts and its components in various sectors. This chapter has been devoted to assess the relative progress in scientific and technological activities achieved by India in comparison to other developing and developed countries. Such a comparison, though prima facie appears to be simple and straight forward, entails a number of difficulties, both conceptual and operational. Though most of the developed countries and a few of the developing countries have a well organised data collection system, yet the concepts vary from country to country. So, it is difficult to compare these data because of the varying concepts and definitions used. A complete data system or recent data are also often lacking for most of the developing countries and even for some of the developed countries. Keeping in view, the constraints given above, an attempt has been made in

the ensuing paragraphs to throw light on the S&T parameters related with socio-economic parameters for selected countries comprising both developing and developed countries.

According to the UNESCO 2004,<sup>1</sup> the total investment on research and development in the world during 1990-91 was of the order of US \$ PPP 409.8 billion. This increased to US \$ PPP 549.7 billion in 1996-97 and further increased to US \$ PPP 755.1 billion in 1999-2000. The investment on research and development by the developed countries during 1990 was US \$ PPP 367.9 billion and the rest US \$ PPP 41.9 billion was by the developing countries. In terms of percentage it works out to be 90% and 10% respectively. In 1996-97, the share of developed and developing countries was 84% and 16% and during 1999-2000 this was 79% and 21% respectively.



<sup>1</sup> UIS, UNESCO, Bulletin on Science & Technology Statistics, Issue No. 1, April 2004.

**Table 8.1****ESTIMATED WORLD R&D EXPENDITURE**

Region	R&D Expenditure (US\$ Billion)			R&D Expenditure as % of GDP		
	1990-91	1996-97	1999-00	1990-91	1996-97	1999-00
World	409.8 (100%)	549.7 (100%)	755.1 (100%)	1.8	1.6	1.7
Developed	367.9 (89.8%)	460.4 (83.8%)	596.7 (79.0%)	2.3	2.2	2.3
Developing	41.9 (10.2%)	89.3 (16.2%)	158.4 (21.0%)	0.7	0.6	0.9

This clearly shows that the percentage share of developing countries in the total R&D expenditure is showing an increasing trend. R&D expenditure as percentage of GDP by developed and developing countries are given in Table 8.1.

One of the most commonly used indicators for international comparison of S&T efforts is the proportion of Gross Domestic Product (GDP) devoted to research and development activities. The expenditure on R&D as percentage of GDP for the whole world in 1999-2000 was 1.7%. For the developed countries this percentage has remained the same with 2.3% in 1990-91 to 2.2% in 1996-97 and to 2.3% in 1999-00 whereas in the case of developing countries, the percentage after a slight decrease in 1996-97 showed a

marginal increase in 1999-2000. The R&D to GDP ratio for these three years was 0.7%, 0.6% and 0.9% respectively.

In nutshell the R&D expenditure to GDP ratio over the decade has remained the same for developed countries while it increased marginally for the developing countries. The information regarding expenditure on research and development by continents is given in Table 8.2.

Table 8.3 gives data for R&D expenditure as percentage of GDP in respect of selected countries comprising both developing and developed grouped in classes ranging from 0.0-1.0%, 1.1 - 2.0% and above 2.0%.

**Table 8.2****SHARE OF R&D EXPENDITURE IN WORLD TOTAL BY CONTINENTS**

Continent	Expenditure on R&D in billion US\$ PPP and % share in brackets		
	1990-91	1996-97	1999-00
Africa	5.2 (1.3)	4.3 (0.8)	5.8 (0.8)
North America	156.4 (38.2)	209.0 (38.0)	281.0 (37.2)
Latin America & Caribbean	11.3 (2.8)	16.8 (3.1)	21.3 (2.8)
Asia	94.2 (23.0)	154.8 (28.2)	235.6 (31.2)
Europe	138.8 (33.9)	157.7 (28.7)	202.9 (26.9)
Oceania	3.9 (1.0)	7.2 (1.3)	8.5 (1.1)
World (Total)	409.8 (100)	549.7 (100)	755.1 (100)

Note : North America includes Canada & United States.

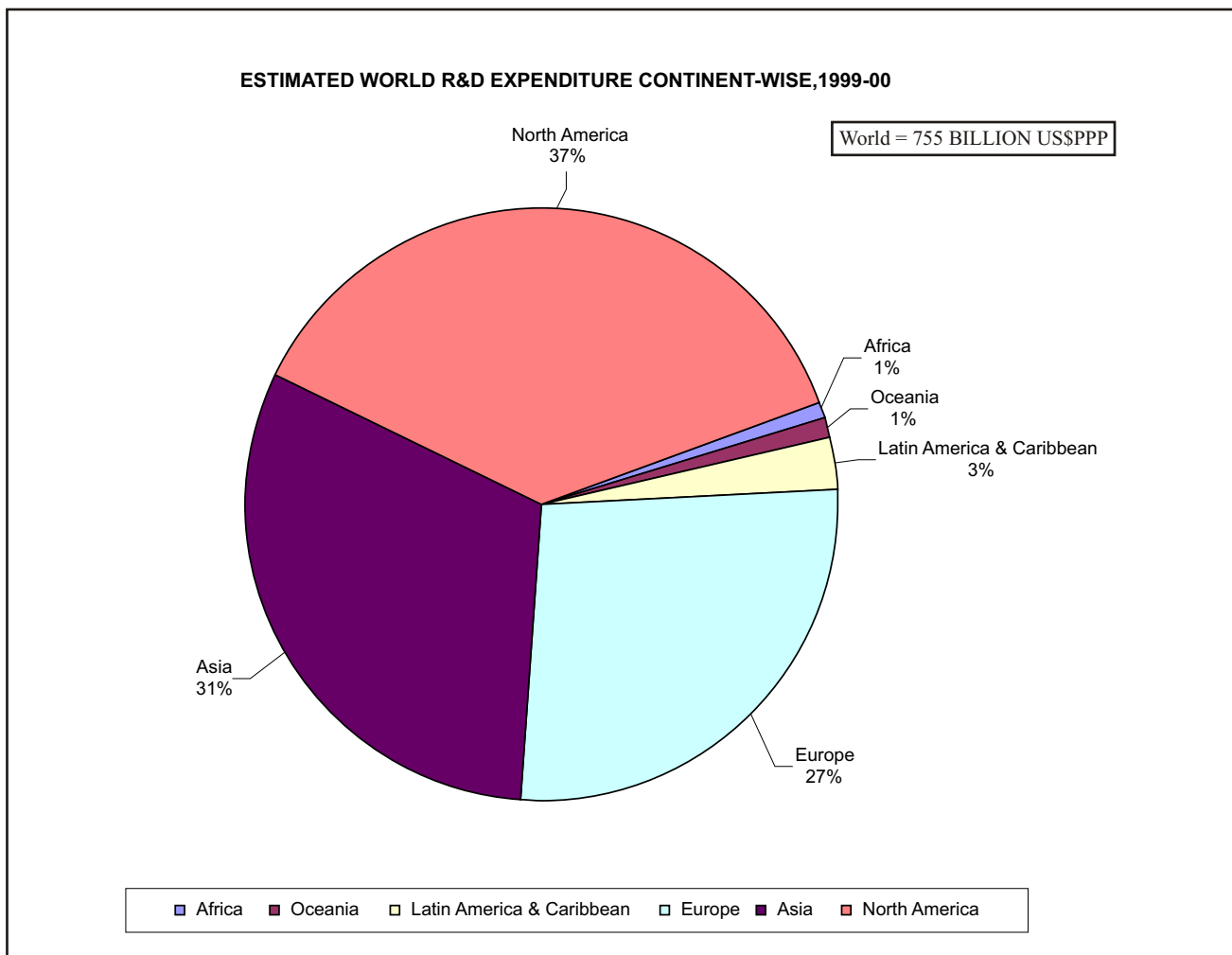
**Table 8.3**

**EXPENDITURE ON R&D AS PERCENTAGE OF GDP FOR SELECTED COUNTRIES, 2000 -02**

<b>R&amp;D/GDP</b>					
0.0 - 1.0%		1.1-2.0%		above 2.0%	
Argentina	0.39	Australia	1.55	Austria	2.21
Cuba	0.62	Brazil	1.04	Denmark	2.51
Egypt	0.19	Canada	2.00	France	2.27
India	0.80	China	1.23	Germany	2.64
Nepal	0.67	Czech Repub.	1.30	Israel	5.11
Pakistan	0.27	Hungary	1.01	Japan	3.11
Sri Lanka*	0.20	Italy	1.11	Repub. of Korea	2.91
Thailand	0.24	Russian Federation	1.24	Singapore	2.20
Venezuela	0.38	Spain	1.04	Sweden	4.27
		U.K	1.88	USA	2.67

Source:-UNESCO Institute for Statistics (UIS) 2005, UNESCO.  
World Development Indicators 2004/2005, The World Bank

- Note : 1. China excludes Hong Kong  
2. \* 1996



**Table 8.4**

**PER CAPITA R&D EXPENDITURE IN US DOLLARS FOR SELECTED COUNTRIES GROUPED BY PER CAPITA GDP IN US DOLLARS, 2000-02**

Per Capita GDP Below US\$ 1000		Per Capita GDP between US\$ 1000-10000		Per Capita GDP between US\$ 10000-20000		Per Capita GDP above US\$ 20000	
China	12.15	Argentina	11.03	Israel	755.91	Australia	281.07
India	3.53	Brazil	22.55	Spain	165.52	Austria	564.59
Nepal	1.50	Czech Rep.	90.26			Canada	459.63
Pakistan	1.13	Egypt	2.20			Denmark	869.68
Sri Lanka*	1.46	Hungary	66.49			France	552.08
		Rep of Korea	288.50			Germany	613.94
		Russian Fed.	29.91			Italy	220.76
		Thailand	5.01			Japan	976.58
		Venezuela	14.48			Netherlands	477.00
						Singapore	475.52
						Sweden	1104.20
						UK	436.40
						USA	962.15

Source :- USESCO Institute for Statistics (UIS) 2005, UNESCO.  
World Development Indicators 2004/2005, The World Bank

Note : 1. China excludes Hong Kong  
2. \*1996

It may be seen from Table 8.3 that most of the developed countries spent, more than 2% of their GDP on R&D. Among the developing nations, Brazil and China spent 1.04% and 1.23% of GDP on their R&D while India spent 0.80% of its GDP on R&D.

It might further be useful to examine whether the countries having high Per Capita Gross Domestic Product also invest more on R&D. For this purpose Per Capita GDP has been broken down into four groups as shown in Table 8.4.

It may be noted from Table 8.4 that amongst the developed countries having a per capita GDP of US\$ 20,000 and above, the per capita R&D expenditure varied from US\$ 220.76 for Italy to US\$ 1104.20 for Sweden. The developing countries whose per capita GDP was less than US\$ 1000, spent per capita R&D expenditure up to US\$ 12. For India this figure was US\$ 3.53.

On the other hand, the developing countries whose per capita GDP was between US \$ 1000 to US \$ 10,000 had per capita R&D expenditure of more than US \$ 20 with the exception of Argentina, Egypt, Thailand and Venezuela.

Scientists and Engineers carrying out the research and development activities constitute another important input for research. In order to iron out inter-country differences due to varying population sizes, their number is usually expressed per million population. It may be noted from the Table No. 33 given at the end that Finland tops the list with 7431 researchers per million population. For Sweden, Japan, Denmark and USA these figures are 5171, 5085, 4822 and 4526 respectively. For India, the number of researchers per million population is 110. However, in terms of total researchers the USA has the highest number of 12,89,910 researchers followed by China 8,05,176, Japan 6,45,795 and Russian Federation 4,95,175 respectively. For India the total number of researchers are 1,15,936.

**To sum up, the salient features are as under:**

- Most of the developed countries spent more than 2% of their GDP on R&D while India spent 0.80% of GDP on R&D.
- India's per capita R&D expenditure was US\$ 3.5 whereas this was between US\$ 220 and US\$ 1104 for most of the developed countries.
- India has 110 researchers per million population as compared to 7431 in Finland, 5171 in Sweden, 5085 Japan and 4822 in Denmark. However, the total number of researchers in India are 1,15,936 as compared to 12,89,910 in USA, 8,05,176 in China and 6,45,795 in Japan.