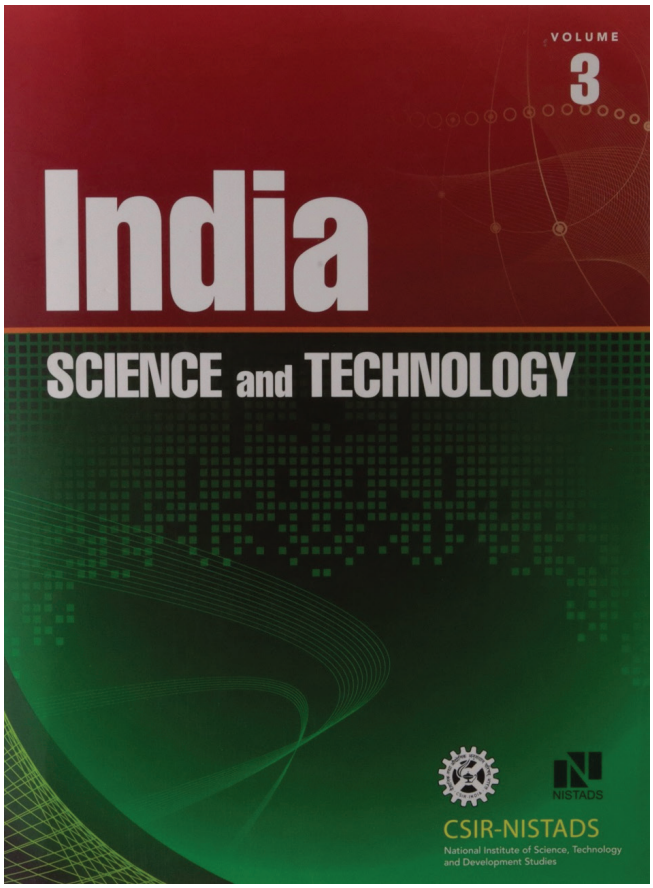
# India: Science and Technology

**Book Review**

***IndiIndia Science and Technology Volume 3*** *(ed: Banerjee, P., Bhattacharya, S., Kumar, V., Mandal, K., Mehra, K., Pohit, S., Raina, R.S., Suman, S.), Cambridge University Press: New Delhi, 2015, 600 pages, ISBN 9789384463045.*




According to UNESCO, Data may be defined as 'facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by human or automatic means.' Also, CODATA (Committee on Data for Science and Technology) defines data as a "crystallized presentation of the essence of scientific knowledge in the most accurate form." The data analysis process essentially involves inspecting, cleaning, transforming and modelling of data with the goal of discovering useful information, suggesting conclusions, and supporting decision-making. It has multiple facets and approaches, orienting versatile techniques under a variety of names, in different subject areas. An increase in the volume of a subject field escalates various characteristic features of data related to the nature of activity, quantity, quality and impact of the activities of practitioners on society.

In the concerned compilation, which is third in the series, the CSIR-National Institute of Science, Technology and Development Studies (NISTADS) collected data over a period of ten years preceding 2012. The data presented here is related to various aspects of science, technology, science policy, innovation, research & development, etc. It is categorized into four main themes: S&T Human Resources, S&T and Industry, and finally S&T Outputs, Rural India: S&T Skills & Employment. The large and versatile data has been collected from various primary and secondary sources. Each of these sections is comprised of large numbers of chapters by different authors on specific issues. The book includes an extensive summary, tables, figures and boxes, references and a short index accompanied by the list of boxes and the list of acronyms and abbreviations.

The book deals with human resources in multiple contexts. It deals with various dimensions of resources that the country's science & technology and innovation system can make use. The book focussed on employment generation, upgradation of skills and several dimensions of Indian science, technology and innovation et al that may be helpful for the decision takers and policy makers who face the paradox of STI having the potential of new avenues of economic growth and revenue which is often convoyed with gradual asymptote of labour force due to growing trend of automation. The incessantly growing manpower, unemployment, and economic discrepancy make this a major issue for the policy makers to resolve. This book provides a large number of datasets spanning

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a wide range of issues related to Science, Technology and Innovation (STI) in India.

It is a fact that, with 356 million 10-24 year-olds, India has the world's largest youth population despite having a smaller population than China, as reported by the United Nations Population Fund's (UNFPA) State of the World's Population report. It said that developing countries with large youth populations could see their economies soar, provided they invest heavily in young people's education and health and protect their rights. Within this generation are 600 million adolescent girls with specific needs, challenges, and aspirations for the future, the report said. The report titled 'The power of 1.8 billion', said 28 per-cent of India's population is 10 to 24 year-olds, adding that the youth population is growing fastest in the poorest nations. The global number of youths is highest ever. As the world is home to 1.8 billion young people between the ages of 10 and 24 years, 9 in 10 of the world's young population live in less developed countries. "Never before have there been so many young people. Never again is there likely to be such potential for economic and social progress. How we meet the needs and aspirations of young people will define our common future," the report said.[1] At this juncture, the human resources in the field of STI in India are of extremely importance since the country has the potential to contribute maximally to the global youth population. Different issues under the purview of human resources are considered here. The inferences based on analysis of data pertaining to school education, higher education, privatization of education, non-formal education are important.

The data presented in this book assert that the country needs to worry about the quality and preparedness of the youth for productive and challenging S & T activities. It is revealed from the book that the expenditure in education escalated from 1.3% of GDP in 1990-91 to 4.4% of GDP in 2009-10. The Gross Enrolment Ratio (GER) was 83% for elementary education in 2011, which is not too bad compared to countries like China, USA, and the UK. But India is far behind the countries like China, USA, and UK in respect of GER in higher education. We have shocked to know that in the Indian higher education system, out of the total enrolled students, only 12.26% is enrolled at the Master's level, and 0.79% is enrolled in research. Also, the striking fact is that, among the choices of the stream, science stream enrolment is coming down in comparison with the commerce stream. The arts stream also shows a steady decline from 60% in the 1970s to 50% in 2007. Ph.D. enrolments, on the other hand, show a steady compounded growth rate of around 13.6% from 1981 to 2001. Concerning the distribution of skill generation across various disciplines in higher education, this book reported that out of the total enrolments of students, 37.09% students are in the faculty of Arts, followed by 18.64% in Science and 17.57% in Commerce/Management during the academic year 2011-12. The remaining 26.7% are in the professional faculties. Among it, the engineering/technology discipline has the highest share, i.e. 16.05%, while only 3.52% are studying Medical courses. As a result, while India does not fare too bad in respect of engineer to population ratio, doctor to population ratio is miserably low, i.e. 1:1700, while the global average is 1.5:1000. Also, the growth of educational infrastructure in terms of number of colleges, universities, and technical institutes is more skewed towards south central, south and northwest region and urban centric. Thus, the eastern part of India, hinterland, and rural India lags behind.

The data in the book revealed that in the non-formal education sector, in spite of substantial increase in public and private Industrial Training Institutes, only about 14 lakh persons could be trained in 2012-13 against a target of 85 lakhs. In the area of Manufacturing Industry, the number of enterprises grew at a rate of 3.52% per annum, and employment grew at 3.9% per annum and value added by 5.61% per annum. Labour productivity, measured in terms of value added to labour, increased at a rate of 2.57% per annum. Major growth was marked in service sector particularly like financial intermediaries, real estate, renting and business service, health and social works and other services. Also, nearly one-third of the manufacturing output was produced in the western part (Gujarat and Maharashtra together) absorbing roughly one-fourth of the total employment. The eastern region states, on the other hand, are continuously losing their prominence. In terms of capital-labour ratio, Gujarat was at the top followed by Uttar Pradesh, Himachal Pradesh, Orissa, Madhya Pradesh and Karnataka. Capital intensity in registered manufacturing increased dramatically in Orissa during the period.

India ranks second or third among countries that 'export' human resources to other countries. The data in the book revealed that the Persons of Indian Origin (PIO) have acquired better S&T expertise, are financially better-off and have good negotiating skills through better networks. India currently spends 0.9% of GDP on research and development (R&D) compared to 2.7% in the USA. While the bulk of India's research funding continues to flow from the government, public funding as a proportion of total R&D expenditure fell from over 80% in 1990-09 to 66% by 2007-08 [2]. The book revealed that the largest

increase in national publication share was observed in pharmacology, toxicology, and pharmaceutics followed by medicine and computer science from 1996-03 to 2004-11. The global publication share of India was highest (6.42) in veterinary science followed by chemistry (4.98), pharmacology, toxicology and pharmaceutics (4.3), agriculture and biosciences (3.98), material science (3.88), environmental science (3.59), chemical engineering (3.51), and physics and astronomy (3.44). The largest share of international collaborative papers (30.95%) of India was observed in physics and astronomy followed by mathematics and earth sciences during 1996 to 2010. The largest citation impact (10.72) of Indian papers as reflected in citation per paper was observed in neurosciences followed by chemical engineering, biochemistry, and genetics & molecular biology. The global share of Indian S&T publication output increased from 1.9% to 2.8% from 2000-05 to 2006-11. India's global share of highly cited papers increased marginally from 0.3% to 0.6% during the period 2000-11. The number of Indian papers in high impact factor journals is very small, which is a very disappointing feature.

While the number of researchers in the country is increasing, data on the number of active researchers, i.e. those with sustained scientific publication record, suggest high drop-out rates. The analysis of newspaper coverage shows that the negative consequences of technologies, environmental health issues, ethical-legal issues, etc. are hardly discussed. The growing trend of national patents accompanied by the substantial increase of the inventors is suggested here.

One limitation of the book is the lack of incorporation between the different chapters dealing with similar kinds of issues. For instance, the research publications indexed in Scopus and ISI-Web of Knowledge are discussed completely independently without any cross-discussions. Besides, the book is silent about coverage in other databases like Pubmed, Indian Citation Index (ICI), etc. Indian Citation Index (ICI). There are several other databases like, Google Scholar, Astrophysics Data System (ADS), Physics Abstracts, INSPEC Database, COMPENDEX Database, Altmetric.com (for measuring article level metrics), eigenFACTOR.org (for measuring author-level metrics), ImpactStory.org (for measuring article level metrics), JournalMetrics.com (for measuring journal level metrics), NSTMIS datasets [Data.gov.in], Publish or Perish (POP) Software (for measuring author-level metrics),etc [3]. There should be at least one or two chapters dedicated to the integration of available data from all their sources. This book is a rich source of data their analysis. It would be of wide use, especially for policy-makers and analysts of various subject fields. It is useful to people interested in seeking information in various fields. It is a very potential source of information on India's R&D in various areas of S&T.

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