Chapter 7
Science and Technology for Socio-economic Development and Quest for Inclusive Growth: Emerging Evidence from India

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7.1 Introduction

This chapter discusses the evolution of science and technology policy in India, its linkage with national developmental plans and the challenges ahead for India in science, technology and innovation policy. In India, as in many post-colonial countries, the state has played a major role in using science and technology for national development besides giving it a special thrust. While India succeeded in creating a sizeable science and technology infrastructure within five decades of independence, the globalization of science and technology and changes in the external economic environment necessitated a change in the orientation of policymakers. The Twelfth Five Year Plan (2012–2017) focuses on sustainable and inclusive growth, while the Science, Technology and Innovation Policy of 2013 emphasizes new models for promoting innovation. In the global innovation discourse, India's capacity for frugal and inclusive innovation is recognized, and the National Innovation System is also bringing about change, with contributions from many quarters ranging from multinational corporations to grassroots innovators.

Although ethical values have not been explicitly indicated in policy statements, key objectives of the policies have applied science and technology for socio–economic development and ensured that the benefits of science and technology reach the masses. In the Indian context, access, inclusion and equity can be regarded

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M. Ladikas et al. (eds.), *Science and Technology Governance and Ethics*,
DOI 10.1007/978-3-319-14693-5_7

as ethical values and guiding principles in science, technology and innovation policy. This is compatible with the vision of sustainable and inclusive growth. The challenges remain translating this into practice and developing suitable indicators.

7.2 Science and Technology Policy in India

'Science: The Endless Frontier', a report by Vannevar Bush published in 1945, played an important role in setting the agenda for post-war science and technology policy in the USA. The report saw it as the task of science policy to contribute to national security, health and economic growth. It emphasised the potential economic impact of investing in science. Science policy is a tool for managing and funding the accumulation of knowledge by establishing, funding and sustaining organizations (e.g. universities and research laboratories) and directing their outputs and accumulated knowledge towards meeting national objectives, among other things—and it can be justified from an economic perspective:

> A general economic rationale for STI policy is that we pursue it because we think it will lead to technological progress, and we think that technological progress is a crucial determinant of economic growth, which in turn we regard as ultimately vital to welfare of the individuals who comprise society (Kane 2001).

Given the wider impact of science policy, it can be analysed from various disciplinary perspectives (see, for example, Husbands Fealing et al. 2011). In post-colonial societies science policy became a prominent policy in national developmental agendas (Salami1 and Soltanzadeh 2012). Thus science policy is primarily a post-Second World War phenomenon. This is equally true of India, but the development of science policy there can be traced to the response of Indian society to modern science (Sinha 1992).

With the introduction of English-medium instruction in higher education in 1835, many Indians were exposed to modern science, and this resulted in a section of the community arguing for modern approaches, including science for social advancement. While the British set up colleges and universities, indigenous initiatives such as the Indian Association for Cultivation of Science and science popularization efforts increased access to science and enhanced the appreciation of science. The responses to modern science in India's traditional society were of three kinds: modernists wanted India to follow the European model, critical modernists argued for a creative synthesis of European and Indian civilizations, absorbing the best from Europe, and critical traditionalists emphasized the need to give primary importance to Indian tradition and culture while drawing upon European knowledge and culture (Parekh 1989). The responses to modern science within the national movement and Indian society were varied, and so was the understanding of science. Often science was equated with modernity.

By the 1930s, groups of scientists, nationalists and others were arguing that science would have to play an important role in post-independence India. The

National Planning Committee constituted in 1940 had a subcommittee on science. India gained its freedom in 1947, and the first prime minister, Jawaharlal Nehru, inspired by Fabian socialism and centralized planning in the then USSR, envisaged centralized planning and strong support for science in India. He gained the support of scientists such as Homi Bhabha, Meghnad Saha and S.S. Bhatnagar, and the restructuring of science and technology infrastructure was started. The infrastructure left behind by the British was upgraded, and many new laboratories and universities and research centres were set up. India gave priority to research in atomic energy.

The first science policy statement was issued in 1958. In 1983 the government came out with a Technology Policy Statement, followed by a Science and Technology Policy Statement in 2003. In 2013 the Department of Science and Technology issued its Science, Technology and Innovation Policy. These statements and policies have provided the overarching frameworks for science and technology policy and its linkage with developmental goals.

Since 1952 there have been 12 five-year plans. The current five year plan (2012–2017) emphasizes sustainable and inclusive growth. The key features of the five year plans are set out in Table 7.1 [Source: Dogra (2011)].

Science for national development and security, and self-reliance, have been at the core of India's science and technology policies. Although India had no document similar to 'Science: The Endless Frontier', its science and technology planning was led by scientists and technocrats who shared the visions of the politicians. This alliance led to a broad consensus on applying science and technology in India and to continued support for science and technology from successive governments. In that sense the post-colonial state in India was an ardent supporter of science and technology.

Table 7.1 India's five year plans[a]

Plan	Timeline	Key feature
First	1951–1956	Agriculture-led
Second	1956–1961	Socialistic industrial policy
Third	1961–1966	Self-reliance in agriculture and industry (plan affected by wars with China and Pakistan in 1962 and 1965 respectively), price stabilization
Fourth	1969–1974	Society-oriented (education, employment and family planning)
Fifth	1974–1979	Non-economic variables
Sixth	1980–1985	Infrastructure (6 % per annum growth achieved)
Seventh	1985–1989	Welfare sector, programmes such as Jawahar Rozgar Yojana
Eighth	1992–1997	Dismantling licence prerequisites and reducing trade barriers
Ninth	1997–2002	Agriculture and rural focus
Tenth	2002–2007	Globally competitive growth
Eleventh	2007–2012	Employment and social indicators
Twelfth	2012–2017	Sustainable and inclusive growth

[a]India had three annual plans between 1966 and 1969

The Department of Science and Technology was set up in 1972. Over the years the number of ministries and departments supporting science and technology has increased. In different periods India set up different departments, such as the Department of Electronics and the Department of Biotechnology, to capitalize on emerging technologies, while the mission mode approach was used for tackling problems. In the mid-1960s India launched its Green Revolution to overcome food shortages and achieve food security. This was the first mission mode application of science and technology to solve problems. The Green Revolution was driven with the support of private foundations, while the US government and the World Bank paid rich dividends and also enhanced the research and development capacity in agriculture. This was followed by the 'White Revolution' in the dairy sector. Later the same approach was used in telecommunications and oil seeds. In 2007 the Department of Science and Technology launched the Nano Mission to promote research in nanosciences and nanotechnologies and to ensure that India did not lag behind in this emerging field.

Science for national development and security has been a key driver in India's science and technology policy. This is expressed in various statements including the Technology Policy Statement, which stressed the point that the fundamental objective of science in India was to meet the basic needs of people: food, water, housing, health and education. Self-reliance in core sectors and in advanced technologies such as atomic energy, space technologies and defence-related applications has been another important driver in India's science and technology policy. This thrust has enabled India to achieve substantial progress in sectors such as space, and self-reliance has helped in applying science and technology for national development.

The opening up of the economy in 1991, subsequent developments in the global economic environment and changes in the science and technology milieu have had their impacts on science and technology policy. The earlier approach of relying solely on publicly funded science and technology, with restrictions on technology imports and licensing, was abandoned. The growth of the Indian economy, the availability of skilled human resources and changes in economic policies resulted in increased foreign investment in research and development in India by multinational corporations, and Indian institutions also increased the level and scope of collaboration with institutions and industries abroad. The change is evident in the Science, Technology and Innovation Policy of 2013, which goes beyond the state-led science, technology and innovation approach. Thus the Indian science and technology policy has come a long way from the 1950s, when science was regarded as a key component of the growth strategy. Table 7.1 sums up the changes over the decades.

Although applying science and technology for social development has been a key principle since the beginning, important initiatives in realizing this were taken by the Department of Science and Technology during the Sixth Five Year Plan in 1971, in the form of the Science and Society Programme. In 2011, based on the experiences gained from various initiatives under the Science and Society Programme and other activities, a new programme, Science for Equity, Empowerment and Development (SEED), was established to provide technology solutions to challenges in rural and urban areas for the disadvantaged sections of society. The idea was to link innovations developed in laboratories with the needs of the disadvantaged sections of society and improve their quality of life.

India's science and technology policy has seen both continuity and change. While there has been change in the choice of policy instruments, areas of thrust and priorities, continuity is evident in issues such as self-reliance in core sectors, and capacity building. In the past two decades, the horizontal focus of science and technology has been replaced with an emphasis on promoting innovation in a range of sectors including biotechnology, pharmaceuticals, automobiles and information technology. In terms of regulation, the emphasis on restrictions on the importation of trade and technology has been replaced with liberal policies, payments for licensing and royalties. Similarly, the push for self-reliance and indigenous development in all sectors of technology has given way to the importance of collaborative research, public-private partnerships and international collaboration, with due acknowledgement of the opportunities that arise from outsourcing research and development to India. In some sectors such as space and atomic energy, self-reliance remains the objective. The shift in focus and instrumentality is quite apparent in the Science, Technology and Innovation Policy of 2013.

Translating advances in science and technology into innovations is a big challenge. In the past few years the government of India has formed a National Innovation Council and announced a Decade of Innovation. The 2013 policy is different from the previous policies on science and technology in many ways. According to the policy:

> Global innovation systems tend to bypass large sections of the community. Innovation for inclusive growth implies ensuring access, availability and affordability of solutions to as large a population as possible. Innovation therefore must be inclusive.

The policy goes on to list 'Linking contributions of science, research and innovation system with the inclusive economic growth agenda and combining priorities of excellence and relevance' as an important objective. The policy advocates the strengthening of linkages between the scientific and socio–economic sectors, and it states that NGOs will be accorded an important role in delivering science, technology and innovation outputs.

Thus, over the past six decades or so, the scope of the policy instruments and the regulatory environment has undergone significant changes. The results are evident in India's global ranking in publications and patents, and in other indicators. The Twelfth Five Year Plan envisages spending on research and development increasing from 0.9 to 2 % of gross domestic product (GDP) by the end of 2017. It underscores the need for research towards breakthrough innovation in important sectors. However, challenges remain and key questions are: how much should India invest in science and technology and what should be the objectives of science, technology and innovation policy in the years to come?

A policymaker, after analysing investments and trends in science and technology, concludes that India has to balance between competitiveness and inclusiveness, and this will be a challenge for the research and development system (Ramasami 2014). Nation-building and socio–economic development became the dominant themes in science and technology policy, and India is not the only country that has had this approach to science and technology policy. Science and technology policy is one of the policy instruments, and it is necessary but not sufficient to address all the issues in socio–economic development.

In India, prior to 1991, centralized planning by the state was the determining factor in setting priorities for science and technology. As Table 7.1 indicates, the key features of the plans have changed, although the basic objectives remain the same. After 1991, economic liberalization and globalization brought new challenges and opportunities in science and technology forward. India joined the World Trade Organization and had to amend its laws and enact new ones to meet the requirements of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Similarly, India enacted a law to comply with the Convention on Biological Diversity. Globalization helped India realize its competitiveness in information technology services and the pharmaceutical industry. India became an attractive destination for foreign direct investment in research and development (Basant and Mani 2012).

According to R.A. Mashelkar, science and technology in India rests on four pillars: techno-nationalism, inclusive growth, techno-globalism and global leadership. He categorizes India as a nation with 'high indigenous science and technology capacity but relatively low economic strength' and includes China, Brazil and Argentina in that category with India (Mashelkar 2008). Pointing out the country's achievements in science and technology, he argues that India should aim for global leadership in some areas in science and technology, and should focus on basic science. In 2010 the Science Advisory Council to the Prime Minister introduced its vision document entitled 'India as a Global Leader in Science' with the following statement:

> In the next two decades, India is likely to become an economically prosperous nation and move significantly towards being a far more inclusive society, with the bulk of its population gaining access to facilities for education and health care and living a life with hope and security. To realize such a vision, it is essential that science is at the heart of the strategy that the next stage of national development demands (Science Advisory Council to the Prime Minister 2010).

It listed India's achievements in science and pointed out that the complex problems the country faced called for a 'proper use of science'. It argued that India itself was the most cost-effective source of research and development in India as it accounted for 0.5 % of global expenditure on science and produced 2.5 % of the global output in science. The document suggested many measures, including more funding for science to help India become a leader in global science (Science Advisory Council to the Prime Minister 2010).

Such statements and documents acknowledge the potential in India for science and technology and innovation and take the position that India can use science to address its complex problems and also aspire to be a global leader in science. This is a formidable challenge, however, because global ranking in publications is not a measure of innovation, and even if the number of publications in a field is reasonably high, their quality and impact matter too. For example, it has been pointed out that while India ranks sixth globally in publications on nanotechnology, its ranking is lower in terms of citations of papers from India.[1] A report from the World Bank published in 2007 pointed out the innovation potential in India and called for a three-pronged strategy to realize this potential: increasing competition and improving innovation infrastructure, strengthening the creation and communication of knowledge, and fostering more inclusive innovation (Dutz 2007). Thus while the literature generally acknowledges India's potential, the suggestions on how this potential should be realized differ. Since independence, the Indian state has played a dominant role in science and technology policy and in funding research and development. It has incentivized private-sector research and development through various schemes. As Daniele Archibugi and Jonathan Michie point out, technological globalization does not mean less support for innovation from governments: more support is needed to enhance a country's competitive advantage (Archibugi and Michie 1997). This is nowhere more true than in India.

Given the fact that India has become the third-largest economy in the world, the mantra 'science and technology for development' is all the more relevant. As Indian companies acquire foreign companies and invest in research and development outside India while India continues to be an important destination for foreign direct investment in research and development, the picture is becoming more complex. According to Sunil Mani, while the knowledge intensity of India's output has increased to 14 % of India's net domestic product, much of this emanates from the services sector, whose share of knowledge-intensive production was 11.55 % in 2009. The proportion of exports comprising high-technology products doubled from 1988 to 2008, when it stood at 16.94 % (Mani 2010). From the current trends in investment, publications and patents it is clear that India is entering a new growth phase in science and technology that has to be sustained if India is to emerge as a global leader in this field. In terms of spending on science and technology, publications and patents, India has made significant progress in the past decade. While the government is the major funder, the private sector's share has increased significantly.

India's planners and scientific establishment are aware of the need to increase investment in science and technology, to enlarge India's share of science and technology publications, and to ensure that India is actively engaged in emerging technologies such as nanotechnology. Various measures have been taken to achieve these objectives. The Innovation in Science Pursuit for Inspired Research (INSPIRE) programme aims to attract talent to the sciences by providing scholarships right from school stage as incentives to students to pursue a career in science. In terms of publications, India's share has increased significantly in the past few years, but to ensure that this continues and that India does not lag

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[1] 'Thus India was ranking 6th and had the fastest growth rate from 2001 to 2011, albeit from a low base. When looking at the citations of these papers, however, India ranks lower. For the top 1 % of cited papers India ranks 14th and for the top 10 % of cited papers it ranks 9th. This indicates that the country's scientific output was not as much in the frontier domain as the simple volume indicator might have led us to believe' (Greenhalgh 2013).

behind countries such as Korea, the Twelfth Five Year Plan India invests heavily in science and technology. A study for the Department of Science and Technology points out that the citation impact of papers has increased to about 0.68 in 2006–2010 from 0.35 in 1981–1985, and the targeted value is 1 for the period covered by the Twelfth Five Year Plan. The number of publications from India increased from 15,000 in 1981 to 40,000 in 2008, while India's share rose from 3 to 3.5 % in the same period (DST 2012). Fully aware of the fact that India has to compete with countries such as Korea, Brazil and China, India's planners believe that it's share should increase to 5 % from the current 3.5 % within the next five years.

The challenge before policymakers is: how can India meet multiple objectives with the available infrastructure and human resources? As there is no guarantee that increased spending will automatically translate into desired outcomes, and as the National Innovation System in India is more complex today than ever before, old approaches may not work. State-supported public-sector research and development are necessary, but not sufficient, and hence new models such as public-private partnerships in research and development and joint product development may be necessary.

To conclude, the science and technology policy in post-independence India has been shaped by concerns over socio–economic development and the need for self-reliance. In years to come, however, the policy will have to address new issues emerging on account of the globalization of science and technology, the opportunities provided by emerging technologies and the technological convergence and other changes taking place in the global science and technology landscape. At the same time, the science and technology policy will have make a substantial contribution to sustainable and inclusive growth.

7.3 Science and Technology Policy Discourses in India

Although science and technology policy in India is largely driven by the state, the debates on the role of science and technology in Indian society and modes of applying science and technology help us understand the policy discourses. For convenience, we can classify these discourses into the following categories:

- Nehruvian discourse
- Gandhian discourse
- People's science movements and their discourse on science and technology
- Other voices and discourses on science and technology

According to Dinesh Abrol:

> The 'Gandhian', 'Nehruvian' and 'Left' political traditions differed radically with each other in terms of the conception of 'socio-technical imagination', 'vision of path of development' and 'social carriers of innovations' to be encouraged (Abrol 2012).

Of these, the Nehruvian discourse has been the dominant one and has had significant influence on science and technology policy-making. This discourse emphasizes the key role of the state in applying science and technology for national development, modernization and socio–economic development. The Nehruvian vision envisaged the transformation of Indian society through the application of science and technology and the inculcation of a scientific temper. Nehru supported big projects, rapid industrialization made possible by state-centred planning and a key role for the public sector. In this perspective the state ensures that the benefits of science and technology reach all sections of society and that science and technology themselves are scale-neutral and value-neutral.

On the other hand, the Gandhian discourse saw the application of science and technology as helping village revitalization. The Gandhian discourse, influenced by the ideas and life of Mohandas Karamchand Gandhi, attached importance to the principle of production by the masses, village self-sufficiency and a decentralized approach to planning. This discourse favoured limiting the role of the state in society and supported the autonomy of communities. Gandhians regarded values in science and technology as important and cautioned against applying science and technology to satisfy greed rather than genuine needs. The Gandhian discourse was influential in the freedom movement, but was eclipsed by the Nehruvian perspective in post-1947 India. Although this discourse gained support from E.F. Schumacher some decades later, and was used by scientists such as A.K.N. Reddy and C.V. Seshadri to develop alternative technologies and approaches, its impact on science and technology policy-making was minimal.

People's science movements are influenced by leftist ideology and see science as a tool for social revolution. While they agree with the Nehruvian discourse on the scientific temper, they are critical of many projects and programmes initiated by the state in the name of development. Kerala Sastra Sahitya Parishad, the best-known people's science movement in India, played an important role in the struggle to stop the Silent Valley project, which the central government abandoned. These movements regard renewable sources of energy as important, are against multinationals in the agri-biotech sector and see a key role for public-sector research and development in finding innovative solutions.

Besides these three discourses, there have been other voices and views on science and technology in India. Scientists including A.K.N. Reddy and C.V. Seshardri advocated a different approach that regarded it as important to find appropriate solutions to meet the needs of people and argued for a blend of traditional technologies and modern science and technology. Groups such as Patriotic and People-Oriented Science and Technology called for a relook at India's traditional science and technology and their relevance to modern society.[2] Figures such as Shiv Visvanathan, Ashis Nandy, J.P. Uberoi, Vandana Shiva, Jayanto Bandhbadhyay and Anil Agarwal, from different vantage points, provided critiques of modern science, of science and technology policy and of major projects. The resistance to large projects such as the Narmada Valley project, nuclear power, genetically modified organisms in agriculture and mega-projects in the power

[2] See Rajan (2005) and Prasad (2006) for a discussion of this.

sector indicated that at the grass roots, the response to science and technology policy and development projects was ambiguous, and that not everyone shared the vision of the Nehruvian discourse. The dissenting voices and discourses did not have much impact on science and technology policy-making, but over the years they have contributed to the debates and discourses on science and technology policy by bringing in issues that had not received much attention. They raised issues relating to equity and development, environmental justice and alternatives that were not being explored. This, in turn, resulted in changes in policies relating to land acquisition, environment impact assessment and rehabilitation of the displaced. The dissidents also worked on alternatives in agriculture, medicine, and energy.[3]

7.4 Ethics in Science and Technology Policy in India

Indian science and technology policies have been shaped by the concern that the application of science and technology should enable faster socio–economic development and that all sections should benefit from scientific and technological advances. The unstated assumption in these policies is that value-neutrality and scale-neutrality are to be addressed by appropriate interventions in favour of marginalized sections of the population. According to Rajeswari Raina:

> Many of the inadequacies in current decision-making in S&T for development stem from a lack of shared understanding of causal relationships and common ethical principles that can guide decision-making (Raina 2010: 27).

The ethical assessment of technologies at their initial stages poses many problems, and there are challenges that have to be addressed by policymakers (Bostrom 2007). But many principles, including the precautionary principle and the principle of public participation, have been developed to address ethical issues in science and technology (UNESCO 2007). An important question, however, is: what are these common ethical principles? India has accepted global norms in bioethics and has created institutional infrastructure to give effect to them. Through the intervention of the supreme court and the efforts of the Indian Council of Medical Research, clinical trials are regulated by ethical principles and guidelines.

Although science and technology are universal, are there universal ethical principles that are relevant for science and technology policy-making in all countries? Should a country like India opt for ethical principles based on European or American values, or should it use its traditional ethics and theories to arrive at more appropriate principles? Those who espouse universal values could argue that since science and technology are universal and common to all cultures, such

[3] For reasons of space we do not discuss this in detail. Suffice it to say that while technocrats such as A.K.N. Reddy and C.V. Seshadri worked on developing alternative technologies, Gandhians worked on rural industrialization, agriculture and textiles.

values should guide science and technology policy. Those who are against the universal values approach would not only question the idea of universal values, but would also point out that in bioethics the debate has been inclusive, taking into account bioethical values in different traditions including religions and cultures. In the case of research integrity and ethics, while there is consensus on some issues, divergent perspectives are expressed on others (Anderson 2011). According to Henk ten Have:

> The need to establish common values and benchmarks, as well as to promote ethical principles and standards to guide scientific progress and technological development, is becoming increasingly acute, especially in developing countries that do not equally enjoy the benefits of scientific and technological advances. UNESCO's work in ethics of science and technology reflects these global concerns. It examines such progress in light of ethical considerations rooted in the cultural, legal, philosophical and religious heritage of the various human communities (ten Have 2006).

Similarly, the report of the European Commission's Expert Group on Global Governance of Science stresses the need to strike a balance between paternalism and irresponsibility. It calls for harmonizing general ethical principles and the recognition of religions, traditions and local cultures in dialogues (Ozoliņa et al. 2009).

As science and technology policy is not an exercise in philosophy and is linked to larger societal visions, aspirations and demands, a blind application of universal value would not be suitable. Taking a culturally relativist approach and denying the need for value orientation in science and technology policy, or arguing that the values of a region or country alone should be considered in determining ethical values, would not be the right approach as such a view reflects a parochial mindset that refuses to recognize that science and technology are global and so are their impacts and implications.

A concern about ethics in science and technology policy can be expressed in many ways. For example, in the Fourth Basic Plan of Japan, ethics is reflected in the objective that policy should be created and promoted with society. The plan attaches importance to the promotion of 'green innovation' and 'life innovation'. It proposes more involvement of the public in science, technology and innovation policies, improving regulatory science and improving technology assessment (Ida 2011). This is a response to the problems—including earthquakes, a tsunami, a nuclear incident, ageing, a declining birthrate and the falling competitiveness of Japanese industries—faced by Japanese society and changes in the global science and technology system (Ida 2011). A concrete response by expressing ethical concerns in science and technology policy is evidence that science, technology and innovation policy can incorporate ethical values based on need and relevance, and can choose from various principles and values the relevant one. Thus, while increasing public participation and improving regulatory science and technology assessment might be found as ethical concerns or norms in the science, technology and innovation policies of other countries, in the Japanese context incorporating them is a response to the needs of the society and its experience with promoting science, technology and innovation.

Often ethics in science and technology is associated with values such as autonomy, human dignity and justice, and it is contended that science and technology should be practiced in such a way that they do not negate or disrespect these values and do contribute to furthering the wellbeing of humankind (Evers 2001). But in the case of science and technology policy, the picture is more complex as distributional effects of policies have to be taken into account. Scholars working on science and technology policy have pointed out that access to science and technology and its benefits are often unevenly distributed, resulting in inequities in distribution that can result in outcomes that aggravate the broader inequities (Cozzens 2007; Woodhouse and Sarewit 2007). Bozeman et al. (2011) have analyzed the equity issues in science and technology and their linkages with science and technology policy. One of the ways of assessing the equity impacts of science and technology policy is to find out whether science and technology policy has enabled the basic needs of most sections of society to be met, and has contributed to better access to the outcomes of science and technology. Access and equity are interlinked. Better access may reduce inequities. In the literature, access is often discussed in the context of access to technology and services, including health services, and how race, gender and poverty affect access (see, for example, UNCTAD 2011).

If we regard equity as distribution with due consideration for basic needs and fairness, access is a determining factor. The policy framework might have taken equitable outcomes as an objective, but lack of access on account of various factors will skew the outcome. Hence policies to promote access may result in better and more equitable outcomes. In the literature, equity in science and technology has been examined in the context of specific technologies (Cozzens and Wetmore 2011). In the case of innovation policies, it has been hypothesized that although innovation policy is not often considered in terms of distributional implications, left-oriented governments are more likely to attach importance to it (Breznitz and Zehavi 2013).

India's Twelfth Five-Year Plan states that 'our focus should not be just on GDP growth itself, but on achieving a growth process that is as inclusive as possible' and rightly accepts that 'strong inclusive growth is the only scenario that will meet the aspiration of the people'. This reflection indicates that the planners are aware of the need to move beyond GDP growth and that the challenge lies in framing policies to promote inclusive growth. In fact, in view of the fact that economic growth does not result in equitable benefits across different sections of the population, inclusive growth has been suggested as an objective. Organizations such as the Asian Development Bank and the Economic Commission for Latin America and the Caribbean have researched exclusion and equality (McKinley 2010; ECLAC 2014). In the case of science and technology policies and specific technologies, inclusion and exclusion issues have been analyzed at length (see, for example, Mercado 2012; Haribabu 2009; Thomas and Fressoli 2011; Sutz and

Tomasini 2013). According to the United Nations Conference on Trade and Development, policymakers should attach importance to addressing horizontal and vertical inequalities. Interestingly. a recent statement from the Indian government on science, technology and innovation for the post-2015 development agenda indicates that it is sensitive to issues of inclusion and to using science and technology to meet basic needs:

> India stands for and will be pleased to contribute on following dimensions of UNCSTD STI efforts vis-à-vis post 2015 Development Agenda:
>
> - Affordable Innovations, encompassing access, availability and usable solutions to meeting basic needs;
> - Accelerated Inclusive Growth for aspiring nations – developing countries with thrust on base of pyramid population (as a better replacement to the prevalent expression of bottom of the pyramid) … (Relia 2014)

Thus, in our view, access, inclusion and equity can be considered ethical values in relation to science and technology policy. There are many issues that need to be addressed, including developing science, technology and innovation indicators for access, inclusion and equity, and developing methodologies for measuring policy outcomes for access, inclusion and equity, and more theoretical work needs to be done on access, inclusion and equity.

7.5 Conclusion

Indian science and technology policy has come a long way since the early 1950s. Today, as India aspires to be a global leader in science and technology, it is important for Indian policy to give attention to ethics in science and technology policy. However, this does not mean that science and technology policy has to import values from Europe or the USA. Rather, in our view, access, inclusion and equity can be considered ethical values and can be used to assess policy outcomes. This makes better sense in the Indian context, as it links societal development with science and technology policy. It also reflects the current thinking on sustainable and inclusive growth.

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