
Editorial

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Biographical notes: Pranav N. Desai is currently the Chairperson, CSSP and is engaged in teaching analysis in science and technology policy and technology futures analysis. He received his PhD in Science Policy Studies in 1985 from JNU and has conducted research in diverse areas of science policy including emerging technologies, intellectual property rights, energy and environment related issues. He specialises in science, technology and international affairs.

Sustainable development was not a new concept while it was initiated at the Stockholm Conference (United Nations Conference on the Human Environment held in 1972) but the efforts made here provided international recognition to the collective responsibility of the nations to protect the earth as a whole. The concept was further popularised by the publication of 'Our Common Future' (Brundtland Report of the World Commission on Environment and Development) in 1987 and provided some direction for comprehensive global solutions. These efforts have also helped broaden the meaning of the term environment by recognising the interconnectedness of social, economic and environmental issues. The understanding so far was devoid of the socioeconomic and political dimensions. The earth was so far perceived as a 'geologic' entity and the enhancement of scientific understanding revolutionised this perspective only to view it as interactive and regenerative 'biogeochemical' processes. It also provided impetus to formation of several national and international agencies and programmes of action that culminated into merging of the concepts like environment and development. In the year 1992, the UN Conference on Environment and Development (UNCED) was held in Rio de Janeiro. The outcome of this conference was the publication of Agenda 21, the Convention on Biological Diversity, the Framework Convention on Climate Change, the Rio Declaration, and a statement of non-binding Forest Principles. Many other concepts that emerged were 'capacity building' and 'uncertainty principle' that replaced optimism about the creation of a modern technological utopia by a more realistic understanding of the forces contributing to the major problems like poverty, diseases and food security.

It was during this period that the nature of the technologies like information and communication technologies, biotechnologies and nanotechnologies was changing rapidly and so was the international system. The launch of the World Wide Web in the year 1991 changed the face of the information flow and communication era that we live in today. Biotechnologies promised new treatment for genetically oriented diseases, increasing agricultural productivity, nutritive qualities of food crops, and reduction in inputs like fertilisers, pesticides and water. The other S&T accomplishments were cloning (1997) and the mapping of human genome (2001). As *there is plenty of room at the bottom*, the *engines of creation* successfully converted theoretical possibility into a

concrete reality while carbon nanotubes (1996) were formed to begin the nanotechnology revolution. Nanotechnologies also have potential for cheaper, cleaner ways of producing and storing energy, boosting agricultural productivity, producing clean water and diagnosing diseases.

The co-evolution of these institutions and technologies still leaves many conflicts unresolved in terms of socioeconomic, political, ethical and legal issues. In the preceding context, the papers in this special issue explore whether economic growth, social equity and environment will keep pace and whether the innovations and emerging technologies as key forces will be the solution to sustainability or whether these technologies will exacerbate the problems in Asia. Asia holds special interest given its specific socioeconomic and S&T conditions. Asia, the largest 'continent' in the world with more than 60% of the world's population, is a predominantly rural region. Some of the world's most industrialised, industrialising and oil-exporting high-income economies also belong to this region. Although this continent has the distinction of reducing poverty at a fast rate, it is estimated that about 800 million people live on less than \$1 a day. Asia also has diverse physiographic and extreme climatic conditions as well as diverse cultural, socioeconomic and political conditions. Recently, this region has witnessed not only economic revival but also rapid economic growth. This is not restricted to the developed but also the developing regions of Asia.

Recently, Asia has witnessed rising consciousness towards application of science and technology for sustainable development not only at national level but also at regional level. This is being reflected in various international cooperation efforts to form regional science organisations and their increasing participation in activities related to science, technology and sustainable development. Moreover, there has been increasing efforts to invest in the emerging technologies. Most notable example are the Information And Communication Technologies (ICT) where more than 80% of world production is concentrated in this region and consumption is also surpassing that of the USA and European regions. Though Asia's share in biotech industry revenues is not so significant (3%), the growth in this sector is much higher compared to other regions of the world. Nanotechnology is a nascent field and some of the Asian countries like Japan, Taiwan and Korea are gaining greater international visibility with their technological leadership and strength in terms of patenting activity. However, the Asian regional S&T order still remains hierarchical as there is unequal distribution of S&T resources, intellectual property rights and the digital divide is threatening to widen. Furthermore, modern S&T have remained relatively ineffective in solving many socioeconomic problems.

Drawing upon Indian experience, Tiwari explores whether ICT growth can be pro-poor and more specifically focuses on rural poverty within the country. The paper identifies issues critical to examining if ICT in developing countries has implicit poverty reduction pathways. After having described the trends in economic growth, the paper has mapped out characteristics of the ICT sector in India and its evolution. It is argued that the ICT sector has urban bias as reflected in the growth of the ICT sector centred around urban clusters leading to regional imbalance and uneven development. This is against the backdrop of predominance of agricultural and rural economy of India. A discussion on poverty in India and the socioeconomic features are discussed to identify the pro-poor growth and questions are raised whether the ICT sector has potential to be pro-poor.

The paper has an interesting analysis of the structure of ICT sector in India and its implications for capital accumulation and human development. Arguing that the digital-divide in India compared to other ICT players of the world is most pronounced,

Tiwari provides comparative figures for some developing as well the developed countries to prove her argument. The assumption here is that the high proportion of rural population may aggravate the participation of people with low skills in a high-skill intensity ICT sector. Furthermore, India's ICT strategy in order to reduce poverty and that might also meet the millennium development goals are delineated. Some of the schemes that have bearing on rural poverty reduction are listed and analysed. These schemes are aimed to enhance opportunities for the poor through improving their access to information and health care, to empower them by increasing their use of government services and provide security through access to micro finance. It is suggested that the model Sumner for FDI-poverty linkage could be transposed to ICT-poverty linkages. Finally, an important feature of this paper is to illustrate a conceptual framework of some of the pathways for making ICT growth pro-poor that could be used for any other developing country.

China, in the last decade, has recorded spectacular growth in terms of production and consumption in mobile communication technology. It is in this context that Jiang Yu has presented an important case study of how China has faced the challenge of building up the *Next generation communication technology with limited technological base and in the changing external environment*. The paper tries to argue that the efforts for radical innovations are inherently risky especially for developing countries where the technological and market uncertainties are relatively high and the innovations in dominant design level is an integrated process. Therefore, the policy-makers and the indigenous enterprises must have an awareness of the innovation paradigm shift to meet the great challenges.

Initially, to enter into the mobile communication markets, the domestic manufacturers employed technical standards and technological architectures set by the MNCs to develop their own 2G products. At this time, only four major MNCs controlled 90% of the GSM system market. The Chinese domestic players had not only limited market share but they also paid heavy royalties to foreign IPR owners. By participating in the design of the 2G system, some of the domestic firms built up capability for the development of the next generation mobile system. One of the firms developed the Synchronous Code Division Multiple Access (SCDMA) system – a new wireless access technology and by the year 2000 this was also accepted by the ITU as one of the three formal 3G transmission standards. This so-called Time Division SCDMA (TD-SCDMA) standard TD-SCDMA also offers several unique advantages over its two alternatives, such as flexible spectrum allocation, low-cost implementation. The TD-SCDMA system marks a milestone for the Chinese high-tech industry. However, while establishing dominant design in the market it was essential to integrate effectively several novel technologies including batteries, chipsets, radio and switching technologies. Amidst these technological and commercial uncertainties, the domestic firms began to develop TD-SCDMA system jointly with the major MNCs and depended on the outsourced innovations. The size of the Chinese markets, government interventions and creation of a favourable institutional framework that have enabled the Chinese firms transform from merely imitators to innovators.

Another technology that is emerging rapidly in Asia is biotechnology. Besides the major countries like China, India, Japan, Singapore, South Korea and Taiwan that have invested heavily, there are many other Asian countries that have started paying greater attention to biotechnologies and especially after the implementation of the Convention on Biological Diversity.

Agricultural biotechnology is expected to provide many solutions to the problems of poverty, malnutrition and stagnating agricultural productivity growth. The uncertainties about the associated environmental risks led to the enforcement of Cartagena Protocol on Biosafety (CPB). However, not only that there is divergence of opinion about its implementation but also there are many conflicts among various international agreements on governance of agricultural biotechnology. In the WTO context, there are several agreements such as Technical Barriers to Trade (TBT), the Sanitary and Phytosanitary Measures (SPS), Trade-related Aspects of Intellectual Property Rights (TRIPs), Agreement on Agriculture (AoA), which may affect introduction of GM products. If one wants to visualise the interplay of various conflicts, complexities involved in implementing these agreements and the multiplicity of standards that exist in different parts of the world and the its serious implication for the developing countries then Chaturvedi's paper is an eye-opener. While discussing the trade impact of the genetically modified food products, the paper has indicated the quantum of economic burden or losses that might entail while implementing CPB by various developing as well as the developed countries. The paper argues that some of the provisions and proposed mechanisms of the CPB are contentious and ambiguities involved might cause hindrance in its implementation. An important policy suggestion made in this paper is that the regulatory mechanism should integrate the socioeconomic concerns and especially the developing countries where important issues like R&D priorities, allocation of funds and their trade-offs are can have serious implications for their food and health security.

It is needless to say that the health sector is crucial for sustainable development in any country. Moreover, medical biotechnology is also assuming significant share of the biotechnology sector of many countries. The Trade Related Intellectual Property Rights (TRIPs) agreement is likely to have grave implications on the behaviour of domestic and foreign pharmaceutical/biopharmaceutical firms in respect to technology acquisition, knowledge transfer, overseas and domestic R&D, technological accumulation and hence the health security of any country. In past, there have been many speculative studies on the subject but very few studies have carried empirical investigations on the subject in the post TRIPs period. Abrol's paper is an illuminating exposition in this direction citing the Indian experience. It is in the context that of the changing intellectual property rights regime and also the socio-technical transformation from pharmaceutical to biopharmaceutical framework that the trends in production, R&D investment and outsourcing patterns are analysed. It is argued that the domestic Pharmaceutical firms were able to cross the barriers erected by the multinational and emerged as significant players as result of the patent legislation (1970), sectoral reservation, price regulation protection; supply of talent developed within the public sector and publicly funded R&D support. Now, after the enforcement of the TRIPs agreement and liberalised policies of the Indian government many restrictions are withdrawn. As a result, the paper argues that the MNCs would like to import the on-patent drugs rather than locate the production of new drugs in India and that many of the domestic bulk drug producers would face extinction. This has forced the domestic producers to change their route for their survival and their orientation during the post TRIPs period reveal that their activities will increasingly cater to the export markets at the neglect of the domestic requirement and public health goals. This is against the backdrop of increasing R&D intensities of the major drug manufactures on the one hand and insignificant R&D carried out by the MNCs. Furthermore, the shifting paradigm from pharmaceutical to biopharmaceutical is also responsible for the declining trend in new drug discovery R&D investment in India.

The MNC are expected to be attracted more towards field like bio informatics and clinical trial for their cost-cutting strategies. Thus, the development of the Indian biopharmaceutical industry hinges not only on the indigenous efforts but also on the overall strategies of globalising R&D. Finally, the major policy insight provided by Abrol is that Domestic firms should not get incentives for inappropriate product targets but these firms should rather be made to enhance their efforts on the real health needs including the diseases that afflict the poor in the counties of Asia and Africa.

Hospitals being the major actors in the health network, their role in adoption, diffusion and efficient utilisation of the emerging technologies like ICT, biotechnologies and nanotechnologies are crucial to health care delivery system. Diagnostic practices and procedural functions in clinics and surgery are dependent on modern instruments, tools and laboratory equipment. What are the factors that influence the diffusion process and adoption of these instruments and equipment? A paper by Ghodeswar and Vaidyanathan has discussed innovation attributes such as compatibility, complexity, cost, relative advantage, trial ability, safety, risk and observability in detail and their implications on hospital adoption. The resulting service is conceptualised to belong to one of the four categories, namely evolutionary service, expansionary service, developmental service, and nascent service depending on newness of the service to the hospital and the target patient population to whom the service is offered. This paper also examines the technology attributes by studying adoption of techniques in cataract surgery by a leading tertiary care hospital in India.

The process of globalisation and the rising income levels in Asia is expected to have wider impact on the education sector, human resource planning and therefore emerging technologies as well. From the 1980s to the mid-1990s, the demand for international higher education worldwide has increased by 61%. Of the 1.5 million overseas students studying worldwide, about 52% comes from the Asian region. However, in recent times there has been a change in the flow of international students. The transformation of international trade in education services into a global export industry has resulted in the gaps in the literature on international education. The present theories on the marketing of higher education were developed in countries that traditionally have been the host country of international students. It is therefore necessary to understand this phenomenon from a new perspective and especially while the General agreement on Trade in Services (GATS) has added new dimensions and raised many questions. Ancheh in his paper has explained the transformation of the higher education sector as a global export industry. This has proliferated to Asian countries that have been the traditional source of international students. It is argued that for a country like Malaysia, the traditional view of the globalisation of international education, the top-down approach, is no longer adequate to explain the phenomenon. A better model to explain the globalisation of international education is through the use of the international product life cycle theory.

The changing landscape of international higher education now has also rendered current literatures on the marketing of international higher education, which are based on the top-down approach, questionable. This is so because the assumptions behind the understanding and the theories may no longer be relevant. Thus, there is now a need to review the current understanding or theories pertaining to the marketing of international higher education. The differences in the nature of the developed countries and the developing countries show that there is a need to know the pull factors that are attracting students to study overseas in a developing country as their study destination, and the selection of the institutions within the developing country.