From policy statements to real policy

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This commentary provides arguments about the new Science, Technology and Innovation Policy of India and its compliance with the processes of formation of the subsystem of grassroots innovations support and development taking place in India. Despite the apparent lack of practical content on the informal sector in the new policy, the existing ecosystem is supported by the State. For its more efficient and large-scale operation, this support should be organized and incorporated into the general pool of measures of development of the national innovation system of India.

In January 2013, a new Science, Technology and Innovation Policy (STIP) for India was unveiled by the Prime Minister Dr Manmohan Singh. Among many comments, critiques and discussions about it, two theses could be highlighted. Krishna[1] evaluated the new STIP 2013 as a 'linear model of innovation' and called it a 'dead model'. The other important comment on STIP 2013 argued that the slogan 'Science, technology and innovation for the people' is a declaration without any actual filling inside, as it has little value for the informal sector of economy, where more that 80% of people are concentrated[2].

This policy was to be the document that declared and extended the new vision and understanding of the unique innovation path of India that had been developed and discussed for years. This policy was preceded by several important documents, in which the evolution of the theoretical understanding of innovation and the innovative path of India can be traced.

The evolution of ideas

In 2008, the Department of Science and Technology released the Draft, National Innovation Act, 2008 (ACT of 2008), one of the first attempts to consider the needs of millions of poor people by providing […] special measures for low cost technologies: the Appropriate Government shall take special measures for supporting public, private or public–private initiatives, which facilitate and encourage innovation, including in low cost technologies, products and services for the benefit of the common man whether in urban or rural India[3].

In this document special measures concerned mainly with waiver of fees and duties and some fiscal incentives (it was recommended to amend the Finance Act, Income Tax Act, and other National tax laws). Critics pointed out the overall fragmentation of the document, which is more a collection of regulations of certain sectors (protection of intellectual property rights [IPR], special innovation zones, etc.)[4–6]. The bill could not get the required number of votes in Parliament.

A more systematic attempt to comprehend the country's innovation development was undertaken in the 11th Five-Year Plan[7]. Typical for all Five-Year Plans (since the 1970s), the section 'Science and Technology' was named 'Innovation and Technology'.

The main message of this section is a statement of the India-specific way of innovation development, which is due to a large number of poor people and the need to provide innovations for this segment of the society, something almost unattainable by relying solely on market mechanisms. Improving quality of people's lives through innovation – this, according to the 11th Five-Year Plan, should be a defining component of innovation policy in India.

Faster growth in a globally competitive market environment demands a national innovation infrastructure that connects knowledge systems to wealth creation efficiently and effectively. In the Indian social context, there is a need to ensure that innovative growth-linked processes do not bypass the poor and leave them out of developmental choices emanating from the benefits of globally competitive innovations. Therefore, the Indian model for innovation should be unique. The innovation infrastructure of India should aim to bridge the internal asymmetries and serve the dual purpose associated with global competitiveness and inclusive growth[7].

This idea received further development in the Mid Term Appraisal for the 11th Five-Year Plan 2007–2012 released by the Planning Commission of India in 2011. In a manner this document contained revolutionary ideas about the understanding of innovation and the path of innovation development of India.

At the heart of the 'new innovation paradigm' is the assertion of the fallacy of the postulate that innovation is equal to science and technology. International ratings and evaluation of countries' innovative potential are based on this formula. They evaluate the innovative ability of the formal economy of the country, but do not take into account the specificities of countries like India, where the size of the informal sector of the economy reaches 86% according to various estimates. The Mid Term Appraisal defined this significant gap, and noted 'a need for innovation in the concept of innovation itself'[8]. The authors of the document point to the fact that formal innovation does not quite match the existing socio-economic situation in India, because formal innovations are not economical, requiring large financial and resource expenditure, and the resulting products are not affordable for the majority of the population.

Thus the concept of innovativeness of the innovation, according to the authors of the document, is to recognize the need, consistency and effectiveness of inclusive and frugal innovations. Hence the recommendation to develop the entire ecosystem of innovation – not only the formal segment, scientific and technological, but also the informal sector as a source of frugal and inclusive innovation.

The importance of supporting this segment is based on the impact of informal innovation on the serious economic and social imbalances in India. Apart from providing employment and improving the quality of life of the poor people, frugal innovation can help solve such problems as lack of urban infrastructure, availability of affordable medical care and education – in fact, in all areas that

'compete' for the state's funding and experience persistent lack of it.

This approach was developed further in the 12th Five-Year Plan (2012–2017). According to the Plan, the Indian model of innovation means: (1) affordable innovations to meet the needs of the people (transport, healthcare, water resources, etc.); (2) innovation accessibility to provide access to formal innovation to the maximum number of people and (3) innovation to reduce the cost of formal innovation.

This approach should ensure the production of solutions at a frugal cost. As stated in the 12th Five-Year Plan, this is a new paradigm of innovation development in India.

The approach announced in these documents seems to be a strong base for the innovation policy of the country, which had been developed all these years and finally formulated and published in January 2013.

New STIP

At the very beginning of the new STIP, it is stated that 'Science, technology and innovation for the people' is a new paradigm of the Indian science, technology and innovation (STI) system, and society is elevated to being the main stakeholder of this system. However, throughout the rest of the document, society is positioned as a separate stakeholder, not included one. Moreover, in spite of bold statements on the fallacy of the conventional approach to innovation and on the need for treatment of the Indian innovation model, the new innovation policy uses the traditional approach to the innovative development of the country, which includes a set of 'traditional' measures: increased spending on research and development (R&D), promoting excellence and relevance in R&D, participation in global R&D infrastructure and big science, and increasing R&D intensity. There are few words about social inclusion and no systematic approach to it.

In general, the new STIP of India does not extend beyond the previous policies (Scientific Policy Resolution of 1958, Technology Policy Statement of 1983, Science and Technology Policy of 2003) and the statement of 'changing the paradigm' is not supported by real measures. Mostly, it formulates Jawaharlal Nehru's idea of 'science and technology for the people' by new, modern words. Meanwhile, innovation in the Indian informal sector requires a systematic approach and attention. In general, it can be called a grassroots innovation (GRI) movement. GRIs are innovative solutions for sustainable development of communities sourced from individuals or communities and mostly aimed to meet the needs of these individuals and/or communities. GRI can be commercialized or have social diffusion (as, for example, for improving people's nutrition, ecology, water supply and purification, etc.). Beginning in the mid-1980s, the process of its scouting and documenting has been performed by Anil Gupta (National Innovation Foundation (NIF)) with a group of adherents in Ahmedabad. In time their activity was supported by the Government of Gujarat and later by the Central Government.

The GRI ecosystem and Government involvement

If we explore the history and process of institutionalization of GRI development in India, it becomes obvious that now a system of GRI support and augmentation has been formed and is already functioning at the regional, national and even international levels. Started as almost a private initiative, it has been developed into the system of 'complete cycle' of GRI development. It includes support to all stages of innovation (GRI) development: (i) scouting and documentation; (ii) validation and verification; (iii) incubation (IPR protection, testing, prototyping, etc.) and (iv) commercialization or social diffusion.

One of the main specifics of this system, is active and effective blending of the formal and informal sectors. Scholars, students, laboratories and business incubators of scientific and educational institutions are involved in the scouting, verification and incubation stages. Private companies are engaged too, through obtaining technology licenses for GRI, and so, are participating in the production and distribution of GRI. For example, in 2010 the Future Group along with NIF, and the Department of Science and Technology, Government of India announced the formation of an innovation laboratory called 'Khoj Lab' that would support grassroots innovations and create a marketplace for them[9]. Future Group is an Indian privately held corporation which operates some of the most popular retail chains (such as Pantaloons, Big Bazaar, Food Bazaar Central, eZone and Home Town), in addition to other businesses. This partnership between Future Group and the NIF aims at redefining innovation in the Indian context and creating markets for India's ingenious innovators among the 220 million customers who visit Future Group retail outlets annually in over 80 cities and 60 rural destinations. This cooperation results in creating affordable and sustainable products designed for the needs of the Indian consumers. The partnership is also aimed at reducing the seemingly immeasurable distance between the market and indigenous innovation[9].

This is also an example of the active role of the Government in promoting GRI long before the release of the new STI Policy. In general, the Government's activity can be summarized as providing financial support in various ways. The most innovative schemes are micro-venture financing and acquisition of grassroots technologies. Institutionally, it is carried out through specially established organizations: NIF (established in 2000), Micro Venture Innovation Fund (2003) and Grassroots Technological Innovation Acquisition Fund (2012). All three organizations are funded by the Government. However, there is a definite lack of financial resources to provide for the fast growing number of GRIs. In 2001 – 1643, in 2002 – 19,461, in 2003 – 25,809 and in 2009 – 35,000 (ref. 10) innovations were scouted. This growth is continuing even faster due to extension of the methods of GRI scouting: through national competitions, awards and fairs. As for micro-venture financing, out of a fund of Rs 40 million, to date, 185 projects have been supported and Rs 35.5 million has been sanctioned; the disbursed amount was Rs 31.5 million and the repayment amount totalled Rs 15.5 million (ref. 11).

These sums are definitely not enough for the scale of a country such as India. Funding is a serious challenge for GRI development and not the only one. Gupta defined a list of changes and support measures needed for further successful development of GRI. It included, for instance, decreasing transaction costs for low-cost technologies (including IPR protection, testing, prototyping); fiscal and other incentives to stimulate participation of public and private institutions and organizations in the GRI ecosystem; changing the Indian Patent Act to protect

IPR of individuals and communities that are outside the formal sector and supporting information flow inside the country to provide availability of innovations of both the formal and informal sectors (for example, through launching a national registry of innovations)[12].

Conclusion

There is a unique situation in India with innovation and the Indian-specific path of innovation development. The country already possesses the framework of its implementation. The ecosystem of GRI support and augmentation has shown its vitality and potential as it functions all around the country and even abroad. It needs a strong state base to reach the needed scale and effectiveness. Recognition and integration of the ecosystem into the national innovation system would bring these results. In reality, this means inclusion of the largest segment of society in creative activity that would provide relief of economic and social tensions caused by great disparity in income, the low level of economic development of many rural and urban areas, and social injustice. It is the right time to go from policy statements to real policy.

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Uniqueness of magnetic field in promoting life on Earth

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A few press statements by various scientists (for e.g. Collinson *et al.*[1]) have recently appeared, attributing the magnetic field of the Earth as being responsible for making it unique and habitable. Likewise, Barabash *et al.*[2] based on the data from Pioneer Venus mission, attributed complete loss of water on Venus to its lack of magnetic field, which resulted in sunlight directly ionizing the water and the ions getting completely stripped away due to the advection of solar wind.

In this context, I would like to draw attention to two papers of this author[3,4], published 34 years ago, on the crucial role of the magnetic field in the evolution of life on Earth. The above papers considered and discussed in considerable detail, two distinct processes through which the magnetic field was able to assist in the evolution of life on Earth.

The first is through formation of the magnetosphere around the Earth which shields it from direct impingement of the continuously blowing supersonic solar wind from the Sun, carrying frozen-in magnetic field, as well as the solar particle radiation on the sunward side of the Earth. It is also responsible for the formation and maintenance of trapped Van Allen belt particles which also shield the Earth's atmosphere from the direct impingement of solar particles.

The second effect of the Earth's magnetic field is to cause the well-established latitude dependence of cosmic ray particles, which results in a significant reduction in the intensity of cosmic ray particles impinging on top of the Earth's atmosphere, particularly at middle and lower latitudes. As a result, global production of cosmic ray-induced NO in the atmosphere is considerably reduced, particularly at middle and lower latitudes[5–7]. Significant reduction in NO, a major sink for ozone, has led to the formation and maintenance of a permanent ozone layer in the atmosphere, which has been responsible for protecting the entire biological life on Earth from direct exposure to solar ultraviolet radiation. Without the formation and maintenance of such an ozone layer, life with oxygen metabolism could not have come into existence.

The two papers by this author, cited above, have shown how the magnetic field of the Earth shielded the Earth from direct impingement of solar wind and particle radiation in addition to controlling the intensity of galactic cosmic rays impinging on the Earth's atmosphere, which was responsible for the development of a permanent ozone layer, both of which became essential for making our planet Earth unique for the development of life.

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