Sociotechnical Imaginaries and India's Crusade for Nanotechnology

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Abstract

This paper using the conceptual framework of sociotechnical imaginaries tries to analyze the developments around nanotechnology in India in the past ten years. The paper argues that the innovation and governance dynamics around nanotechnology in India is shaped by the 'nanoimaginaries' which are being assembled by various actors through transposition of the sociotechnical imaginaries from previous technological intervention such as Green Revolution and agricultural biotechnology.

Introduction

There is a recent 'craze' in Indian science, policy and media circles 'to not miss the nanotechnology revolution.' The 'craze' is grounded in the bipolar narratives and justifications of getting competitive economic advantages in order to 'leap-frog' and 'catch-up' with the developed economies of the world (Mashelkar 2008), and to embrace the social goals of 'inclusive development' and 'technology for the poor' (STI Policy 2013). The 'poor' defined primarily on the basis of 'people not having access to food,' among other things, situates agriculture at the core of any technological intervention in the Indian sociopolitical imagination. This paper aims to reflect upon the sociopolitical space in which nanotechnology is being imagined in India. In doing so, the paper employs the conceptual framework of sociotechnical imaginaries (Jasanoff and Kim 2009, 2013) to develop a historical understanding of the ways in which the relationship between technology and society was imagined over the Green Revolution and agribiotechnology eras. The paper argues that the sociotechnical imaginaries developed over these two technological interventions are being transposed (Felt 2013) to the nanotechnology scenario in order to assemble a 'nanoimaginary' which could be employed as a yardstick to

justify policy and investment initiatives, to understand public responses, to formulate regulatory measures, and to situate nanotechnology in the democratic imagination of India.

Theoretical framework: sociotechnical imaginaries

As an important cultural resource, imaginations facilitate the development of systems of meaning that enable collective interpretations of social reality (Castoriadis 1987 in Strauss 2006), and a shared sense of belonging (Anderson 1991). As performative visions, imaginaries link aspects of the present with preferred futures, which could be institutionalized and routinized as practices, thus potentially creating the possibility to attain them (Levidow and Papaioannou 2013).

In contemporary societies technologies play a significant role in framing and reinforcing the imagination of a nation (Jasanoff 2005). The science and technology issues and related policies are thus closely intertwined with nation-building projects that reaffirm what a nation stands for (Jasanoff 2005, 1995). In this context, sociotechnical imaginaries are, as argued by Jasanoff and Kim (2009, 120), 'imagined forms of social life and social order reflected in design and fulfillment of innovative scientific and/or technological projects.'

Sociotechnical imaginaries are at once 'descriptive of attainable futures' and 'prescriptive of the kinds of futures that ought to be attained' (Jasanoff and Kim 2009, 120). As an influential cultural resource in technopolitical societies, imaginaries have the power to shape technological design, channel public expenditures, and justify the inclusion or exclusion of citizens with respect to the presumed benefits (or risks) of technological progress. According to Smith (2010), who studies the Rockefeller Foundation's experimental interest in rice for global agriculture, imaginaries are normatively loaded visions which reflect larger socio-political and techno-scientific understandings and sensibilities, and contain the belief that science and technology can solve societal problems.

There are multiple, competing sociotechnical imaginaries at play in any given society (Felt 2013; Jasanoff et al.2009; Levidow and Papaioannou

2013; Smith 2010), and some tend to be more durable at the national level. As per Jasanoff and Kim (2009), the powerful instruments of identity-making often lie within the control of the states (e.g., state controlled media, defense systems, and policy instruments), enabling it as a prominent actor in assembling socio-technical imaginaries (Jasanoff and Kim 2009).

Commenting on the coexistence of complimentary or contradictory imaginaries, in their study of Biofuels in the UK, Levidow and Papaioannou (2013) suggest that 'all the imaginaries were present together for a long time in that geopolitical context. They are elaborated and employed as a cultural resource more persuasively for specific innovation pathways' (47).

Hence, in order to fully understand the cultural politics of science and technology, it becomes important to see how particular sociotechnical imaginaries emerge and become stabilized, the role political culture and practices play in these processes, how various cultural resources are mobilized (Hogle 1999 in Jasanoff and Kim 2009), and the different material, social, and policy consequences these imaginaries entail (Jasanoff and Kim 2009).

Jasanoff and Kim (2009) in their comparative study of USA and South Korea showed how public dissent is fashioned in order to play a significant role in the stabilization of sociotechnical imaginaries. Public dissent in the USA led the government to focus on 'containment', and eventually disassociation from nuclear power as a state project. Whereas, in Korea dissent was framed in terms of 'national dependence on foreign powers,' as well as 'hazards', where the former won in public imagination.

Ulrike Felt (2013), in her study related to the national imagination of nanotechnology, argues that the process of creating, nourishing, and stabilizing an imaginary moves through the stages of assembling, rehearsing, stabilizing, and transposing (14). During the phase of assembling a sociotechnical imaginary, she shows through the case of nuclear power in Austria, many competing and complementary imaginaries co-exist. These imaginaries are rehearsed at various occasions through the networks of power and politics, and instruments of referenda, elections, and legal debates. 'Successful rehearsals' enable a co-created, shared imaginary to stabilize in a standardized format where 'little or no other interpretations

are given space' (15). The stabilizing sociotechnical imaginary could be transposed and integrated into other technological debates to serve as a cultural resource to feed people's imagination of the relation between technology and social order.

Taking the above discussions as the conceptual framework, the present study tries to address the following questions in the context of India, traveling through two grand technological projects—the Green Revolution and agribiotechnology—to reflect upon the assembly of a sociotechnical imaginary of nanotechnology. Questions pursued include: How did the state imagine the relationship between development, technology, and the poor during the era of the Green Revolution and agribiotechnology? And how is it projecting that into the nanotechnology debate? Taking these imaginations into consideration, how does the state channel and justify public expenditure into specific techno-scientific programmes? How did state sponsored imaginaries get stabilized in different forms (in the Green Revolution and agribiotechnology), despite being promoted with the same enthusiasm? What is the role of public and non-state actors and their agencies in assembling, stabilizing, and transposing particular socio-technological imaginaries?

In the aftermath of World War I, the future of India was viewed as an empty space to be filled in by desires and expectations. Leading political actors were engaged in assembling an 'idea of India' based on their social assessment and political ideologies. 'Development', as Zachariah (2001) observes, stood forth as a category through which concerns related to a future India could be ordered and connected with the ideas of progress and regeneration. Most prominent among these visualizations were the Nehruvian 'Developmentalist State', and the Gandhian 'Hind Swaraj'.[1] Implicit in these visions was the role science and technology might play in the national development, in the relationship between state and society, in the imagination of the 'people', and in the relationship between technology, nature, and culture. The echo of these visions can be seen in all major science and technology policies and development initiatives in the country since independence. In order to get a better grasp on how the relationship between technology and society is imagined in the country, the next section discusses the Nehruvian and Gandhian visions in detail.

Science, technology and imagination of post-independence India: Gandhian and Nehruvian perspectives

Addressing the Indian Science Congress in 1937, Nehru made clear his aspirations for the role of science in shaping the future of a 'modern' India. He declared that, 'science is the spirit of the age and the dominating factor of modern world … the future belongs to science and those who make friends with science and seek its help for the advancement of society' (Nehru 1976 in Arnold 2013, 365). In a time when Gandhi promoted the idea of villages as the basic unit of a decentralized, locally governed, self-sufficient India, and rejected modern cities as a sign of colonial domination, Nehru's view was that industrialization was inevitable (Jodhka 2002). Addressing the Associated Chambers of Commerce in Calcutta in December 1947, he said '…while we want to help the peasants and agriculturists, industry also is of dominant importance in India. Agriculture can produce more wealth if more people are taken from agriculture and put in industry. In fact, in order to improve agriculture we must improve industry, as the two are allied' (Gopal 1986 in Jodhka 2002, 3349).

While Gandhi wished to revive the 'essential spirit' of village life, Nehru wanted to transform social and economic structures of the village using modern technology. He believed that the *kisan* (farmers) were the real populace of the country, and solving their problems was one of the main objectives of *swaraj* (Gopal 1973 in Jodhka 2002). At the same time he criticized them for using 'outdated traditional methods.' He proposed that modern technology was good for farmers, and that they could produce twice or thrice as much as they did if they learned new techniques of farming (Gopal 1997 in Jodhka 2002, 3349). The seeds of mechanization of Indian agriculture through modern technology and industry were thus planted as a necessary requirement to lift Indian agriculture from the doldrums.

Nehruvian Science (NS) was an attempt to create a space for post-colonial ownership and subjectivity, establishing the centrality of science in the autobiography of the Indian nation. Simultaneously it acted as a

platform to invoke the feeling of 'regaining the old glory,'[2] and striving to become a 'superpower'. NS was a science of the state—science conducted for the people, but at the discretion of the state. He considered the deployment of science for social causes to be strategic and specialized enough to be relegated to decentralized systems such as local universities (Arnold 2013).

Gandhi's *Hind Swaraj* (1908) was an attempt to create a technological and scientific conscience for Nehru's India, which had no sense of its roots and the tensions within modern Western science (Vishvanathan 1998). The basic objective of science, for Gandhi, was to encourage a sustainable coexistence of human and non-human beings. Since 'modern' 'western' science (as per Gandhi) does not comply with this basic criterion, in order for it to be used as a tool for nation-building (rather than serving its own advancement), science and technology would need to be redefined and customized according to local priorities (Gandhi 1908). The Gandhian imagination of modern India thus appears to have been founded on an idea of 'development' which is context-specific, all-encompassing (people, animals and nature), and sustainable. There was no doubt about the choice of 'sustainability' over 'development', and a preference for both to go together.

The Nehruvian model of development relies on a universal science which is the mother of all remedies. It was essentially a big science project, characterized by heavy, centralized investment in R&D and rapid industrialization. For Nehru, a future India could only be imagined as a place where hydroelectric dams were the 'temples of the new age,' and national laboratories were 'temples of science built for the service of our motherland' (Arnold 2013).

While for Gandhi, science and scientists needed to be redefined to incorporate local, context-specific skills in a self-reliant village republic where 'every man (would be) a scientist and every village a science academy' (Vishwanathan 1997 in Subramanium 2009, 3), Nehru sought to redefine the idea of the citizen in terms of the project of big science as those who 'make friends with science' and develop a 'scientific temper' (Arnold 2013, 362).

If these were the competing visions which guided the construction of the imagination of a post-independence India, it is apparent that

India embraced the big science imagination for the future through the Mahalnobis plan.[3]

Green Revolution and the 'imaginary of development'

For the post-independence ordering of India into the imagination of a nation with the Nehruvian ideals of development and progress (Zachariach 2005) written all over it, 'Green Revolution' played a pivotal role (Dey 2009). India, at that time, was seen as the 'sum of its villages,' with agriculture as the main source of sustenance and primary cultural resource. In order to generate a collective sense of identity there was a need to address and organise its agriculture (Jodhka 2001). 'Green Revolution' as the package of high-yielding varieties, associated technologies of farming (such as tractors, irrigation, fertilizers, and pesticides), foreign philanthropic aid, and favorable state-sponsored policies served as the perfect moment to address India as 'nation'. In South and Southeast Asia in particular, the formula of food self-sufficiency, modernization, and technicism found resonance with the 'new generation of populist leaders, whose slogans emphasized developmentalist goals' (Cullather 2004, in Brooks 2005, 362).

At that time, for the newly independent India—high on the ideals of freedom and self-reliance—the administrators and policy-makers were faced with the dilemma of whether to accept foreign aid. As Subramaniam (the then-agriculture minister) pointed out,

> this was an area where risks were two fold. One was the risk of continuing scarcity, the other was that in trying to remove scarcity something would go wrong … it was a question of which alternative posed bigger, more dangerous risks. I thought facing scarcities was the most dangerous and therefore wanted … to launch the programme (Subramaniam 1995 in Vishwanathan 2003, 10-11).

The embracing of the 'modernization of agriculture' through high yielding hybrid seeds-tractors-fertilizers-pesticides-irrigation alliance seemed to be the only way out of this difficult situation for Indian administrators and scientists; even at the cost of unforeseen sociopolitical risks.

The increased production of food grains in the consecutive years, coupled with rehearsals of the narrative of 'crises and plenty' at various national and international platforms, stabilized Green Revolution as the 'imaginary of development', thus sidelining the alternative stories of environmental and socioeconomic damages. The 'imaginary of development' embodied the celebration of the Nehruvian developmental model with modernization characterized by heavy industrialization and scientific innovations (Arnold 2013). The 'imaginary of development' established the state and scientists as 'saviors' capable of controlling and managing the 'nation'-related issues, such as agriculture, and the 'people' or 'farmers' as welcoming the science-mediated changes.

Acclaim for the Green Revolution perhaps reached its peak in 1970, when Norman Borlaug, the scientist who developed the hybrid varieties of seeds, was awarded the Nobel Peace Prize for his pioneering role and some thirty years of work on the development of 'miracle seeds'. A host of national and international awards were also showered on M.S. Swaminathan—the Indian scientist who developed the hybrids along with Borlaug—for outstanding contributions to Indian society. The Green Revolution thus stabilized as the 'imaginary of development'. The capability of Green Revolution to address agriculture, which was the most diffused, yet most crucial factor of Indian social life, gave it the intensity and legitimacy to be transposed repetitively to assemble and justify other state sponsored technological developments.

Agribiotechnology and the imaginary of dissent

Over the years, the links between science, technology and agriculture have changed dramatically. The set of actors (promoting biotechnology) and the frames of their action have drifted to a new horizon (Scoones 2006). According to Vishvanathan (2003), the transition from the Green Revolution to the agribiotechnology revolution should be seen as crossing a threshold rather than a border. The old categories of nation-state-science-development, which constituted the 'aura' of the Green Revolution in the 1960s, are now taken over by new concepts, necessitated both by the

centrifugal forces of the decades of struggle by the grassroots groups, and the centripetal forces of the emerging demands of globalization.

The intertwining of biotechnology with Information and Communication Technologies (ICT) intensified international relations worldwide (in a post-liberalization era). This projects biotechnology as an outcome of globalization (Giddens 1990). Being situated in a globalized world, the activities, events and decisions related to biotechnology can have significant consequences in distant parts of the globe. Under such pressures the authority and decisions of the nation-state are repeatedly challenged. Along with this, the informatization of the life sciences has given rise to new discourses of public and private, risk and safety, naturalness and artificiality, innovation and ownership, and constitutional rights and bioethics (Jasanoff 2005).

Despite these changes in the characteristic features which constitute and further a technology-driven change, agriculture biotechnology was promoted in India as an extension of the Green Revolution through the narratives of a second Green Revolution and 'evergreen revolution' (Vishvanathan and Parmar 2002). A new entrant to the 'imaginary of development' was the imagination of 'catching-up', which took over the narrative of self-reliance in the changing relationships of the post-liberalized, globalized world. The visions of 'catching-up' through technological competence rejuvenated the Nehruvian imaginaries of 'regaining the lost glory' and 'becoming a superpower'.

Though promoted with the 'imaginary of development', somewhere, implicit in these narratives was the acceptance of the failures and dissent, which were accumulating as the alternative stories of Green Revolution. On the basis of the second-generation problems of the Green Revolution,[4] the 'paradox of plenty', and the notions of science-based development and progress came under close scrutiny (Scoones 2006; Vishvanathan 2003). This moment provided the space for people with diverse opinions, who did not fit within the 'imaginary of development', to be heard. These voices echoed the Gandhian ideals of decentralized sustainable development. The ill effects of Green Revolution on agricultural labourers and the rural poor (Bardhan 1970; Omen 1990), the politicization and exploitation of agriculture for industrialization, and loss of biodiversity

and eco-violence (Shiva 1991) all provided the feedstock for an alternative vision of the Second Green Revolution (as opposed to the state-sponsored 'imaginary of development'). Dissent thus served as the ideological resource for the imagination and assembling of agribiotechnology discourses in India. For the promoters of 'imaginary of development', dissent served as 'the problem to be solved through technological innovation,' thus justifying funding and engagement with agribiotechnology innovations. For others dissent served as the instrument to engage with the agribiotechnology in order to reinstall the marginalized discourses on diversity and alternatives into the democratic imagination of the country.

The imaginations of agribiotechnology were fed with controversies right from the beginning related to state verses private science, natural verses synthetic, farmer verses corporate control, followed by rehearsals of dissent through protests, litigations, and demonstrations during the Bt cotton, BRAI[5] bill and Bt brinjal[6] (eggplant) phase. Actors relying on various symbolic, cultural, and historical resources embedded the dissent into wider and longer political struggles over the democratic imagination of the country (Scoones 2005; Vishvanathan and Parmar 2002).

Taking an anti-poor, anti-nature stand on the Green Revolution and its possible extension to agribiotechnology, Vandana Shiva—an eloquent environmental activist—attempted to re-invent the Gandhian notion of cultural situatedness (Shiva 1999, 2003). Invoking Gandhi's struggle against the British during her protest marches against Monsanto, she has called the widespread use of Bt Cotton a 'second cotton colonization' (Scoones 2005, 269). Another social activist and farmers' leader, Professor Nanjundaswamy, asked for a homespun or Khadi (a symbol of Gandhian self-reliance) curtain as the barrier between the peasants and the capitalists (Scoones 2005). Agribiotechnology in India got stabilized as the 'imaginary of dissent' through the final act of the moratorium on the commercial release of Bt brinjal for an unlimited period (Gupta 2011).

The 'imaginary of dissent' re-enacted the post-independence tension between the Nehruvian and Gandhian ideals of development and progress, and the place of science and the citizen in the imagination of India. The stabilized 'imaginary of dissent' embodied the Gandhian ideals of constructive dissent, forming the crucial part of a participatory democratic

space (Gandhi 1938). It urges for science and technology to be context-specific, people-centric, harmonizing with 'nature', the control over resources to be decentralized, lay-expertise to be valued, and innovations to respect sustainability.

Assembling nanoimaginaries in India

In the ten years of development around nanotechnology[7], the 'desire' of the state actors to push the 'imaginary of development' seems quite apparent. This enthusiasm is occasionally shared by academicians and scientists who, in the process of trying to erase the memory of the agribiotech era, are once again calling for a nano-based second Green Revolution (Shastri et al. 2011). One of the key features of the nanotechnology initiative (2001–2006) was the promotion of basic research through capacity-building in infrastructure and skilled manpower (www.nanomission.gov.in). This was later furthered to promote public-private partnerships and applied research in the nanomission (2007–2012) phase. The discussions about risk, governance, and ethical, legal, and social implications (ELSI) were completely absent in the first phase, and were very little in focus in the second phase[8] (Bhattacharya et al. 2012; TERI 2010). In the last decade since nanotechnology was first launched in the country, no attempt has been made to initiate an inclusive dialogue on the 'intent' and 'governance' of nanotechnology research and development in India. Although capacity building programmes have assisted in setting up infrastructure and research units, a core institutional structure for regulation and governance is still missing. This leads to a messy coordination situation between various agencies (Jayanthi et al. 2012), leaving no one directly accountable to the public.

The nanomission website addresses only the technical and factual issues, and does not address any social, economic, legal and ethical aspects.[9] The government actors seem uninterested in discussing these aspects of nanotechnology in India.[10] Patra et al. (2011) conducted a study on the understanding of ethical issues among nanoresearchers, and found that most nanoresearchers (95 percent) are aware of the ethical issues such as nanotechnology increasing the divide between rich and the poor, unsafe

and unhealthy laboratory conditions, environment and health conditions, cyborgs, self replication, and media hype. Despite being aware of these aspects, they are seldom discussed in public. Scientists and policy-makers are skeptical of initiating a debate on such issues, speculating on a decline in market interest (Choudhary 2006; Jayanthi et.al 2012), as the 'imaginary of dissent' from the agribiotech story lies quite fresh in the memory of the nation.

A discussion initiated by the author in November 2012 on an online forum of social scientists working on the issues of Science Technology Innovation policy (STIP) met with similar outcomes. Most scholars, interested in expressing their views on responsible research and innovation for nanotechnology, did not participate openly in the discussion, purportedly due to so much 'hype' attached to emerging technologies and their future in India, and a fear of politicizing the issue, attracting controversies, and eventually hampering investment.[11] Thus, while the 'imaginaries of development' are presented in a renewed fervor, the 'imaginaries of dissent' seemed to have moved big science projects to more secrecy, and more bureaucratic, expert-oriented, and technocratic directions. The science-society relationship which was hoped to be forged anew during the Bt brinjal episode seems to have withered away.

The role of NGOs, in contrast to the activism seen in the agribiotech era, seems dull and confined to producing stale 'transposed' reports with no new angle. Media groups, uninformed of the alternative voices, continue to project the 'imaginary of development' promoted by the government. The 'imaginary of development' is increasingly strengthened by the advertisement of various brands, especially in the nanotechnology scenario, who have creatively employed 'nano' as a celebration of small, efficient, smart and effective. Even though the 'imaginary of development' is being fed to the public imagination through popular media, the public, with their own gauges and knowledge-ways (Jasanoff 2005), will play a crucial role in the development and practice of nanoimaginaries in India. In this situation, the attempt to play down the 'imaginary of dissent' in comparison to the 'imaginary of development' could prove detrimental. Utilizing both imaginaries as an intellectual resource to reflect, guide, and develop a future course of action for nanotechnology in India

seems like a feasible course of action to further the discourse on the governance of nanotechnology.

The 'imaginary of development' and the 'imaginary of dissent' thus serve as the instrument of communication between the present and the possible futures of nanotechnology in India. They carve out a future space which is not empty (Grooves 2013) just to be filled by hopes and expectations, but is constantly assembled through narratives and stories, discourses and silences, politics and interests.

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Notes

1 Indian home-rule.

2 Drawing examples from the glorious past before colonization, for example Indians leading in arithmetic and alchemy.

3 The building of institutions like CSIR (Council for Science and Industrial Research), and big dams along with heavy investment on industrialization and atomic science (Subramanium 2009).

4 Salination of irrigated areas, over-harnessing of water, pest increase, decline of productivity and less returns to input.

5 Biotechnology Regulatory Authority of India's single window regulatory system, as opposed to the earlier three-tiered system.

6 In 2010 public consultations were conducted in seven district states of India on different aspects of genetically modified eggplant. For details refer to Pandey (2013).

7 First through the pilot Nano Science and Technology Initiative (NSTI) 2001-2006, and later its extension through Nano Science and Technology Mission (NSTM) 2007-2012.

8 Limited research focusing only on scientific aspects of possible health and environment hazards is being conducted at various government and private institutions.

9 www.nanomission.gov.in

10 Communication with mission director as mentioned on the website www.nanomission.gov.in.

11 Online discussion conducted between November and December 2012 in a closed group of social scientists on the'CSSP Forum', mediated through the Centre for Studies in Science Policy, Jawaharlal Nehru University, New Delhi, India.

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