

Mediating Science and the Public: Biotechnoscience, Media and Science Communication in India

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Abstract

This paper is an attempt to understand how bioscience, media and the public interact with each other and shape the discourse on the regulation of transgenic technologies in India. For this propose I looked at the news paper reports related with the Bt Brinjal controversy which took place in the last two decades. The communication of policy science to the public is more challenging than the communication of the basic science. I analyzed biotechnology related coverage in three national English dailies such as *The Hindu*, *Times of India*, and *Indian Express*. Paper mapped changing trends in the media reporting on transgenic products and processes. Thus, paper argued that analysis of the media coverage helps us to unearh the production of knowledge in a mediated setting.

Keywords

Biotechnology, India, Print Media, Public Engagement, Public Understanding of Science, Science Communication.

Introduction

Academic discussions about recent media debate about the science and society is mostly centered on GM crops and biotechnology. Thus, the analysis of the media coverage and reports about biotechnology helps us to understand the dynamics of science communication in the contemporary time. This paper looks at how bioscience, media and the public interact with each other and shape the discourse on the regulation of transgenic technologies in India. For this propose I will look at the news paper reports related with the Bt Brinjal controversy which took place in the last two decades. The mapping the trends in the media report on Bt Brinjal controversy helps us to unearh the production of knowledge in a mediated settings. It also helps us to understand different frames used by scientist, technocrats, policy makers, policy analysts, civil society activist, and lay public.

The communication of policy science to the public is more challenging than the communication of the basic science. While the basic science is more concern with the theoretical and technical details related with knowledge productions, the policy science is wider in nature which concerns with ethics,

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political mobilization, ecological and environmental issues, governance and regulations of risks associated with it. Policy science also considers socio-political issues related with the application of knowledge and technologies. In another word, policy sciences have to consider different dimensions of the new knowledge and technology.

While introducing Bt brinjal in the agricultural domain of the country it have to consider the goals of this new technical interventions. It also has to look the current trends in the agricultural, agro-economic, agro-ecological and market fields. The analyses of the percent condition of the technological applications, income from agricultural production, etc are very important policy questions. It also has to consider the short term and long term consequences of the technology and the projection of future developments. The invention, evaluation, and selection of available alternatives in the market and in the technoscientific field are another crucial dimension of the policy science. So, proper communication of policy science to the public is more challenging than basic science. Science communication research focuses on the communication of basic sciences. They ignore the complexities related with the communication of policy sciences.

First part of the paper discuss about the development of science and different efforts to communicate it with the public. I mapped it from the colonial period to the recent debate about the Bt brinjal controversy. In the second part I briefly explained the methodological complexities involved in this investigation. I selected three English dailies, *The Hindu*, *Times of India*, and *Indian Express* to understand the current trend in the media coverage on biotechnology and related debate. Third part emphasizes on the biotechnology controversy in the last three decades. This part will help us to locate media debate in the larger context of agricultural biotechnology governance. Emphasize of the fourth part is to the trends to the media debate. This part will explain some common trends in the media coverage on GMOs and biotechnology. In the final part I conclude the paper by summarizing the debate.

Western Science in Modern India- Science Communication in India

In this session I will give a brief history of science communication in India context. Science communication in India broadly looks at the construction of science related stories and reports and their impact on the readers and audiences. The socio-cultural and historical context play an importance role in the knowledge production process and as well as the communication of it to the masses. According to David Arnold,

"there were three main elements that broadly typified science, technology and medicine in India over this 200- year period. Firstly, there were the traditions of India's own science, technology and medicine, themselves subject to wide internal variations and different historical influences and cultural practices, and the legacies these provided for the subsequent era of British rule. Secondly, there was the nature of Western (or 'colonial') science, technology and medicine as practised in India, their social and intellectual impact, their organisational forms and dual relationship to the colonial regime in India and to metropolitan science in Europe. And thirdly, there was the authority of science, technology and medicine as central attributes of India's modernity, drawing upon indigenous as well as Western sources and finding contested expression in both imperial ideology and nationalist agendas (Arnold, David: 2000)."

These three phases have their own variants of communication modalities and institutional frameworks. In the traditional Indian science knowledge production and its dissemination were highly bonded with cultural and religious practices. Caste position in the hierarchical structure played an important role in this process. British rule reconfigured these hierarchical relations and helped to the spread of western science in modern India. In the independent India we witnessed the development of modern institutional setups and civil society movements for the communication of science.

Before going to the details of the topic I will briefly explain the historical trajectory of the development of modern science and effort to communicate it with a larger audience. During the colonial period India witnessed the penetration of modern science in the everyday life of the people. In the latter half of the 19th century different individuals and small groups of peoples took initiatives to communicate science with the public. During this period a number of books were translated to Indian languages from English. These efforts to disseminate modern science in to the public were limited in its reach, mostly concentrated in urban upper class and caste people. During the freedom straggle leaders of the movement emphasized on the inculcation of scientific outlook and scientific values to people of the country. And since independence India witnessed a rapid development in science and technology. India's scientific establishment is spread across the country. Under CSIR we have 38 research laboratories and research centre. Along with this Bhabha Atomic Research Centre (BARC), Indian Space Research Organisation (ISRO), and the Defence Research Development Organisation

(DRDO) play an important role in development of the country. Beside these establishments, we have good number of prestigious research institutions in the private sectors, such as Tata Energy Research Institute (TERI), Tata Institute of Fundamental Research (TIFR) and the Centre for Science and Environment (CSE). Through these scientific establishments India achieved different kinds of progress in the field of agriculture, medicine, environment, biotechnology, satellite technologies etc. They achieved different patents and brought technologies in to the market for the benefits of the public.

In the Nehruvian era both science and science communication effort got flourished. He coined the term 'scientific temper' which emphasized on the application of critical and scientific thinking in the day to day life. According to Jawaharlal Nehru,

The applications of science are inevitable and unavoidable for all countries and peoples to-day. But something more than its application is necessary. It is the scientific approach, the adventurous and yet critical temper of science, the search for truth and new knowledge, the refusal to accept anything without testing and trial, the capacity to change previous conclusions in the face of new evidence, the reliance on observed fact and not on pre-conceived theory, the hard discipline of the mind—all this is necessary, not merely for the application of science but for life itself and the solution of its many problems (Nehru, 1946, p. 512).

For Nehru, use of material and practical benefits of science and technology for the development of the nation along with the use of scientific method and approach in the daily life of the people. As Chakraborty, Anwasha, Raman, Usha and Thirumal, Poojraj (2020) "the enduring legacy of Nehru and his contribution to post-colonial scientific debates: the shift of understanding from science and technology as an imposition of Western authority, to science and technology as answerable to the state and the public for its capability of delivering a better, more inclusive and humane society".

In 1952 the National Institute of Science Communication (NISCOM) began publishing of the Hindi popular science journal *Vigyan Pragati* (Progress in Science). And NISCOM also published *Science Reporter* (English monthly) and *Science Ki Dunia* (an Urdu quarterly). In 1960s we witnessed the formation people's science movements accross the country such as 'Kerala Sastra Sahitya Parishad (KSSP)' and All India People's Science Network (AIPSN). These movements played an important role in the communication of modern science in the grass root level (Jawhar, C: 2011). Along with this,

different governmental and other initiatives took place for the development of science communication infrastructure in the country. In 1976, by the 42nd constitutional amendment the inculcation of scientific temper was added to the Indian Constitution. According to this amendment the development of scientific temper is the one of the 10 fundamental duties of every citizen under Article 51(A) (H) which sited 'to develop the scientific temper, humanism and spirit of inquiry and reforms' (Raza et al., 2014)

As we see Indian scientific establishments are very large in size which cover different field of expertise and discipline. This complex situations demand more science communicators and journalist to bridge the gap between scientists and the public. Unfortunately, in India the media coverage for science is relatively very less compared to other developed and developing countries. But in the last one decade we can see some positive trends in the field of science communication and journalism. At the same time the population and literacy dynamics of the country should be keep in mind. So, the herculean task of the communicators and journalist is to communicate science in a country with a one billion pulse population and among them a significant number of people are illiterate. The linguistic diversity also triggered the gap between science and society in the country.

In this context public engagement with science plays an important role in the process of bridging the gap (real or imagined) between scientific establishments and the public. In the academic literature, the debate about science communication have moved from *public understanding of science to public engagement with science*, from *deficit model of communication to dialogical model* of communication, deficit model (Miller, J.D, 1998) to contextual model and *science and society to science in society*. These shifts epitomize the changing nature of science and society relations as well as the nature of science communications.

In the modern time print and visual media play an important role in the public engagement and public communication of science. On the one hand it spread scientific and technological knowledge and information. On the other hand media helps to shape public opinion on critical and controversial issues related with technoscience policies. In the contemporary time both scientists and civil society groups use media to communicate their versions of science to the public. For scientific community engagement with media help those to communicate their research and other activities with the public and it also will help them to collect public opinion regarding mega research project. This public attention also helps scientific community to mobilize public and privet fund for their research and related activities.

The important function of these public engagement and communication effort is to facilitate the public to participate in informed decision making process. The informed decision making process uphold the informative, logical and rational application of scientific knowledge and technological artifact. The governmental and nongovernmental institutions and organizations are taking good efforts to spread scientific knowledge to the public.

Methodology of the study

In this paper I focused on the national English dailies, mainly *The Hindu*, *Times of India*, and *Indian Express*. Since we have a number of regional media houses and news papers we have to address this question, why English dailies? This four news papers are widely read by educated medial class of the population. Most of the times these paper are extensively read by politicians, bureaucrats, academics and the general public. Understanding and examining the coverage in these news papers will help us to get a dominant trend in the debate about biotechnology in the country. In 2019 Indian Readership Survey (IRS) conducted by Nielsen for the Media Research Users Council *The Hindu* was the second most popular English language news paper in the country. It marked 17% increase compared to the IRS 2017. *The Times of India* was the number one in the terms of the readership and *Indian Express* positioned fifth in the IRS 2019 report.

	Publication	IRS 2019 Q1	% Rise (2017-19)
1	The Times of India	15,236	16.8 %
2	The Hindu	6,226	17.47%
3	The Economic Times	3,701	19.27%
4	Mumbai Mirror	2,165	19.42%
5	The Indian Express	1,855	16.01%

Indian Readership Survey 2019

As Chakraborty, Anwasha, Raman, Usha and Thirumal, Poojraj (2020) noted "until the late 1990s, most large English and regional language dailies had multiple-page sections devoted to science, but by the early 2000s these sections had been incorporated into the main paper and reduced to one or two pages". They further elaborated that "despite the disappearance of exclusive science sections, the daily newspaper has more science and technology news today than in the past".

So, the focus on English dailies helps us to understand the dominant trends in the science journalism in the country. Methodologically speaking, I used discourse analysis to unearth the interrelation between science, media and society in the post liberalized India. Most of the time studies on science and media focus on the quantitative nature of reporting. They focus on the width and length of the science related news, the positions of the news report, number of headlines, etc. dominated the nature of the analysis. The coverage, the placement of news, and source of the information are another ways through which the academic analysis focused. Here I focus on the major trends in the media coverage on biotechnology in the English news papers. I am sure that it will be very different in the regional language news papers in different part of the country.

Biotechnoscience and the Public: Cartography of the Controversy

The 'GM saga', during the last two and half decades has made a substantive contribution in the way we understand and engage with science and technology. It has also changed our perception towards the role of science and the public in policy making. In this period India witnessed the proliferation of public debate over and discussions about various aspects of this particular technology, ranging from the environmental and health related risks to the benefit for the farming community and the nation's food security. These controversies lead to the development of a mixed opinion among the public on the application of transgenic technology in Indian agriculture. It also reflected in the debate about the process of regulation and governance as well.

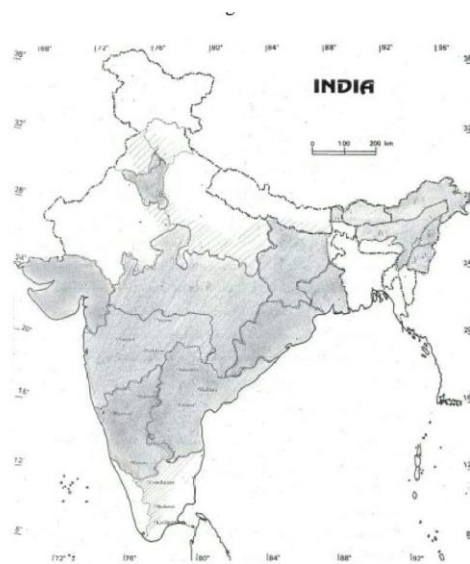
The last two and half decades has witnessed phenomenal development in the area of new life sciences around the world. Because of this, some commentators have called this century as 'century of biology' (Dwyer, J: 2008, Venter, Craig and Daniel Cohen: 2014). The applications of new bioscience and biotechnology in the field of medical treatments, agricultural productions, energy creations, etc. have testified this hope and it even has electrified the hype for a bio-economy and related economic growth. In the last couple of decades biotechnological interventions in the agricultural practices have reshaped the way we understand, practices and manage agriculture. Such interventions have changed the traditional agricultural practices, such as seed collection, seed production, pest resistance and production of plant varieties.

Thus, the developments in agro-biotechnology have created different kind of hope and hype on the economic growth and human development. As stated in *Report of the Task Force on Application of Agricultural Biotechnology*

(2004) “biotechnology offers opportunities for converting India’s biological wealth into economic wealth and new employment opportunities on an environmentally and socially sustainable basis”.² The trends in the cultivation of biotech crops in global and national context have testified this hope and hype.

Recently, after Bt cotton, the introduction of Bt brinjal for the open field trial and consequent commercialization triggered huge public debate in the Indian sub-continent. Brinjal is the second most popular vegetable in India after potatoes (Rajam. M V. *et al.* 2008). Its importance in the dilatory practices, medicinal value, biodiversity etc. made this vegetable popular among common people and genetically engineered brinjal triggered debate in the last decades. Another important reason for this public appraisal against or for Bt brinjal is that India is the place of origin of this vegetable and there are around 2400 varieties of brinjal in the country with different shapes and various colors.

Figure-1-3



Solid shading indicates a traditional brinjal growing area while light feathering indicates sparsely spread area under brinjal.
Source: Series of Crop Specific Biology Documents, *Biology of Brinjal*. Ministry of Environment and Forest and Department of Biotechnology, Government of India.

² Task Force on Agricultural Biotechnology, *Report of the Task Force on Application of Agricultural Biotechnology* by: M. S. Swaminathan Chairman, Task Force on Agricultural Biotechnology, May 2004, Ministry of Agriculture, India, p. 6.

The development of new Bt brinjal by inserting a bacterial gene (*cryIAC*) derived from *Bacillus thuringiensis* (Bt) which resists infection from various pathogens opened up a new debate and discussion in the context of India. The official reason for the introduction of this new technology in the traditional brinjal was to prevent high level of loss due to the fruit and shoots borer (FSB, *Leucinode orbonalis*) most common insecticide which weakens the plant and reducing yield. It caused 70 percent of the loss of the brinjal output and led to the heavy use of chemical pesticides in the field to resist insects.

On the other hand, those who oppose these arguments state that there are a number of domestic and wild varieties of brinjal in our country. The introduction of transgenic brinjal leads to the loose of varieties due to cross pollination and gene flow. And Genetically Engineered Brinjal will have adverse impact up on human health and environment. The controversy on Bt brinjal gives us a black and white picture of the story. This 'science war' between pro and anti-bt brinjal advocates didn't touch up on the gray areas in the debates and dynamics of the issues involved in the genetic engineering technology.

The media debates and controversies in and around the use of transgenic techniques in Indian agriculture have focused on the complexities involved in the relationship between science, politics and policy. But the important question is that can these technical developments fix the complex problem of agriculture in India? Since the larger aim of the new developments, especially the application of new technologies, is to ensure food security in the country and survival of the agricultural system and farming communities.

Agriculture as a policy domain, the politicians, technocrats and policy makers stress the need for the 'technological fix' or applications of 'sound science' for its development. In other word, this scientization of policy domain negate the role of complex socio-political and cultural variables in the operation of Indian agriculture. The underlying assumptions of this over-emphasis on the technological artifacts and scientific knowledge in solving complex issues is the idea of technological determinism or giving 'experts' the final say in the policy relevant issues. And it also reflects the ways the mainstream policy discourses look at the public and their engagement with the policy relevant issues. It considers public as ignorant, irrational or even hysterical (ESRC Global Environmental Change Programme: 1999). And the decision making in the area of science and technology is exclusively the business of the scientific experts and technocrats. This policy culture marginalizes different constituencies from the domain of policy making.

The involvement of different section of the public such as farmers' groups, environmental movements, traditional seed collectors and distributors, anti-globalisation movements, consumers groups, civil society activist etc. changed the nature of the issues. The involvement of these diverse constituencies highlighted the need of a more democratic intervention in the policy issues. The 'technical fix' for a complex issue was vehemently criticized in the democratic participation debate. Mapping these complexities and discussing the hybrid forums involved in the process of policy making will help us to understand the short comings of the current policy culture and the importance of widening the canvas of governance and public policy related to transgenic technology.

Mediating the Science: Reporting of Biotechnology related Controversies

As I mentioned, since 1980's, the application of Genetic Engineering technologies in agriculture became a site of contestations, producing mixed responses in the society. On the one hand, policymakers, mainstream scientists and technocrats consider biotechnology as a solution for the local and global food crisis due to the unprecedented increase in the population. On the other hand, environmentalists, anti-globalisation activists, and various groups of farmers consider this technocratic intervention in agriculture a threat to the environment, biodiversity and local agricultural systems. Broadly, there were multitudes of stands, meanings and frames attached to the application of biotechnology and GM crops in agriculture.

After the introduction of Bt³ cotton in the late 1990s and the 'Bt Brinjal controversy' on the commercial introduction of Bt Brinjal in the mid 2000s, biotechnology and life sciences have become contentious subjects in Indian media. Last three decades (1990-2020) represents a unique point in history in which India has tried to address different kinds of ethical, socio-political, legislative and administrative dilemmas related to the agricultural biotechnology. There are multiple studies on the risks and benefits of biotechnology, its effect on biodiversity and sustainable agricultural practices, and the corporate takeover of agriculture and its impact on small scale farmers (Chaturvedi, S; 2002, 2010, Bhargava, PM; 2009).

³ *Bacillus thuringiensis* is a soil bacterium that carries in its DNA a gene which produces a toxin for certain insect pests (cotton bollworm, Asian and European corn borers). By transfer of this gene into the plant DNA, an automatic resistance is developed in the plant against such insect pests.

As we know, in India mass media (print and visual) act as an important source of information about biotechnology. The analysis of the news report on the Bt brinjal controversy in particular and GMOs in agriculture in general shows that the media play an important role in providing technical and scientific information to the public and as well as addressing critical questions related with risk related with biosafety issues. According to Scheufele (2007) "media plays a crucial role in providing people with the information necessary to make decisions about policy options and the potential risks and benefits associated with agricultural biotechnology" (Scheufele, 2007).

The print media engaged with the controversy by providing different frameworks of the actors, such as the regulatory agencies, policy analyst, public intellectuals, farmers' leaders, and local farmers. The media house act as commentator, communicator and educator on public policy related with the application of GMOs on agriculture. In India, print Medias like, *The Hindu*, *Times of India*, *Indian Express*, and *Deccan Chronicle* play an important role in defining the public debates about biotechnology and help to the formation of public opinion in and around biotechnologies. These media houses set the agenda and tone of the public debate by mediating between scientists, policy makers, technocrats and the public.

The analysis of the media coverage on biotechnology in the above mentioned national dailies shows the trend of 'issue-cycle perspective' (Brossard et al. 2007). According to issue-cycle perspective the media coverage to biotechnology is not constant but at varying levels due to triggering events (Navarro, Mariechel J. 2011). Different controversies, such as death of goats and sheep grazing on post-harvest Bt cotton fields (2007), commercial approval of Bt brinjal (2009), public consultation on Bt brinjal (2010), illegal Bt brinjal in the farms in Maharashtra (2019) etc. triggered media debates on biotechnology in India. During these controversies the framing of the issues and the focus of the debate varies according to the source of the information and who provide it.

The analysis of the media content shows different types of reporting on biotechnology, such as (1) Reports about the conference, 2) Comments and review of article from peer-reviewed article, 3) Opinion piece, 4) Statements of the experts. In these reports there are different frames and views on the benefits and risks of biotechnology. In these categories we see two kinds of reports. On the one hand we see scientist coming out in the public and campaigns against anti GM activist and politicians. On the other hand, in some instances scientist are coming to the public and reporting the negative aspects of the GMOs.

In the analysis of the media coverage shows some common trends. On the one hand, reports focus on the benefits in terms of controlling pests and saving the plants. On the other hand some reports focuses on the environmental and health related risks as well as the issues of food security. So these media played an important role in the process of polarizing or 'black boxing' the debate. Some time, the stories are biased or set to influence the reader to a specific frame. This unbalanced reports and opinion pieces created a kind of technophobia among the masses. These kinds of reports ignore the gray areas of the issue and marginalize the small scale farmers and consumers perspective on GMOs.

When we look at the reports about the application of GMOs in agriculture we can see different level of illusion. On the one level we see the illusion of understanding, where the reporter things that he understood the technical and scientific matters of the problem. And the readers also think that they understood the issue while reading reports. At the same time both, reporters and readers are reluctant to admit that they did not understand the scientific and technical details of the issues. My interactions, during the Sastrayaan⁴ and multi-sited ethnographic work, with reporters and general public highlight the deficit of understanding and communication of scientific details. Most of the time reporters reproduce press release or media briefings of scientist and technocrats. The reporters are often reluctant to admit that they do not understand the subject; instead, they merely reproduce the contents of the press releases or briefings.

Another important trend is that most of the time the coverage of the biotechnology emphasized on the development narratives of the state and biotech industries, especially in the initial stage of its development. In the post liberalization phase, biotechnology and new innovations in agriculture were linked with the global market. The term such as progress, growth, bioeconomy etc. popped up in different time in the reports. This developmental narrative highlighted the benefit of biotechnology and projected it as a new development in agriculture and health.

Analysis of the recent media coverage, especially (2000-2020) shows a balanced reporting. During this period we can notice frequent reference to the terms like public consultation, public participation, public engagement etc. in different reports. These references were evident in the context of agricultural biotechnology and its regulation. During the time of Bt brinjal consultation media debates focused on the limitation of the current

⁴ Sastrayaan is an outreach program to facilitate conversation between university science departments and general public.

technocratic and bureaucratic mode of governance.

Other major trend in the nature of reporting is the shift from the developmental or progressive narratives to public engagement or participation narrative. In the initial stages the news coverage focused on positive media coverage for the agricultural biotechnology. This homogeneous narrative produced mixed response in the society. But the involvement of different stockholders in the media debate led to the development of a heterogeneous narrative in the media. The biosafety issues were the focus of the debate in 1990s and early 2000s. But in the later part of 2000s and 2010s the debate shifted in to socio-economic and ethical issues related to transgenic technologies.

Conclusion

As we know, majority of the Indian public remains relatively ambivalent and uninformed about the application and risk of agricultural biotechnology. Print and visual media played an important role in the process of communicating science to the general public. This paper is an attempt to understand the relationship between biotechnology, media and society. It will try to examine some common trends in the media coverage on biotechnology related stories in three leading English language news papers.

In India print media played an important role in shaping and reshaping public opinion about converging technologies in general and biotechnology in particular. As I mentioned, most of the studies on media and science communication focus on the issues and possibilities of 'framing' biotechnology in the media coverage. In this paper I mapped some common trends in the media coverage on biotechnology.

To sum up, in the media coverage Nehruvian imaginaries of development got prominence. At the same time scientific temper and scientific method got excluded from the day to day engagements. As different scholars noted the issue in the media coverage is that most of the reports biotechnology is often framed in a nationalistic perspective. It tried to equate development of science with the development of nation and create a sense of pride in the products of scientific development. In this context we miss a sense of critical appreciation for the process of science in general and development in particular.

References

Arnold, David (2000) *Science, Technology and Medicine in Colonial India*, Cambridge University Press.

- Bhargava, P.M. (2009) "The social, moral, ethical, legal and political implications of today's biological technologies: An Indian point of view", *Biotechnology Journal*, vol. 1, pp. 34-35.
- Brossard, Dominique, James Shanahan, and T. Clint Nesbitt (Eds) (2007) *The Public, the Media and Agricultural Biotechnology*. CAB International, Wallingford, Oxon, United Kingdom. 405 pp.
- Chakraborty, Anwesh, Raman, Usha and Thirumal, Poojraj (2019) INDIA: Tracing science communication in independent India, in *Communicating Science: A Global Perspective*.
- Chaturvedi, S. (2002) *Status and Development of Biotechnology in India: An Analytical Overview*, RIS, Discussion Papers, RIS-DP # 28/2002.
- Chaturvedi, S. (2010) "Emerging Indian entrepreneurship in biotechnology and National Innovation System: exploring linkages and prospects", *International Journal of Technology and Globalisation*, vol. 5, n° 1/2, pp. 76-92.
- Dwyer, J. (2008) *Sustainability Science*
- ESRC Global Environmental Change Programme (1999) *The Politics of GM Food: Risk, Science and Public Trust*, Special Briefing No. 5, University of Sussex.
- Jawhar, C (2011) *Engaging with Science: People's Science Movement in India - The Case of Kerala Sastra Sahitya Parishad*, M Phil Dissertation submitted to University of Hyderabad, Hyderabad.
- Miller, J.D (1998) *The Measurement of Scientific Literacy' Public Understanding of Science*, Sage.
- Navarro, Mariechel J. (2011) *Science Communication: Building Consensus on Crop Biotechnology in Navarro, Mariechel J. and Randy A. Hautea. Communication Challenges and Convergence in Crop Biotechnology*. ISAAA: Ithaca, New York and SEARCA: Los Baños, Philippines.
- Nehru, J. (1946). *The Discovery of India*. New Delhi: Oxford University Press.
- Rajam. M V. *et al.* (2008) *Eggplant in Compendium of Transgenic Crop Plants: Transgenic Vegetable Crops*. Edited by Chittaranjan Kole and Timothy C. Hall, Blackwell Publishing Ltd.
- Raza, G., Singh, B. P., Venkateswaran, T. V., Gopichandran, R. and Rautela, G. S. (2014) Scientific temper: an arena of contestation in a globalised world. Paper presented at the 13th International PCST Conference, Salvador, Brazil.
- Scheufele, Dietram (2007) *Opinion Climates, Spirals of Silence and Biotechnology: Public Opinion as a Heuristic for Science Decision-making*. In *The Public, the Media and Agricultural Biotechnology*. Edited by D. Brossard, J. Shanahan, and T.C. Nesbitt. CAB International, Wallingford, Oxon, United Kingdom. pp. 231-244.
- Swaminathan, M. S and Chairman (2004) *Report of the Task Force on Application of Agricultural Biotechnology*, Ministry of Agriculture, India, p. 6.
- Venter, Craig and Daniel Cohen (2014) *The Century of Biology, New Perspective Quarterly*.