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Problematizing GM technology in India: exploring the communications role of Indian scientists in the Bt-Brinjal controversy

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by

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Abstract

While most research in science communication has focused on media coverage and public understandings of scientific controversies in the past, less attention has been directed to the role of scientists in the public communication of such controversies. In my thesis, I address this gap in the literature by investigating the role of the Indian scientists in the controversial case of Bt-Brinjal–the first genetically modified eggplant in India that was approved for commercial distribution in 2009, but was subjected to a moratorium in 2010 as a result of the ensuing controversy, a status which remains to the present. I particularly focus on the ways by which the Indian scientists communicated the issue by implicating the discursive practices around the identification of problem and their reinterpretations in the public sphere. I specifically draw upon the Foucauldian concept of 'problematization' which proposes examining how an idea becomes interpreted as problematic in particular ways. Using critical discourse analysis (CDA), I compare the content of the diverse media platforms in a qualitative analysis to investigate how the Indian scientists classified, framed, questioned and analyzed Bt-Brinjal as a social problem or opportunity. I conclude that the forms of extended participation in the public arena on policy controversies via an extended range of media platforms offer a perspective on 'deviation' from scientists' normal science communication practices that are illustrative of post-normal science conditions.

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My mom and dad, thank you for your love and care. You always believed that despite many hardships and challenges, I would reach my goals. My brother Rajat, thank you for cheering me up during stressful times. And last but not the least, my husband Amish, for all that love and support. Thank you for putting up with those endless speeches about my work in progress; you were good at pretending that you were listening!

Dedication

I wish to dedicate this work to my late grandmother Pushpa (meaning *flower* in Hindi) whom I have grown up watching as always cheerful and rosy. She used to affectionately say that I have her exact genetic makeup. She always asked for my well-being– to her last breath in 2016 –unfortunately which was during the course of my studies. I could not see her during her last days on Earth due to my professional and personal commitments in Canada, but she remains in my heart forever.

She never liked the taste of eggplant – although with her usual humor, she claimed she had given it up as part of her veneration to Lord Shiva.

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CHAPTER 1 INTRODUCTION

1.1 Background

The most common platforms by which science is channeled to the public are the newspapers, magazines, television, and the Internet (Besley & Tanner, 2011, p. 239). These platforms often operate like a close network which binds together the scientists and the public as the main actors of the network on issues involving science. Although scientists are an integral part of the network and responsible for providing scientific information or discoveries for news, in most circumstances, they remain distant from the public when it comes to communicating science. In other words, the public communication of science in most routine circumstances is carried out as a process in which science or scientific information is generated by the scientists and channeled to the public via mediators or science communicators.

Recent research suggests that there are certain factors which may encourage scientists to increase their public communication activities and communicate with the public on scientific information or issues on routine basis (Dudo, 2013). However, the nature of such direct communication between scientists and the public which is generally harmonious does not account for the instances that occur during marginal situations, or in cases of scientific crisis or controversies. In those circumstances, the routine channels of communication get disrupted, with communications initiated from all directions and intensifying the activity of all the actors in the network −the scientists, the public and the media, generally in non-harmonious, problematic ways (Bucchi & Trench, 2008b). For example, in the case of a particular controversy, media coverage of the story is likely to rise, which may include repeated telecasts of the story, broadcasts of the story on multiple media channels and coverage of live debates etc. Similarly the public is likely to agitate over the possible outcomes of the scientific issue at hand, and may also form protest groups. Scientists in such cases may then come out of their comfort zone of scientific technocracy and be obliged to communicate directly with the public to clarify matters, regain public confidence and trust in science (Lewenstein & Brossard, 2006) or even in some cases, politically advance the controversy (Jasanoff, 2003). This non-routine communication by the scientists is likely to be problem-oriented and may involve greater mobilisation of actors (Bucchi & Trench, 2008b). This suggests that public communication of such scientific controversies and particularly the role of scientists in such instances can be highly influential in giving political direction to the controversy as well as setting the policy agendas for the future.

However, in the scholarly literature of science communication, the study of the social conditions which characterize such problem-oriented communications by scientists is an under-explored area. Even less attention has been paid to the nature of scientists' communications in such controversies. My study aims at filling this gap in the literature by investigating the communications role of scientists in one of the more recent and intriguing cases of scientific controversies–the case of the first genetically modified eggplant known as Bt-Brinjal or BtBr in India which, after eight years of development was publicly announced for local commercialisation in 2009. However, it was subjected to a moratorium in 2010 due to the ensuing public controversy–a status that remains to the present. In the following sections, I discuss the problem associated with this case, followed by the rationale for my research inquiry on this case, the significance of my study and the organisation of my thesis.

1.2 Statement of the Problem

In 2009, the Indian government's announcement of the commercialisation of Bt-Brinjal (BtBr) −a genetically modified eggplant type which was the first GM food product in the country−set ablaze the existing and unique discourses on genetically modified food crops and the processes of approval of GMO products in India. While the cultivation and commercialisation of GMOs in India was already on the country's socio-political agenda since the advent of Bt-Cotton[1], the proposal of commercialisation of BtBr as the second modified crop (the first as an edible crop and an Indian staple vegetable) triggered claims for the revision of policies and regulation on approvals of GMOs in India. The *problem* was apparent when commercialization of BtBr was regarded as a divisional 'issue' in a series of national consultations that were held in seven cities across the country between 13 January to 06 February, 2010 as facilitated by 'The Centre for Environment Education' on the order from the Ministry of Environment and Forests (MoEF). One of the points of contention was whether it is a 'scientific' issue, an 'economic and commercial' issue or a 'consumer' issue (Centre for Environment Education, 2010, p. 4). Different actors engaged in the discussions including individual farmers, farmer organizations, groups focused on organic agriculture, consumer groups, scientists, agriculture experts and students, NGOs, environmentalists, veterinary doctors, politicians, groups affiliated to different political parties and representatives of the State Governments as well as representatives of the company, Mahyco (Maharashtra Hybrid Seed Company) which had developed and proposed the introduction of BtBr in India.

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[1] Bt-Cotton is a genetically modified type of cotton first introduced in 2002 and is now grown commercially in India. Almost 95% of cotton cultivation in India is of Bt-Cotton.

After considering various issues raised in this debate, the Indian ministry (by the verdict of then minister of agriculture and forests, Mr. Jairam Ramesh) concluded the public discussions with an indefinite moratorium on BtBr in 2010 until further investigations could be carried out ‒a status that remains to the present.

A closer scrutiny of these debates reveals considerable disagreement on the nature and extent of the problem, not only at the level of finding solutions to the proposal of commercialisation of BtBr, but at the very level of defining the 'problem' of BtBr. Indian scientists were particularly influential in expanding the controversy which re-directed the policy decision from commercialisation to moratorium. They engaged in constructing and redefining the problem of BtBr at the public level‒by communicating through various popular media platforms. Therefore, their communication activities in this debate are particularly interesting as they featured unique ways of articulation as well as circulation of meanings, suggesting the non-routine patterns of public communication of science in cases of controversies. Thus, the main focus of my study is to investigate these patterns by which scientists tend to communicate directly with the public in controversial contexts, also known as *deviations* (Bucchi, 1996).

1.3 Research Questions

The main objective of my study is to investigate the role of scientists in the public communication of science during controversies‒situations in which non-routine patterns of communication emerge as deviations. I specifically investigate the communication role of Indian scientists in the controversial BtBr case as it provides "the real-world examples of the conditions and the patterns of non-routine communication" (Bucchi, 1998, p. 33). To meet this objective, I formulate my research questions as follows:

- In what ways did the Indian scientists communicate the problem of BtBr in India?
- In what ways did they deviate from 'normal' patterns of communication?
- How did they specifically articulate and circulate meanings around BtBr in public?

1.4 Research Rationale

There are certain factors that encouraged me to choose this case to investigate. First, the BtBr case is about the controversies around GMOs and, more broadly, about the introduction, implementation (or rejection) of biotechnology in society. Before joining the Master of Arts program in the department of Communication, Media and Film at the University of Calgary, I had approximately six years of post-secondary education in science and technology, with my first graduate degree in Biotechnology and my post-graduate work in plant physiology and cellular biology, with emphasis on the development of GMOs in agriculture.

During my MSc. thesis project at the University of Toronto, I was testing the growth response of tomato plants which were genetically modified with the gene that is naturally found in some salt tolerant plants and bacteria. It was earlier theorized that this gene can possibly bring tomato plants (and other crops in future), the same 'biological capacity' to tolerate high salt environments and thus allow its cultivation in areas where salinity is a major problem, frequently in some developing countries. My project was to test this ambitious 'scientific theory' which could potentially bring many social benefits. However, modifying plants with this gene had some environmental implications which were not too concerning at this early stage of development. For example, these tomato plants after modification were releasing a greenhouse gas that has the potential to cause global warming and deplete the ozone layer if accumulated in large amounts. This might be expected if this gene was to be used for modifying tomatoes produced in large commercial quantities. Thus from my personal experience, I learned that the implementation of technology may bring parallel consequences – both positive and negative -- which could be both biological as well as social. As I progressed in my profession, I became keen to examine the impact of new technologies such as biotechnology in society. During my time as a post-secondary student in India, biotechnology was assuming a place in Indian agriculture. Bt-Cotton− a variety of cotton genetically modified to be pest resistant was first introduced in India. In fact, I happened to be in the first cohort in my university to graduate with the Bachelor of Biotechnology degree which was only recently integrated as a ‘post-secondary academic programme’ in the faculty of science and engineering in 2004.

Currently, India has been increasingly adopting biotechnology at a fast pace[2]. The national Department of Biotechnology (DBT) of India periodically proposes new biotechnology ventures and various other industry-related schemes as well as the public-private partnerships that are aimed at developing Indian entrepreneurship in biotechnology (Malhotra et al., 2012). At the same time, India can serve as one social arena for investigating the social contexts for the introduction of new and controversial technologies. Moreover, since I was born and raised in India for almost twenty three years before I migrated to Canada, I bring a cultural knowledge base that compliments my scientific and technological understandings for this investigation.

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[2] https://www.ibef.org/industry/biotechnology-india/showcase

1.5 Significance of the Problem

One of the more intriguing scientific controversies of modern times is over the genetic modification of living organisms and the use of such genetically modified organisms (or GMOs) for various purposes. Among these, the application of genetic modification to pharmaceutical and agricultural products use of GMOs are the primary areas of application. Interestingly, the use of GMOs for pharmaceutical purposes such as the development of vaccines using recombinant micro-organisms has found utility worldwide[3] with little public concern whereas their agriculture applications have seen considerable opposition in many countries.

In general, people are more skeptical about GMOs in agriculture than in pharmaceuticals although both industries utilize the same technology in principle (Bauer, 2002; Braun, 2002; Gaskell et al., 2000). One of the common notions is that GMOs in pharmaceuticals are still acceptable due to their life-saving purposes whereas there is no such urgent requirement for their use in agriculture. Indeed there are countless assumptions about GMOs in public which render their uses especially as 'food' quite controversial.

This overall view has hampered the development of genetically modified *food crops* in agriculture in many countries. The case of Bt-Brinjal or BtBr is one such controversial case in which the first genetically modified food crop (eggplant) of India was subjected to a moratorium due to ensuing public controversy which followed the initial public announcement of its commercialisation after about eight years of research and development.

[3] The most widely known is the production of insulin by a common bacterium, E. coli, engineered to carry the human insulin gene. For 60 years after the discovery of insulin by Canadian scientists, cattle and pigs were the insulin sources but concerns about the growing diabetic population and possible allergic reactions prompted the development of recombinant DNA technology-based insulin.

Indian scientists became embroiled in this situation as were many other actors including civil society organizations, farmer groups and members of the public, subsequently re-directing the policy decision from commercialisation to moratorium.

It has been argued that scientists may engage in non-routine ways of communication during extreme controversies–which are often accompanied by conditions of urgency and greater mobilisation of a range of actors. Such controversies involving scientists and science offer a unique site for analysis of the public communication of science in non-routine and problematic social circumstances which most scientific endeavors of modern times become part of–as science today is more complex, demand greater public attention than ever and is communicated on the global scale. However, there have been fewer efforts investigating the public communication of science in such circumstances in a modern case-study approach. Moreover, the communication role of scientists in these situations has been less frequently addressed. Therefore, my analysis of the communications role of the Indian scientists in the Bt-Brinjal controversy aims to fill this gap in the literature and hopes to make significant contributions to the understanding of the emerging trends of science communication in modern times.

1.6 Literature Review and Theory

In order to focus my research inquiry examining communication of science in cases of scientific controversies, I primarily rely on the concept of ‘deviations’ put forward by Massimiano Bucchi (Bucchi, 1996). This concept refers to the non-routine form of the public communication of science in scientific controversies or crisis in which scientists skip the routine or intermediate stages of public communication (often occupied by media and other institutions) and directly speak in the public domain. I preface these non-routine modes by describing the 'continuity' model of the public communication of science, to illustrate the routine pathways in which science is generally communicated from scientific experts (scientists) to the public. I aim to direct the reader's attention primarily to the non-routine pathways of the public communication of science and the conditions which cause such non-routine forms of communications, also known as deviations–the primary focus of my analysis.

I frame my analysis through two theoretical concepts–one is Michael Foucault's idea of 'problematization' (Foucault, Rabinow, & Rose, 2003, p. 29) and the other is the description of post-normal science' (PNS) by S. O. Funtowicz and J. R. Ravetz (Funtowicz & Ravetz, 1991, 1993). Problematization is a suitable framework for my analysis of the public communication of science in instances of deviations because it poses as a question how a subject comes to be described or interpreted as "problematic" and the varied ways such a subject comes to be discussed in the public sphere. In other words, the problematic conditions which delineate many forms of arguments around the object in a scientific debate, by associating the object with a series of problems which are often unresolved–resulting in a controversy are likely to cause deviations in communications. In my inquiry I specifically analyze the arguments laid out by the Indian scientists around BtBr during the national controversy which associated it with a series of problems. I aim to study the communication patterns by which the Indian scientists *problematized* BtBr and examine whether or how such communications might extend beyond the traditional science-based evaluation of BtBr.

1.7 Method/Research Design

My methodology includes text analysis of the public texts written by the Indian scientists to address the problem of BtBr in India. I analyzed these texts by using the methodological framework of critical discourse analysis (CDA) by Norman Fairclough (Fairclough, 1995) which suggests texts as the particular configurations of various genres, styles and discourses of a given time or situation which include the ways of acting, self-being and representing as part of the social activities analysed. I specifically focus on the various patterns of articulations by which Indian scientists problematized BtBr in public in (a) their ways of *(inter)acting* analysed as genres, which may include the tendency to producing popular texts or other ways of circulating the problem of BtBr; (b) their ways of *self-being* analysed as *styles* such as their particular standpoints on BtBr and their orientation to particular expressions, and (c) their ways of *representing,* analysed as discourses such as the use of discursive frameworks and patterns of re-contextualization.

1.8 Outline of the Thesis Chapters

The first chapter of my thesis is this introduction which gives a brief overview of the research problem which I investigate, the specific research questions that I formulate for my analysis and the significance of the problem. It also includes a brief snapshot of the scholarly literature I review and the theoretical as well as methodological frameworks I choose for my inquiry.

In chapter two, I review the literature on the public communication of science, with focus on some of the theoretical models which illustrate the routine communication patterns in which science is generally communicated in society. Then I draw attention to the 'continuity' model of the public communication of science which elaborates both on the routine, as well as the non-routine patterns of communication−the latter called deviations. Finally I elaborate on the concept of deviations by also discussing some of the typical factors that may lead to these non-routine patterns.

Deviations particularly involve controversial situations which may force scientists to skip the routine, mediated channels of the public communication of science, explore different modes of communication, and address the public directly. For my analysis I chose the controversy over the first genetically modified food crop in India−Bt-Brinjal (eggplant) or BtBr. To build an understanding of the controversy, I discuss the background of the case in chapter three which includes a brief overview of the national importance of Brinjal (another common name for eggplant) in India, its genetic modification into the BtBr variety, the major phases of the BtBr development followed by a description of the mounting controversy around it. In chapter four, I present the theoretical underpinnings for my analysis−problematization and post-normal science (PNS).

In chapter five, I elaborate on my methodological framework of critical discourse analysis (CDA) which I utilize to analyse the popular texts of the Indian scientists in the BtBr controversy. I particularly emphasize CDA's assumption of the 'text' as a particular configuration of various genres, styles and discourses in a given time or situation. The ways of acting, self-being and representing respectively as part of the social activity are analysed. Thus I provide a detailed explanation of the three-dimensional framework of CDA's text analysis−analysis of genres, styles and discourses which all together illustrate the articulation of meanings in any communication event. Then I move on to explaining the specific methods I used to conduct my analysis. I present the results of my analysis of these popular texts in chapter six. In chapter seven, I discuss how BtBr represents a deviation case in the public communication of science in terms of the ways in which the Indian scientists problematized BtBr. I also discuss that such conditions portray post-normal science. I conclude with a note on the significance as well as the limitations of my work, also the considerations and recommendations for future research.

CHAPTER 2 LITERATURE REVIEW

2.1 Overview

In the broader literature of science communication, public communication of science is marked by the “the cross-sectoral” boundaries of communication between scientific communities and those of wider society (Trench & Bucchi, 2010), in ways that conceptualize the ideal conditions in which such communication may be facilitated. This has led to many theoretical models of public communication of science which idealize the process in which science is generated at the expert level of scientific community and passed out to the wider publics. While the majority of the earlier models assumed publics as only passive audiences to scientific information, with little to contribute, scholarly advancements in the field led to more refined models which acknowledged the possibility of the exchange of ideas between the scientists and the public. Yet, even the more refined models of public communication of science “fail” to recognize the conditions which may lead to the kind of communication that is different from what is idealized in routine circumstances (Bucchi, 1996). Such an alternate form of communication is conceptualized as the “deviations” in the public communication of science (Bucchi, 1996).

In this chapter I review some of the theoretical models which illustrate the routine communication patterns in which science is generally communicated in society. Then I draw attention to the ‘continuity’ model of the public communication of science which elaborate both on the routine, as well as the non-routine patterns of communication−the latter called deviations. Finally I discuss the concept of deviations by also examining some of the typical factors that may lead to these non-routine patterns.

2.2 Public Communication of Science

Public communication of science is at the heart of the strong communicative relationships between science and society via the effective use of “dialogue, trust, relationships, and public participation [in scientific endeavors] across a diversity of social settings and media platforms” (Nisbet & Scheufele, 2009, p. 1767). An obvious need for the effective public communication of science comes due to the fundamental role of science in society–the *public* is the ultimate bearer of the risks and benefits of the scientific and technological development (Bubela et al., 2009, p. 515). Furthermore, the effective public communication of science includes recognition of the benefits and risks of science in order for publics to make sound choices (Fischhoff, 2013, p. 14033). Therefore, the science-society relationship is not only prominent from the sociological perspective, but also important from the socio-economic aspect. For example, new scientific discoveries can help nations to economically compete in the market with their novel or improved products (Swann, 2009). At the same time, the acceptance of novel products is highly dependent upon the structural and cultural aspects of society where it is intended to be adopted (Greenhalgh, 2005). Thus there is an ultimate social dependency of novel technological products for their successful implementation into society and is well-documented under the ‘diffusion’ model of scientific innovations, which emphasizes social characteristics that help to speed up the spread and implementation of new scientific ideas in society (Rogers, 2002, 2003). However, today’s science-society relationship is too complex for the simple ‘diffusion’ and implementation of scientific ideas in society. Contemporary scientific issues are much more “interdisciplinary, bureaucratic, global in scale, [and] problem-based” (Bubela et al., 2009, p. 514), and at the same time, there is a constant public demand for information and engagement in scientific endeavors, especially those which are controversial such as the development of nuclear research, nanotechnology and genetically modified organisms (Bubela et al., 2009, p. 515). Therefore, the successful implementation of many scientific outcomes involves a more complex process that includes recognition of many "publics" in their heterogeneity (Einsiedel, 2008, p. 174), and broader public discussions and debates which may involve consideration of different knowledge bases−including scientists, policy decision makers as well as the general public.

2.3 Models in Public Communication of Science

2.3.1. Traditional vs newer models of science communication.

Under the broader umbrella of science communication, many models of the public communication of science have been proposed over the years, in various specialized fields such as the Public Understanding of Science (PUS) (Miller, 2001; Shapin, 1992), the Public Communication of Science and Technology (PCST) (Stekolschik, Draghi, Adaszko, & Gallardo, 2010, p. 625) and the Public Understanding of Science and Technology (PUST) (Barben, 2010, p. 277) . Most of these models previously entailed the 'diffusion or dissemination' mode of science communication, posing it as the one-way flow of knowledge streaming from the scientific experts to the publics. Such models assumed a 'knowledge deficit' among people and therefore the need for the *effective* communication strategies to educate them (Treise & Weigold, 2002, p. 312). It implied that public skepticism related to new scientific discoveries existed because people were simply 'deficient' in the scientific knowledge required for understanding new ideas and discoveries of science (Bauer, Allum, & Miller, 2007); and that such knowledge limitations created hurdles in putting public trust in science, creating a major roadblock for the scientific progress in society (Sturgis & Allum, 2004, p. 57).

However, recent research accounts have largely criticised the one-way flow of science communication, and replaced it with the newer ‘dialogue model’ that engages publics in two-way communication with the scientists (Bucchi & Trench, 2008b; Einsiedel, 2008; Irwin & Wynne, 1996; Miller, 2001; Wynne, 1991, 1992). Also known as the ‘public engagement model’, it focuses on public engagement activities such as the “consensus conferences, citizen juries, deliberative technology assessments, science shops, deliberative polling, and other techniques” etc. by which the public participation in science policy can be enhanced (Lewenstein & Brossard, 2006, p. 8). Among the aims of these initiatives was to contribute to democratizing the technology assessment process.

2.3.2. Assumed channels and participants.

Previous diffusion or one-way communications models assumed the sharp knowledge divide between the “science community” or “science practitioners” – the people who are experts and directly involved in some aspect of the practice of science, and the “lay public”, often the non-expert in a particular field (Burns, O’Connor, & Stocklmayer, 2003 p. 184). Both the scientists and the public were assumed as the two extremes of the communication channel which was in turn mediated by the journalists or other media professionals whose task was to simplify scientific information or put it in the broader context, which can then be mass-disseminated via various communication platforms. Because the public was largely considered as having a ‘deficit’ of scientific knowledge, their contribution to the science-related policy decision making was hardly recognised. As a result, the public was known only as the ‘passive audience’ (Bucchi & Trench, 2008b, p. 58) for a long time, both in science communication scholarship as well as in the practical policy making. On the other hand, scientists were hardly recognised for their public engagement initiatives, and were deemed least responsible for communicating with the public (Weigold, 2001, p. 172). As a result, the public communication of science was known as mainly the activities of professional communicators such as journalists or public information officers etc. (Treise & Weigold, 2002, p. 311). In only a few special circumstances, some “visible scientists” generally of elite status or popularity would address the public directly through public conferences, media interviews or publish in journals monitored by the press (Weigold, 2001, p. 172). This understanding of the role of participants in public communication channels is perhaps the main reason that many studies in the past focused on the role of mass media and journalists as the primary channels and gatekeepers of scientific information in public (Dunwoody & Scott, 1982; Mazur, 1981; Weigold, 2001).

However, later models recognised the communication channel between the scientists and the public as two-way or multi-way, in which publics can also communicate back with their own ideas and perceptions about new scientific discoveries. Greater emphasis was placed on the importance of public dialogue with scientific experts through various public engagement activities which brought both the public and the scientists in direct proximity with each other and allowed direct exchange of ideas without the interference of the media. These models also situated scientists as active public communicators, a comparatively new dimension to the role of scientists in society which was seldom recognised before.

2.3.3. The continuity model.

The *continuity* model of public communication of science is a refined version to give an overall picture of science communication as a process (Bucchi, 1996; Bucchi & Trench, 2008b) . For example, it differentiates the traditional single channel of science communication into four specialised stages. The first stage is called the ‘intrapecialistic’ stage in which the scientists of closely related scientific fields are located. Here, scientific ideas are developed as typically expert oriented scientific texts, to be discussed among people within the same field of scientific research. Then, the next stage is called the 'interspecialisitic' stage of communication in which the scientists of inter-disciplinary fields are focused. At this stage, communications among researchers of interdisciplinary fields is emphasized and facilitated. Then there is the third stage called the 'pedagogical' stage, also referred as the 'text-book science' stage in which academic and other institutions are located. At this stage the already established scientific ideas are disseminated to the public via institutions with little room for evaluations and discussions. Finally, the fourth stage is called the 'popular' stage at which the general public and the mainstream media are located. At this stage, science is represented in metaphorical ways with less focus on the scientific data/results and more emphasis on the public appeal of the scientific content, such as those evident in science magazines and TV science documentaries to appeal to wider audiences (Figure 1).

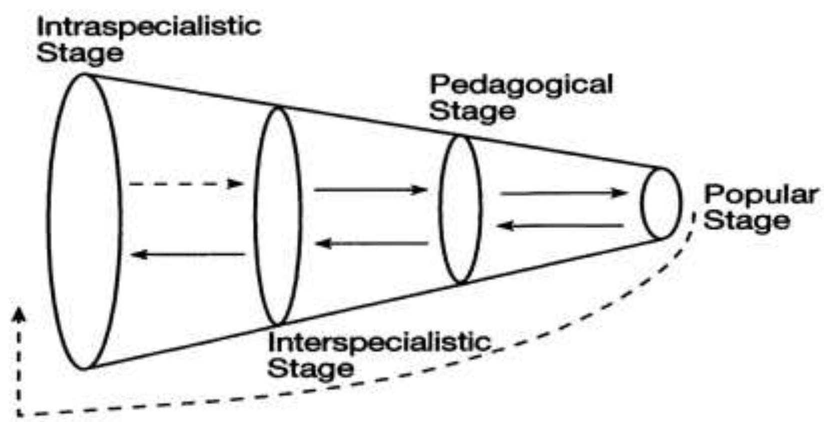

Figure 1. The continuity model shows the information flow of science communication in four stages. The first stage (intraspecialistic) is where the scientific discourse of science is initially developed, and after passing through intermediate stages, finally reaches the last stage (popular) where it is converted into the public discourse.

Image source: (Bucchi, 1996)

Thus, the continuity model describes the process of the public communication of science in four stages at which various participants such as the scientists (both experts and non-experts of a particular scientific area), the institutions, the media and the public are situated. It illustrates the routine trajectory by which scientific ideas are not only passed on, but rather developed and transformed through each passing stage before it reaches out to the public in the 'popularised' version. Each passing stage is not separated by the rigid boundaries but is defined by the porous, fluid dimension which can allow exchange of ideas across various participants. In other words, the model recognises the two-way interaction between the participants of each consecutive stage during the process of the development and transformation of scientific ideas.

2.4 Public Communication of Science in Routine versus Non-routine Circumstances

The above models depict the scholarly progress made over the years in the general understanding of both the process of the public communication of science and the relationship among its participants. However, none of these models is idealistic or standard to be applied to all social circumstances in which science proliferates, and in fact are only the representation of some forms of the public communication of science. For example, one model may best describe the ways science communication works in one society or even country but may not be applicable in another. Within a society, a certain scientific topic of say less public attention may be communicated in the traditional deficit-style way while another more controversial topic may be communicated in a dialogue-style way. It is also possible that one scientific research at the initial stages of development is communicated in deficit-style but later may attract greater public attention such that the dialogue-style communication is activated. In short, science communication is a dynamic, context-specific process and it is inappropriate to choose the one best model to describe the way science communication works in different contexts (Bucchi & Trench, 2008b, p. 70). Therefore, the aforementioned models of public communication of science can pave ways to an even bigger question in science communication–under what circumstances does one form or style of public communication emerge and what conditions lead to those circumstances? (Bucchi & Trench, 2008b, p. 70).

In order to address such questions, the distinction between the social circumstances has been suggested by which, on one hand there exists the 'routine' circumstances which are characterised by the situations in which scientific ideas to be communicated are of low public resonance and almost undisputed scientific knowledge. Whereas on the other hand, there exist the 'non-routine' or 'problematic' circumstances which are characterised by the situations in which scientific ideas to be communicated are of high public resonance, involves disputed scientific knowledge and are often accompanied by controversies. Also, there are the specific conditions which determine the nature of science communication in each of the circumstances. These conditions may also define the role each actor or participant may play in each of the circumstances. The following discussion highlights some of the forms of public communication of science in routine versus non-routine circumstances. Because the focus of this research is mainly on the scientists as the participants in the public communication of science, the discussion also highlights the conditions in which the scientists' communication role varies in both routine as well as non-routine circumstances.

2.4.1. Public communication of science in routine circumstances.

It is suggested that in many social and demographic contexts, the public communication of science may operate in the traditional deficit- style way on a routine basis (Bubela et al., 2009; Bucchi & Trench, 2008b; Trench, 2006) in which the scientific outcomes are communicated via traditional media channels, with little emphasis on public feedback. In many cases, public too may choose to remain passive to most of those scientific outcomes which are generally of low impact or public salience. In either of the scenarios, there may be barely any direct communication between the scientists and the public.

On the other hand, societies may promote the dialogue-style communication of scientific ideas on a routine basis through various public-engagement (PE) activities, generally because such societies acknowledge the complex nature of science in the modern world as well as the importance of public dialogue in routine scientific practice. Therefore, at the institutional level, there may be much push towards public communication and engagement activities by improving scientists' communication skills. At the individual level too, scientists may be seen as participating in various public consultation events or using the internet as part of routine scientific practice for representing the *context* of their ongoing scientific endeavor and seeking public reviews for the same (du Plessis, 2008).

2.4.2. Conditions or factors of routine public communication.

Factors or conditions which may bring scientists in direct contact with the public may vary depending upon societies in context. For example, in societies in which the traditional one-way style of communication persists, scientists' direct engagement with the media and the public remains minimal. In those societies, conditions such as time constraints, professional norms and the professional reward structures etc. remain the norms of science practice that require scientists to stay dedicated to their work and share scientific information through peer-reviewed publications. Hence, any engagement with the public can compromise scientists' integrity towards their profession. In other words, in such societies, scientists generally “proclaim themselves extraneous to the process of public communication [of science] so that they may be free to criticise errors and excesses – especially in terms of distortion and sensationalism” by the media (Bucchi & Trench, 2008b, p. 58).

Language is perhaps another barrier that most scientists face in many societies and hence they remain distant from direct public communication. In general scientists are not trained for linguistic skills required for the simplification of scientific information and thus are not considered as effective communicators; all of which contribute to their minimal communication in the public domain and to the use of mediators such as journalists or professional communicator for the task of communicating science in public. Some scholars support this sort of mediated public communication and indeed suggest that scientists should not be expected to devote substantial efforts toward PCST (public communication of science and technology) activities (Pearson, 2001). On the other hand, the general awareness and institutional encouragement has recently become common in some western societies that have led to scientists adopting the interactive, two-way public communication as part of their routine scientific activity. In a national survey conducted by the Royal Society−the prestigious and the oldest independent scientific academy of UK, it was found that communication training activities increase the likelihood of scientists to participate in public communication activities (Royal Society, 2006). In this context, the availability of institutional funding to support scientists’ public communication activities can also be a determining factor (Davies, 2008, p. 414). Accessibility via the internet and popular media has also largely contributed for scientists to actively participate in public communication activities on a regular basis. Dudo (2013) suggests that scientists who tend to use the internet and popular media themselves have more positive outlooks towards public communication activities (Dudo, 2013, p. 482). Therefore in modern times, the internet is a common factor for scientists to communicate with the public on routine basis.

2.4.3. Public communication in non-routine circumstances−cases of deviations.

In most circumstances as described above, there is some sort of autonomy for scientists to take the deliberative decision about whether or not to take part in public communication of science; and if yes, then how and to what extent. However, there may be some other social conditions which can make such an activity as the social obligation for scientists. These conditions are generally problematic, non-routine and cause variations to the general communication continuum of the public communication of science in which scientists are separated from the public by the intermediate institutions and the media. Such variations to the routine public communication of science are called ‘deviations’ (Bucchi, 1996; Bucchi & Trench, 2008b).

The communication under deviations can be described using the ‘continuity’ model. For instance, the model suggests that in routine circumstances, the scientific idea or knowledge is initiated at the very first expert or Intraspecialistic stage comprising mainly of scientists of closely related scientific disciplines and after passing through the intermediating stages (Interspecialistic and pedagogical which comprises inter-disciplinary scientists and institutions respectively), the scientific idea is received at the popular stage comprising of the media and the public. In this process (depending upon the sociological conditions) there is also the possibility of the ‘cross-talk’ between the participants of the adjacent stages in a two-way communication style by which the scientific idea can be enriched or transformed (Bucchi, 2004, p. 273). For example, the emergence of inter-disciplinary and multidisciplinary studies and projects bridge this gap between the scientific community and the public who may engage in a dialogical way to discuss over a scientific issue at hand (Pereira & Funtowicz, 2006). Hence according to the continuity model, the process of science communication is fluid and always in the making. It is this fluid nature of science communication that makes it vulnerable to disruption in certain problematic conditions. Deviations then may refer to communications in those situations or cases in which the routine ways of science communication is disrupted. In other words, deviations may be referred to as the non-routine communication which emerge in those circumstances in which the routine sequential trajectory of the scientific knowledge, ideas, topics or discourse (that generally emerge from the specialistic or expert stages) is deviated from and specifically targeted to the popular stage of the communication continuum, skipping the intermediate stages so that the particular scientific idea gets an immediate and greater public attention. This is an alternative to the routine, generally unproblematic itinerary of scientific ideas through the different levels of communication as suggested by the continuity model.

2.4.4. Conditions or factors of deviations.

Because deviations represent the disrupted, non-routine public communication of science, they typically involve situations of scientific crisis. Under those situations, the professional competence and legitimacy of scientific ideas and even science as profession are re-assessed in the wider public arena. Issues become publicly salient and often involve public controversy. Scientific matters may be filled with uncertainty, debate and conflict of interest among stakeholders, as a result of which public intervention becomes necessary to determine a possible outcome or success of one party over another. In other words, controversies as well as disagreements among actors during the instances of deviations may result in greater instability and therefore mobilise actors who often contest ideas in the wider public domain

(Bucchi & Trench, 2008b, p. 71). As a result, scientific experts in such circumstances often tend to communicate directly to the public, skipping the routine stages of public communication of science.

Another characteristic of deviations is the frequent framing of scientific outcomes as *problems* in the larger public sphere via the mainstream media. For example, the safety or nutrition value of certain foods has been the focus of public controversy and concern, encouraging some scientists to directly address the public. It is also possible that in deviations, the scientific "facts" may also be "dissolved, deconstructed or simply manipulated by social groups for their own purposes" (Bucchi & Trench, 2008b, p. 65). For example media actors who are external to the scientific community are likely to manipulate scientific claims and incorporate them in the public arena (Bucchi, 1996, p. 387). As a result, the "scientific claims may eventually be assimilated into interest- and value-laden political claims" (Bucchi, 1996, p. 387).

Therefore all these conditions as described above can contribute to the situations in which non-routine ways of public communication of science emerge. Although in a recent account of his work, Bucchi acknowledges that these conditions as described above could simply be (routine) part of the evolving face of science communication in modern situations of uncertainty in science‒in which both the "quality and context" are central to scientific topics. As, due to many factors of the present times (such as the availability of internet), scientific issues are "increasingly pushed in real time into the public domain without being 'filtered'"(Bucchi, 2017, p. 890) in ways which are perhaps on-going and no longer account for non-routine, deviation-like scenarios. However, in many societies, deviations may still be a useful concept to distinguish the modalities of extreme scientific crisis which could account for greater visibility of scientific issues as well as scientists in the public domain. For example, in a different study, Horst and Michael (2011) have put forth a ‘model of emergence’ in which they have theorized that the process of science communication as an event may sometime trigger unanticipated forms of interaction among actors by which these actors stabilize and even demonstrate new identities *momentarily* during the event (Horst & Michael, 2011). Therefore, in its more refined version, deviations can also be understood as the ‘transient state of communication’ which may develop when certain modalities of scientific controversy or crisis emerge (Bucchi & Trench, 2008b). Therefore, with respect to the scholarly account of various forms of public communication of science, I summarize Bucchi’s idea of deviations in the following diagrammatical representation (Figure 2).

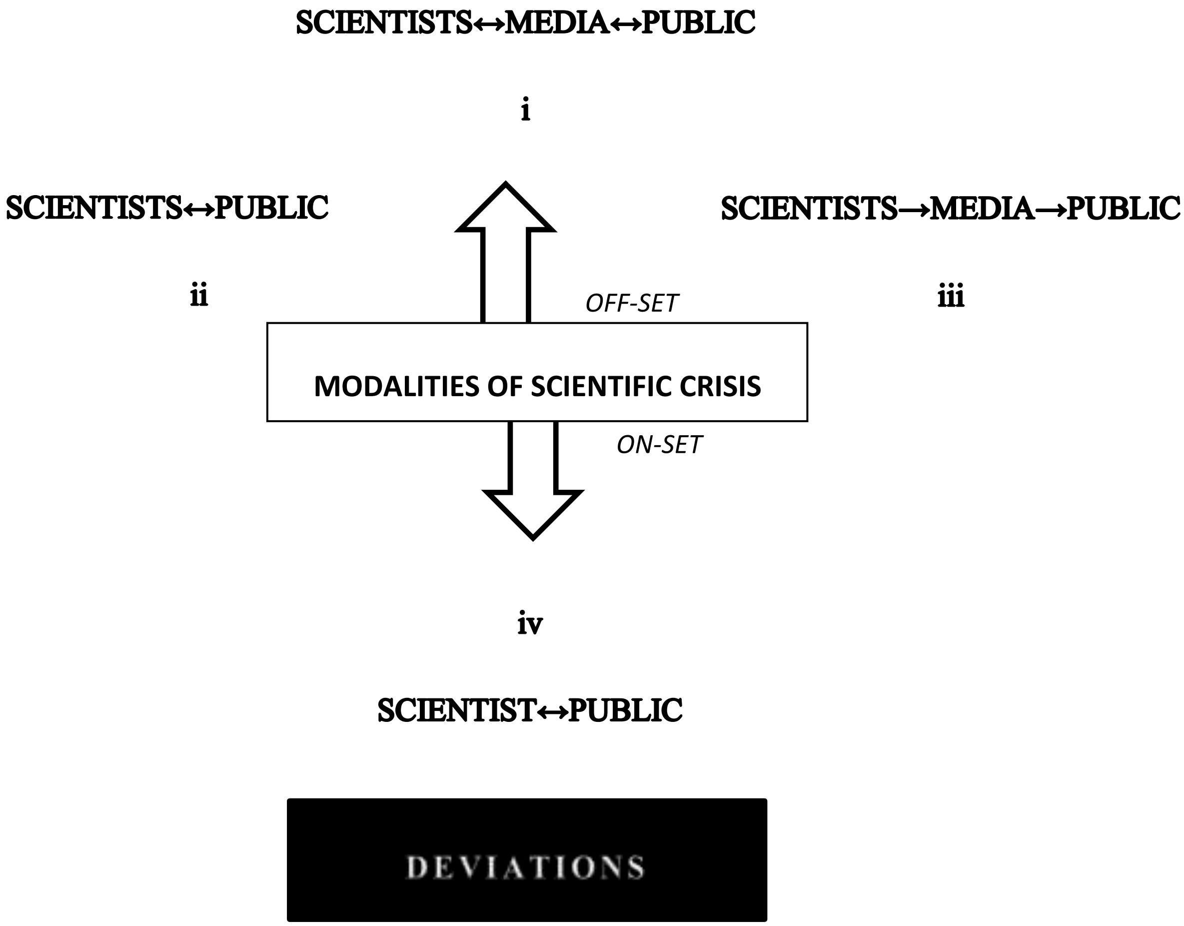

Figure 2. Illustration of the process of science communication based on various models in the literature. i. routine communication often mediated by the media or other institutes, allows cross-talk among participants through various events and platforms; ii. advanced communication allows direct engagement between scientists and the public in an ongoing basis, fosters awareness and newer forms of scientific engagement and practices; iii. traditional communication may persist in some societies, acknowledges limited public engagement and generally follows the one-way flow of scientific information/news; iv. deviations, occur when certain modalities of scientific crisis emerge which bring scientists in direct public arena, often involve political debate and urgent policy decisions[4].

[4] Idea of deviation and other forms of public communication of science summarized from Bucchi's discussion on various models of science communication in (Bucchi & Trench, 2008a)

2.5 Summary

In sum, the public communication of science can be described as the exchange of information or ideas between the scientific community and broader publics. In routine circumstances this activity often takes place through mediated channels (media and institutions etc.) which generally separate scientists and the public from direct communication. It is a unidirectional mode from scientists through intermediaries to publics. But when scientific topics are considered publicly salient (as it is in most cases of modern times), the communication activity between scientists and the public can take place in different ways and may in some instances involve public dialogue or may erupt in controversy where there are many competing voices supporting different policy directions or technological futures. During such controversies, scientists may be forced (by moral obligation or political pressure) to speak on the controversy directly at the public level, skipping all the intermediate stages of routine communication.

It is likely that modern cases of scientific controversies reveal patterns of problematic communication and serve as a useful context for the study of deviations. One such topic is the application GMOs in agriculture, a topic which has aroused considerable public controversies in numerous countries around the world (Gaskell, 2001; Isaac, 2002; Kinchy, 2012; McHughen, 2000; Zemlicka, 2015). In the next chapter, I will give an overview of the case of the first genetically modified eggplant in India–the Bt-Brinjal (eggplant) case, which is a highly controversial case and is the case that I will draw upon to study the role of scientists in the public communication of science in deviations.

CHAPTER 3 REVIEW OF THE BT-BRINJAL CONTROVERSY

3.1 Background

The main focus of my research is to study the communications role of scientists in cases of deviations− that is, in situations of extreme public controversies which trigger the non-routine forms of public communication of science. One of the most intriguing scientific controversies of modern times is the use of technology for the genetic modification of living organisms, and the use of such genetically modified organisms (or GMOs) for various purposes. Among these, pharmaceuticals and agricultural products are the primary application areas. Interestingly, the use of GMOs for pharmaceutical purposes such as the development of vaccines using recombinant micro-organisms has been appreciated worldwide; whereas their agriculture use has been largely opposed in many countries. In general people are more skeptical about GMOs in agriculture than in pharmaceuticals although both industries utilize the same technology in principle. One of the common notions is that GMOs in pharmaceuticals are still acceptable due to their life-saving purposes whereas there is no such urgent requirement for their use in agriculture. Indeed there are countless assumptions about GMOs in public which render their uses especially as ‘food’ quite controversial. This overall view has hampered the development of genetically modified *food crops* in agriculture.

Many cases of GMO controversies in agriculture have been reported in the past (Anthony & Ferroni, 2012; Eaton, 2013; Gaskell, 2001; Huang, Hu, Pray, Qiao, & Rozelle, 2003). The European Union was mired in this controversy for years, resulting in a moratorium on GM crop approvals from 2001 to 2013[5]. One of the recent cases is that of the modified eggplant in India, also known as Bt-Brinjal (BtBr). BtBr is the first genetically modified food crop in India developed by the Indian seed corporation Mahyco (The Maharashtra Hybrid Seeds Company) in a public private partnership with the Indian government. It remained under development for about eight years between 2000 and 2009. In late 2009, it was approved for commercial distribution by the Indian government but in 2010, was subjected to a moratorium as a result of the ensuing public controversy. The period between 2009 and 2010−that is, after the first public announcement of BtBr's commercialisation until its moratorium−was highly intense as many stories regarding BtBr's safety emerged in the Indian as well as international media. As well, many actors communicated their opinions on BtBr at the public level with intentions to influence the final decision on whether BtBr would be allowed or rejected in the country. However, due to concerns and potential safety risks raised by some Indian scientists, pressure from the public and other stakeholders, and the overall lack of support for BtBr, the then minister of environment, Mr. Jairam Ramesh imposed a moratorium on BtBr until further scientific research could be carried out on its safety. Initially, the minister suggested a six months moratorium, which was later extended for a period of two years. But as no conclusions acceptable to many publics could be made, he imposed an indefinite moratorium on BtBr, a status which remains to the present.

Thus BtBr case has been quite controversial with many actors taking part in the controversy. It also raised debates among Indian scientists at the public level such that many

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[5] https://www.loc.gov/law/help/restrictions-on-gmos/eu.php

interesting topics as well as the patterns of communication were visible in those debates. The study of such patterns of communication by Indian scientists in the BtBr controversy becomes one of the most suitable ways to fulfill the focus of my research.

In order to analyse the communication roles of Indian scientists in the BtBr controversy, it is important to understand the background of the case. Therefore, in this chapter, I will give a brief overview of the national importance of Brinjal (another common name for eggplant) in India and its genetic modification into the BtBr variety. Then I will summarize the major events of the case including the major phases of the BtBr development, followed by the period of its field trials, regulatory and independent evaluations as well as the mounting controversy around it.

3.2 The Bt-Brinjal Controversy

3.2.1. National importance of Brinjal (eggplant) in India and its genetic modification into the BtBr.

Brinjal is another name for eggplant or aubergine that is commonly used in India. In fact Brinjal is so popular in India that it is also known by more than fourteen other names in the local dialects. The vegetable crop holds great importance in India, as it is featured in the dishes of virtually every household in the country. It is also known as the common man's vegetable in India as it is among the cheapest and most affordable vegetables. It ranks as the second highest consumed vegetable in India (after the staple vegetable potato), along with tomato and onion. It is also an economically important cash crop for poor farmers such that at least a total of 1.4 million small, marginal and resource-poor farmers grow Brinjal on 550,000 hectares annually in all the eight vegetable growing zones throughout the year (Centre for Environment Education, 2010). The market share for Brinjal in India is about

8.4% with about 16.0 tons per hectare of the national average productivity. It is grown in almost all parts of India, the major regions being the central and southern states in India mainly West Bengal, Orissa, Gujarat, Bihar, Maharashtra, Andhra Pradesh, Chhattisgarh, Madhya Pradesh, Karnataka, Assam, Haryana and Tamil Nadu (Centre for Environment Education, 2010). Based on some morphological and molecular studies, it is now generally assumed that Brinjal is likely to have originated from India (Cericola et al., 2013). Evidence from archaeological records supports the contention that Brinjal's cultivation in India is as old as 100–300 B.C., and that it was present in diets of people of the Indus Valley civilisation, one of the oldest known civilsations on earth (Cericola et al., 2013).

Figure 3. Typical egpplant variety that is common in India

The national and cultural importance of Brinjal paved the way for the first genetically modified variety of the same, the first vegetable (or food) crop developed in India. The bacteria derived gene called *Bacillus thuringiensis* or 'Bt' in short, was inserted into the eggplant which gives the modified variety its name as 'Bt-Brinjal'. This additional gene (*cry1Ac* gene) from the Bt bacteria releases an insecticidal chemical in the plant which is effective against many common pests such as the fruit and shoot borer (FSB), a common pest that largely infests and damages the shoots and fruits of Brinjal throughout its life cycle. Bt based chemicals have been previously known for their insect-killing properties and frequently used for many years to control the fruit and shoot borer and other common pests, mainly in the synthetic granular or powder form (and in the form of live bacterial sprays by many organic farmers) as an effective pest control measure in agriculture. Such widely used agricultural products as corn, rice… have had Bt versions developed. Inserting Bt genetically into the plant allows it to make these chemicals from within and prevent the common pests destroying the crop. In India, about seventy percent of Brinjal gets destroyed by the feeding pests almost every year. Thus BtBr was developed as the pest resistant crop variety capable of making Bt-based chemicals from within, eliminating the need to use pesticide sprays against its common pests.

3.2.2. The BtBr development phase (2000-2002).

The transformation and initial processes of BtBr development took place in the year 2000. The research and development was carried out under a public-private partnership (PPP) in which Mahyco−a big agriculture corporation of India partnered with the pioneer public institutes in India such as Tamil Nadu Agricultural University (TNAU), University of Agricultural Sciences (UAS), Dharwad and the Indian Institute of Vegetable Research (IIVR), Varanasi. The Bt-gene used for transformation was obtained from the US-based agriculture giant Monsanto which also has about a twenty six percent stake in the Indian corporation Mahyco. The BtBr project was primarily funded under the Agricultural Biotechnology Support Project-II (ABSP-II) which is a consortium of the United States

Agency for International Development (USAID)[6]. Thus, various public and private organisations hold stakes in BtBr.

3.2.3. Field Trials and the first phase of evaluation (2002-2006).

After successful genetic transformation, BtBr was ready for its evaluation through the various contained and open land safety trials. The first preliminary tests included the greenhouse breeding experiments which were conducted between 2001-2002 to test the initial growth, development & efficacy of BtBr against common pests. After the success of initial trials, BtBr was evaluated for its performance on a large scale– in field trials where BtBr was grown and tested in a dedicated farm area. The field trial approval process had three stages during which the biosafety studies were done: strip or confined field trials, multi-level research trials (MLRTs), and large-scale field trials (LSTs)[7].

The first level of confined field trials took place between the years 2002-2004, during which many scientific and physiological tests were performed which tested BtBr for its pollen flow, germination, weediness, biochemical toxicity and allergenicity. After the success of the confined trials, the multi-location research trials (MLRTs) were conducted between the years 2004-2005 in various locations across India. In May 2006, Mahyco submitted the biosafety data generated from these trials and sought permission from the national regulatory bodies for the large-scale open field trials (LSTs) of BtBr.

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[6] ABSP-II is a funded consortium of the United States Agency for International Development (USAID) which is led by Cornell University, USA. Monsanto, Mahyco, the International Service for the Acquisition of Agri-biotech Applications (ISAAA), and the Indian Council for Agricultural Research (ICAR) are among its many partners. The ABSP-II has also been involved in developing and commercialising Bt Brinjal in the Philippines and Bangladesh.

[7] Since 2008, the new approval system has been in effect in India which replaces these old systems of field trials with the Biosafety Research Level 1 (BRL 1), and Biosafety Research Level 2 (BRL II) trials.

The management of safety trials and the regulation of GMOs in India come under the six national bodies, among which the Review Committee for Genetic Manipulation (RCGM)[8] and the Genetic Engineering Approval Committee (GEAC)[9] are the main bodies. RCGM is mainly responsible for the greenhouse/contained research approvals whereas GEAC is responsible for the environmental release through field trials and commercial approvals of GMOs (Figure 4).

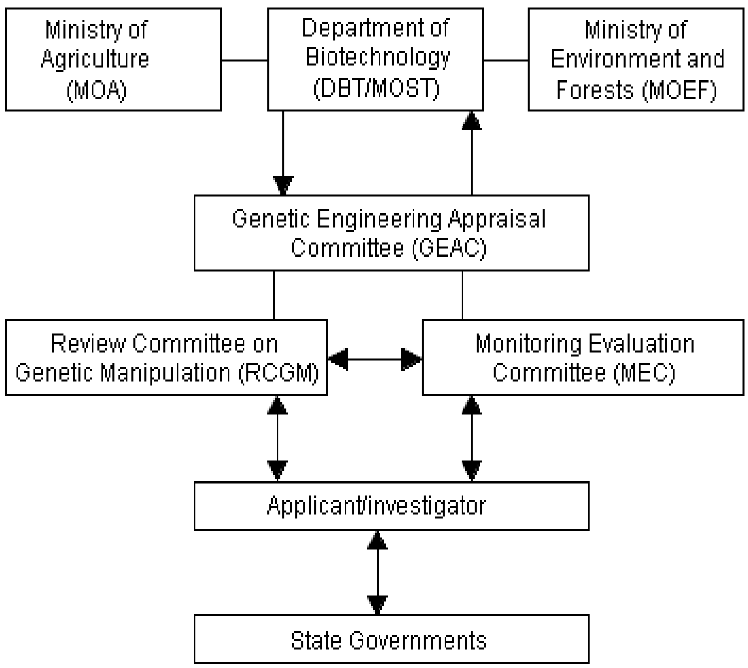

Figure 4. Biotech regulatory mechanism in India

Source: (Dang, Gilmour, & Kishor, 2015)

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[8] The Review Committee for Genetic Manipulation (RCGM) housed under the Department for Biotechnology (DBT) in the Ministry of Science & Technology

[9] Genetic Engineering Appraisal Committee (GEAC), the apex regulator, housed under the Ministry of Environment & Forests (MoEF)

3.2.4. The emerging controversy on BtBr safety data− formation of expert committees (2006-2007).

The biosafety data from limited trials which was submitted by the corporate developer Mahyco got approved by GEAC on basis of which Mahyco sorted permission to conduct large scale field trials of BtBr which eventually raised safety concerns among some anti-GM lobby organisations (such as the Environment Support Group and Greenpeace) in India. These NGO groups raised objections against BtBr safety on grounds of inadequacy of the biosafety data and the lack of transparency in corporate research. In response, the GEAC decided to constitute an expert committee (Expert Committee 1 or EC-I) comprising mainly of scientists to examine the data outside the regular regimes in August 2006. Until this evaluation, the Supreme Court of India−on appeal from the civil society[10] −ordered an immediate ban on the field trials of all other genetically modified crops which were also under development[11] due to potential threats of contamination of non-modified crops by the modified plants' pollens and seeds. Legal orders from the Supreme Court halted BtBr large scale field trials for the next two planting seasons.

The civil society also demanded to independently evaluate the same BtBr's safety data as a result of which it formed an independent committee of scientists to evaluate biosafety data approved by the GEAC. This independent committee reviewed the safety data and submitted its independent evaluation report in October 2006 with stronger invalidation of

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[10] The civil society groups included the Bhartiya Kisan Union, the Centre for Sustainable Agriculture, the Karnataka Rajya Raitha Sangha, the Right to Food Campaign, Madhya Pradesh, Greenpeace India, Samvad, Sampark, Thanal and Living Farms.

[11] An interim application of a previously filed Public Interest Litigation suit to the Supreme Court of India was made against GM crop field trials by Ms. Aruna Rodrigues- an environmentalist.

the GEAC's basis for approval. At this point, two opposing groups of scientists had formed−one which was in favor of BtBr and approved BtBr's safety data (scientists of the committee set up by GEAC) and the other which was against BtBr and rejected BtBr's safety data (scientists of the committee independently set up by the civil society groups)

Meanwhile, divisional issues among the Indian scientists−those who were invested in ministry's decision from one side and civil society's support from the other− were largely taken up by the local media which raised serious doubts about the transparency of scientific evaluation of BtBr's safety. Thus to facilitate a non-biased evaluation, the Supreme Court of India recommended that two independent experts be nominated to the GEAC. As a result, Dr. Pushpa Mittra Bhargava and Dr. M. S. Swaminathan (the two scientists with expertise in biology/gene technology and of elite national reputation) were recommended as the special invitees to the GEAC in February 2007. These scientists recommended more stringent protocols and independent testing on BtBr as well as the moratorium on all GMO trials until concerns were resolved.

Yet, on 8 May 2007, the court directed the resumption of BtBr open field trials but only under stringent oversight and with all necessary precautions taken to ensure that no contamination takes place. Meanwhile, in July 2007, the expert committee formed by the GEAC concluded that the BtBr biosafety data was in accordance with the protocol and procedures stipulated by GEAC and thus approved BtBr on biosafety grounds (Government of India, 2009). Subsequently, the large scale open field trials of BtBr were conducted between the second half of 2007 and in 2008 under the supervision of the Indian Institute of Vegetable Research (IIVR) which is under the Indian Council of Agricultural research

(ICAR) −an autonomous body responsible for coordinating agricultural education and research in India and which reports to the Ministry of Agriculture.

3.2.5. The rising public controversy and moratorium.

The open field trials became the subject of significant controversy in India. Numerous concerned individuals and professionals from different segments of society such as environmentalists, health professionals, civil society and other lobby groups became increasingly concerned over the issue of BtBr. Some of these groups began working together as loosely organized coalitions on the issue. As a result, many more groups and individuals from around the country joined the campaign against BtBr.

Attack on biosafety data*:* The first public attack was focused on the biosafety data generated from the field trials. The representatives from the Centre for Sustainable Agriculture (CSA), Greenpeace and several other civil society groups appealed to the ministry to make the biosafety data public. They specifically demanded to have the data posted on the Ministry of Environment & Forests website for feedback. As a result, the GEAC complied with the pressure and on 25 August 2008 released the biosafety data on legal orders made by the Supreme Court of India due to petitions by Greenpeace and other independent environmentalists. These groups took the data and approached some independent scientists of international repute for an independent evaluation and feedback. These scientists identified serious flaws in the data and claimed BtBr as unsafe for human and animal consumption.

Public protests*:* This intensified the matter and added to the controversy. The media reporting of these events further led to public outrage on the matter. For example, during the same time in mid-2008, an urban awareness campaign called “I am no lab rat” was launched, creating awareness and collecting more than 70,000 petitions to the then Minister of Health & Family Welfare asking them to stop the commercialisation proposal for BtBr. Meanwhile, a rural awareness campaign resulted in 17,000 handwritten postcards being sent from farmers addressed to the same minister, who then publicly expressed his opposition to BtBr in December 2008. Brinjal seed and food festivals were held around the country by various groups from 2008-2009, drawing thousands of people. Many scientists and activists also started publicly expressing their opinions in newspapers and other media platforms, including public speeches at seminars about their concerns over the problems surrounding BtBr. Public protests also followed in various cities across India (Figure 5).

Figure 5. Photo showing public protest against BtBr in one of the cities in India.

Source: http://www.thehindu.com/opinion/lead/The-path-of-science-for-GM-crops-in-India/article16614744.ece

***Initial decision of commercialisation**:* As the matter further intensified in the public arena, in May 2009 the regulatory body GEAC formed another Expert Committee (Government of India) of scientists to evaluate the results of the ongoing large scale BtBr field trials as well as examine the findings from the independent committee of scientists and the report by the Ministry of Health & Family Welfare about the potential adverse impacts of BtBr. Contrary to the claims of some independent scientists against BtBr, the expert committee EC-II declared that BtBr was safe and ready for approval. On this basis, on 14 October 2009 the GEAC recommended the commercial release of BtBr and forwarded it to the Minister of Environment & Forests, Mr. Jairam Ramesh for the final decision.

Public consultations and moratorium: Independent individuals and lobby groups sent letters to the minister and protested against the GEAC recommendation to approve BtBr. Subsequently, the Minister decided to put the BtBr evaluation report up on the Ministry's website for feedback. Meanwhile, a series of public consultations were also held by the minister himself in seven cities across India between 27 Jan -06 Feb, 2010 to arrive at a decision in the public and national interest. These consultations were attended by over 8000 people, characterized by large crowds of protestors and participants. The minister also wrote to the major Brinjal growing states in India to solicit their views and interests in BtBr. At least eleven states responded with their objections and concerns over BtBr.

Some of the major issues that were brought during these consultations were the "Biodiversity and the Environment, Pest Management, Economy and Livelihoods, Consumer Concerns, Human Health and Bio-safety and Approval Process" as summarized by the five hundred pages comprehensive report by the Indian Center for Environment Education on behalf of the Ministry (Centre for Environment Education, 2010). Within these broader categories of issues, some of the main safety concerns that were raised were the risk of cross pollination of BtBr with other non-GM varieties, development of more immune and adamant pests in future, potential human infections after consuming BtBr etc. Economic concerns such as the cost of Bt-seeds and potential corporate control over agricultural sector were also raised. Moreover, concerns specific to the Indian context were also raised which included national, cultural and ethical consideration. For example, problems such as the insufficiency of the current Indian regulatory system with respect to evaluation and management of GM crops were discussed. Topics such as India as the center of origin of Brinjal were also disputed.

After listening to the participants and reviewing all the feedback and responses received, the minister Mr. Jairam Ramesh announced his decision to declare a moratorium on BtBr on 9 February 2010.

3.2.6. The post moratorium spill overs.

After the moratorium, the Minister asked the six national science academies of India to submit a report on BtBr. The report which came out in September 2010 recommended the limited release of BtBr and found it "safe for human consumption and that its environmental effects are negligible". However, this report was also attacked by the NGOs[12]. As a result, the Minister had to dismiss the report citing lack of scientific rigour. Also, some international scientists, such as Prof. David Andow, an expert on the environmental risks of GM crop plants and faculty member of the University of Minnesota, and Dr. Lou Gallagher,

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[12] The Coalition for a GM-Free India pointed out that a significant part of the section on Bt brinjal in the report had been reproduced from an article in a biotechnology newsletter written by Dr. Ananda Kumar, a Bt Brinjal developer and a member of GEAC (whose conflict of interest in being part of EC-II had been raised earlier).

an environmental epidemiologist and risk assessment expert submitted their reports in September 2010 and January 2011, respectively, calling BtBr as unsafe and developed by older technology. Meanwhile, the GEAC held a meeting along with some experts in April 2011 to deliberate on the key concerns raised during the public consultations on BtBr. This meeting recognised the need for additional studies on GM food crops, protocols and procedures. Thus overall, the Bt-Brinjal controversy impacted the regulation and policy of GMOs in India as well as the progress of many other genetically modified crops such as mustard, rice, corn, tomato, potato, and okra that were in the pipeline for future release in India. In the following table, I summarise the key events of the Bt-Brinjal controversy for quick referencing (Table 1).

Table 1. Summary of the Bt-Brinjal case in chronological order of the occurrence of events[13]

2000	Transformation and breeding for Bt gene into Brinjal hybrids by Mahyco
2001-2002	Preliminary greenhouse evaluation to study growth, development & efficacy of modified Bt-Brinjal eggplants
2002-2004	Confined field trials to study pollen flow, germination, aggressiveness, weediness & biochemical toxicity and allergenicity
2004-2005	RCGM approves multi-location research trials (MLRTs) of seven Bt-Brinjal hybrids of Mahyco
2006	**February**: Greenpeace, followed by Gene Campaign, seek Bt-Brinjal biosafety data through right to information act **May**: Mahyco submits biosafety data from MLRTs & seeks permission for large scale field trials (LSTs) **June** : Civil society gives feedback to GEAC pointing out the inadequacy of the data and other fundamental issues related to Bt-Brinjal; GEAC posts only summary of test results of Bt-Brinjal on MoEF website **August**: GEAC appoints an expert committee to look into Bt-Brinjal biosafety **September**: Supreme Court halts all new field trials in response to interim appeal in public interest litigation on GM crops **October** : Independent expert committee appointed by civil society releases report

[13] Bt: Bacillus thuringiensis (soil organism); Bt-Brinjal: Brinjal (eggplant) engineered with the insect resistant gene from Bacillus thuringiensis; Mahyco: Maharashtra Hybrid Seeds Co; MoEF: Ministry of Environment & Forests; RCGM: Review Committee for Genetic Manipulation; GEAC: Genetic Engineering Approval Committee; MLRTs: Multi Level Research Trials; LSTs: Large Scale Trials

2007	**February**: Supreme Court orders biosafety data of GM crops under trials to be put in the public domain **May**: Bt-Brinjal limited open trials resume on court orders **July**: EC-I submits report, recommends additional studies but gives go ahead for LSTs of Bt-Brinjal hybrids **August**: GEAC approves LSTs for seven Bt-Brinjal hybrids of Mahyco
2008	Two-year LSTs of Bt-Brinjal conducted: pollen flow, soil microflora, genetic cross-ability studies conducted **May**: More than a thousand citizens protest at New Delhi against second year LSTs of Bt-brinjal **August onwards**: Civil society launches "I AM NO LAB RAT" campaign against Bt-Brinjal; Poison on the Platter- documentary film launched in various cities of India; Brinjal festivals held; petitions and postcards sent to the Health Minister & Prime Minister. **August** : In compliance with Supreme Court orders of 2007, GEAC uploads complete (raw) biosafety data of Bt-Brinjal on the MoEF website **December**: The then Minister of Health& Family Welfare Dr. Anbumani Ramadoss opposes Bt-Brinjal
2009	**January-February**: Independent international experts critique Mahyco's biosafety dossier on Bt-Brinjal (Prof. Séralini, Dr. Carmen, Dr. Doug Gurian-Sherman, Prof. Jack Heinemann and others) **January**: Data from Bt-Brinjal LSTs submitted to GEAC **May**: Expert Committee (Government of India) constituted to evaluate Bt-Brinjal biosafety data, reports from independent scientists and other feedback **8 October**: EC-II submits report recommending release of Bt-Brinjal **14 October**: GEAC recommends Bt-Brinjal for commercial release **15 October**: Minister of Environment & Forests makes EC-II report public, decides to hold public consultations and seeks feedback on EC-II report
2009-2010	**December- February**: Independent scientists appraise Bt-Brinjal dossier & EC-II report and submit reports to the Minister of Environment & Forests **November- February**: Eleven Indian states say No to Bt-Brinjal
2010	**12 January - 6 February**: Public consultations in five major Indian cities (Kolkata, Bhubaneswar, Ahmedabad, Nagpur, Chandigarh, Hyderabad and Bangalore); see massive opposition to Bt-Brinjal from all sections of the society. **9 February**: Minister of Environment & Forests, Mr. Jairam Ramesh, declares moratorium on Bt-Brinjal **September**: The discredited inter-academy report favouring release of Bt-Brinjal is rejected by the Minister of Environment & Forests **September**: Prof. David Andow submits his environmental risk assessment on Bt-Brinjal
2011	**January**: Dr. Lou Gallagher submits report on Bt-Brinjal **April** : GEAC holds its first meeting on Bt-Brinjal with selected experts **June:** National Biosafety Authority (NBA) decides to take legal action against Mahyco, Monsanto & collaborators for violation of Biological Diversity Act 2002 **August:** Mahyco, Monsanto & collaborators indicted by NBA for genetically engineering native Brinjal varieties without approval (bio-piracy)

Adapted from (PANAP, 2012)[14]

[14] PANAP: Pesticide Action Network Asia and the Pacific; a conglomerate of civil society groups across many countries

3.3 Summary

In this chapter I highlighted some of the important events in the BtBr case for building the reader's understanding of the long-running story and to illustrate its importance in the national context. Brinjal is an important vegetable crop in India, both in economic, social and cultural contexts. The genetic modification of Brinjal was carried out to develop a pest resistant GM hybrid known as Bt-Brinjal (BtBr), by the Indian corporation Mahyco in collaboration with the US agriculture giant Monsanto. The initial development of BtBr included confined greenhouse trials in 2000-2002 to assess its safety and effectiveness against the target pest. Later on, it extended to the limited as well as the large scale open field trials which became the initial focus of controversy in 2006 and thereafter. As a result of public litigation against field trials, independent evaluations of BtBr safety data that was previously approved by scientists in the regulatory committees were suggested by the Indian legal authorities that led to the direct involvement of many prominent Indian scientists in decision making. The scientific assessments of the same field trials safety data was thus carried out by two groups of scientists, one representing the public and the other representing the ministry. Due to two different and opposing evaluations of the same data, a scientific divide was established during 2007-2009 which is when the matter intensified and was largely taken up in the media, leading to a major controversy. During this peak time, many Indian scientists whether directly involved or not, communicated the matter publicly via personal appearances in consultations events, seminars and television interviews. This form of popularity of the Indian scientists gave the first clue of their communication role in the BtBr controversy. The majority of the media coverage of this issue was observed as either mentioning and/or quoting scientists. Some newspapers also reported that the Minister of

Agriculture Mr. Jairam Ramesh who declared the moratorium had also reached out for guidance to some of India's prominent scientists prior to raising the moratorium.

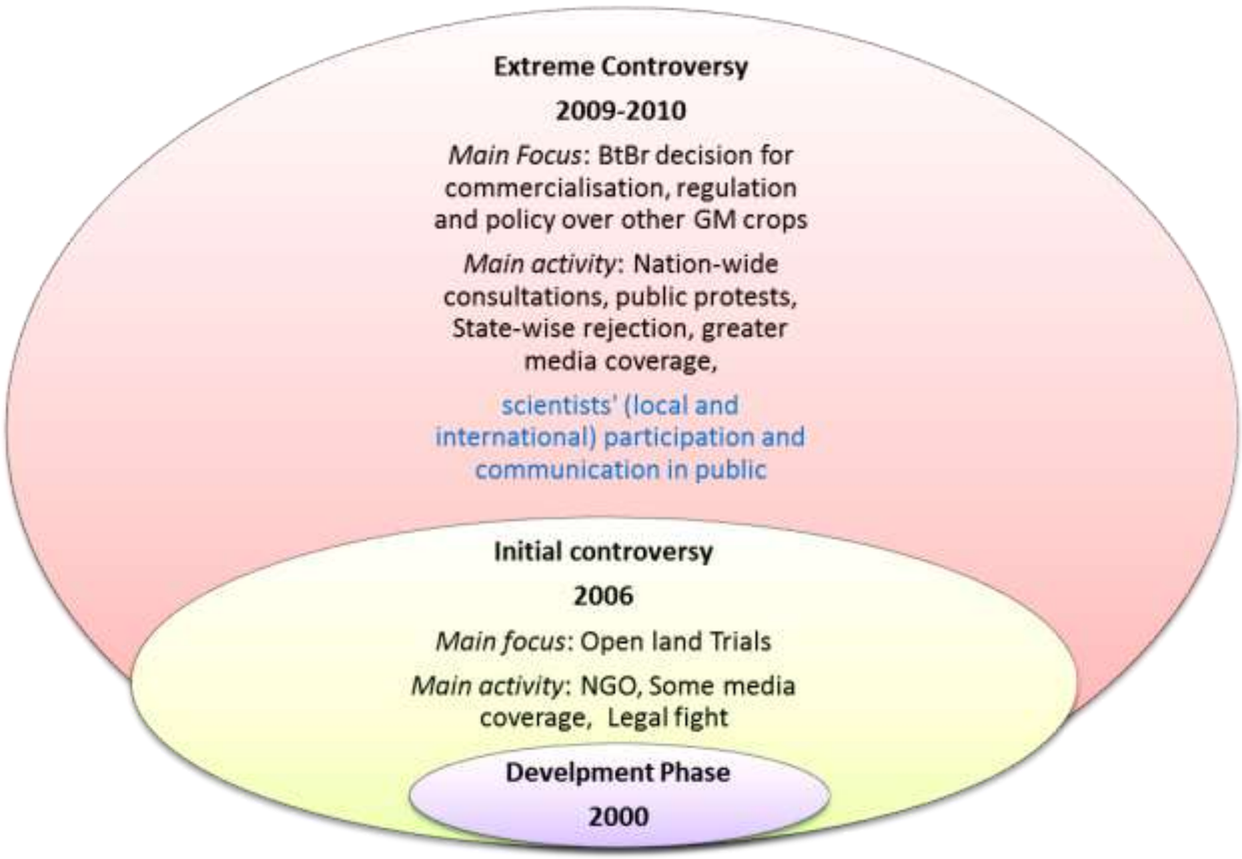

Figure 6. A diagram showing the rising controversy in the BtBr case

Therefore, the earlier hints of the Indian scientists' involvement in the communication of this controversy provide a strong indication of the non-typical ways of science communication as well as policy. These non-routine ways of communication has been one major site for problem-oriented science communication (Bucchi, 1996) in a post-normal science context(Funtowicz & Ravetz, 1993). Therefore, this critical inquiry can be best described within the theoretical frameworks of problematization and post-normal science, respectively. The next chapter describes the two main theoretical frameworks chosen for this inquiry that is the Foucauldian concept of problematization and post-normal science (PNS).

CHAPTER 4 THEORY

4.1 Overview

The Bt-Brinjal (BtBr) controversy is one of the great examples of deviations in which new, non-routine forms of the public communication of science emerged. It delineates many problematic conditions in which a common vegetable was scrutinized in public and was associated with various scientific as well as social problems. In this scenario, the role of Indian scientists in representing BtBr in a series of problems via public communication of the issue also emerged as significant. Therefore, to analyze the ways in which BtBr was problematized by the Indian scientists via public communication, I have chosen the theoretical framework ‘Problematization’ developed by Foucault. Also, such practices of public communication during controversies as manifested by the Indian scientists in this case are generally a non-routine part of the larger scientific practice and can also have practical implications on policies. Therefore, to analyze the emerging trends of communication during scientific controversies in modern times, I have chosen the theoretical framework of post-normal science or PNS to provide additional context for understanding problematizing practices.

In this chapter I will discuss each theoretical framework separately. First I will introduce the theoretical underpinnings of problematization, followed by its use as an analytical tool with a few examples of recent studies which have used problematization for similar analytical instances. And then to conclude this part, I will discuss the specific use of problematization in my study. Second, I will begin with the conceptual ideas of post-normal science or PNS, followed by a discussion on how scientific issues can be framed using PNS. Then I will discuss the specific use of PNS in my study by also including a few examples of recent studies which have used PNS for similar analyses. I will conclude the chapter by giving a brief summary of the preceding discussion on problematization and post-normal science.

4.2 Theoretical Frameworks

4.2.1. Theoretical framework I: Problematization.

It has been suggested that the concept of problematization began during the mid-1970s mainly as a preliminary thought of Michel Foucault and first appeared as 'problématisation' in his work *Discipline and Punish* (Foucault et al., 2003, p. 12). The concept then started appearing more frequently in his later works in which he commonly used *problematization* as 'elements of a problem' to develop an inquiry on the elements which are relevant for a given 'problematization'. These are the elements which, taken together, help to characterize, analyse, and treat a given problem. For example, one of these elements can be the government itself which "helps to create a discursive field in which exercising power is "rational" " (Lemke, 2011, p. 55). In one of his inquiries, Foucault himself raised the question about "how and why were very different things in the world gathered together, characterized, analysed, and treated as, for example, 'mental illness'?"(Lemke, 2011, p. 55). In other words, problematization is a form of inquiry to understand why certain phenomena are "questioned, analyzed, classified, and regulated" at specific times and under particular circumstances (Deacon, 2000, p. 127).

This means that in order to study how and why certain phenomena are problematized, it is important to study the particular *ways* as well as the particular *circumstances or conditions* in which those phenomena are problematized. Analysing the particular *ways* of problematization may imply investigating the various methods or modes by which an 'object' is scrutinized on certain grounds which may be scientific, moral or ethical and are those which have socially affixed the meaning of that object. For example, one of the inquiries for Foucault was the practices of the nineteenth century through which sex was seen as holding the “key to self-understanding”. He was critical about the vast proliferation of scientific definitions about "sex”, the growth of medical terminologies about sexuality and how sexuality was linked to the health of the individual, to race and so forth (Foucault & Rabinow, 1984, p. 11). Because of such prior selected social meanings of an object, it then becomes common for the object to enter into public discourse of what is true or false and right or wrong when it is problematized.

> Problematization does not mean the representation of a pre-existent object nor the creation through discourse of an object that did not exist. It is the ensemble of discursive and nondiscursive practices that make something enter into the play of true and false and constitute it as an object of thought (whether in the form of moral reflection, scientific knowledge, political analysis, etc). (Foucault et al., 2003, p. 29)

Similarly, problematization includes the study of the circumstances or conditions in which such practices of problematizing the object emerge. As a result, it links the object to the political structures, laws, regulations and practices ―those which surround that object and those which give meanings― the ‘commonly known’ or taken for granted status to that object in society. Then the process of problematizing reaches out to investigate various modern bodies of knowledge about an object and also produce new knowledge during this investigation about that object.

> It [problematization] refers to the practical conditions that make something into an object of knowledge, specifically to the networks of power, institutional mechanisms, and existing forms of knowledge that direct the attention of theorists to specific phenomena and thereby produce new knowledge. (Deacon, 2000, p. 131)

In short, problematization is "the putting into question of accepted 'truths'" (Bacchi, 2012, p. 1) and the study of both the ways and the conditions which allow such action of scrutiny. Therefore, the theoretical concept of *problematization* can also be used as an analytical tool to study the ways of and the conditions for the action of problematization.

4.2.2. Problematization as an analytical tool.

In saying that the study of problematization is the study of both the ways and the conditions which 'allow' such actions of scrutiny, a distinction is observed between the object which is under scrutiny and the subject which scrutinizes or by whom the actions of scrutiny are 'allowed'. This allows some agency to the agents who problematize the object through the particular practices of which the agents themselves remain outside. Although the "Foucault-influenced" use of problematization regards it as the products of governmental *practices* that investigate the bases for the socially constructed problems rather than on social actors as problematizing agents, some scholars argue for a clear distinction within its use as an analytical tool which emphasizes the role of people such as policy makers/workers, social scientists or scientists etc. as problematizing agents. This distinction between the use of the term has given way to the two slightly different scholarly perspectives -- the "Foucault-influenced" perspective that studies problematization through the deep, age-old social practices \ which actors are also part of; and the “interpretivist” perspective that regards problematization as the construction of actors by specific actions (Bacchi, 2015b).

Within the “Foucault-influenced” perspective, problematization refers to the ways of thinking that emerge from practices rather than from people as agents, and hence does not account for the ‘agency’ of subjects, whereas within the “interpretivist” perspective, problematization refers to the ways by which a problem is constructed and focuses on “people engaged in problematizing” (Bacchi, 2015b, p. 3). Within this perspective, subjects are seen as “agentic”, as sovereign or foundational, who stand outside of reality and shape it (Bacchi, 2015a, p. 3). Although the interpretivist approach of problematization allows for the ‘social representation’ of the problem as the problem is constructed by actors, its main premises still remain largely Foucauldian and can be seen as an extended thought of the original Foucauldian use of problematization.

> The term “problematization” tends to be used either as a verb (i.e. to problematize) to describe what people (policy makers/workers, researchers) do, or what governments (broadly conceived) do, or as a noun (i.e. problematizations), generally to refer to the outcomes of problematizing. The verb form can be used in two ways: first, to describe a form of critical analysis; second, to refer to putting something forward, or designating something, as a “problem”—that is, to give a shape to something as a “problem”. (Bacchi, 2015b, p. 2)

4.2.3. Some examples of the use of problematization for analysis.

Problematization has been widely used as the analytical tool in various academic fields such as Politics (Vaughan-Williams, 2006), Law (Dent, 2009; Hunt, 2002), Nursing (Frederiksen, Lomborga, & Beedholma, 2015), Health Policy (Bacchi, 2016; Whelan & Asbridge, 2013) and Aesthetics (Venn, 2010) etc. In some studies, problematization has been used to analyze the ways in which the object is problematized through social practices whereas in others, it has been utilized to investigate the object's association with various social or political problems by the actions of specific agents. For example, in one study, the Copyright Act was seen as a "unifying set of practices" that *defines* the civil actions of breach or infringement of the copyright material and imagines potential infringers on the basis of such definitions. This way it also defines what subject-matter comes under the copyright regime. In this study, the concept problematization was used to analyze how the Copyright Act (as the object) was associated with problems ranging from music downloaded by children to large scale music piracy as an international issue. In this way, the act of problematizing is considered act through practices (Dent, 2009). In another study, the social representation of the OxyContin drug in medical journal articles was analysed (Whelan & Asbridge, 2013). OxyContin is a narcotic pain medication used to treat moderate to severe pain. This study focused on the drug's association with the problems of drug abuse and addiction pain medicine as well as the agents responsible for problematizing it (Whelan & Asbridge, 2013). Problematization has also been linked to the policy-relevant issues in a WPR approach – or "What's the Problem Represented to be?" − which assumes that "problems" are produced as problems of particular kinds *within* policies and thus are not outside of the policy processes and regulations (Bacchi, 2016).

4.2.4. Problematization as the conceptual framework for the present research inquiry.

One of the main focuses of my research is to analyze how scientists as key social actors confronted the Bt-Brinjal issue and represented the problem at the public level. For this purpose, I draw upon the theoretical concept of problematization which in my opinion provides an appropriate fit to answer a critical inquiry such as this. For example, in using problematization, I aim to investigate the different ways in which the Bt-Brinjal issue was *problematized*, or shaped as a "problem" by Indian scientists who are among the key social actors in the controversy. This approach takes into consideration the agency of social actors in constructing a problem, similar to the interpretivist approach of problematization as discussed above.

4.2.5. Theoretical framework II: Post normal science or PNS.

Post normal science or PNS is a fairly recent conceptualization of science or scientific practice as "coping with many uncertainties in policy issues of risks and the environment" (Funtowicz & Ravetz, 1993, p. 146). By referring to 'modern times', the PNS context is a fast paced contemporary society in which natural systems (or simply the material world) are recognized as more dynamic and complex, and constantly interacting with humanity than the rigid realities of the world. In other words, in this context, most scientific endeavors are approached with a humanitarian element which is always concerned with the social implications of those scientific endeavors. As these social conditions persist almost everywhere, the science appropriate to these new conditions will be based on the assumptions of "uncertainty [ies], value loading, and a plurality of legitimate perspectives" (Funtowicz & Ravetz, 2003, p. 1). By this, the authors maintain that scientific facts are no longer treated as objective and certain, and are often loaded with uncertainties in knowledge which can only be managed to some extent but are not diminished completely. Second, today's scientific issues are context-specific and are appraised under different value systems including cultural and moral values. Science and technology are no longer applied only for the production and consumption of commodities to meet current demands, but rather also involve ethical considerations such as the welfare of future generations, other species and the planetary environment as a whole (Funtowicz & Ravetz, 1993, p. 751). Third, today's scientific issues involve an ever-growing set of legitimate participants who assume responsibility for the quality of scientific inputs and outcomes (Funtowicz & Ravetz, 1993, p. 752). In other words, today's scientific endeavors involve broader societal and cultural implications such that many institutions, groups, movements claim some stake in those endeavors.

4.2.6. Framing scientific issues with PNS

Scientific issues which are not solved on time often bring controversies. PNS assumes that the ways of tackling scientific issues in post-normal times are through the *management* of those issues by taking into consideration the societal conditions in which those issues occur rather than through routine, puzzle-solving tasks in constant environments as predominant in the technocratic view of scientific practice (Funtowicz & Ravetz, 1995). PNS generally accepts that the conditions in which science is practiced in modern times are such that the " [scientific] facts are uncertain, [social] values are in dispute, [investment] stakes are high, and [policy] decisions are urgent" (Funtowicz & Ravetz, 2003, p. 1). Therefore, scientific problems of modern times should be seen as the problems of post-normal times and should be tackled accordingly. Theoretically PNS proposes that in many scientific problems of recent times, at least two sorts of 'normality' may not always hold true. One is the normality in scientific practice as routine puzzle-solving in scientific research. Another is normality in its practical implications in policy-making which relies on the unquestionable knowledge coming from normal science (Funtowicz & Ravetz, 2003).

In modern times, system uncertainty is sometimes likely which may be both of a physical as well as societal nature. For example, uncertainties can persist due to conflicts among various stakeholders regarding the veracity of scientific outcomes. Similarly, uncertainties can also exist due to lack of confidence among stakeholders in predicting the success of a technological innovation in a specific social setting (technological products pushed by international corporates have seen backlash from the local people in the past). Therefore it is imprudent to wait for facts to resolve issues. Instead, scientific issues should be resolved by acknowledging uncertainty and trying to manage it rather than finding objective answers to the problem. This may allow the successful implementation of the science within the conflicting purposes and interests of different stakeholders (Funtowicz & Ravetz, 1993).

Tasks of *managing* uncertainties can be performed by recognizing the "plurality of perspectives" coming from different participants in the discussion by allowing "a more rigorous and wide-ranging exploration of people's values" in discussions and debates such that a range of viewpoints and perspectives can be considered, and individual values are expressed and heard (Ravetz, 1999, p. 653). One way to achieve this in practice is providing opportunities for participation by the "extended-peer community" in policy discussions which may include a broad range of participants, including societal and cultural institutions and social movements as an extension to the scientific expert community to provide 'extended facts and relevance' to scientific developments. "The extension of the peer community is then not merely an ethical or political act; it can positively enrich the processes of scientific investigation" (Funtowicz & Ravetz, 1993, p. 753). The blogosphere (internet and new media) can also be the platform for the extended peer community as it can provide a vital link between science, the media and the public and open up new forms of participation when trusted platforms are used. For scientists, using and managing the blogosphere may also require skills for post normal times which can be different from those used in traditional scientific outlets (Ravetz, 2011, p. 156).

4.2.7. Post-normal Science (PNS) as the contextual framework for the present research inquiry.

PNS is a useful framework for the analysis of scientific problems and controversies in a policy context (Turnpenny, 2012). For example, in one study, the new policies of transitions from fossil fuels to renewable sources of energy in the future have been investigated using PNS. In this study, the issue of sustainability arising from our dependence on non-renewable fossil fuels for energy is compared with the current energy challenges by which we run into the problems of "the pressure on the atmosphere, international balances of payments, and political tensions around the world" (Tainter, Allen, & Hoekstra, 2006). In another study, the role of publics as the extended peer community in the controversial management of hazardous chemicals in the European marine environment was investigated. (Udovyk & Gilek, 2014). Similarly, the controversy over the commercial release of GM crops in UK has been analysed using PNS to address the challenges of scientific uncertainty which seems pertinent in GM controversies as new areas of conflicts keep emerging in such controversies (Myhr, 2010).

With regard to my study, post-normal science is a useful approach to additionally frame the controversy of Bt-Brinjal as it describes the conditions of scientific disputes in modern times. These conditions according to PNS often emerge in non-routine circumstances that are characterised by the uncertainty of facts, value-disputes, high stakes and urgent policy decisions-all of which are pertinent in the Bt-Brinjal controversy.

4.3 Summary

In sum, the scientific issues of modern times which include non-routine characteristics such as the uncertainty of scientific knowledge or facts, context-specific values, high stakes due to the involvement of multiple stakeholders, and urgent decisions due to high public salience or even controversy should be seen as the issues of post-normal times which can only be resolved by addressing the conditions of uncertainty through the “voices of various legitimate interpretations of the extended peer community” (Ravetz, 2006, p. 278).

CHAPTER 5 METHODS

5.1 Overview

My current inquiry is relevant to the study of deviations which I describe as the non-routine forms of the public communication of science, observed in cases of scientific controversies. The particular focus is on the communication role of scientists in deviations. As the study of deviations and the communication role of particular actors within are best studied via the specific cases of real social events, therefore, for my inquiry I choose the controversy over the first genetically modified food crop in India−the Bt-Brinjal (eggplant) case. For analysis, I draw upon the publicly communicated texts (in the form of journal commentaries, newspaper columns and internet blogs) written by some Indian scientists in which they addressed the problem of BtBr in India and raised concerns around it. The particular methodology that I chose to analyze these texts is critical discourse analysis (CDA) approach by Norman Fairclough. In this chapter, I describe the details of my methodological framework of CDA followed by the details of specific methods used to analyse the texts.

5.2 Methodological Framework−Critical discourse analysis (CDA)

Within the illustration of the communication of Indian scientists in the BtBr controversy, I examine more closely the ways of articulations by which Indian scientists problematized BtBr in public, because such problematization or "problem-oriented" communication is one of the common yet hidden elements of deviations (Bucchi, 1996, p. 381). In the problematization inquiry, Foucault himself considered the ways of problematisation from "the point of view of practices and discourses rather than from ideas and ideologies" (Bogner & Torgersen, 2015, p. 519). Moreover, in the continuum of the public communication of science (as illustrated by the continuity model), the two extreme stages of the continuum−the specialist or scientific expert stage of scientists and the popular stage of the public−are called the two "discursive stages" at which the scientific discourse and the public discourse of science originate (Bucchi, 2004).Therefore, my analysis leads to investigating the shaping of scientific discourse at the popular level, for which I choose the critical discourse analysis or CDA approach by Norman Fairclough (Fairclough, 1995) as it aims at the linguistic discursive dimensions of the social and cultural phenomena and processes of change (Jørgensen & Phillips, 2002, p. 61).

Background:

CDA is an analytical tool by which relationships between discursive practices, events and texts are systematically explored in relation to their wider social and cultural structures, relations and processes (Fairclough, 1995, p. 132). These discursive practices, events or texts are the elements which together make up for a discursive or a communication event (Fairclough, 1995, p. 134). In other words, a discursive event is "an instance of language use", that is, analysed as − (a) Texts as the spoken or written expression, (b) Discourse practices as the production and interpretation of text and (c) Social practices as the political aspect of the event within relations of power and domination (Fairclough, 1995, p. 135). I mainly focus on the analysis of texts for my study.

Understanding of the text:

Fairclough emphasizes that text is a combination of both the content and the subject's 'texture' (Fairclough, 1995, p. 188). By texture, he means the textual organisation of the text which tells how texts draw upon configurations of "conventionalized practices of the particular social circumstances" (Fairclough, 1995, p. 188). For example, a medical text -- such as a medical prescription -- is likely to have been organised in a particular textual configuration common to the practices of medicine and medical institutes. Such particular textual configurations by which texts are organised are the *orders of discourse* and are divided into three main elements− (a) genres as the *ways of acting*, (b) styles as the *ways of identifying or being* and (c) discourses as the *ways of representing*. In other words, texts are organised into particular configurations of various genres, styles and discourses of a given time or situation by ways of acting, self-being and representing respectively as part of the social activity. In this sense, social agents as text producers or even interpreters are the key as they are the ones who "act, identify and represent" as part of the social activity− in ways which are part of the more established ways (of acting, identifying and representing) of the social practices (Fairclough, 2013, p. 75). This way, any social event is shaped by the local actions of social agents and more broadly by social practices.

Analysis of the text:

From the perspective of CDA, the analysis of the text is generally the first step, which is then used to make connections with the discursive practices and social phenomena at large (Fairclough, 2013). Text is understood as the "interdiscursive" mix of genres, styles and discourses and ways in which they are articulated together. Therefore a detailed level of text analysis includes a simultaneous analysis of genres, discourse and styles and their linguistic forms of articulation. In other words, text analysis is the combination of both (a) linguistic analysis and (b) interdiscursive analysis (Fairclough, 2013, p. 75).

The linguistic analysis begins by treating texts as documents and includes the analysis of documents for their linguistic and lexico-grammatical characteristics such as the wording, grammar style, use of metaphors etc. (Jørgensen & Phillips, 2002, p. 83). On the other hand, the interdiscursive analysis treats texts beyond its linguistic characters−as "semiotic elements of social events" and focuses on the analyses of genres, styles and discourses used in the articulation of text. For example, the analysis of genres includes the analysis of the diverse *ways of acting and interacting* of social agents such as the everyday conversations, meetings, interviews or any other forms of communication in which texts are produced and circulated. Similarly, the analysis of styles includes the ways of identification−the *ways of self-being* by which social agents identify themselves and which they use in their texts. Examples include the particular styles of speaking or writing of business managers, political leaders or scientists. The analysis of discourse includes the analysis of the *ways of representations* of how things are and have been, in reality and/or might or could or should be in imagination. Discourse as the ways of representation of social life−as form of self-representation and/or representation of other (objects) are ways in which social agents see and represent social life in different ways through social structures and practices (Fairclough, 2001, p. 2). For example, social agents located within the social practices of politics, education and medicine etc. may see and thus represent the life of the poor as lacking basic resources, basic education and basic health coverage, respectively− as different forms of discourse on the poor.

Both linguistic and interdiscursive analyses of texts are complementary rather than two separate forms of analysis. Indeed scanning of texts from a linguistic point of view will eventually aid the analysis of diverse forms of acting/interacting, identity/being and representing −which make up the investigation of genres, styles and discourses respectively in an interdiscursive analysis. For example, *specific actions* of social agents in texts such as legitimization, knowledge exchange, activity exchange etc. can be analysed by the author’s tendency to express “authorisation, rationalization or moral evaluation” in statements, which might be expressed in declarative or interrogative grammatical mood (Jørgensen & Phillips, 2002).

Example of a declarative statement:

> *I let my children play outside* (speaker expressing some sort of authority on children by allowing them to play outside, in a declarative mood)

Example of an interrogative statement:

> *How could someone ignore their children like this?* (Speaker expressing moral evaluation of parents' duty towards their children in an interrogative mood)

In such statements, the object or entity of specific actions can also be scanned easily, as for example in the above two statements, children are the entity of the specific actions of playing or being ignored by parents.

Similarly, actions such as blaming, advising, warning etc. might be expressed in *particular styles of being* which can be investigated by checking on the author's use of modalities. Modalities define the author's affinity to his statements, expressed in a specific style of expression, such as statements or questions reflecting exchange of knowledge (known as epistemic modality), statements suggesting exchange of actions such as demands, offers, blames, warnings etc. (known as deontic modality) or statements suggesting authority (categorical and objective modality). For example, use of epistemic modality by the speaker indicates the possibility or necessity of some knowledge without necessarily requiring him to provide any inference, reasoning, or evidence of that knowledge. Use of deontic modality shows freedom to act as ability, permission, and duty. Objective modality "works to reinforce the power of the statements, presenting them as facts independent of the speaker rather than as merely subjective opinions" (Jørgensen & Phillips, 2002, p. 168).

Example of epistemic modality (knowledge exchange between participants):

*Diabetic patients should avoid taking more than 100 g of sugar a day (*shows speaker's possibility of knowledge on diabetes)

Diabetic patients must take 10 ml of insulin a day (shows speaker's high possibility of knowledge on diabetes)

Example of deontic modality (action exchange between participants):

*You should go to the gym today (*shows specific action of suggestion by speaker and the ability for the 'you' to go to the gym)

You can/must go to the gym today (shows specific action of command by speaker and the obligation for the 'you' to go to gym)

Example of objective modality (authority of speaker):

*Eating an apple is healthy (*affirms author's strong affinity with his statement which is presented as fact)

I 'think' eating apples 'can be' healthy (shows author's weak affinity with his statement present only as a possibility).

These modalities reflect on particular styles of writing in texts and are useful in finding the level of commitment in the expression of truth, necessity or value assumptions of the author. The use of specific vocabulary, metaphors, idioms etc. are also useful in finding particular ways of the author's identity or self-being in texts.

And third, the representation of an object in texts can be understood by the arrangement of topics within the text, the discursive frameworks used and the specific grammatical use such as 'nominalization' and 'transivity' in statements. Nominalization is the way of articulating a noun from a verb or adjective such that it results in the passive verb in statements, reducing agency and emphasising mainly on the effect of the phenomenon. For example, use of 'legalization of…something' as opposed to 'we legalize….something' is nominalization. It is often used in representing or promoting an identity (Jørgensen & Phillips, 2002, p. 85). It also results in the generalization of a problem or simply in the abstracting or the reducing of a real social situation into objects or the impact, without bothering with who is responsible for that problem. For example, representation of economic market forces as objective things rather than the contingent results of human actions is an example of the nominalization of economic processes (Billig, 2008, p. 786). In other words, it is a shift from the concrete and particular representation of actions and processes (involving specific persons in specific times and places) to an abstract representation (excluding such specific details as *who, when and where* of actions) (Fairclough, 2013, p. 360). On the other hand, transivity can be used to represent a problem into its detailed social phenomenon‒as Actor (cause of problem) + Process (with which problem occurs) + Affected (who is affected by the problem).

Therefore, both the linguistic analysis and the interdiscursive analysis go hand in hand in a detailed level of analysis of texts in CDA. They primarily focus on the linguistic features and the organisational or discursive elements (genres, styles and discourses) of a text (and a social event) respectively in given social circumstances or contexts. But at the same time, they are also used to analyze changes (such as deviations) in a social event which may happen when social agents incorporate discursive elements of other practices into their own practices. In such an analysis of changes in particular social practice, CDA can be used to make a comparative analysis of the dissemination of discourses and their "re-contextualization" in new social fields (Fairclough, 2001).

> Social actors within any practice produce representations of other practices, as well as (reflexive) representations of their own practice, in the course of their activity within the practice. They re-contextualize other practices–that is, they incorporate them into their own practice, and different social actors will represent them differently according to how they are positioned within the practice. (Fairclough, 2001, p. 2)

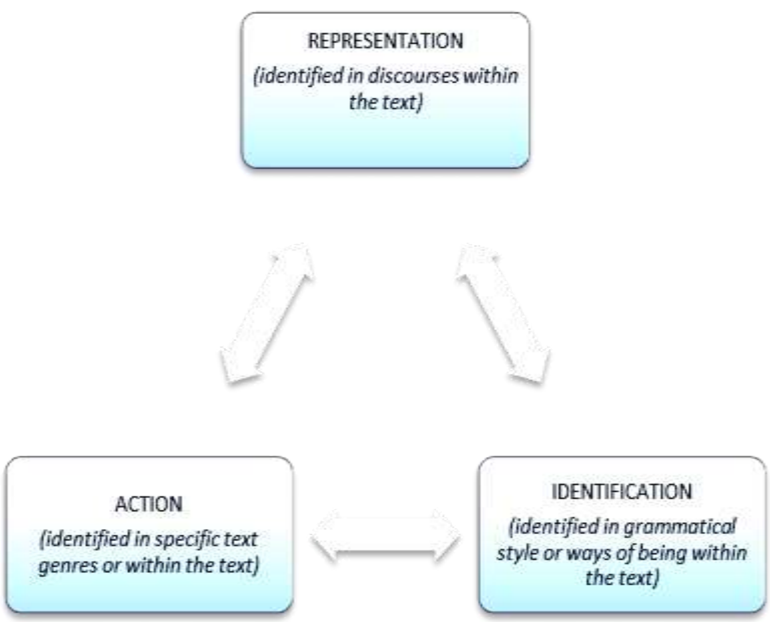

Figure 7. Schema of CDA showing the multi-directional way of doing text-analysis and expressing results in the three major elements-the action or modes of text articulation and circulation (genres), the style of expression (styles) and representations (discourses)

(Fairclough, 2003, p. 26)

5.3 Methods

5.3.1 Case review.

I started by reviewing the case for the preliminary evidence of the role of Indian scientists in the Bt-Brinjal controversy. For this, I started off by investigating the stories published in major Indian and some international newspapers as well as some government reports as were available online, using Google Scholar and the university library search engine i.e. 'library.ucalgary.ca', with the basic search inquiry of 'Bt-Brinjal'. I also shortlisted some of the articles on BtBr which had more emphasis on the key events and insights on the story, This was used primarily for collecting the evidence and mapping the key events of the larger case of the Bt-Brinjal story as it played out over the course of the last seven years. Eventually, this helped me to construct an overall picture of the controversy, including understanding of the major events that characterized Bt-Brinjal development, the associated scientific evaluations, regulatory frameworks, the role of the Indian ministry, and the public protests during the controversy.

Within these broader events, I specifically located the role of Indian scientists in utilizing popular media to communicate in the controversy. This particularly became the unit of investigation of my research since these were the non-routine circumstances of public communications by scientists in the public arena (Bucchi, 1998; Bucchi & Trench, 2008b).

> Despite the fact that elements of deviation are also to be observed on occasions apparently belonging to the routine, popularization modality, it seemed advisable to select cases in which the deviation modality was overwhelmingly predominant so that its nature could be more easily an

> object of sociological inquiry: ‘bold-relief deviations’ cases. (Bucchi, 1998, p. 33)

5.3.2 Selection of texts for analysis.

As preliminary findings of the case suggested that some Indian scientists had written journal commentaries about BtBr and some newspaper columns, so I searched online for more of those texts written by the Indian scientists in Google, Google Scholar and the University of Calgary library database using the search word ‘BT brinjal’. I scanned for texts whose authors were the Indian scientists, mainly employed or at least in some way affiliated with Indian institutes/organizations. I also used the bibliography list of the selected journal commentaries to search for more commentaries by the Indian scientists. Also, as the names of some prominent scientists appeared in the media coverage of the story and in some government reports, I refined my online search by using these scientists’ names in the inquiry as the [scientist’s name] + [Bt brinjal], which linked me to some more newspaper columns as well as some on-line blogs on BtBr written by the Indian scientists. From this process, I sorted about forty texts for analysis, which included texts from about twenty five Indian scientists in the form of journal commentaries, online newspaper/magazine columns, and internet forums/blogs.

5.3.3 Analysis of selected texts using CDA.

I found that most Indian scientists had written their opinions in journals compared to other media platforms. Therefore, I began by reducing journal commentary texts into defined categories on a code sheet. Each category was used to define the key features and arguments of the text. With coding, all journal commentaries could be arranged in standard format of the code sheet for quicker referencing of the material. The other more popular texts such as the newspaper columns and/or internet forums/blogs were not categorised in code sheets but analysed in a similar manner as journal commentary texts. An example of the code sheet created for a journal commentary of a scientist is provided separately (see Appendix I).

Then I analysed my sample texts in detail using CDA which included journal commentaries, newspaper/ magazine columns and internet blogs/forums. I specifically conducted my analysis of texts as the combination of linguistic analysis and interdiscursive analysis as suggested in CDA. For example, I first scanned each text from a linguistic viewpoint to highlight both the key content (such as specific arguments, representations, target object etc.) and the writing style (such as scientist's way of expressing agency, degree of affinity to his statements, grammatical mood in his statements, etc.). Then I arranged the data into the three elements of the interdiscursive analysis−genres, styles and discourse. For example:

(a) First, I scanned for specific grammatical moods (whether the scientist is declaring or interrogating) and the use of auxiliary verbs to check on modalities (whether the scientist was using auxiliary verbs of low affinity such as *should, could*, etc. or high affinity such as *must, need to* etc. in his statements). This was done in order to highlight the specific actions of scientists in these texts and compile them into *genres* as ways of acting.

(b) Second, I looked at the style of writing in these texts and analyzed whether they were typical or not of a scientist's routine way of writing). For example, I examined the texts to see whether the scientists had supported their arguments using numerical data or scientific facts in their statements. Then, I checked for any presence of nominalisation or rationalisation in such statements−by analysing if the numerical data/studies were presented as 'facts' without referencing; to show authority or legitimization. Then I also looked for statements showing transitivity–statements expressed in an *Actor (cause of problem) + Process (with which problem occurs) + Affected (who is affected by the problem)* format in which an entity is clearly associated with the problem. I compiled these statements into *styles* as ways of identifying or self-being as indicated in CDA

(c) I then investigated texts for the specific representations of the target object– Bt-Brinjal in this case. I also compared whether these representations are similar to the ways GMO are represented generally or are unique to the Indian context. I compiled them into *discourses* as ways of representation.

This way, using linguistic and interdiscursive analysis as a combination of text analysis of CDA, I analyzed both the content and the organisation of my sample texts from all the three major media platforms–journals, newspaper and online media separately as the first level of analysis. Then as the second level of analysis, I compared the writing styles and representations across these three media platforms to analyze how the content and language use/writing style of the scientists differed across different media platforms. As the third level of analysis, I compared the representation of the target entity (Bt-Brinjal) with some of the already established representations of GMOs to investigate how meanings have been articulated in relation to existing meanings or how they have been put into new contexts as part of re-contextualisation (Fairclough, 2013, p. 76). A quick snapshot of this analytical approach as applied to one of the journal commentary texts is given separately (see Appendix II).

5.4 Summary

To summarize, my study of the communication role of scientists in deviations relied on the investigation of the particular case of the first genetically modified food crop in India–

Bt-Brinjal (eggplant), focusing primarily on scientists' discourses within the larger case of Bt-Brinjal in India. In this I particularly investigated the publicly communicated texts (in the form of journal commentaries, newspaper columns and internet blogs) written by some Indian scientists in which they addressed the problem of BtBr in India; using the critical discourse analysis (CDA) approach. This required me to begin the analysis with the understanding that these publicly communicated texts are the semiotic elements of the particular social event (BtBr controversy in this case); which should be analysed both for their content as well as texture (or organization). Therefore, I drew upon text analysis as the combination of both the linguistic and the interdiscursive analysis as described in CDA; and worked on these texts to specifically analyze the diverse ways of (inter)acting (genres), self-being (styles) and representing (discourses) by which the Indian scientists articulated the problem of BtBr in India. About forty opinion texts including journal commentaries, newspaper columns and on-line blogs written by twenty five Indian scientists were analysed using CDA. About half of the opinion texts were exclusively journal commentaries and the other half were the newspaper columns and on-line blogs combined. Journal commentary texts were the predominant form of communication as they were more frequent than any other media texts alone and were also written by majority scientists. Therefore the journal commentary texts were organized in code-sheets to analyze the bigger picture and summarize the key arguments. Then, these commentary texts along with other opinion texts (newspaper columns and internet blogs) were analysed using CDA's approach of text analysis which combined both the linguistic and the interdiscursive analysis of the text. As a result, the data was compiled into genres, styles and discourses to investigate the diverse ways of articulation of Bt-Brinjal in popular texts by the Indian scientists. I describe the results of my study in the next chapter.

CHAPTER 6 RESULTS AND ANALYSIS

6.1 Overview

In this chapter I outline the results of the critical discourses analysis of my sample texts−the publicly available texts written by the Indian scientists, i.e. journal commentaries, newspaper columns and internet blogs, through which they openly addressed the problem of BtBr in India. I drew upon CDA's approach which considers texts as particular configurations of the ways of acting, self-being and representing as part of the social activities analysed (Fairclough, 2003, p. 26). Therefore, I choose to describe my results through genres, styles and discourses as the ways of (inter)acting, being and representing, respectively, of the Indian scientists in the articulation of meanings during the BtBr controversy. These results are the outcomes of my analysis arising from the combination of both the linguistic and the interdiscursive analysis of Indian scientist's opinion texts to describe ways in which they articulated the problem of BtBr. However I consider this formulation of my results into genres, styles and discourse (as ways of articulations) only as the first level of analysis. Then in the second level of analysis, I compare these ways of articulation across the three media platforms (journal commentaries, newspaper columns and internet blogs) to investigate how different media platforms might have influenced scientists' opinions, topics of concerns and their writing expressions. Finally, I investigate the elements of re-contextualization within these representations in the third level of analysis. I summarize the results of all the three levels of my analysis in the end.

6.2 Results of the First Level of Analysis−Genres, Styles and Discourses

The specific ways of acting (genres), being (style) and representing (discourse) used by the Indian scientists to articulate the problem of BtBr via popular texts indicated communication which was both routine or widely held in the society via concrete, unchallenged social practices as well as non-routine, indicating social change (Fairclough, 2013, p. 356) or deviations in communication. For example in many instances, scientists used typical forms of expressions such as use of scientific data to back up their arguments, statements indicating support for science based evaluation of BtBr and even style of writing indicating scientific authority. However, specific to my inquiry, I was more interested in the non-routine forms of communication exhibited by these scientists throughout their texts. I describe these non-routine forms below.

6.2.1 Scientists expressed various non-routine actions through texts.

Actions or ways of acting as genres are part of expression through texts. In the BtBr controversy, one of the earlier observations was that many Indian scientists used popular texts such as journal commentaries, newspaper columns and internet blogs to express their views. This is atypical of scientists as they largely prefer platforms such as scientific journal articles for routine communication of science. While a number of Indian scientists still used journal commentaries to express their views, only extending their views through other more popular platforms such as newspapers and the internet, there were a few scientists who exclusively wrote internet blogs. Therefore, the use of diverse media genres by the Indian scientists indicated non-routine way of interacting with publics in this controversy. The complete list of Indian scientists and their preferred media platforms for public communication of BtBr is given as below (Table 2). Also included is a snapshot of a scientist's internet blog (Figure 8).

Table 2. List of Indian scientists and various forms of communication media chosen by them to communicate in the BtBr controversy.

Scientist	Journal Commentary	Newspaper column	Online forums/blogs
1. Bandhopadhyay, R.	✓		
2. Banerji, D.	✓	✓	
3. Bhargava, P.M.	✓	✓	✓
4. Bokolial, D.	✓		
5. Byravan, S.	✓	✓	✓
6. Chokshi, A.H.	✓		
7. Giri J.	✓		
8. Gupta, P.K.	✓		
9. Hanur, V.S.	✓	✓	
10. Jagadish, M.N.	✓		
11. Khetarpal, R.		✓	
12. Kocchar, V.K.	✓		
13. Kranthi, K.R.	✓		
14. Krishnaswamy, V.R.			✓
15. Kumar, P.A.	✓		
16. Nair, K.P.		✓	✓
17. Padmanaban, G.*	✓	✓	
18. Rao, C.K.			✓
19. Rath, S.	✓		
20. Seetharam, S.	✓		
21. Shanmugam, G.	✓		✓
22. Shantharam, S.*	✓	✓	✓
23. Sivaramanan, G.			✓
24. Swaminathan, M.S.*	✓	✓	✓
25. Vennila, S.	✓		

*expressed in more than one journal commentary

Figure 8. Snapshot of an internet blog on Bt-Brinjal by one of the Indian scientists

6.2.2 Scientists manifested non-routine ways of being by assuming overall positions for BtBr.

Described as *style* of articulation, ways of being in expressions illustrate ways by which social agents identify themselves and which they use in their texts (Fairclough, 2003, p. 26). Indian scientists manifested non-typical ways of being by identifying various overall positions or standpoints for them in regards to BtBr. This is atypical of scientists who generally portray themselves as abiding by the established norm of scientific practice which is to communicate an unbiased and disinterested position. These overall positions assumed by the Indian scientists can be summarized into the four major categories as below.

Approve-it suggests that the Indian scientists unconditionally approve the cultivation/ approval of BtBr in India and/or reject the moratorium decision.

Approve with conditions- it suggests that the scientists generally approve the cultivation of BtBr, but raise some concerns based on various scientific or non-scientific factors.

Wait until precautionary conditions met- it suggests that the scientists are somewhat hopeful but largely skeptical about the cultivation of BtBr and express greater concerns based on various factors.

Reject- it suggests that the scientists overall reject BtBr

Details of expressions used by the Indian scientists with respect to each of these overall positions are given as below.

Approve: Scientists who approved BtBr generally argued for the benefits of GM technology. In most texts, they highlighted the cultural, environmental and national importance of BtBr supplemented with substantial scientific data. In some, they also defended the approval committee’s (GEAC) clearance of BtBr biosafety data. For example, in his commentary, Dr. P.A. Kumar referred to the regulatory protocols of GEAC to assess BtBr as 'rigorous' and the GM technology as 'safer' than the other alternatives of pest management. He also concluded his position by saying that "Cultivation of Bt Brinjal will be a *great boon* to the resource poor farmer"[15].

Approve with conditions: Scientists who generally supported BtBr and GM crops/technology but proposed a few conditions which would help to assure success of BtBr particularly in India, identified an 'approve with conditions' standpoint for themselves. This meant that they were generally in favor of GM technology and were positive about the long term effects of GM crops. For example, they expressed various strengths of GM technology such as the economic benefits through GM crops and its potential to solve food problems in India. They also generally found the technology safe and the protocols which were used to assess the biosafety of BtBr as quite exhaustive. However they articulated one or a few 'conditions' that interfered with overall approval. Their arguments included expressions such as 'need to' or sentence structuring such as 'This is desirable if….' Or 'This is good, however…'[16]

Obviously the conditions pointed out by scientists were not all the same. Some scientists like Dr. Kocchar asserted that it is the lack of a transparent risk management framework in India that needs to be remedied for the successful introduction and distribution of GM crops. Some argued that the eggplant hybrids for transformation should have been selected properly while others suggested that the eggplant should have been developed entirely by the indigenous research and development bodies to resist foreign monopoly.

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[15] Kumar, P.A. (2009). Bt Brinjal. A pioneering push. *Biotech News*, *4* (6)

[16] Modal auxiliary verbs indicating doubts or lesser affinity to statements

Wait until precautionary conditions are met: A large part of the opinions of scientists with precautionary mindset included the highlight on risks and problems of GM crops, with more precautionary focus on the decision of commercialisation of BtBr and the related controversy in a national context. In some cases, there were indications for exercising greater precaution signaled by such terms as "wait" in their arguments.

Reject: Finally, some scientists explicitly rejected BtBr and GM crops/technology. They were particularly skeptical of the safety and efficacy of GM crops and supported other methods such as conventional breeding for raising crop yields. In the larger context they were concerned with the future impacts on other GM crops in the pipeline and the Indian agriculture sector following the approval of BtBr. For example, as one of the most celebrated scientists of India, Dr. P.M. Bhargava was very active in this debate. He was quoted in many news articles, had direct communication with Minister Jairam Ramesh and wrote in all media platforms. Another well-known scientist, Dr. K.P. Prabhakaran Nair clearly expressed his position against BtBr via popular media (no journal commentary found). He also served as the chair of the independent expert committee appointed by the supreme court of India on public petition to independently assess the GEAC approved BtBr biosafety data.

Overall, out of twenty five scientists in the sample, a total of eight scientists *approved* BtBr. Seven scientists suggested that BtBr should be approved *but with some conditions.* Six scientists expressed that the approval for BtBr should wait until *all or at least most* of the precautionary conditions were fulfilled. The remaining four scientists rejected BtBr (Figure 9).

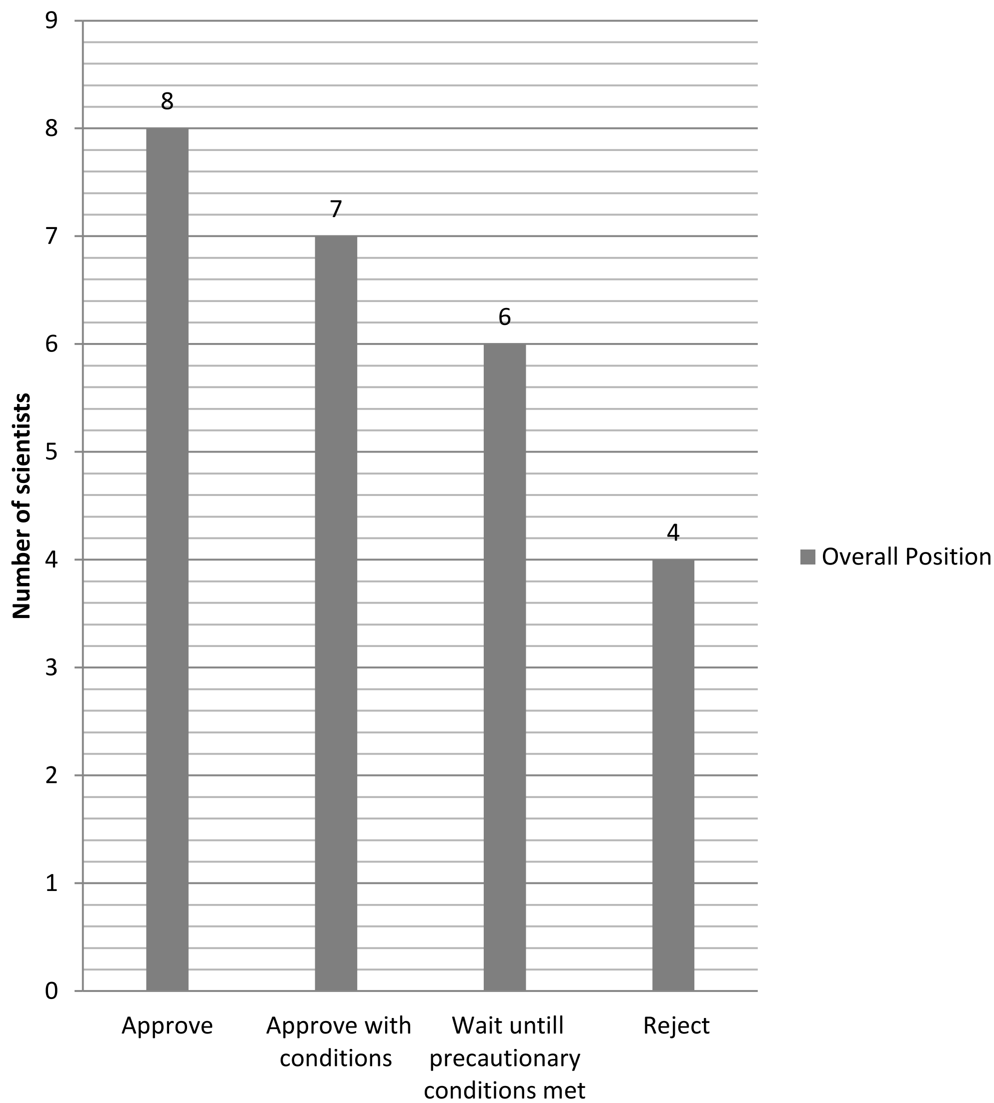

Figure 9. The four overall positions of the Indian scientists for BtBr

Scientists' overall positions corresponded with their professional affiliations.

In many instances, the scientists' arguments clearly indicated their respective standpoint or overall position for BtBr. Although it was not a primary aim to carry out an in-depth analysis of the reasons behind their overall positions, yet I noted that there are bases to link scientists' background and affiliations to their assumed overall positions which suggest that their specific interests might explain their particular position on BtBr. For example, most scientists who were on extreme sides of BtBr (approval or rejection) had professional backgrounds and/or ongoing research in the core areas of agriculture/ horticulture research. Some of them were also affiliated with the principal scientific disciplines such as genetics, biochemistry and microbiology. However a few belonged to the non-specialist areas such as health sciences and even materials engineering who expressed precautionary views towards BtBr. Their lack of direct connection to the core field or their broader perspective through specialty areas beyond biotechnology may have prompted an interest in touching other areas of considerations. Also, some scientists in the debate either had an elite national reputation or stronger affiliations to corporate or other lobby groups, an observation that may also partially explain their overall position. For example, Dr. P A Kumar, who clearly approved BtBr is a proponent of the technology and has been actively involved in GM research. He is the director of the National Research Center for Plant Biotechnology (NRCPB) and was actively involved in developing Bt-Brinjal in 1995 using a similar technology as that employed by Mahyco (the corporate body which developed BtBr). His modified plants were also field tested by the Indian Agriculture Research Institute (IARI), but did not show sufficient effectiveness against pests as did the plants from Mahyco. He was also one of the members of the expert committee, EC II, formed to assess safety data and which had initially approved Mahyco's Bt-Brinjal. Similarly, scientists in favor, such as Dr. S. Santharam had been previously employed by Syngenta International (another agricultural giant corporation that also deployed GM technologies), and Dr. C K Rao who currently remains associated with the Foundation for Biotechnology Awareness and Education (FBAE), a non-profit group but also considered a lobby group for GM technology. FBAE had actively argued against the moratorium and supported the government of India in countering the public interest litigation before the Supreme Court of India.

Among scientists who rejected BtBr was Dr. Nair who served as the chair of the independent expert committee which was appointed by the Supreme Court of India on public petition to independently assess BtBr biosafety data on which basis the national regulatory committee (GEAC) had earlier approved BtBr for commercialisation. Although the independent committee chaired by him had rejected BtBr based on the same biosafety data, yet GEAC had announced the approval of BtBr based on its routine evaluation. In fact, this scientist wrote his blog against BtBr in 2009 in response to the first public announcement of commercialisation of BtBr even after the independent committee chaired by him had rejected it. Similarly, another scientist actively urging rejection was Dr. Sivaraman who is a ‘Siddha’ physician (practicing in Siddha alchemy-a traditional system of medicine similar to Ayurveda), and the proprietor and managing director of the Arogya Healthcare─a private business of manufacturing propriety ‘traditional’ medicines, primarily using organic herbs and plants.

Therefore, even though not investigated in depth, there is an indication that scientists especially those who were at the polar opposite sides of the disagreement (either approval or rejection of BtBr) had vested interests in assuming their overall position for BtBr. A complete list of all scientists in the sample with their affiliations and corresponding overall positions is given in Appendix III.

6.2.3 Scientists represented BtBr as a social problem.

Representations in texts illustrate specific ways of articulation through discourses. There were many instances which indicated the diverse ways in which the Indian scientists represented BtBr as the target problem object. For example, on one hand some scientists clearly identified BtBr as a benefit or a disaster, while on the other hand some were skeptical and indicated BtBr as a ‘yet to be resolved’ problem. Within these ways of representing BtBr as the ‘problem entity’, the Indian scientists used various discursive frameworks to articulate the problem, some of which were common to established representations of GMOs in society (Dibden, Gibbs, & Cocklin, 2011; Legge & Durant, 2010) as well as unique to the context of Indian culture. These ways of objectification and use of discursive articulations for BtBr by the Indian scientists are discussed in detail as below.

6.2.3.1 Objectification into specific identities.

BtBr was represented as the target object which was evaluated by the Indian scientists on various social indicators and represented accordingly. For example, on one hand, some scientists who approved BtBr identified it as beneficial for India, which may bring national prosperity and food security by being the low cost vegetable both for farmers and consumers. On the other hand, some scientists who rejected BtBr identified it as a disaster for India, arguing that it will cause corporate monopoly and eventually high pricing to both farmers and consumers. Other scientists who were mainly precautionary remained skeptical about BtBr by bringing both the negative and positive aspects of it. An example of each identity is given below.

BtBr as a Benefit: Positive identification

> Cultivation of Bt brinjal will be a great boon to the resource poor vegetable farmers of India. This will go a long way in reducing pesticide usage in agriculture thus protecting human health, biodiversity and environment[17]

BtBr as a Disadvantage/disaster: Negative identification

> Brinjal is a food crop of direct consumption and any mishandling can lead to disastrous consequences.[18]

BtBr as a Skeptical object: Neutral identification

> Personally, do you feel it's safe to consume BT Brinjal?: I can't say because it's not a question of astrology. Scientists should not predict the future. They should shape the future.[19]

6.2.3.2 Discursive frameworks.

In representing BtBr as a problem object, the Indian scientists used various discursive frameworks to target BtBr. Of these, three major frameworks were found as common to previous GMO controversies (human health, environment safety, farmer's rights, corporate monopoly and legal rights etc.) whereas two were specific to the Indian context (cultural

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17 Kumar, P.A. (2009). Bt Brinjal. A pioneering push. *Biotech News*, *4* (6)

18 Nair, P. (2015, January 07). Genetically modified crops and Indian agriculture [Blog post]. Retrieved from http://www.vijayvaani.com/ArticleDisplay.aspx?aid=3450 .

19 Swaminathan, M.S. (2010, February 20). M.S. Swaminathan: No Urgency for BT Brinjal. *Forbes*, *India*. Retrieved from http://www.forbesindia.com/printcontent/10402

context and national context). Within each framework, BtBr was represented both as the favorable as well as the objectionable object by the Indian scientists who were in favor and against or skeptical of BtBr respectively. These are discussed as below.

6.2.3.2.1 Discourses reflecting broader international GMO controversies.

(a) Human health and Environment safety: Concerns over human health mainly included the topics of chronic and long term side effects on consuming BtBr. The environmental concerns were primarily portrayed as the danger to crop biodiversity, occurrence of new and more persistent pests and cross contamination to other crops due to pollen transfer. Scientists from either side articulated their arguments within this framework in ways that supported their respective positions. For example, the arguments of scientists who supported BtBr rejected claims of potential threats and represented BtBr as safe and non-toxic to human health as well as to the environment.

> Are you sceptical of the safety of the Bt gene? This is a scientific question, but to answer simply, the Bt gene product cannot be toxic in humans or animals because it gets degraded in the stomach of humans and animals, while it does not get degraded in the pest. Regulation still demands that you test it on animals. All these tests have been done, but what opponents say is that this is not adequate[20].

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[20] Padmanaban, G. (2010, March 12). I support Bt Brinjal. *Frontline*. Retrieved from http://www.frontline.in/static/html/fl2705/stories/20100312270502000.htm

On the other hand, scientists who either rejected or were skeptical about BtBr most commonly argued for the potential threats of BtBr to either human health or environment safety, representing BtBr as toxic to both human health and the environment. They specifically linked the unpredictable nature of GM technology to support their arguments.

> Genetic manipulation of Bt brinjal will have far-reaching environmental and bio-safety consequences. Gene modification technology is in its infancy and totally unpredictable consequences could follow. The development of super weeds, observed recently in UK, is an example. But the most perplexing question of all is, who is behind this game to push a half-baked technology on unsuspecting millions? It does look as if India is up for sale, certainly its agriculture[21].

(b) Farmers' right/consumer benefit/ corporate monopoly: The main arguments under this framework included public versus private entrepreneurship and ownership in developing BtBr. A socio-economic argument was around 'seed trade' between a corporate entity and farmers. Scientists opposing BtBr argued against corporate owned large scale cultivation of BtBr, thus representing BtBr as a threat to subsistence or small scale farming which is still predominant in India in which farmers collect and use seeds from previous seasons to sow for the next harvest.

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[21] Nair, P. (2009, November 13).The truth about Bt Brinjal. *Expressbuzz*. Retrieved from http://library.wur.nl/WebQuery/file/cogem/cogem_t4c526d58_001.pdf

> The ultimate goal of Monsanto-led Bt brinjal in India is to obtain control over Indian agriculture. With 60 percent of the population engaged in agriculture and living in villages, this would effectively mean not only complete control over our food security but also a direct threat to our farmers and rural sector. Whosoever controls the seed and agro-chemical production in the country, will control India.[22]

On the other hand, scientists supporting BtBr attributed the economic benefits of the large scale corporate cultivation of BtBr to the high crop yield and the low requirement for the external pesticide spray for farmers which will ultimately benefit consumers with the low cost of the vegetable, thus representing BtBr as economically beneficial, ruling out the possibility of corporate monopoly.

> One reason proffered for the ban was that multinational companies would have a monopoly over the seeds—a generic complaint against all GM crops and one that is fallacious[23].

> I dont think there is a risk of big business dominating Indian agriculture. Holdings in India are small. There are 115 million farming families, 25 percent of world's farming population. A few big businesses - at

[22] Bt Brinjal saga

[23] Shantharam, S. (2015, March 11). Bt Brinjal ban a costly mistake. *Livemint*. Retrieved from http://www.livemint.com/Opinion/p3MBHWrspBqKJNTgmv7voO/Bt-Brinjal-ban-a-costly-mistake.html?utm_source=copy

best can control some areas. That's why Jairam Ramesh [the minister who put moratorium] has been talking about public funded research in bio technology[24].

***(c) Legal rights*:** In this context, scientists against BtBr linked brought the issues of biopiracy[25] –the legal issues of patenting of natural resource such as Brinjal (eggplant) and raised concerns over corporate exploitation and control over India's natural resources. Similarly these scientists linked the possibility of cross contamination of non-Bt Brinjal and other closely related crops with Bt pollen within the legal context as it may cause the shortage of non-Bt Brinjal varieties in future and thus may potentially cause the illegal trading of non-Bt seeds. Further some scientists who were precautionary argued that against the present legal regulation and rules in India, calling them as unclear and insufficient to resolve farmer disputes if pollen from one field drifts to a neighboring field which may belong to a different farmer which may also include the problems of patents and intellectual property rights. Thus BtBr was represented as a potential source of legal disputes.

India has to be very vigilant on two counts, first to seal in a fully foolproof manner any cross-border illegal trade in Bt brinjal seeds. When the Indian Government has failed to effectively seal the migration of illegal Bangladeshi refugees into West Bengal, sealing the cross-border against illegal sale in Bt

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[24] Swaminathan, M.S. (2010, February 20). M.S. Swaminathan: No Urgency for BT Brinjal. *Forbes, India*. Retrieved from http://www.forbesindia.com/printcontent/10402

[25] Act of exploiting the natural heritage of a country (plant and animal species) by claiming patents to restrict their general use by the people of that country.

> <u>brinjal seeds is nothing but wishful thinking.</u> The larger question is, would India want to risk its large collection of native brinjal varieties to pollen contamination from Bt brinjal, and make everything uniform?[26]

However, scientists in favor of BtBr articulated their arguments by simply rejected the links of BtBr with potential risks in the legal context.

6.2.3.2.2 Discourses specific to the Indian context.

<u>(a) Indian culture-heritage and center of origin:</u> Within this discourse arena, main arguments included the Indian heritage and India as the center of origin for the Brinjal (eggplant). Some scientists who were either against or skeptical of BtBr contested BtBr for being a culturally important crop. Their arguments were premised on indicators such as the long history (about 4000 years) of Brinjal cultivation in India, the vegetable's common use in ethnic cuisine and its geographically widespread cultivation. Similar these scientists also brought in the widely held belief about India being the 'center of origin' of Brinjal (eggplants). They supported these beliefs on the basis of the long cultural history of Brinjal in India, the large biodiversity of Brinjal as indicated by the large 'germplasm size' available in India[27] and mentioning of Brinjal in Ayurveda and other ancient Indian literature.

> <u>The first point is that brinjal has its origin in the Indian subcontinent.</u> The biological rigour of a plant species is lost when it is genetically modified,

[26] Nair, P. (2015, January 07). Genetically modified crops and Indian agriculture [Blog post]. Retrieved from http://www.vijayvaani.com/ArticleDisplay.aspx?aid=3450

[27] Germplasm size generally refers to the single, plant variety available. Brinjal grows in about 2000 single varieties in India indicating large germplasm size and hence large biodiversity

> more so in its place of origin. Mexico has vetoed genetic modification of maize, despite American pressure, as that is its place of origin[28].

However, some scientists who supported BtBr simply rejected the claims that formed basis of BtBr's rejection by other scientists.

> Citations from Ayurveda cannot be taken to infer that India is the centre of origin of Brinjal. Sanskrit names have been regarded as evidence that the Brinjal was first domesticated in India, although no further detailed and continuous evidence about the domestication process can be gleaned from the ancient Indian literature. It is essential that the primary sources of exact dates be re-examined in order to explore this further[29].

(b) National context– national investments and indigenous research: Scientists in favor of BtBr argued that the controversy over BtBr and the resulting moratorium led to the sudden loss of the long-time national research efforts and monetary investments. In a broader sense, these scientists represented the moratorium on BtBr as a national issue because it also impacted the on-going advancement of biotechnology research and development in India as well as the future policy stakes of other modified crops in the pipeline.

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28 Nair, P. (2009, November 13).The truth about Bt Brinjal. *Expressbuzz*. Retrieved from http://library.wur.nl/WebQuery/file/cogem/cogem_t4c526d58_001.pdf

29 Hanur, V.S. (2011). GM crops and centres of origin – a case study of Bt brinjal in India. *Current Science, 100*(9).

> Irrespective of the fate of Bt brinjal, the moratorium on GM food crops will have a telling effect on the future of modern biotechnology in India. Scientific organizations, their funding, collaborations, education and training, and private investment in technology development will all take a beating and set the clock backwards by decades[30].

On the opposing side, scientists portrayed BtBr as the potential window for western colonization (due to partnering with the US based Monsanto), hence a threat to the national security of Indian agriculture. In this context, the lack of proper regulatory governance for safety assessment and approval mechanisms for genetically modified crops within the Indian regulatory system were also linked to the problems like breaching of scientific protocols and plagiarising of documents in India, all of which could potentially create national issues.

> The Arthur Anderson strategy is clearly unfolding in India. The larger strategy of Monsanto is to control the entire seed industry in India in 10-15 years. Bt cotton was the first step. Bt brinjal is the second. Before long, it will be Bt rice (clandestine field trials were conducted in Ramanathapuram district in

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[30] Shantharam, S. (2010).Setback to Bt brinjal will have long-term effect on Indian science and Technology. *Current Science*, *98*(8).

> Tamil Nadu and Jharkhand two years ago), Bt maize (field trials have started in India), Bt sorghum, Bt cauliflower, Bt cabbage, and so forth[31].

Some precautionary scientists used such arguments as western colonization and monopoly in Indian agriculture to emphasise one the 'indigenous' research and development in India.

> Indian scientists have indigenously developed genes ready to be used and they are the ones who are affected by this preference for seeds developed by foreign companies. <u>We do not need Monsanto any more for this country.</u> I feel that these indigenously developed genes should be used. All this agitation against the Bt brinjal is affecting Indian research and no one else[32].

To summarize, the results of the first level of analysis described –through genres, styles and discourses as ways of articulations, the Indian scientists assumed various overall positions with respect to BtBr and represented it as a problem reflective of a broad range issues via diverse media platforms.

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[31] Nair, P. (2009, November 13).The truth about Bt Brinjal. *Expressbuzz*. Retrieved from http://library.wur.nl/WebQuery/file/cogem/cogem_t4c526d58_001.pdf

[32] Padmanaban, G. (2010, March 12). I support Bt Brinjal. *Frontline*. Retrieved from http://www.frontline.in/static/html/fl2705/stories/20100312270502000.htm

6.3 Results of the Second Level of Analysis−Comparison of Texts across Media Platforms

In the second level of analysis, I compare the Indian scientists' texts across the three media platforms −journal commentaries, newspaper columns and internet blogs − to infer how the media might have impacted scientists' ways of articulation of the problem. For this type of analysis, I mainly compare journal commentaries on one hand which I consider non-typical, in the sense that commentaries remain outside the norm of scientists' practices but the journal outlets are still familiar territory−with newspaper columns and internet blogs on the other hand, which are considered as more popular media texts. An overall comparison of the structural features of the texts across media platforms suggested that most of the public communication through these texts was made by the Indian scientists between the years 2009 and 2012, the proximity years before and after the moratorium. A few texts from each media platforms were also found as published in 2015 and as recent as in 2016. One of the inferences that can be made to the significant public communication in the year 2015 is that some Indian scientists perhaps used BtBr to influence the fate of the next, and the most recent genetically modified food crop of India− GM Mustard for which the application for commercial release was filed in December 2015.

6.3.1 Scientists held the same overall positions across media platforms.

Generally one may not expect scientists to change their overall position for BtBr across media platforms and one might question the need to compare opinions from the same scientist across media platforms. However, given that the controversy around BtBr had started during its open field trials around 2007 and lingered for quite a long time until at least 2010 when the final decision of the moratorium was announced, I would expect that some scientists might have initially expressed overall support for BtBr in journal commentaries, the earliest of which is dated 2008‒the time of rising public controversy on BtBr. When the controversy peaked around 2009-2010, some could have assumed more precautionary positions as a consequence of the large public outcry which they then had expressed in more readily available media outlets such as newspapers and even blogs which are almost instantaneous.

However, I found no particular differences in scientists' overall positions across media platforms. Also, in some cases there was consistency in the choice of issues raised across media platforms. For example, one scientist Dr. Padmanaban, a nationally recognized biochemist, who assumed an 'approve with conditions' standpoint suggested his overall support for BtBr but raised specific concerns over corporate monopoly in both his journal commentary and his one magazine interview. For example, in his journal commentary he wrote:

> Monsanto may be far ahead of us in this game, but encouraging indigenous research to reach commercial potential would be the answer to this bogey of MNC monopoly. Is there a policy on the commercialization of GM crops with herbicide degrading genes? In fact, many of the controversial issues of GM-technology are with the use of herbicide-resistant genes rather than with the use of Bt genes to protect against insect infestation. With a large number of women labour being involved in manually removing weeds and with the use of biocontrol agents, do we really need GM-technology for this purpose in India? It may not be a good idea to totally remove the weeds. Should not India give priorities to commercialize GM-crops with improved nutrition and

> to protect against abiotic stresses (low rainfall, saline soils, etc.)? Would not Bt rice with adequate beta-carotene, micronutrients and survival in low rainfall conditions be a boon to the community?[33]

Then he made similar arguments in his magazine interview.

> Indian scientists have indigenously developed genes ready to be used and they are the ones who are affected by this preference for seeds developed by foreign companies. We do not need Monsanto any more for this country. I feel that these indigenously developed genes should be used. All this agitation against the Bt brinjal is affecting Indian research and no one else. Once our public sector starts using its own products, costs will come down. Somebody should advise the government. Agricultural companies, both foreign and Indian, will only make hybrids, which can only be used for one generation. A farmer cannot store the seeds. Instead of this, you should create a variety by which the gene is permanent and seeds are generated. Once we do this, we do not need to pay any royalty to Monsanto.

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[33] Padmanaban, G. (2009). Bt-brinjal–ban or boon? *Current Science*, *97* (12).

6.3.2 Scientists raised social issues more frequently in popular media platforms.

While writing across media platforms, many scientists chose broader social contexts in more popular media platforms which in some cases was only subtle and in others was more overt. In fact a few scientists exclusively wrote newspaper columns and/or internet blogs and no journal commentaries. Also, the newspapers in which their opinions appeared have a broad reach as India's leading mass media providers such as The Hindu, The Frontline magazine (from the publishers of The Hindu), The Indian Express, The Zee News, The Livemint and the DNA. The internet itself is of course a wide ranging public forum. As more popular media platforms such as newspapers and the internet have greater reach so in this regard, it made sense to compare ways of articulation across media platforms to study what particular topics were raised across platforms.

I found that most journal commentaries were a mix of predominantly scientific discussions on BtBr's development and general discussion over BtBr's safety and economic prospects and national concerns with respect to Indian regulations. Health, biosafety and farmers' rights were the predominant topics in most journal commentaries. In many instances, scientists used scientific data and/or references to scientific studies to support arguments in journal commentaries. On the other hand, discussion on the roles of other key actors (mainly the regulatory committee which approved BtBr−GEAC; and the minister Jairam Ramesh who had put moratorium) as well as references to other countries which have adopted BtBr (such as Bangladesh) were predominant in more popular media texts, mainly the newspaper columns. For example, some scientists against BtBr utilized more popular texts to praise the minister for placing a moratorium on BtBr

> I am very happy. Jairam[34] is a friend and he has done a courageous thing. I think it is unprecedented in India what he has done today[35].

On the other hand, scientists in favor of BtBr were critical of the minister for imposing a moratorium in their newspaper columns and blogs.

> [Jairam] Ramesh's articulated stance that the Bt-brinjal moratorium should not be misconstrued as a hindrance to biotech research and development (R&D) is a joke. More than Rs.12, 000 crore [120000 million Indian rupees] of investments in biotech R&D have dried up since the moratorium[36].

6.3.3 Scientists manifested non-routine ways of dramatic expressions in popular media platforms.

Indian scientists expressed certain non-routine ways of espousing views such as assessing blame and providing warnings which could be observed linguistically in their writing style and use of specific wording in arguments. For example, 'blaming' was observed as one of the most common discursive actions in many texts. For example, out of the total twenty five scientists who publicly communicated about BtBr, at least ten scientists blamed someone for the problem of BtBr. Among those ten scientists, six scientists blamed the regulatory

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[34] India's Minister of Environment overseeing the policy process on Bt Br

[35] Bhargava, P.M.(2010, February 10). India doesn`t need Bt Brinjal: PM Bhargava. *ZeeNews*, Retrieved from http://zeenews.india.com/exclusive/india-doesn-t-need-bt-brinjal-pm-bhargava_2790.html

[36] Shantharam, S. (2015, March 11). Bt Brinjal ban a costly mistake. *Livemint*. Retrieved from http://www.livemint.com/Opinion/p3MBHWrspBqKJNTgmv7voO/Bt-Brinjal-ban-a-costly-mistake.html?utm_source=copy

practices in India for the problem of BtBr, in some way. Two scientists blamed the anti-GMO activism by lobby groups for the public outrage against BtBr and subsequently for the problem. Interestingly, two scientists also blamed scientific negligence for the problem. Also, while some scientists criticized the corporate body that developed BtBr (Mahyco) for partnering with the US giant Monsanto and indicated potential problems with them such as the corporate monopoly of Bt-seeds or western colonization of Indian agriculture, yet none of the scientists was observed to explicitly blame the corporate group for the current public controversy on BtBr in India. Similarly, the consumers and the farmers (combined as the 'public' here) were portrayed as mainly victims and were not blamed for the problem (Figure 10).

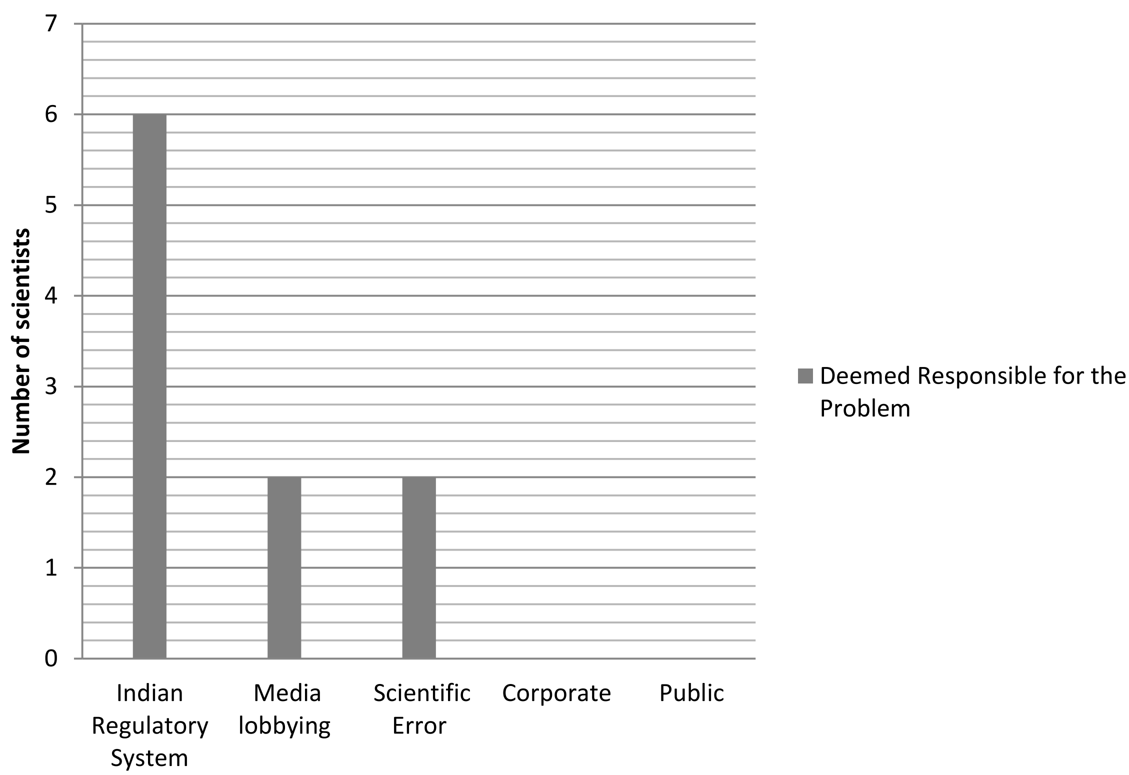

Figure 10: Targets of 'blame' by the Indian scientists for the problem of Bt-Brinjal in India

Some examples of arguments from the texts showing blaming are given below.

Blame on Indian regulatory practices/system:

> There are no labeling laws in India[37] like in the countries which have introduced some modified eatables. I must know what I am eating and I ought to have a choice in this matter. There are no liability laws in this country. For example, if a farm is growing Bt Brinjal and the field beside it is producing organic Brinjal, then who will take responsibility of mutation of the natural Brinjal?[38] The whole approach is quite absurd, unscientific and unplanned. We have been using in our own country techniques like proteomics and transcriptonics, but the government was giving flimsy excuses, such as high expenses involved[39].

Blame on anti-GMO activist groups:

> Almost all anti-GM folks believe in organic agriculture and they have been active at the state level in India to convince gullible politicians that organic agriculture can feed the world and give food security. This is not accepted by most established agricultural scientists. Most farmers' organizations in India, including BKS and SJM,

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[37] Declarative statement showing absolute knowledge of Indian laws

[38] Interrogative statement showing moral responsibility

[39] Bhargava, P.M. (2010, February 10). India doesn`t need Bt Brinjal: PM Bhargava. *Zeenews*, Retrieved from http://zeenews.india.com/exclusive/india-doesn-t-need-bt-brinjal-pm-bhargava_2790.html

are champions of organic farming, and organic farming completely prohibits the use of GM seeds.[40]

Blame on scientific practices:

Despite the advances, the use of an underdeveloped r-DNA technology of mid-nineties [used by Mahyco to develop BtBr] is improper, although it could be due to the financial constraints imposed by IPR [intellectual property rights] regimes. But, for public good, solutions must[41] be found in this matter too[42].

Similarly many scientists highlighted the urgency and higher stakes in BtBr, articulating arguments with warnings and supplementing with scientific facts/data to legitimize and rationalize their positions. For example:

Farmers usually spray insecticide twice a week, applying 15-40 sprays, or more, in one season depending on the levels of infestation. As a result, pesticides levels are high in the fruits, which is a matter of serious concern from a health perspective. On an average, 4.6 kg of active ingredient of insecticide per hectare per season is applied on Brinjal at a cost of Rs. 12,000 per hectare….There is an urgent need to

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[40] Shantharam, S. (2015, December 31). Lies, lies and more lies. *Swarajya*. Retrieved from https://swarajyamag.com/ideas/lies-lies-and-more-lies

[41] Use of ‘must’ shows strong affinity of the scientist with the statement, a deontic modality showing a moral obligation, conversion into a passive statement shows nominalization that too shows a moral obligation for all.

[42] Banerji, D. (2010). Bt Brinjal and GM crops: towards a reasonable policy ahead. *Current Science*, *99* (10).

reduce the dependence on pesticides by using safer alternatives to manage insect pests.[43]

Indian science and technology now stands completely politicized and unless the scientists (at least some of them) are willing to play the same game, there is a good chance that Indian science will be controlled by street level activists and shouting brigades motivated by ideology and politics. The Bt-Brinjal episode must serve as a real wake up call[44].

In short, the comparison of the general text structure, content and writing style between journal commentary texts and more popular newspaper and on-line media texts suggests that the Indian scientists predominantly emphasized national and cultural contexts in more popular texts and manifested non-routine ways of articulation such as via blaming attributions and warning impositions in more popular texts which also raised the subject of moral responsibility (indicated in various instances in footnotes).

In many cases, scientists used more sensational and exaggerated expressions in newspapers or blogs by discussing the problem in larger social/global context. For example, Dr. Byravan who has expertise in Genetics and often writes on science and technology policy chose to only specifically target the scientific review of transgenic crops in her journal commentary and reported various policy flaws in this review which was conducted by the

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[43] Kumar, P.A. (2009). Bt Brinjal. A pioneering push. *Biotech News, 4* (6)

[44] Shantharam, S. (2010). Setback to Bt brinjal will have long-term effect on Indian science and technology. *Current Science, 98*(8).

highly reputed National Academy of Agricultural Sciences in India−the body which reviewed BtBr after the moratorium and recommended it as safe. On the other hand in a newspaper column (which was also later uploaded on an NGO website), she wrote outside her expertise and raised a mix of concerns including safety and socio-economic issues of BtBr. For example, in many instances in this newspaper column she used ‘global warming’ to compare the salience of the current problem of BtBr in India as shown:

> The debate in GM plants is even more deeply suffused by vested interests than that on global warming. In addition to impeding research, companies also exert their influence on review and approval by way of revolving doors between agribusiness and regulators…….Let me compare the GM debate with the other major scientific debate - global warming. While scientists who work on climate change and global warming rightly embrace the precautionary principle, many who work in the area of GM plant technologies abandon it altogether. A charitable explanation is that this may have to do with differing perceptions of risk in each case. Perhaps global warming is seen as a serious threat to the entire world, and GM crops may not be understood in the same way. Moreover, some benefits have been attributed to these crops by promoters, making it harder for people to reject them. [45]

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[45] Byravan, S. (2009, November 06). Where is the science? [Blog post]. Retrieved from https://www.saynotogmos.org/ud2009/unov09.php

In fact, a few scientists exclusively wrote blogs to articulate the problem in the national context. Interestingly all four scientists who exclusively wrote blogs have affiliations or vested interests as discussed earlier, and thus spoke for either overall rejection or overall approval of BtBr depending on their interests. For example, Dr. Nair who also served on the Independent evaluation of the BtBr safety data wrote a blog against BtBr in a more popularized language, suggesting 'the day will go down in history' and by mentioning names of authentic eggplant cuisines for emphasizing the cultural importance of Brinjal as shown below.

> The next time you savour your baingan ki bartha or kathirikai poriyal [traditional Indian recipes of eggplant], you might be ingesting some highly toxic Bt toxin as well. Yes, I am writing about the just released Bt brinjal. October 14 will go down in the history of Indian agriculture as the day when the government-controlled Genetic Engineering Approval Committee (GEAC) unrolled the red carpet for Monsanto and changed the course of Indian agriculture for all the time to come[46].

Similarly Dr. Sivaramanan who is a proprietor of traditional Ayurveda medicines and is against BtBr criticized it by making references to Bt-Cotton (the only commercialised genetically modified crop in India), which he metaphorically compared with Mahatma

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[46] Nair, P. (2009, November 13).The truth about Bt Brinjal. *Expressbuzz*. Retrieved from http://library.wur.nl/WebQuery/file/cogem/cogem_t4c526d58_001.pdf

Gandhi's *khadi*[47] movement, the Indian independence movement from the British rule during 1918 in which Gandhi promoted the socio-cultural aesthetic of the *khadi* cotton, and suggested that Indians could be self-reliant on cotton and be free from foreign cloth.

> The whole world is moving towards an eco-friendly lifestyle in many areas. India is one among the few countries having large biodiversity zones with a huge potential to go organic. … But for this Independence Day … we will be hoisting the tri-coloured national flag made of genetically modified BT cotton owned by a big American corporate and not with Gandhiji's swadeshi[48].

To summarize the results of the second level of analysis−which compares ways in which Indian scientists articulated the problem of BtBr across media platforms, the Indian scientists held the same overall position for BtBr across media platforms but framed the problem through broader social concerns in popular media platforms such as newspapers and internet blogs, that too in dramatic forms of expressions.

6.4 Results of the Third Level of Analysis−Re-Contextualisation of Meanings

In my view, one of the most interesting observations in my study is that the Indian scientists not only raised social issues around BtBr in non-typical ways of expressions, but also promoted discourses which were both typical of the GMO debates around the world as

[47] Khadi is handspun, hand-woven natural fiber cloth from India, mainly made out of cotton.

[48] Sivaraman, G. (2014, August 12).Why we don't need genetically modified crops in India – G. Sivaraman [Blog post]. Retrieved from https://bharatabharati.wordpress.com/category/agriculture/monsanto-mahyco-india/gm-foods-monsanto-mahyco-india/

well as specific to the Indian context. Therefore, my third level of analysis is about drawing meanings from some of the predominant discourses in scientists' opinion texts and closely inspecting them for 're-contextualization'─how the meanings have been taken out of one context and reformulated. This is discussed in detail below.

6.4.1 Scientists articulated meanings of some of the existing representations of GMOs.

With some of the following examples of discourse (in bold), I illustrate how the Indian scientists uniquely represented these otherwise widely held GMO discourse by reconfiguring their contexts.

(a) Biodiversity: Biodiversity is not only understood as the measure of all plant and animal life on Earth, but also used discursively as an indicator of the health of the natural environment, as a resource of economically beneficial varieties of organisms as well as an area of focus for the government agenda on the management of environmental resources and risks (Cardinale et al., 2012; Kohli & Bhutani, 2015; Maclaurin & Sterelny, 2008, p. 3). All these involve human interaction, and hence human impact on biodiversity is a common discourse which is also widely used in discussions of the impacts of GMOs on the environment (Carpenter, 2011). In my analysis, it is not to argue whether GMOs are good or bad for biodiversity, as a plethora of research on both sides exists in the literature. Instead, it is to investigate how the Indian scientists in this case articulated their meanings within this discourse to fit their chosen side. For example, some scientists against BtBr argued that BtBr will *decrease* biodiversity as pollen can accidently transfer to the non-Bt crops during open cultivation of BtBr, resulting in cross pollination of non-Bt with Bt in the future.

> There is general agreement among scientists and academics on the adverse effects on biodiversity as a result of cross-pollination from engineered to non- engineered crops. Still, field trials for GM crops in unmarked areas blow caution and engineered pollen to the winds in closely cultivated fields in India[49].

In this instance, the impact of BtBr on biodiversity was articulated on the basis of the natural phenomenon of 'cross pollination' of crops and the knowledge around it. While scientists who believed that BtBr would *decrease* biodiversity– brought up the issue of 'accidental crossing' of genes, some other scientists in favor of BtBr challenged this knowledge by arguing that "gene flow has always taken place in nature" and that "nature will automatically balance" any gene exchange.

> Ever since man started practising agriculture, there has been such a large-scale transfer of genes, horizontal and vertical. I wonder as to how introducing a couple of genes can change biodiversity. How did the 2000 varities of Brinjal evolve?[50]

Through this argument, for example, the scientist implied that the 'accidental crossing' is in fact good for biodiversity (as it has resulted in more than 2000 Brinjal varieties in India in the past), suggesting that BtBr would *increase* biodiversity by adding to the existing eggplant

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[49] Byravan, S. (2009, November 06). Where is the science? [Blog post]. Retrieved from https://www.saynotogmos.org/ud2009/unov09.php

[50] Padmanaban, G. (2009). Bt-brinjal–ban or boon? *Current Science*, *97* (12).

varieties. Interestingly, some scientists who were in favor of BtBr disputed claims of the effect of BtBr on biodiversity. For example, some scientists in favor of BtBr argued that even if the next generations of the non-Bt crops become Bt due to the accidental crossing of Bt and non-Bt genes, the resulting Bt crops will be no different from the other non-Bt varieties of eggplant. Therefore, BtBr will in fact *not affect* biodiversity. In other words, while scientists who rejected BtBr represented it in context of its effects on biodiversity, yet in response, some scientists from the pool of supporters either re-contextualised it with counter-claims that BtBr will increase biodiversity whereas others from the same supporter pool simply scooped out BtBr from the context by suggesting that there is no risk as BtBr will not affect biodiversity at all. This further indicated that the Indian scientists were framing biodiversity on the basis of the physical/physiological appearances of plants and also re-contextualised the genetic basis of cross pollination to favor their respective positions.

(b) Food security: The discourse of 'food security' was de-constructed and re-conceptualised in a similar manner. Food security is already a well-established discourse comprising the complex set of indicators which extends well beyond mere abundance of food achieved by technological advancements in agriculture (FAO, IFAD, & WFP, 2014). BtBr was developed as the pest resistant crop that ultimately saves the eggplant yield from the annual loss due to pest infestation. In this case, many scientists simplified the idea of food security into the availability of more food to favor their support for BtBr—by arguing that the greater yield of BtBr compared to other non-modified varieties will result in greater profit margins to farmers as well as low product prices to the consumer, which will increase their affordability, hence will eventually result in *greater* national food security.

> These issues need to be seen in the larger context of Indian agriculture and food security. With a growing population and with persistent problems of poverty and malnutrition to address, there is little doubt that increases in food production would be immensely useful.[51]

This indicates that some scientists were framing food security on the basis of scientific studies which will verify the annual increases in the BtBr yield on farms. On the other hand, some precautionary scientists raised the issue of high prices of the modified eggplant due to patented seeds and greater corporate control over the market, especially in specific context of developing versus developed countries. This may imply that the actual measure of food security is not on the farms but outside of it– in markets where the prices of commodities are decided. Of course, because BtBr is a corporate owned variety, it includes the issue of patent rights which is about the monopolized control over the market, not really synonymous with *security* in favor of the public good. Therefore the discourse of food security was articulated in a discursive mix of *orders of the discourse*–scientific, economic, legal and social.

> If we really need Bt brinjal, why did we not do so ourselves? We did not need a foreign company to do that. With many other GM food crops in the pipeline of foreign multinationals, wouldn't this be the first step of

[51] Purkayastha, P., & Rath, S. (2010).Bt Brinjal: Need to Refocus the Debate. *Economic & Political weekly, 14*(20)

> megacorps acquiring total control over our food business and thus our food security. What kind of a free country we would then be?[52]

At the same time, some scientists also argued even if BtBr showed improved yield in field trials, it was not due to the transformed gene but because of the already superior hybrid eggplant varieties chosen for transformation. Further, it was argued that the use of high yielding varieties for transformation generally require greater resource input which jeopardizes soil ‘rigor’ for long term agriculture use, resulting in barren lands and scarcity of resources for the cultivation of other crops. So the overall outcome of the equation is that GM crops *decrease* food security. These claims in the broader agricultural context disputed perhaps the most commonly taken for granted benefit of GMOs in agriculture‒the improved yield for better food security. Interestingly, scientists overlapped the discourse of *climate change* with food security as climate change in the future is likely to cause variable environmental constraints which may not support cultivation of high resource demanding GMO crops‒a threat to global food security. This pattern of scientists’ differing representations of food security shows the de-construction and re-conceptualization of the idea in multiple forms.

(c) Health Safety: Safety was not only simply challenged in terms of whether BtBr as a product is safe or not, but on the basis of the knowledge of ‘safety’‒how it is defined and evaluated. For example, one scientist showed his support for BtBr but framed its safety to put forth the condition on basis of which he resists an unconditional approval for BtBr. He argued that advanced methods such as “choloroplast transformation” over the traditional

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[52] Bhargava, P.M. (2015, July 26). The Bt Brinjal saga [Blog post]. Retrieved from http://pmbhargava.com/article/brinjal-saga/

cauliflower mosaic virus transformation (used in BtBr) would have made BtBr "safer"[53]. This way he re-contextualised safety on the basis of the choice of technological methods which is an upstream process, decided before plant modification takes place. In this sense, safety is an important factor in 'precautionary' measurement. On the other hand, some scientists argued that the BtBr was unsafe because it did not 'sufficiently' pass the allergenicity standard. In this sense, safety was contextualized as a factor predicted downstream of the transformation process. Moreover, safety was further re-contextualised on basis of the *type* of tests that *appropriately* measure safety (as in case of BtBr, some scientists argued that safety tests for 'Bt' chemicals were insufficient as they were conducted only on brown Norway rats but not on male rabbits).

> A part of the base sequence of the promoter (35S CaMV) [virus used for transformation of BtBr] resembles some sections of the HIV virus[54].

In short, Indian scientists articulated meanings within these identified discourses which either challenged previously held notions of GM technology or framed them in the specific Indian context to support their respective positions. In a similar way to favor their standpoints, these scientists *uniquely developed* some discourses which were specific to the Indian context. These are discussed in detail below.

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53 Another method of inserting genes across plants which is assumed more advanced and safer than the traditional method in which genes are transferred by infecting plants with a virus carrying the gene of interest.

54 Bandhopadhyay, R., Sinha, P., & Chaudhary, B. (2012). Is Bt-brinjal ready for future food?−A critical study

6.4.2 Scientists brought new meanings into the specific social and cultural contexts of India.

(a) Historical origin in India and Traditional medicinal use: 'India is the center of origin of Brinjal' has been a long-held belief in the country. Similarly, Brinjal's use in traditional Ayurveda practice is widely known, and so is its reference in some of the ancient Indian texts. Some scientists against BtBr strongly propagated this belief in their arguments.

> Brinjal has its origin in the Indian subcontinent, and it is mandatory that no genetic manipulation of a crop, much less an edible one, be attempted in its geographic place of origin. Sadly, both these core stipulations have been violated in the production of Bt Brinjal[55].

On the other hand, scientists in favor of BtBr disputed the cultural beliefs related to Brinjal (eggplant) in India–so much so that they led to the 'archeological' analysis of these historical notions. For example, one scientist wrote an exclusive commentary against these widely held assumptions, arguing that India as the center of origin of Brinjal (eggplant) is a false assumption, given the long history of its domestication or the large number of Brinjal varieties available in India etc.

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55 Nair, P. (2015, January 07). Genetically modified crops and Indian agriculture [Blog post]. Retrieved from http://www.vijayvaani.com/ArticleDisplay.aspx?aid=3450

> They [opponents of the commercialization of Bt Brinjal] have also argued that Bt brinjal should not be released in India, which is the centre of origin of brinjal. Most of the Indian literature considers India as the centre of origin of brinjal…. Unfortunately, there are no strong points of argument about India being the centre of origin of brinjal. Comprehensive and critical analysis of the literature suggests varying indications about the origin, domestication, speciation and evolution of brinjal. The following are some of the pointers that counter the veracity of the belief that India is the centre of origin of Brinjal[56].

(b) Choice of plant characters for transformation and women's labor: There were interesting overlaps of contexts manifested in scientists' arguments such as the consideration of what plant characters should be transformed for the most benefit in agricultural which is a scientific issues and the condition of women's employment which is a socio-cultural issue. For example, transformation for herbicide tolerance impart plants the unique capacity to thrive under the large scale herbicide sprays for weed removal. Therefore, in farms where herbicide tolerant varieties of crops are planted, the weeds are efficiently removed without the need for manual labor. Some scientists framed this use of GM technology as beneficial in agriculture and also framed it within the Indian context that suggested Indian farmers will benefit from the technology and minimize crop loss due to weeds.

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[56] Hanur, V.S. (2011). GM crops and centres of origin – a case study of Bt brinjal in India. *Current Science, 100*(9).

> Indian farmers need technologies that can save on labour and bring efficiency. Indian agriculture loses 30-40 per cent of its crops due to weeds[57].

However, for some, this may further disadvantage poor women in some regions of India. For example some Indian scientists who were precautionary raised concerns such as how GMOs such as herbicide tolerant plants may affect women in regions where women's labor is extensively employed for manual weed removal. Thus scientists overlapped scientific contexts with the social contexts to support their positions. Such considerations of social conditions in India were also reflected to emphasize nutrition over convenience.

> Many of the controversial issues of GM-technology are with the use of herbicide-resistant genes rather than with the use of Bt genes to protect against insect infestation. With a large number of women labour being involved in manually removing weeds and with the use of biocontrol agents, do we really need GM-technology for this purpose in India?........It may not be a good idea to totally remove the weeds. Should not India give priority to commercialize GM-crops with improved nutrition and to protect against abiotic stresses (low rainfall, saline soil, etc.)? Would not Bt rice with

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[57] Shantharam, S. (2013, August 15). GM and the biodiversity balderdash. *The Hindu*. Retrieved from http://www.thehindubusinessline.com/opinion/gm-and-the-biodiversity-balderdash/article5026084.ece

> adequate beta-carotene, micronutrients and survival in low rainfall conditions be a boon to the community?[58]

(c) Indigenous research: The corporation which developed BtBr (Mahyco) is a partner with the US-based agriculture giant Monsanto. Many scientists framed BtBr as a foreign or non-indigenous crop, however the idea of what is considered 'indigenous' was clearly disputed, as "indigenous research/products" was referred variably–as one primarily done on Indian soil, carried out by Indian scientists or made only by Indian companies–showing that Indian scientists re-contextualised the idea of indigenous research from various perspectives to favor their standpoints.

> Indian scientists have indigenously developed genes ready to be used and they are the ones who are affected by this preference for seeds developed by foreign companies….Once our public sector starts using its own products, costs will come down[59].

(d) India's natural conditions: Some scientists also argued about the *suitability* of BtBr with respect to the natural conditions of India. The knowledge of choosing specific plant characters for transformation was framed against the natural/ farming conditions in India. The diverse climatic conditions in the country were said to pose serious challenges in agriculture, especially in the context of irrigation and water availability:

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[58] Padmanaban, G. (2009). Bt-brinjal–ban or boon? *Current Science*, *97* (12).

[59] Padmanaban, G. (2010, March 12). I support Bt Brinjal. *Frontline*. Retrieved from http://www.frontline.in/static/html/fl2705/stories/20100312270502000.htm

> In India, 65% of the agricultural land is still dependent on monsoon. There is need for more investment in biotechnology-driven solutions to increase yields[60].

To summarize the results of the third level of analysis, the Indian scientists in many instances (re)formulated the context of their arguments in ways that corresponded with their overall standpoint.

6.5 Summary

To summarize, the results of the first level of analysis indicated that the Indian scientists manifested diverse, non-routine ways of articulation of BtBr in public as observed in various *genres, styles and discourses* across the variety of the opinion texts (journal commentaries, newspaper columns and internet blogs). For example, scientists showed *diverse ways of (inter)acting* in using multiple popular media platforms to publicly speak about the problem of BtBr. These actions reflected upon certain *ways of being* of the Indian scientists which assumed a specific standpoint or an overall position for BtBr in their articulations. Their positions ranged across the spectrum of viewpoints: they either approved, approved with conditions, suggested to wait until precautionary conditions are met or rejected BtBr. Within their chosen ways of writing in various media platforms and taking various standpoints, these scientists identified BtBr as a problem object and thus *represented* it in a broader context by using diverse discursive frameworks which were noted as both common to the widely held beliefs about GMOs in society (in such areas as human health

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[60] Kocchar, V.K.,& Kocchar, S. (2012). Need for management and risk assessment of genetically modified Organisms. *Current Science, 102*(2).

and environment, food security, and farmers' issues and legal rights). They also addressed issues specific to the Indian context (the eggplant in Indian culture and heritage and India as a center of origin. They further addressed the national context, national investments and indigenous research).

As noted in the second level of analysis, Indian scientists barely changed their standpoint or opinions about BtBr across media platforms. However, a significant difference in the topics and ways of expression was observed for some scientists, who raised more of the socially oriented topics and manifested more of the non-routine ways of communication in newspaper columns and internet blogs compared to journal commentaries.

From the third level of analysis, I highlighted those instances where Indian scientists re-contextualized some of the discourses in order to favor their chosen standpoints.

Overall, my analysis illustrates that the Indian scientists' communication via journal commentaries, newspaper columns and internet blogs during the BtBr controversy manifested ways which were atypical and non-routine of the ways in which scientists communicate in society. And therefore, the communication of scientists in this case was reflective of *deviation* in routine public communication of science. A closer look at the scientists' ways of articulations in this case suggests that they *problematized* BtBr at the public level. Moreover, these ways of articulations indicate scenarios in which scientific issues of modern times are discussed in public as well as elaborate on the role of scientists in such discussions. In my next and the last chapter, I discuss these observations in details– in the broader context of deviations, problematization and post-normal science.

CHAPTER 7 DISCUSSION

7.1 Overview

Models of public communication of science have largely focused on the routine circumstances in which science is communicated in public through mediated channels and have seldom addressed the cases of deviations–those circumstances of controversies when scientists address the public directly by skipping the usual stages of science communication (Bucchi, 1996). The nature of communication in cases of deviations and the role of scientists within these instances, such as their ways of making and circulating meanings in controversies, have been particularly ignored. Using the theoretical frameworks of Foucault's problematization and post-normal science and the methodological framework of Fairclough's critical discourse analysis (CDA), my study examines the communication roles of scientists in cases of deviations by analysing the popular opinion texts (journal commentaries, newspaper columns and Internet blogs) of the Indian scientists in the BtBr controversy where they addressed the problem of BtBr at the public level in India.

The BtBr case is an interesting one of controversy where the first genetically modified food crop in India was publicly announced for commercialisation that led to the ensuing controversy subjected to the indefinite moratorium–a status that remains to the this day. In the context of deviation, I suggest that the Indian scientists played an important communications role–as perhaps the decision would have been different if the Indian scientists had not participated in the debate. Therefore, this case is a compelling example that illustrates how in modern controversies the local conditions (large public outcry, NGO protests, media coverage, etc.) can compel scientists to participate in the debate and communicate directly with the public–an onset of the conditions for deviations.

In my investigation, I used the critical discourse analysis of the popular texts by which the Indian scientists communicated in the controversy. My analysis suggests that the Indian scientists manifested diverse, non-routine ways of articulation of BtBr in public by their emphasis on the social, cultural and regulatory aspects rather than the scientific aspects of the problem. In other words, their contending strategies of (inter)acting on the problem, non-typical ways of self-being in addressing the problem and socio-cultural representations of the problem reflect how they problematized BtBr at the public level. These ways of articulating the practices or of rules of conceptualized genetic modification and the regulation of genetically modified products on a broader societal scale framed the problem beyond mere decision of the commercialisation of BtBr. This suggests that such problem constructing of BtBr by the Indian scientists exemplifies the post-normal conditions that highlighted conflicts around social and moral value-systems rather than scientific objectivity.

In the following sections, I elaborate on my analysis of the discursive articulations of the Indian scientists to illustrate (a) how their communication strategies as used in the BtBr controversy make BtBr a deviation case, (b) how such strategies reflect elements of problematization of BtBr and (c) how framing of BtBr as a problem is suggestive of post-normal times.

7.2 BtBr Case as a Case of Deviation in Communication

In chapter-2 literature review, I elaborated on the concept of deviation in communication and the conditions that lead to deviations. Briefly, deviations represent an alternative form of public communication of science in which scientists tend to communicate directly with the public, skipping the intermediate stages of communication in situations of scientific controversies or crisis.

When the implementation of a technological product attracts a national level of public controversy, then their professional or moral responsibility may prompt scientists to directly address the public, on-setting the modalities or conditions of deviations. As was the case in the BtBr controversy, Indian scientists directly addressed the public via popular texts resulting in a national controversy over the first genetically modified eggplant in India.The non-typical way of communication deviates from the general communication continuum of the public communication of science where scientists are separated from the public by intermediate institutions and the media (Bucchi, 1996; Bucchi & Trench, 2008b).

Indian scientists specifically used non-typical media platforms such as journal commentaries, newspaper columns and Internet blogs to express themselves in the controversy. This broader range of outlets used by them served as a “plurality of sites” for (re)making scientific claims, which demonstrates conditions of deviations (Bucchi, 1996, p. 381). Moreover, most of their journal commentaries, newspaper columns and Internet blogs were published between 2009 and 2010, with some texts published between 2010-2012, which indicates that this use of popular media by the Indian scientists was in response to the rising public controversy which reached peak levels around the same time (from the first announcement of commercialisation of BtBr in 2009 to its moratorium in 2010).Furthermore, they took different standpoints or overall positions for BtBr in public which clearly demonstrated their disagreement with each other. In many cases, scientists’ positions were reflective of their particular interests or backgrounds. For instance, one scientist who supported BtBr in public also served as the member of the committee that approved BtBr. The influence of background and affiliations of scientists influenced their standpoints and cannot be ignored. In fact, these positions were themselves problem-oriented as they represented complex perspectives as opposed to mere approval and rejection. These observations suggest that the communication of the Indian scientists in the BtBr controversy was illustrative of deviation in communication.

The nature of the arguments in popular texts further supports my interpretation. For example, as opposed to presenting solutions to the problem of BtBr, the Indian scientists represented BtBr as a social problem, tagging it with positive, negative or neutral identity (such as a benefit, disaster and skeptical objection, respectively). Discursively, they used frameworks of both GMO debates at broader international levels as well as those specific to the Indian context including socio-economic, environmental and political contexts in India – contexts normally absent in their ways of writing in standard scientific papers. This presented the broader complexity of scientific thoughts in multiple hues of opinions by the Indian scientists which is also typical of deviations (Bucchi, 1996; Bucchi & Trench, 2008b). Moreover, in articulating their opinions, the Indian scientists manipulated meanings of some of the existing representation of GMOs as well as brought new meanings into the specific social and cultural contexts of India. I have given several examples of this in my results and analysis chapter. For example, Indian scientists brought forth the common GMO issue of the 'impact on biodiversity' and in addition to discussing the potential impact of BtBr on biodiversity, they debated on what biodiversity really meant and how the 'impact' on biodiversity is appropriately assessed. Further, they used the context of the large biodiversity of BtBr as indicated by the availability of more than 2,000 Brinjal (eggplant) varieties in India to raise the cultural issue of India being the centre of origin of Brinjal. These examples demonstrated how in this case the scientific "facts" were "dissolved, deconstructed or simply manipulated" (Bucchi & Trench, 2008b, p. 65) by the Indian scientists to support their standpoint which often happens in deviation cases. Moreover, frequent use of tags for BtBr such as ‘eco-friendly technology[61]’ by scientists who support BtBr or as ‘foreign technology’ by those who reject BtBr promoted self-interested claims. Also, claims such as how on one hand the specific characters in plants (e.g. herbicide tolerance) may be useful to enhance agriculture productivity by clearing lands from the unwanted weeds on a large scale, but on the other hand may cause employment crises for women in certain Indian regions where female labour is extensively employed for manual weed removal, raised value-based assessments of BtBr. These and similar examples in my analysis suggest that the scientific claims were “assimilated into interest- and value-laden political claims” indicative of deviations (Bucchi, 1996, p. 387).

7.3 Indian Scientists Problematized BtBr

The role of the Indian scientists in problematizing BtBr is at first indicated in their use of the broad public media platforms which accounted for the vast proliferation of the problem at the public level (similar to Foucault’s inquiry of sex in the nineteenth century, about the vast proliferation of scientific definitions about “sex”, the growth of medical terminologies about sexuality and how sexuality was linked to the health of the individual, to race and so forth) (Foucault & Rabinow, 1984, p. 11). In using more popular media platforms, they linked BtBr with broader social problems of the contemporary world such as global warming to publically indicate the severity of the problem.

A closer look on their arguments and discursive formulations illustrates this further. As stated earlier, the Indian scientists represented BtBr as a problem by giving it several tags

[61] Claiming that BtBr will reduce the amount of external pesticide generally required for eggplants and thus will reduce the heavy agricultural dependence on chemical pesticides and their release into the environment.

or identities. Such instances indicated that BtBr was subjected to objectification and had become the "object of thought" for the Indian scientists (Foucault et al., 2003, p. 29). Within these representations, certain expressions such as blaming of the Indian system at large and warning against others' standpoints further illustrated scientists' ways of describing what the problem was, who was responsible for it, and how it could be solved. For example, the Indian scientists attributed blame largely at the Indian ministry and the Indian regulatory system for not properly evaluating BtBr safety data from field trials and approving BtBr for commercialisation. They also warned against several social, economic and legal aspects of the problem by linking BtBr's distribution and regulation with bigger social issues such as the corporate monopoly and illegal trade[62]. In other words, Indian scientists asserted responsibility of the problem on other actors as well as moral obligation on others and not themselves to solve the problem. Such "responsibilisation" both of self and specific others is closely inclined to the act of problematization in ways which indicate how an object on moral grounds can be exhorted as good or bad and if something turns out to be bad, then how can people be held responsible for it, thus problematizing both the object as well as people who are responsible for the problem (Whelan & Asbridge, 2013, p. 404). Such conditions advance the debate by bringing the object into "the play of right or wrong" (Foucault et al., 2003, p. 29) as was observed in this case in which scientists debated whether it was right or wrong to approve BtBr.

Furthermore, the grounds on which BtBr were assessed were problematic as they presented a rather contentious representation of ideas. For example, some Indian scientists

[62] vast proliferation of Bt eggplants may result in the shortage of non-Bt eggplant seeds in future further leading to the problem of the illegal seed trade of non-Bt seeds across the country

framed BtBr as the solution to the heavy dependence on chemical pesticides but others framed it as a problem that may cause gene contamination and loss of biodiversity. Thus, overall in the debate, BtBr was framed both as a solution as well as problem to the broader problem of the environment.

There are other similar instances in my analysis that indicate this problematizing of the solution (the BtBr) by the Indian scientists. The discourses within the specific Indian context attributed moral meanings to the BtBr, as jeopardy to the employment of poor Indian women, as lessons to devise the truly indigenous practices of agriculture in India, as trespassing of the rich Indian flora by foreign authorities, and as threats to long held beliefs within the Indian culture and tradition.

Also, some Indian scientists extended their views on the known phenomenon of gene transfer (about how genes are transferred in nature from one specie to another) in ways that produced "new knowledges" or claims (Deacon, 2000, p. 131), such as the claim that BtBr may accidently contain segments of the HIV virus gene which also identifies with the conditions of problematization (Deacon, 2000). Some scientists also challenged the widely accepted notion in India that it is the centre of origin of the eggplant, so much so that they analytically investigated some of the historic documents (some of which are in Sanskrit, the ancient Indian language) −in an archeological investigation (in Foucault's language), to find out the context in which the use of eggplant in historic times was mentioned. Such acts that "put into question accepted truth" are illustrative of problematization (Bacchi, 2012, p. 1).

All these instances clearly illustrate that the Indian scientists problematized BtBr via various discursive representations in their arguments.

7.4 BtBr can be understood as a Problem of Post-Normal Times

Earlier in the controversy, the terms for the approval of BtBr had become more contentious when the experimental phase was extended into the final phases of commercialisation, which altogether raised regulatory as well as policy conflicts. Beyond the regulatory route of approval of GMOs in India, such as the safety assessment and final decision on GMOs by the scientific experts of the regulatory body− GEAC[63], the ministry had to consult with many participants in the debate including farmers, state-ministers and some elite scientists on the proposal of commercialisation of BtBr through personal meetings as well as country-wide public consultations. The official procedures underwent tensions before BtBr was subjected to an indefinite moratorium−a status that still persists. The role of the Indian scientists in this policy debate was unique in its own sense as they manifested non-routine ways of articulation and problem representation of BtBr which were both contentious and illustrative of the criteria of the policy-driven scientific problems of the post-normal times (Funtowicz & Ravetz, 2003, p. 1) − those which constitute the uncertainty of scientific facts (and knowledge), the dispute of the social and cultural values in Indian context, the high stakes invested in the form of large capital investments and eight years in the product development and the urgency of decisions which also led to various country wide public consultations.

In post normal times, uncertainties which are not easily tractable from within a narrow technical definition of the problem at hand, as a result of which "the plurality of legitimate perspectives" which were previously neglected in traditional scientific practices,

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[63] Genetic Engineering Approval Committee

emerge (Funtowicz & Ravetz, 2003, p. 1). Such plurality was observed within the arguments of the Indian scientists, some of whom did not simply approve or reject BtBr; instead, they put forth various social, cultural and regulatory recommendations before the ministry (via direct consultation) as well as before the public (via opinions in popular media). In those recommendations, there was no single or multiple solutions that could immediately solve the BtBr problem and lay down a clear policy pathway for the future GMOs in India. Instead, there was the tendency to find the best ways of implementing BtBr in the future, indicating that such problems of the post-normal times are not to be sorted out through the scientific objectivity (of the unquestionable knowledge) but must be addressed for the best possible outcomes by considering "soft" social and cultural values (Funtowicz & Ravetz, 2003).

The non-routine, often problematic conditions are recognized as the "new" conditions of the scientific activity in post-normal times (Funtowicz & Ravetz, 1993, p. 739). In this context, new ways of scientific communication (as part of scientific activity) such as the use of popular media platforms by the Indian scientists to politically influence the policy-debate on BtBr, also suggest the emerging trends of post normal times in which science may be communicated. Also, in such times, arguments in a public debate must resonate with the "public meanings" which then "depend less upon whether discursive claims have factual validity than upon whether they offer culturally believable diagnoses of societal problems" (Levidow & Carr, 2007, p. 410). In the case of BtBr, the arguments raised by the Indian scientists such as the centre of origin of Brinjal (eggplant) and indigenous research offer an exact interpretation of how the problem of BtBr was diagnosed on culturally believable assumptions rather than on factual validity.

Moreover, the policy-debate which involved only a handful of the elite Indian scientists as the subject-matter experts was later joined by many other Indian scientists (both experts and non-experts on biotechnology and GMOs on diverse media platforms− on "blogosphere" (Ravetz, 2011, p. 156)− as part of the extended-peer community (Funtowicz & Ravetz, 1993, p. 753). This gives a sense of how some policy-based scientific problems of current times can be based on values which attribute moral responsibility to those who are directly or indirectly involved in the decision making, setting-up conditions to attract the extended peer community in the debate.

Furthermore, the very name of the authoritative regulatory body on GMOs in India−GEAC−, was seen as a problem to the unbiased and ethical assessment of GMOs in India. The GEAC which was previously known as the Genetic Engineering 'Approval' Committee, was subjected to great criticism by some Indian scientists for giving the regulatory clearance to BtBr. Its name was particularly framed as indicative of the biased regulatory regime that aimed at only approving rather than disinterestedly appraising GM crops in India. As a result, while imposing a moratorium on BtBr in Feb 2010, the Ministry announced the change in the name of GEAC to the Genetic Engineering 'Appraisal' Committee. The change was announced publicly through a gazette notification issued on July 22, 2010. In addition, the Biotechnology Regulatory Authority of India (BRAI) Bill was introduced in the Indian cabinet on April 22, 2013 to replace GEAC with the proposed Biotechnology Regulatory Authority for regulating GMOs in India[64]. These policy changes, which were implemented shortly after the moratorium and as part of the on-going debate

[64] Source: http://www.prsindia.org/billtrack/the-biotechnology-regulatory-authority-of-india-bill-2013-2709/

over BtBr, suggest that the problem of BtBr is a non-objective, value laden problem of post-normal times and hence should be addressed accordingly.

7.5 Conclusion

The BtBr case shows the conditions of the policy-driven, controversial and un-resolved scientific matters that need to be addressed in the post normal view of science practice. Scientists' communication has given greater impetus to the problem with non-typical, socio-cultural framing of the problem in public. However, so far from the regulatory aspect, the problem of BtBr lingers in India, as it has been almost seven years since a moratorium on BtBr, and no certain policy outcome has been noted on the decision of BtBr as well as other modified crops in the pipeline. At most, BtBr field trials continue only to inundate safety data. The question then arise What new data will emerge from these continuing trials that can possibly guide policy for the commercialisation of BtBr? As of now, my study indicates that it is not the scientific data but the problematic presentation of scientific knowledge in the form of discursive articulations by scientific experts whose words are still revered in countries like India. And when those experts contend and problematize at the public level, it is likely that marginal situations will arise and controversies will only get worse, triggering modalities of deviations. In those circumstances, the problem should be seen as the problem of post-normal times that must be adequately addressed through value-based systems rather than mere scientific objectivity. In cases like the BtBr case, we must acknowledge the plurality of perspectives in order to properly address scientific problems that can lead to conclusive or more broadly acceptable outcomes (Petersen, Cath, Hage, Kunseler, & Jeroen, 2011, p. 365).

7.6 Significance of the Present Study

My study provides a more recent account of deviation cases in modern scientific controversies by focusing on the case of Bt-Brinjal for analysis. It particularly sheds light on the role of scientists in the public communication of scientific controversies, which remains an under-explored area in the scholarly fields of science communication and public understanding of science (PUS).

Developing countries provide huge markets, cheap labour and desirable resources that are the particular targets of many western corporations. For example, in the case of Bt-Brinjal, the U.S.-based agriculture giant Monsanto holds a 50-50 partnership with the Indian-based Mahyco that promotes the development of GM crops in India. By focusing on some of the insights of the Bt-Brinjal story and highlighting the discursive representations that were at play, my study also directs attention to the intriguing scenarios in rapidly developing economies, particularly in a very large country like India where the trajectory of development of GM crops may be different from other developing economies in the global south. This vase illustrates the important consideration of socio-cultural factors in modern science and technology debates.

Policy-wise, my study emphasizes how policies and decision-making around the scientific inquiries of modern times should be directed, that they should account for both uncertainty as well as plurality of legitimate perspectives as illustrated by the theory of post normal science. To further contribute to this notion, my study also demonstrates how a specific national and cultural context can significantly impact policy outcomes and hence should be part of policy discussion over the successful implementation of technology.

7.7 Limitations of the Present Study

My study specifically aimed to investigate the communication strategies by which the Indian scientists publicly addressed the problem of BtBr in India. As a result, the roles played by other actors were not analysed which may have given a larger picture of the network. For example, the role of media as another player in the controversy was not thoroughly analysed. Comparison of scientists' opinion texts with those of media news stories could provide an understanding of how the media specifically framed the problem and how similar or different the media framing of the problem was from the representations that were propounded by the scientists as experts.

Sample-wise, my analysis was limited to journal commentaries, newspaper columns and Internet blogs−all of which were readily available online. Locally printed popular texts were not investigated due to the limitation of the availability of resources. Transcripts of interviews of scientists were also not analysed due to time constraints. Although, it could have given more information, I preferred to investigate the free flowing opinion texts as opposed to the typical Q/A format of news interviews in which opinions by the interviewer may cloud the results of the interview.

Also, the work primarily relied on the printed forms of opinion texts for analysis and I did not interview the chosen scientists for clarification of their arguments or propositions. Reading intentions from texts is a tricky proposition. However, it served the purpose of the research inquiry as it was to answer how the Indian scientists problematized BtBr through publicly circulating texts, irrespective of whether they intended to do so or not. My focus was more towards investigating how their opinions (and what messages lay within) were circulated in the larger public domain than to deeply ponder their actual intentions through interviews. The opinions of foreign scientists were also not included. This is because the focus was to investigate scientists' communication activities within the Indian context and within the limited time frame of this analysis. Another limitation of this study is that I did not use a second coder that perhaps would have been helpful to compare against my judgment of the text.

7.8 Further Considerations/Future Inquiries

Another theme that is central to both the academic fields of Science Communication and Public Understanding of Science is the "issue of credibility and reliability of information" (Bucchi, 2017, p. 890). By elaborating on the wide range of scientists' perspectives on the problem which drew on a range of social, environmental and economic considerations than simply approval or rejection for Bt-Brinjal, my study reflects on the role of experts in policy debates and outcomes as well as the use of scientific knowledge in cases of social controversy.

Also, I have demonstrated that the Indian scientists problematized the solution to the current agriculture and food problems in India, as previously advocated by the Indian government and many scientists in favour of Bt-Brinjal. In this context, it would have been useful to elaborate on the political aspects of the case and the role of the government which I did not cover but which is also closely linked to the concept of problematization as introduced by Foucault in his study of power relations (Lemke, 2011). I do provide a hint of this in my study in the briefly describing the role of Indian regulatory bodies in initially approving Bt-Brinjal and advocating the need of GM crops to mitigate the current agriculture and food crisis in India. For example, I provide an insight into how scientists can also be part of assessing the solution (BtBr) initially proposed by the ministry on socio-cultural grounds.

I suggest that this aspect can be analysed using Foucauldian concept of governmentality (Lemke, 2011).

7.9 Questions for Further Research

To provide some answers to future research inquiries as discussed above, it may be useful to investigate more recent cases of scientific controversies with different national and cultural contexts, which may bring to light unique societal factors and discursive representations that my study did not cover. The broad range of literatures my study relied on did not allow for further investigation of GM food controversies in many other countries and further studies might focus on different ways of problematization of the same GM technology.

The present inquiry on the Bt-Brinjal case can also be expanded to focus on the role of various Indian publics, to illustrate how the different Indian communities would interpret the popular messages about BtBr, or how they would specifically evaluate the role of scientists in this controversy. From a communications perspective, such a study of the public may shed light on the traditional models of the passive audience, public trust in experts and the views of different Indian publics who engage with the issue in different ways, making connections with the public understanding of science literature perhaps in a different cultural context. The theoretical as well the methodological frameworks chosen in my study can also be applied to the future GMO cases within the Indian context− such as for the case of GM-Mustard, which is another recently developed GM food crop in India that is currently under policy review. By using another theoretical framework such as the actor-network theory (ANT), this work can also be extended to understand the interplay of other key actors in this controversy such as the pro- and anti-GMO lobby groups, the media and the public.

References

Anthony, V. M., & Ferroni, M. (2012). Agricultural biotechnology and smallholder farmers in developing countries. *Current opinion in biotechnology, 23*(2), 278-285.

Bacchi, C. (2012). Why Study Problematizations? Making Politics Visible. *Open Journal of Political Science, 2*(1), 1-8.

Bacchi, C. (2015a). Problematizations in Alcohol Policy: WHO's "Alcohol Problems". *Contemporary Drug Problems, 42*(2), 130-147. doi: 10.1177/0091450915576116

Bacchi, C. (2015b). The Turn to Problematization: Political Implications of Contrasting Interpretive and Poststructural Adaptations. *Open Journal of Political Science, 5*, 1-12.

Bacchi, C. (2016). Problematizations in Health Policy: Questioning How "Problems" Are Constituted in Policies. *SAGE 6*(2). doi: 10.1177/2158244016653986

Barben, D. (2010). Analyzing acceptance politics: Towards an epistemological shift in the public understanding of science and technology. *Public Understanding of Science, 19*(3), 274–292.

Bauer, M. (2002). Controversial medical and agri-food biotechnology: a cultivation analysis. *Public Understanding of Science*, *11*(2), 93-111.

Bauer, M., Allum, N., & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science, 16*(1), 79-95. doi: 10.1177/0963662506071287

Besley, J. C., & Tanner, A. H. (2011). What science communication scholars think about training scientists to communicate. *Science Communication, 33*(2), 239-263.

Billig, M. (2008). The language of critical discourse analysis: the case of nominalization. *Discourse & Society, 19*(6), 783–800.

Bogner, A., & Torgersen, H. (2015). Different ways of problematising biotechnology - and what it means for technology governance. *Public Understanding of Science, 24*(5), 516-532. doi: 10.1177/0963662514539074

Braun, R. (2002). People's concerns about biotechnology: some problems and some solutions. *Journal of Biotechnology, 98*(1), 3-8.

Bubela, T., Nisbet, M. C., Borchelt, R., Brunger, F., Critchley, C., Einsiedel, E., . . . Caulfield, T. (2009). Science communication reconsidered. *Nature biotechnology, 27*(6), 514-518.

Bucchi, M. (1996). When scientists turn to the public: alternative routes in science communication. *Public Understanding of Science*, *5*, 375–394.

Bucchi, M. (1998). *Science and the Media: Alternative Routes to Scientific Communications*: Taylor and Francis.

Bucchi, M. (2004). Can genetics help us rethink communication? Public communication of science as a 'double helix'. *New Genetics and Society, 23*(3), 268-283.

Bucchi, M. (2017). Credibility, expertise and the challenges of science communication 2.0: SAGE Publications Sage UK: London, England.

Bucchi, M., & Trench, B. (2008a). *Handbook of public communication of science and technology*: Routledge.

Bucchi, M., & Trench, B. (2008b). Of deficits, deviations and dialogues: Theories of public communication of science. *Handbook of public communication of science and technology,* 57-76.

Burns, T. W., O'Connor, D. J., & Stocklmayer, S. M. (2003). Science communication: a contemporary definition. *Public Understanding of Science, 12,* 183–202.

Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., . . . Wardle, D. A. (2012). Biodiversity loss and its impact on humanity. *Nature, 486*(7401), 59-67.

Carpenter, J. E. (2011). Impact of GM crops on biodiversity. *GM crops, 2*(1), 7-23.

Centre for Environment Education. (2010). *National Consultations on Bt Brinjal Report*. Ministry of Environment and Forests (MoEF).

Cericola, F., Portis, E., Toppino, L., Barchi, L., Acciarri, N., Ciriaci, T., . . . Lanteri, S. (2013). The population structure and diversity of eggplant from Asia and the Mediterranean Basin. *PloS one, 8*(9), e73702.

Dang, H., Gilmour, B., & Kishor, N. (2015). India's Agri-Biotech Policies, Regulations, and Decision-making.

Davies, S. R. (2008). Constructing Communication:Talking to Scientists About Talking to the Public. *Science Communication, 29*(4), 413-434.

Deacon, R. (2000). Theory as practice: Foucault's concept of problematization. *Telos, 2000*(118), 127-142.

Dent, C. (2009). Copyright, Governmentality and Problematisation. *Griffith Law Review, 18*(1), 129-150. doi: 10.1080/10383441.2009.10854633

Dibden, J., Gibbs, D., & Cocklin, C. (2011). Framing GM crops as a food security solution. *Journal of Rural Studies, 29*(Journal Article), 59. doi: 10.1016/j.jrurstud.2011.11.001

du Plessis, H. (2008). Public communication of science and technology in developing countries. *Handbook of public communication of science and technology,* 213.

Dudo, A. (2013). Toward a model of scientists' public communication activity: The case of biomedical researchers. *Science Communication, 35*(4), 476-501.

Dunwoody, S., & Scott, B. T. (1982). Scientists as Mass Media Sources. *Journalism & Mass Communication Quarterly, 59*(1), 52-59. doi: 10.1177/107769908205900108

Eaton, E. (2013). *Growing resistance: Canadian farmers and the politics of genetically modified wheat*: Univ. of Manitoba Press.

Einsiedel, E. F. (2008). Public participation and dialogue. *Handbook of public communication of science and technology*, 173-184.

Fairclough, N. (1995). *Critical discourse analysis: the critical study of language*. New York: Longman.

Fairclough, N. (2001). The dialectics of discourse. *Textus, 14*(2), 231-242.

Fairclough, N. (2003). *Analysing discourse: Textual analysis for social research*: Psychology Press.

Fairclough, N. (2013). *Critical discourse analysis: The critical study of language*: Routledge.

FAO, IFAD, & WFP. (2014). *The State of Food Insecurity in the World.Strengthening the enabling environment for food security and nutrition.* Rome: FAO.

Fischhoff, B. (2013). The sciences of science communication. *Proceedings of the National Academy of Sciences, 110*(3), 14033–14039.

Foucault, M., & Rabinow, P. (1984). *The Foucault reader*. New York: Pantheon Books.

Foucault, M., Rabinow, P., & Rose, N. (2003). *The essential Foucault: selections from the essential works of Foucault, 1954-1984*. New York: New Press.

Frederiksen, K., Lomborga, K., & Beedholma, K. (2015). Foucault's notion of problematization: a methodological discussion of the application of Foucault's later work to nursing research. *Nursing Inquiry, 22*(3), 202–209.

Funtowicz, S., & Ravetz, J. (1991). A New Scientific Methodology for Global Environmental Issues. *Ecological Economics: The Science and Management of Sustainability*, 137-152.

Funtowicz, S., & Ravetz, J. (1993). Science for the post-normal age. *Futures, 25*(7), 739-755. doi: 10.1016/0016-3287(93)90022-l

Funtowicz, S., & Ravetz, J. (1995). Science for the post normal age *Perspectives on ecological integrity* (pp. 146-161): Springer.

Funtowicz, S., & Ravetz, J. (2003). Post-normal science. *International Society for Ecological Economics* 1-10.

Gaskell, G. (2001). Agricultural biotechnology and public attitudes in the European Union. *AgBioForum, 3*(2), 87-96.

Gaskell, G., Allum, N., Bauer, M., Durant, J., Allansdottir, A., Bonfadelli, H., . . . Gutteling, J. M. (2000). Biotechnology and the European public. *Nature biotechnology, 18*(9), 935.

Government of India. (2009). *Report of the Expert Committee (EC-II) on Bt Brinjal event EE-I* New Delhi.

Greenhalgh, T. (2005). *Diffusion of innovations in health service organisations: a systematic literature review*. Malden, Mass: BMJ Books/Blackwell Pub.

Horst, M., & Michael, M. (2011). On the shoulders of idiots: Re-thinking science communication as 'event'. *Science as Culture, 20*(3), 283-306.

Huang, J., Hu, R., Pray, C., Qiao, F., & Rozelle, S. (2003). Biotechnology as an alternative to chemical pesticides: a case study of Bt cotton in China. *Agricultural Economics, 29*(1), 55-67. doi: 10.1016/s0169-5150(03)00044-6

Hunt, A. (2002). The problematisation of law in classical theory. In R. Banakar & M. Travers (Eds.), *An introduction to Law and Social Theory*. Oxford-Portland Oregon: Hart Publishing.

Irwin, A., & Wynne, B. (1996). *Misunderstanding science?: the public reconstruction of science and technology*. Cambridge;New York;: Cambridge University Press.

Isaac, G. (2002). *Agricultural biotechnology and transatlantic trade: regulatory barriers to GM crops*. Wallingford, Oxon, UK: CABI Pub.

Jasanoff, S. (2003). (No?) Accounting for expertise. *Science and Public Policy, 30*(3), 157-162.

Jørgensen, M. W., & Phillips, L. J. (2002). *Discourse analysis as theory and method*: Sage.

Kinchy, A. (2012). *Seeds, science, and struggle: the global politics of transgenic crops*. London, England: The MIT Press, Cambridge, MA.

Kohli, K., & Bhutani, S. (2015). Access to India's biodiversity and sharing its benefits. *Economic & Political Weekly, I*(31), 19-22.

Legge, J. S., & Durant, R. F. (2010). Public opinion, risk assessment, and biotechnology: Lessons from attitudes toward genetically modified foods in the European union. *Review of Policy Research, 27*(1), 59-76. doi: 10.1111/j.1541-1338.2009.00427.x

Lemke, T. (2011). *Foucault, governmentality, and critique*. Boulder, Colo: Paradigm Publishers.

Levidow, L., & Carr, S. (2007). GM crops on trial: Technological development as a real-world experiment. *Futures, 39*(4), 408-431. doi: 10.1016/j.futures.2006.08.002

Lewenstein, B. V., & Brossard, D. (2006). Assessing models of public understanding in ELSI outreach materials: Cornell University.

Maclaurin, J., & Sterelny, K. (2008). *What is biodiversity?* : University of Chicago Press.

Malhotra, B., Siddappa, S., Gupta, R., Pattanayak, D., Huddone, S., Verma, A., . . . Patil, V. U. (2012). Indian entrepreneurship in biotechnology comes of age. *Journal of Plant Biochemistry and Biotechnology, 21*(S1), 90-99. doi: 10.1007/s13562-012-0145-y

Mazur, A. (1981). Media coverage and public opinion on scientific controversies. *Journal of Communication, 31*(2), 106-115. doi: 10.1111/j.1460-2466.1981.tb01234.x

McHughen, A. (2000). *Pandora's picnic basket: the potential and hazards of genetically modified foods*. Oxford: Oxford University Press.

Miller, S. (2001). Public understanding of science at the crossroads. *Public Understanding of Science, 10*(1), 115-120. doi: 10.1088/0963-6625/10/1/308

Myhr, A. I. (2010). The Challenge of Scientific Uncertainty and Disunity in Risk Assessment and Management of GM Crops. *Environmental Values, 19*(1), 7-31. doi: 10.3197/096327110x485365

Nisbet, M. C., & Scheufele, D. A. (2009). What's next for science communication? Promising directions and lingering distractions. *American Journal of Botany 96*(10), 1767–1778.

PANAP. (2012). India's BT Brinjal Battle Pesticide Action Network Asia and the Pacific.

Pearson, G. (2001). The participation of scientists in public understanding of science activities: The policy and practice of the UK Research Councils. *Public Understanding of Science, 10*(1), 121-137.

Pereira, A. G., & Funtowicz, S. O. (2006). Knowledge representation and mediation for transdisciplinary frameworks: tools to inform debates, dialogues & deliberations. *International Journal of Transdisciplinary Research 1*(1), 34-50.

Petersen, A. C., Cath, A., Hage, M., Kunseler, E., & Jeroen, P. v. d. S. (2011). Post-Normal Science in Practice at the Netherlands Environmental Assessment Agency. *Science, Technology, & Human Values, 36*(3), 362-388. doi: 10.1177/0162243910385797

Ravetz, J. R. (1999). What is post-normal science. *Futures, 31*(7), 647-653. doi: 10.1016/s0016-3287(99)00024-5

Ravetz, J. R. (2006). Post-Normal Science and the complexity of transitions towards sustainability. *Ecological Complexity, 3*, 275 – 284.

Ravetz, J. R. (2011). ‘Climategate’ and the maturing of post-normal science. *Futures, 43*(2), 149-157. doi: 10.1016/j.futures.2010.10.003

Rogers, E. M. (2002). Diffusion of preventive innovations. *Addictive behaviors, 27*(6), 989-993.

Rogers, E. M. (2003). *Diffusion of innovations* (5 ed. Vol. 12). New York: Free Press.

Royal Society. (2006). Survey of factors affecting science communication by scientists and engineers. Final report. London.

Shapin, S. (1992). Why the public ought to understand science-in-the-making. *Public Understanding of Science, 1*(1), 27-30. doi: 10.1088/0963-6625/1/1/006

Stekolschik, G., Draghi, C., Adaszko, D., & Gallardo, S. (2010). Does the public communication of science influence scientific vocation? Results of a national survey. *Public Understanding of Science, 19*(5), 625–637.

Sturgis, P., & Allum, N. (2004). Science in society: re-evaluating the deficit model of public attitudes. *Public Understanding of Science, 13*, 55–74.

Swann, G. M. P. (2009). *The economics of innovation: an introduction*. Northampton, MA: Edward Elgar.

Tainter, J. A., Allen, T. F. H., & Hoekstra, T. W. (2006). Energy transformations and post-normal science. *Energy, 31*(1), 44-58. doi: 10.1016/j.energy.2004.06.002

Treise, D., & Weigold, M. F. (2002). Advancing Science Communication: A Survey of Science Communicators. *Science Communication, 23*(3), 310-322.

Trench, B. (2006). *Science communication and citizen science: how dead is the deficit model.* Paper presented at the IX International Conference on Public Comunication of Science and Technology (PCST), Seoul, Korea.

Trench, B., & Bucchi, M. (2010). Science communication, an emerging discipline-road maps for the 21st-century research in science communication. *Journal of Science Communication, 9*(3).

Turnpenny, J. R. (2012). Lessons from post-normal science for climate science-sceptic debates. *Wiley Interdisciplinary Reviews: Climate Change, 3*(5), 397-407. doi: 10.1002/wcc.184

Udovyk, O., & Gilek, M. (2014). Participation and post-normal science in practice? Reality check for hazardous chemicals management in the European marine environment. *Futures, 63*, 15-25.

Vaughan-Williams, N. (2006). Towards a problematisation of the problematisations that reduce Northern Ireland to a ‘problem’. *Critical Review of International Social and Political Philosophy, 9*(4), 513-526.

Venn, C. (2010). Aesthetics, politics, identity: diasporic problematisations. *Critical Arts, 24*(3), 321-347. doi: 10.1080/02560046.2010.511870

Weigold, M. F. (2001). Communicating Science: A Review of the Literature. *Science Communication*, *23*(2), 164-193. doi: 10.1177/1075547001023002005

Whelan, E., & Asbridge, M. (2013). The OxyContin crisis: Problematisation and responsibilisation strategies in addiction, pain, and general medicine journals. *International Journal of Drug Policy*, *24*(5), 402-411. doi: 10.1016/j.drugpo.2013.01.007

Wynne, B. (1991). Knowledges in Context. *Science, Technology, & Human Values, 16*(1), 111-121. doi: 10.1177/016224399101600108

Wynne, B. (1992). Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science*, *1*(3), 281-304. doi: 10.1088/0963-6625/1/3/004

Zemlicka, K. (2015). *Public argument and the "human": Rhetoric, values, and difference in the biotechnology debate.* Dissertation/Thesis, ProQuest Dissertations Publishing.

Appendix I: A code sheet of one of the journal commentary articles indicating different categories in bold in which the content of the text was arranged.

1.1 Code: Byravan, S. 2010. The Inter-Academy Report on Genetically Engineered Crops: Is It Making a Farce of Science?, Economic & Political Weekly
1.2 Type: Commentary
1.3 Outlet: Journal
1.4 Author (s) Sujatha Byravan
1.5 Author(s) background: Geneticist, Principal Research Scientist, Center for Study of Science, Technology & Policy, Bengaluru.
1.6 Overall recommendation/position: (1) Approve (2) Approve but with conditions (3) Wait till precautionary conditions achieved ✓ (4) Reject
1.7 Summary The author mainly questions the validity of the IAR (Inter-Academy Report) which was in favor of BT Brinjal. Argues about the affiliations of stakeholders (mainly those who were scientists) involved as biased in favor of Bt Brinjal. Supports her arguments by basing her knowledge of genes-skeptical about gene technology (gene manipulation for a desired trait) and support agriculture alternative of GM technology
1.8 Key arguments: -The IAR report ignores already established concerns of GM crops. i.e. environment (gene contamination) ad human health - it is practical to invest (financially) in already tested and 'safe' methods such as conventional breeding - there is evidence to support that GM technology does not result in yield increase whereas conventional breeding does -Transferring genes does not necessarily result in desired traits as there are other molecular factors to affect in gene expression - patents prevent full access to research material and GM plants to be tested by independent scientists - significant portions of the IAR report was plagiarized from documents of an industry lobby group and proponent scientists -scientists involved in decision making must not be part of the 'revolving doors between science-business-government', or any affiliations to industry - affiliated scientists are often partial in decision making - There are other factors such as funding, fear of losing jobs, need for recognition and fame, peer pressure etc. which contribute to the 'professional culture of science' guiding scientists to behave in a certain way- they are trained to think in a certain way, generally comfortable in their own space
1.9 Other relevant observations -mentions Ananda Kumar, as a proponent of GM (his article Kumar, 2009 referenced here is also selected for analyses) -There seems an overall attack on the Indian regulatory framework, the IAR report has been called unethical, containing several problems

-does not believe in the unanimity within science, questions unanimous outcome of IAR report in favor of Bt-brinjal -the author is problematizing Bt-brinjal by revisiting and challenging the outcome of the IAR report which supports Bt-brinjal. she is highlighting factors that might contributed in that outcome-It is because scientists who came out with the report • ignored the established dangers of GM crops, • plagiarized documents from industry and scientists already supporting GM crops • came out in a unanimous decision, hence ignored critical and independent perspective in evaluations • were affiliated, hence biased with their decision to support Bt-brinjal
1.10 Emerging discourses/debate *Food security*- It is linked to poor farmers and their ownership to small farms versus big agro-industrial lands operated by agri-business giants. Quoted here from the text "Patents and seed monopolies by agribusiness are a serious threat to food security everywhere and are especially important in a country like India dominated by poor farmers working in small farms." *Safety*-conventional breeding methods are tested are much known about therefore are safe *Patents linked to food security and assessment of technology*- interfere access to seeds and food security. Limit GM plants and research material to be tested independently *Who should be in decision making*?-scientists are often partial when they are affiliated with industry. Scientists are also subjected to other factors of profession ("there is a "fear of losing their jobs, fear of being called a Luddite, the need for recognition and fame, and peer pressure."), *Scientific authority/ deficit model*- scientists are trained to think in a certain way. scientists are associated with the 'professional culture of science' *Professional culture of science*- "There is also a professional culture of science, which includes the desire to be objective, loyalty to colleagues, belief in the scientific process – perhaps even when it may not be working – and faith in technology".
1.11 Other sources from the author http://indiatogether.org/gmsci-agriculture http://www.saynotogmos.org/ud2009/unov09.php

Appendix II: CDA's linguistic tools as applied to texts for analysis

.

COMMENTARY

Bt brinjal – ban or boon?

G. Padmanaban

REPRESENTATION: presence of event (used for context)

The Genetic Engineering Approval Committee (GEAC) cleared *Bt* brinjal for commercialization on 14 October 2009. The activists are up in arms terming the approval as a shame. The government has chosen to go slow and states that it would consult the stakeholders before making a decision on the release. It is not clear as to how this consultation process would help, because this process has been gone through earlier. Besides, the stake holders have taken hardened positions and would not relent. The arbiters would be the farmers. They would accept it if they can make profit, as has been the case with *Bt* cotton, clandestine or otherwise. The *Bt* brinjal trials have indicated a significant gain in terms of reduced insecticide sprays and increased marketable yields of *Bt* Brinjal.

STYLE: Epistemic modality in speech function- knowledge exchange

The *Bt* brinjal trials have been reviewed by two expert committees, EC-I (2006) and EC-II (2009). Gilles-Eric Seralini, a French scientist and President of the Committee of Independent Research and Information on Genetic Engineering (CRIIGEN) and commissioned by Green Peace, has contributed his bit on behalf of the activists by stating that *Bt* brinjal is potentially unsafe for human consumption. But, if one were to go through carefully the points raised by Seralini[1], it is in the nature of picking holes on the extensive environmental and food safety studies carried out by the developers of *Bt* brinjal since 2002. The comments range from describing the *Bt* gene used as an unknown chimeric toxin containing *Cry1Ac* and *Cry1Ab*, whose safety remains unsubstantiated, to the use of prohibited antibiotic resistance markers and significant alteration of blood chemistry in the experimental animals used. Every parameter assessed from gene flow in non-target organisms to duration of the animal experimentation studies has been questioned, revealing a mindset to oppose anyway. It would be instructive to go through the assessment provided by the Expert Committee (EC-II)[2], which has given a positive evaluation of the product, to each of the points raised by Seralini. First of all, the gene product is not an unknown toxin. It is 99.4% identical to that produced by *cry1Ac* gene and the 0.6% difference is due to replacement of one amino acid in the entire sequence, although amino acids 1 to 466 are derived from *cry1Ab*

Inter-textuality: voice of others (Seralini) used for making argument

Inter-textuality: voice of others (Seralini) suppresed

and 467–1178 are derived from *cry1Ac*. The antibiotic resistance markers used, *nptII* and *aad* genes, are poorly expressed in the plant and widely accepted in other countries including USA, EU, Australia, Philippines, etc. Many of the so-called adverse changes highlighted by Seralini are within normal variations seen in control animals. This is typical of biological systems and Seralini states that calculation of statistical significance is not possible, since the differences vary by 237% in a given case.

The EC-II report is exhaustive and covers every aspect of the trials carried out for the last seve[illegible] 150 scientists have b[illegible] trial and two dozen [illegible] food safety studies have been carried out since 2002. After all, nobody, least of all scientists, would want to compromise on food safety. The government should also be guided [illegible] sive in[illegible] of *Bt* [illegible] mous n[illegible] health-related safety studies have been conducted. More than 25 countries including USA, Canada, China, Brazil, European countries, Egypt and Australia, even those with reservations, have agreed to try GM technology. GM crops were grown in 125 mha in 2008. *Bt* gene products would constitute 30–[illegible]% of the total GM-crops in the form of *Bt* cotton and *Bt* corn. There has been no report of adverse consequences in environmental or health parameters in different countries as a result of *Bt* crop cultivation. It also needs to be recognized that spraying of the organism *Bacillus thuringenesis*, a bio-pesticide which produces the *Bt* toxins, is an age-old practice and is still prevalent. There has been a recent report [illegible] (2009) [illegible] n[3] [illegible] study on [illegible] Con[illegible] to the technology, [illegible] contributed is is a large- in the USA genetic engi- fferent crops with different traits. The study has elicited critical responses on several counts[4], but even so, interestingly it makes the point that *Bt* corn is the only exception, showing a 7–12% operational yield

identity representation

REPRESENTATION: Assumption,

STYLE: high modality

value assumptions, high level of author's committment with his statement; use of generalisation in representation

Overall position is approving BtBr with some conditions expressed in policy suggestions

[illegible] typical conven[illegible] insecticide use. [illegible] tion. The limited point is the positive conclu[illegible] drawn for the commer[illegible] brinjal, a heavily pest-i[illegible] EC-II report states that [illegible] jal crop has required 4[illegible] in a season and in B[illegible] crop was sprayed wi[illegible] times in a span of 6–7 [illegible] has been developed by [illegible] company) and UAS, Coimbatore (Public [illegible] stitutions) with other [illegible] II. Should we not recognize the toil of our own outstanding Agriculture Universities and a private partner, who is equally committed? The scientists involved in generating the EC-II report are outstanding and internationally recognized for their contributions. Why should we ever think that they will compromise on the environmental and health safety of the nation? There is no reason for the government to delay the release of *Bt* brinjal. In a couple of years one would know its success or otherwise in the field and farmers would provide the answer. A second green revolution is necessary for the country.

(scientists involved in clearing BtBr safety data)

STYLE: Epistemic modality in speech function- knowledge exchange in style of posing question

ACTION: knowledge exchange and legitimiztion (use of outstanding and internationally recognized to support scientists' decision)

identity representation (common use of 'we')

ACTION: grammatical mood declarative

The government should actually use this occasion to come up with a policy framework on the commercialization of GM-crops. While there can be no bar on any aspect of GM-crop research, commercialization needs a well-deliberated policy issue. To start with *Bt* brinjal, how would the government ensure an affordable price for *Bt* seeds? What would be the mechanism for technology advice to the farmer, year after year? What next? Would it be *Bt* bhindi? *Bt* rice is on the horizon and is almost ready. China is ahead of us and will eventually go for *Bt* rice in a big way. With all the international trade and many countries going for GM technology, what is the point in trying to put irrational obstacles without a scientific basis?

STYLE: deontic modality-'demand' in speech

policy relevance context. in interrogative grammatical mood. represents conditions

showing activity exchange (deontic modality in style) by offering suggestions

Scientists should also deliberate on the consequences of creating a *Bt* world. Even if the different *Bt* genes code for different proteins, they all seem to act through the gut receptor in the insect, although binding to different sites. What would happen if the receptor protein gets mutated? Resistance to different *Bt* gene

Appendix III: Scientists' affiliations and their corresponding overall positions

	Scientist	Expertise	Academic affiliations	Other affiliations	Media Output	Overall position
1.	Bandopadhyay, R.	Agricultural Science.	University of Burdwan, Barddhamān	NA	Journal commentary	Wait till precautionary conditions achieved
2.	Banerji, D.	Botany	Formerly botany dept., CCS university, Meerut India	samaj pragati sahayog-SPS an organisation registered under the Societies Registration Act, 1860.	Journal commentary + newspaper column	Wait till precautionary conditions achieved
3.	Bhargava, P.M. *elite	Microbiology	First former head, the Centre for Cellular and Molecular Biology in Hyderabad, India	Suggested nominee by the Supreme Court of India for independent evaluation of the BtBr safety report.	Journal commentary + newspaper column + internet blog	Reject
4.	Bokolial, D.	Botany	dept. of Botany, St. Anthony's College	NA	correspondence/ journal	Approve but with conditions
5.	Byravan, S.	Genetics	Principal Research Scientist, Center for Study of Science, Technology & Policy, Bengaluru.	NA	Journal commentary + newspaper column + internet blog	Reject
6.	Chokshi, A.H.	Material Science and Engineering	Department of Materials Engineering, Indian Institute of Science, Bangalore	NA	Journal commentary	Wait till precautionary conditions achieved
7.	Giri, J. Tyagi, A.K.	Plant Science	National Institute of Plant Genome Research, New Delhi.	NA	Journal commentary	Approve
8.	Gupta, P.K.	Genetics	Department of Genetics and Plant Breeding, Chaudhary Charan Singh University, Meerut	NA	Journal commentary	Approve
9.	Hanur, V.S.	Horticulture/ Agriculture Science	Principle scientist of the Indian Institute of Horticulture Research (IIHR)	Representative of IIHR in the meeting of Biotechnologists, organized by the Foundation for Biotechnolog	Journal commentary + newspaper column	Approve but with conditions

				y Awareness and Education (FBAE), for a representation to the Government of India on rescinding of the moratorium on GM crops, July 2010		
10.	Jagadish, M.N.	Biotechnology	Head, Biotech Facilitation Cell (BFC), Karnataka Biotechnology and Information Technology Services (KBITS) Karnataka Government	Former-Academia & Industry Consultant, Avesthagen, Biotech Industry	Journal commentary	Approve but with conditions
11.	Khetarpal, R.	Plant Science	Former Head of the Plant Quarantine Division, National Bureau of Plant Genetics Resources, ICAR, New Delhi	Regional Advisor, Strategic Science Partnerships, for CABI-South Asia CABI is a not-for-profit scientific research, publishing and international development organization.	Newspaper column	Approve
12.	Kochhar, V. K.	Botany	Retired Senior Scientists from National Botanical Research Institute, India	NA	Journal commentary	Approve but with conditions
13.	Kranthi, K.R.	Plant Genetics/ recombinant DNA technology	Director, CICR-Central Institute for Cotton Research, Nagpur, Maharashtra	NA	Journal commentary	Approve
14.	Krishnaswamy, V.R.	Genetics	Secretary to India's Department of Biotechnology DBT	NA	Internet blog	Approve
15.	Kumar, P.A.	Genetics/ recombinant DNA technology	Director, NRCPB (Nation research center for plant biotechnology)	Actively involved in Developing Bt Brinjal in 1995 using Cry1Ab, which were field tested by IARI (Indian	Journal commentary (Cover story for Biotech news)	Approve

				Agriculture Research Institute) Mahyco used Cry1Ac -One of the member of EC II (independent expert committee) which approved Bt brinjal		
16.	Nair, K.P. *elite.	Agricultural (Soil) Science		committee chairman, (independent expert committee) set up to examine Mahyco field data by the Centre for sustainable agriculture, Hyderabad	Newspaper column + internet blog	Reject
17.	Padmanaban, G. *elite	Biochemistry	Former director, dept. of Biochemistry, IISC Bangalore	NA	Journal commentary + newspaper column + internet blog	Approve but with conditions
18.	Rao, C.K.	Biotechnology		official at the Foundation for Biotechnolog y Awareness & Education, a GM advocacy institute	Internet blog	Approve
19.	Rath, S.	Medicine		NII-National Institute of Immunology, New Delhi	Journal commentary	Approve but with conditions
20.	Seetharam	Medicine		Independent researcher	Journal commentary	Wait till precautionary conditions achieved
21.	Shanmugam	Cellular Biology		Founder and Director of non-profit Oncophyta Labs- a phytoceutical company developing plant-based drug formulations. Shanmugam Foundation	Journal commentary + internet blog	Wait till precautionary conditions achieved
22.	Shantharam, S.		Science, Technology and Environmental	-previous employment with Syngenta	Journal commentary + newspaper column +	Approve

			Policy Program, Princeton University formerly with IPRI (International Food Policy Research Institute, Washington)	International -launched FBAE (Foundation for Biotechnolog y Awareness and Education), a non-profit movement group, also considered as a lobby group	internet blog	
23.	Sivaraman	Ayurveda/Siddha (traditional) medicine		managing Director and Proprietor Arogya Healthcare, Chennai	Internet blog	Reject
24.	Swaminathan, M.S. *elite Renowned for his leading role in India's Green Revolution "Indian Father of Green Revolution"	Genetics	various positons in national institutes	Founder and chairman of the MS Swaminathan Research Foundation.	Journal commentary + newspaper column + internet blog	Wait till precautionary conditions achieved
25.	Vennila, S.	Soil science	National Centre for Integrated Pest Management	NA	Journal commentary	Approve but with conditions