

**POST NORMAL SCIENCE (PNS) PERSPECTIVE ON  
GENETICALLY MODIFIED (GM) FOOD CONTROVERSY:  
THE CASE OF BT BRINJAL IN INDIA**

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## **Chapter VII**

### **Summary of findings and Conclusion**

Biotechnology as a sector has crosscutting and complex impacts on various aspects of life and livelihoods in this large and diverse country where a majority of the population engaged in agriculture. The technology has many implications for the country's biodiversity, public health, and certainly on the economy. Further, applications of Agricultural Biotechnology in India have proved contentious with the debate spanning a wide range of economic, social, cultural and ethical issues in addition to the scientific ones. On 9 February 2010, following the public consultations, the then Minister for Environment and Forests (MoEF) Mr. Jairam Ramesh imposed a moratorium on the environmental/commercial release of Bt brinjal by invoking *precautionary principle*. This has been the first ever case in the Indian history where a series of public consultations were held and all the apprehensions of the public were given a patient hearing before taking a final decision on any technology. The national consultations on Bt. Brinjal in India can be seen in the light of the fact that the controversies around modern biotechnology cannot be resolved purely based on scientific risk assessment. Drawing upon the insights of Post-Normal Science (PNS) framework, the main thrust of the thesis has been an ex-post-facto analysis of the considerations employed for Minister's moratorium decision on Bt brinjal in the Indian context.

The thesis has been organised into seven chapters including introduction and conclusion. The first chapter introduced various facets of the thesis attempting to capture the Post Normal Science perspective, rationale for the topic, research questions, objectives of the study, argument of the thesis, methods of analysis, structure of the study, and so on. In the second chapter a brief account of trajectory from green revolution to gene revolution, lessons learnt from Bt cotton

experience, and socio, cultural and religious and economic importance of Brinjal in India was presented. This chapter emphasises the need for the social embedded analyse of the technology before taking any decision. The third chapter is an appraisal and analysis of the various strands of evidences that have gone into the Minster's moratorium decision on commercial release of Bt brinjal. There were three main evidences namely scientific evidence, views from the state governments, and outcome of the public consultations.

In the face of conflicting knowledge claims, risks and uncertainties, various social actors tend to frame the controversies, depending on their respective values and interests. To arrive at the heart of what is at stake, as argued by Maeseele (2011), these controversies on emerging technologies should be approached from an identification of the competing values and interests at work, instead of starting from an unproblematised 'scientific consensus'. On the other hand, food safety is not purely a scientific concept to be defined and controlled exclusively by food scientists or scientific risk assessment. Food choices are framed by cultural, social, and material circumstances (Draper and Green 2002). Therefore, when examining risks, it is important to judge what is considered as acceptable risk beyond the frequency and probabilities of the impacts. The reductionist approach adopted by the dominant risk discourse reduces all questions concerning governance of emerging technologies to questions of risk. In this context, drawing on the data from the public consultations, a detailed analysis of the farmers' and consumers' concerns on Bt brinjal was presented in fourth and fifth chapters respectively.

Modern Biotechnology seeks to transform the organic world, which is deeply embedded in the interests and meaning structures of different social groups. This transformation is fraught with uncertainties and risks for humans and environment. In this context, public have raised various questions on the lacunae in the existing regulatory and approval mechanism of GM crops. In this

context, the sixth chapter presents an analysis of public concerns on the existing regulatory and approval mechanism of GM crops in India. This chapter argues for the shift in the regulatory paradigm from a government-centred model one to that of a governance-centred one in line with the Post Normal Science (PNS) approach which addresses the issues of scientific uncertainty and conflicting values and interests of different interest groups by incorporating the contextual specificities. The present chapter (seventh) is the summary of the findings of the study and concluding remarks

The following are the three main objectives of the thesis a) to understand various strands of evidence that have gone into government's moratorium decision on commercial release of Bt brinjal; b) to understand the concerns arising out of their interests and meanings articulated by farmers and consumer groups on Bt brinjal in public consultations; and c) to understand and analyse the publics' concerns on the existing regulatory and approval process of GM crops in India.

As discussed earlier, as a theory the Post Normal Science (PNS) theory links epistemology and governance and this framework is applied in the context of policy relevant science which typically deals with post normal problems where 'facts are uncertain, values in dispute, stakes high, and decisions urgent' (Funtowicz and Ravetz 1990).

### **Facts are Uncertain**

The findings of the study indicate that according to the stakeholders, the facts produced by industry and regulatory body are not infallible. There are conflicting knowledge claims and there is no consensus on the consequences for health and environmental safety of the Bt brinjal among the scientific community. On the one hand, many scientists have raised concerns on the inherent

unpredictability with the GM technology especially when dealing with the organic world. Lack of transparency and conflict of interest were the other issues highlighted in this regard. Similarly, the analysis of the views of the state governments on the environmental release of Bt brinjal clearly shows that all the major brinjal growing states have expressed their concerns. The West Bengal, Orissa, Bihar, Andhra Pradesh states account for 30%, 20%, 11%, 6% of the total brinjal production in India. More than ten states including the above major brinjal growing states expressed their apprehensions on Bt-brinjal on various grounds including uncertainties associated with knowledge claims and have called for extreme caution. Hence questions were raised by consumers and society at large on the health and environmental safety of the Bt brinjal.

### **Values in dispute**

The findings clearly indicate that the values of farmers and consumers on the one hand and those of the industry and regulatory bodies on the other are in conflict. For the biotechnology industry, life forms or parts of life, such as the seed (whether it is a Hybrid or GM) constitute physical means of production. Similarly, scientists tend to view the shift in the understanding life processes from phenotypic level to molecular level a gradual improvement over earlier understanding and does not constitute a paradigm shift. The farming community and civil society may argue that the genetically modified seed is a new concept and that is going to order agriculture in a qualitatively different way. It will have impact on their interests and change the meaning of agriculture. The new concept will destabilize the earlier meanings of agriculture and associated practices, environment and food. For farmers, consumers and society at large life forms carry religious and aesthetic meanings. Social groups attach a divine meaning to life and hence, any interference in life processes through genetic engineering amounts to interfering in divine creation. Further, it is a common feature of all cultures to attach meanings to what is

consumed as food. As a corollary, the important questions like: “Is it right to promote a technology which compromise the publics’ cultural and ceremonial values?”.

### **Stakes of the Different Stakeholders are high**

The development of genetic engineering technology closely related to the stakes/ interests of several social groups such as industry, scientists and technologists, government, farming communities, and consumers. Stakes of the industry which invested its economic resources in developing Bt. Brinjal would like to sell the product to as many farmers as possible and in as many countries as possible with the motive of making profit. Making reasonable rate of profit is not disputed. However, making profit unscrupulously is immoral. The industry should establish the principle of transparency in its governance as it is acceptable to its shareholders and users of its product and the public at large. Historically, farming communities had the customary right to save the seed for the next season and also to exchange seeds. For the farmers the seed is both a material and a cultural resource that symbolizes food security. The Government of India enacted the Protection of Plant Varieties and Farmers’ Rights (PPV&FR) Act, 2001<sup>23</sup> adopting a *sui generis* system. It will establish intellectual property rights of farmers on their varieties and safeguard their varieties from piracy. But the industry which was unhappy on the PPV&FR Act, influenced the Government of India to go for the membership of The International Union for the Protection of New Varieties of Plants for UPOV membership, a move that would seriously undermine Farmers Rights. The UPOV system grants one right that is the breeders’ right. There is no farmers’ right in UPOV. It sought to undermine the comprehensive rights granted to

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<sup>23</sup> <http://agricoop.nic.in/PPV&FR%20Act.%202001.pdf> retrieved on 24 September, 2013

farmers. Similarly, the genetically modified seed, which is a proprietary product protected by the patent law, will undermine the customary material and cultural right.

Any questions that we raise about safety and potential risk in the Indian context will have to be from the perspective of Indian cropping environment and resource-endowments of the highly differentiated peasantry in terms of size of land holdings, access to resources including reliable and complete information about technology. Therefore, the analysis of the concerns of the farmers' group shows that economic benefits and risks, ownership over technology, affordability, marketability, right to choose, plurality of knowledge systems, sustainability and compatibility of the technology, relevance, food security, unpredictability/unknown risks and health safety are the most salient to the perceptions of the farmer in India. As a corollary, the following are the important questions raised by the farmers group in the consultations: How objective is an evaluation, how safe is safe enough? Who owns the technology? Is technology affordable? Can private science work for public benefit? What is the need, relevance, and who decides? Is the technology sustainable? Is it possible to grow refugia in India given they own small size of land holdings? Is it possible to introduce co-existence (growing Bt and Non Bt crops in close vicinity) measures in India? What is the fate of the non-Bt and organic growers, if their crop gets contaminated with Bt gene, who takes liability for the damages? Without co-existence measures, what will be the impact of the effects contamination/gene flow on environment, Biodiversity in general and brinjal diversity in particular? Is it moral to take away farmers' right to choose non Bt seeds? Is it possible to implement traceability, segregation measures in India? If not, what is impact on marketability in domestic market or on exports of brinjal or exports of other vegetables?

The analysis of the consumer concerns indicates risk benefit perceptions of the consumers' are driven by following aspects: Price benefits, food safety, Health risks (lack of long term allergency chronic toxicity studies, lack of Inter-generation studies, use of antibiotic resistance markers and chemical like glyphosate and Animal morbidity and mortality, Impact on medicinal plants), unpredictability and unknown health risks, cultural, religious, moral concerns, freedom of choice, and so on. As a corollary, the following are the important questions raised by the consumers group in the consultations: In case of any adverse health impacts are reported from eating Bt.brinjal, who would be liable to pay compensation? How would the liability be fixed and what would be the quantum? How will GM food be labelled in a country where food grains and vegetables are sold in weekly markets and individual street vendors? When the government cannot implement the labelling mechanism, does the Government have the authority to introduce a new technology? Is it moral to take away consumers' right to choose non-Bt varieties? Is substantial equivalence an adequate measure of bio-safety? In the absence of any kind of preparedness or safeguards, what would be the liability of the government for approving such food crops?

In terms of environment, what are the consequences of gene flow from Bt fields to non-Bt fields? Who will pay the compensation for Environmental losses? Therefore, the cost benefit analysis, which is generally concerned with economic benefits and costs, now has to reckon with social and environmental costs as well.

The analysis of the concerns and questions raised by the social groups clearly indicates that the Bt brinjal debate in India not only originate from risk in scientific understanding, but rather from a wide ranging concerns such as economic, social, religious, political, moral and environmental considerations. In other words, the publics' have adopted holistic approach to risk. But, from the

beginning, the regulatory bodies such as the GEAC has been trying to frame the Bt brinjal debate in such way that it can be solved only through the science based risk assessment. As a result, the approval processes are heavily hinged on the risk science based on probability models despite the fact that civil society actors have time and again questioned this narrow mandate of the GEAC (Shah 2011: 31). If we closely observe the approval process of the Bt-brinjal, whenever the civil society organisations express their concerns on the tests conducted and various other aspects, the GEAC constitutes an Expert Committee with scientists treating all the concerns of the public as concerns of risk and safety.

### **Decision making on Bt Brinjal is Urgent**

The decision making on the Bt brinjal is particularly important as several private seed companies and public sector research institutions are working on the development of various genetically engineered (GE) food crops. According to Global Agriculture Information Network (GAIN) report IN 3083, out of 91 applications for field trial before the Genetic Engineering Appraisal Committee (GEAC), 44 are GM food crops. There is pressure from industry that developed Bt Brinjal and other proponents of genetic modification of food including scientists to see that Bt brinjal is approved for commercial release at the earliest. The other stakeholders who either oppose or those who insist on the need more independent tests to ensure safety demand that the decision be announced for not approving for commercial introduction. In this context, the question of how to regulate GM crops in India becomes prominent.

With regard to regulation and approval, the following are the main public concerns on the existing regulatory mechanism of GM crops in India: Lack of Independent testing mechanism for Biosafety, lack of transparency, Conflict of Interest, absence of post release surveillance, absence

of Liability and Compensation mechanism, concerns over IPRs and PPP, Bio-Piracy, absence of long term environmental impact and chronic toxicology studies. On the other hand, serious concerns have been raised on the systems unpreparedness to regulate the GM crops. The parliamentary committee on GM crops has also highlighted the systems unpreparedness/ virtual non-existent nature of various agencies who should ideally be involved in various oversight in both, pre and post commercialization surveillance responsibilities in the context of transgenic crops like National Biodiversity Authority (NBA), Protection of Plant Varieties and Farmers' Right Authority (PPV&FRA), Food Safety and Standards Authority of India (FSSAI), Department of Consumer Affairs (DCA) etc.

The important question raised here is that : Is it right to release the GM corps when various players in the system of governance, who have some role or the other in the regulation, management, handling, oversight, distribution, consumer affairs, human health, livestock health, etc. are unprepared to shoulder the responsibility of ensuring that any potential harm or damages are eliminated ? In the light of the above, the public have expressed their lack of trust in the existing regulatory mechanism and demanded for precautionary approach and upstream public engagement prior to the approval of GM crops. They have also demanded for the initiation of nationwide public debate on not only Bt brinal but also on the entire GM approach to Indian Agriculture.

Therefore, failing to adequately deal with uncertainties, conflicting values and interests undermines the quality of the knowledge and consequently the quality of the decisions in policy relevant science. Under the above conditions, Article 15 of the Cartagena Protocol on Biosafety to which India is signatory would call for implementation of the precautionary principle to protect the environment and human health. The precautionary principle that “one should not

undertake activities about which there is scientific uncertainty about their impact” should guide the discourse on safety of genetic engineering (Haribabu 2004). Such precautionary research is emphasised by post-normal science. Here, PNS as an alternative approach advocates that, the decision making under the above conditions should not be restricted to scientists only, but should also involve impacted parties and the general public, through ‘extended peer review’ (Funtowicz and Ravetz 1990, 1993). This requires new interdisciplinary contacts and integration (internal extension of the peer community) on one hand, and new knowledge partnerships with policy makers, NGOs, industry, media, and the public (external extension of the peer community) on the other hand, to meet the challenges of quality control in the assessment of complex risks (Funtowicz 2006).

There have been many ways as a response to the new challenge some form of the extended peer community is being organised in different countries namely ‘focus groups’, ‘citizen juries’ ‘consensus conferences’ ‘public consultations’ and so on with some degree of legitimacy to encourage dialogue. Here the idea is to treat all the stakeholders either the counter-experts or lay publics, as potential peers, sharing the definition and management of a problem so as to mobilise resources of local knowledge and understanding which complement the generalized knowledge of scientific experts. There is no standardized approach to doing Extended Peer Community (EPC) and this will be very different for varying issues. Therefore, no single template will improve democratic accountability in diverse settings and contexts. In India, except the public hearing in Environmental Impact Assessment (EIA) of development projects, there is no political tradition of public engagement in decisions related to technological choices. In the case of Bt brinjal in India, public consultation mode of Extended Peer Community (EPC) was adopted, in which all the publics’ irrespective of whether they have stakes or not were invited to participate.

The Minister personally sat through the entire process of seven consultations. Thus, by holding public consultation prior to the decision on Bt brinjal, the Minister adhered to Principle 10 of the Cartagena Protocol on Biosafety to which India is a signatory.

According to Nupur Chowdhury *et.al*, (2010:18) the process of arriving at the decision to call for national consultations was unprecedented in two ways, First, that decisions on emerging technologies that bear an environmental and health risks, should not only be based on scientific risk assessment but also should undergo a process of public engagement in order to gauge the social acceptance of that technology. Second, that the scientific assessment report of expert committees on such technologies should be made public and comments invited on the report prior to a decision being taken. The decision, therefore, seems to establish two critical parameters – social engagement and transparency in environmental regulation and has been lauded as a wise decision by a number of experts in India (Press Trust of India 2010).

The consultations have certainly enriched and democratised the process and has been useful for airing multiplicity of situated positions which exist in society. Maasen and Weingart (2005: 4 &10) refer to public participation in technical decision making as the ‘democratisation of expertise’ and argue that it allows societies to address the lack of public trust and the empowerment of citizens. Visvanathan, S. (2014) views that the public consultation on the Bt-brinjal in India actually strengthened the democratic process. Thus, the Minister has set a precedent or pioneered an institutional mechanism in place for the regulatory approvals on the emerging technologies which have potential to impact public health and environmental risks. This is a timely move that the Government of India upholding the importance of science, transparency and public participation in its decision-making process regarding the technological choices.

Therefore, formulation of regulatory policies and implementation strategies have to be evolved by eliciting a broad-based participation of stakeholders- scientists, technologists, social scientists, farmers, industry and civil society organizations. As discussed earlier, judgments on the acceptable level of risk are never purely scientific when the weighing of incommensurable costs and benefits involves trade-offs among diverse values (Barbour 1980:175).

Technology development should be on the basis of an understanding of the needs of the peasantry and consumers based on the relevance, sustainability and plurality. The stakeholders should be involved right from the beginning of the design of technologies rather than participating in the use of technology developed by others. In this context, Shah (2011) argues that the debate needs to broaden its frame from science-based assessment of consequences to evaluating society-oriented causes and objectives. Hence, instead of promoting GM crops as a technical fix to complex agronomic and socio-economic problems, a detailed broad based needs assessment study in the Indian context is warranted in the light of socio-economic and environmental consequences of Green revolution and Bt cotton adoption. Article 26 of the Cartagena Protocol on Biosafety (CPB) emphasises the need to understand socio economic considerations (SECs) in the context of handling Living Modified Organisms (LMOs) and their importance within the broad policy framework. It has been pointed out that Article 26 is perhaps one of the most significant aspects of the protocol from the perspective of developing countries (Chaturvedi *et al* 2007). Here, the scope of socio economic analysis of new technologies should not be based only on a narrow utilitarian analysis focusing on the average profitability of farm but extend to ones considering a wider variety of human values and concerns. Here, the issue is not only limited to whether to accept or reject Bt brinjal, but the entire GM approach to Indian agriculture must be debated. It should not be accepted just because Bt gene is available for

licensing. It amounts to promoting supply driven innovation rather than demand driven innovation. A thorough Needs Assessment must constitute the first step. Which trait in a crop does the transgenic crop attempt to address? Are there alternative approaches? Has the conventional breeding failed to solve the problem? What are the apprehensions on Bt Binjal hybrids? And how to go ahead with Bt food crops? Who decides on this solution, how was it arrived at? Who does it benefit? The whole decision regarding GM crops and Bt birnjal was based on a reductionist view of science being the solution to higher productivity. The decision on whether we need GM crops at all should be debated at a much broader and wider level through upstream public engagement. The scope of socio economic analysis of new technologies which is generally based on a narrow utilitarian cost-benefit analysis now has to reckon with social, environmental costs and wider variety of human values and concerns. There are other countries like Norway which ask pertinent questions that go beyond biosafety like, ‘is this socially and ethically justifiable?’ as the regulators look at impact assessment of GM crops. In order to answer such questions, there is a need to adopt widespread, broad-based democratic processes of eliciting views and expert opinions. (Kuruganti 2006).

To conclude, in the present changed context of knowledge production in which science has become an intellectual property and also in the context of the world becoming-for-itself the classical ‘government’ model of regulation is not appropriate, especially in the context of science and technology that seeks to transform the organic world, which is deeply embedded in the interests and meaning structures of different cultures. This transformation is fraught with uncertainties and risks for humans and environment. What should be the appropriate governance model in which the uncertainties are openly acknowledged and which accommodate the economic, social, religious and moral concerns of the various interest groups while taking

decisions on the emerging technologies?. There is a need to move towards a model of regulation based on governance.

The thesis argues that there should be a shift in the regulatory paradigm from a government-centred model one to that of a governance-centred one. Unlike the government model where the framing of policy issues and the processes of regulation and implementation are centralised in the hands of formal public institutions, the governance model refers to inclusion of wide range of actors into policy domain such as: industry, scientific organisations, pressure group, consumers, farmers, market and the public at large. In the process of grappling with uncertainties and assumptions about risks and the methodology of risk studies that are associated with normal science are not adequate and hence there is a need to shift to post normal science which addresses these issues by incorporating the contextual specificities and by recognising the knowledge held by technology users and consumers of the products of technology. Regulators should carry out independent tests and put out the results in public domain. Take the results to publics to review the moratorium decision through public consultations. Achieving more democratization of science through consensus based on publics' rationality should form the basis for decision. Technology development should be seen as a means to achieve social justice, equity and sustainability. As Bijker *et al* (2009) put it; the social and scientific appraisal of emerging technologies thus needs to be based on a methodology that can combine scientific expertise with democratic participation of public at large.

Therefore, the controversies around genetic modification of food suggest that innovations have to be socially acceptable in terms of safety, equity, and sustainability, environmental safety and the cultural considerations. In order to produce such innovations, stakeholders should be involved from the beginning of the innovation process as co-participants, and incorporate their

perspectives in the innovation process. Methodologies have to be evolved to make technology development a participatory creative activity. Democratic norms and transparency should be overarching guiding principles that govern the process of negotiation (Haribabu 2004)

Post Normal Science is a new paradigm to look at the technological choices which hitherto were based on the knowledge of experts: Scientists, technologists, and policy makers. Post Normal Science is a departure from this conventional and received perspective on technological policy options. It is an evolving perspective; this has to be applied to various contexts of technological choices to evaluate its robustness. It calls for more empirical studies to examine technological choices and adoption in various contexts. The empirical studies are to be conducted by involving a wide spectrum of stakeholders whose lives in different domains are going to be changed either directly or indirectly with the introduction of the emerging technologies.

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