People’s Biotechnology: Knowledge, Attitudes and Perceptions towards Genetically Modified Organisms in India

Abstract

A three year research study was undertaken by Gene Campaign and the University of Hyderabad to study the awareness, attitudes and perceptions to GM technology and GMOs among farmers, consumers and other stakeholders. The study, with quantitative and qualitative approaches, was conducted in five states, Andhra Pradesh, Maharashtra, Punjab, Jharkhand and Assam.

The general trends seen in the research results were fairly uniform across states. We found that attitude to food was overwhelmingly guided by cultural-religious factors, irrespective of educational and economic status. This, rather than a rational analysis of the benefits of a particular food determined food choice. The sanctity of food is underlined by the clear articulation by the rural communities that any food that had been transformed in the way that GM foods have been, would be unacceptable for special ceremonies and religious festivals. People said they would not offer such food to deities during religious festivals or serve it on special occasions like a wedding feast. Attitudes to modified cash crops are more relaxed than to food crops but even there, the notion of 'tampering' in some way with the seed, is met with resistance and reservations. Above all, there is enormous ignorance about GM foods among farmers and consumers alike and people expressed considerable wariness of making fundamental alterations to food.

Our findings show the deep inadequacy of the narrow science-based risk assessment approach to GMOs advocated by the government and call for a much wider participation in framing policies for GMOs. The poor awareness about GM food and how it is produced must be appreciated in the context of current government policy that is keen on releasing GM foods (e.g., Bt brinjal) to a population which is uninformed and therefore unable to exercise any kind of choice. Attempts to introduce GM foods among people who are not aware of the nature of GM foods, nor of their benefits and risks, fly in the face of democratic policy making.

Research Team

Field work for the study was carried out during 2008 and 2009. Primary data collection from quantitative surveys, FGDs and interviews was done by trained researchers. In Jharkhand primary data was collected by a research team led by Prof. Ramesh Sharan, (Dept. of Economics, Ranchi University); in Assam by a research team led by Mr. Bhaskar Jyoti Mahanta heading the North East Centre for Rural Livelihood Research, in Punjab, Andhra Pradesh and Maharashtra by researchers led by Dr. B K D Raja head of the development research agency Samaj Vikas as well as Prof Ajay Dandekar, Ms Geet Lamba and Mr Kuldeep Singh from Punjab University. The overall guidance and supervision was provided by Dr. Suman Sahai, Prof.E. Haribabu and Prof. Amrit Srinivasan.

Executive Summary

Research Highlights – Farmers

- Awareness of GM seeds including Bt cotton was very low – even in states where Bt cotton is being cultivated for five or six years.
- Farmers are more willing to cultivate cash crops with modified seed than they are to cultivate food crops with such seed. Attitude to food is conservative, there is a sacredness attached to food. Neither are farmers willing to cultivate food crops with seeds they perceive as unnatural, nor are they willing to eat food derived thereof.
- About 40% of the farmers studied said they would be willing to cultivate cash crops with modified seed. But 80 % of the farmers said they would not cultivate food crops from seeds containing a poison to control pests. The response was consistent across big and small farmers and educated and uneducated farmers.
- Farmers greatly value soil fertility and biodiversity and are not willing to sacrifice these for other benefits offered by a technology, for instance better pest and weed control or reduction in use of pesticides.
- "Weeds" are not useless plants. They constitute either leafy green vegetables for the family or green fodder for the livestock that the family keeps. Surrounding flora also yields valuable medicinal plants on which the community depends for health and veterinary care.
- About 90% of farmers said they would not use technology (Herbicide Tolerant seeds) that allowed the use of chemicals to control all weeds effortlessly but also destroyed surrounding flora (medicinal plants, fodder plants, leafy greens etc.). Farmers were also not inclined to cultivate crops with seeds that would not allow mixed cropping.
- The perception, that food grown from seed that is 'modified' with animal or insect parts is different to food grown from other, normal seed, was seen across all age groups and educational status. The former kind of food is viewed as "tampered", not natural and not desirable. Farmers across the board rejected food that may be nutritious if it was grown from 'modified' or 'tampered' seed.
- Farmers across all ages and education levels said they would never offer 'modified' food in temples or use it in religious ceremonies and festivals; they would also not serve such food at their daughter's wedding feast.
- Farmers trusted government agencies the most for information and materials. Seed dealers come next and scientists come third, followed by the media.
- Farmers said they would take the advice of government agencies and seed dealers on selecting seed and other inputs but not of NGOs or university scientists.
- Scientist have lost connection with farmers. There is no extension system and scientists from agricultural universities in the region seldom go to the field. For the farmer, the scientist has lost the pre-eminent position he enjoyed during the days of the green revolution.

Research Highlights – Consumers

- Awareness about GM crops and foods is very low among urban consumers. Even among the middle class, which is educated and exposed to the media, internet and sources of information, about 80 per cent of the consumers studied had not heard of GM food.
- Most consumers are not clear about what exactly GM foods are or how they are produced. Consumers have not heard much either about the risks or the benefits associated with GM foods.
- Consumers are actively aware that they must have the right to choose their food.
- Most consumers felt strongly that not enough information is available about the risks and benefits of GM foods and that much more research is needed.
- Consumers overwhelmingly thought that they did not benefit from GM foods but that seeds companies were the prime beneficiaries.
- There is confusion about whether GM foods are labeled or not in India. Some consumers said they were, others thought they were not. All agreed that GM foods should be labeled.
- Consumers thought that 'large' vegetables like tomatoes and cauliflowers were GM. They said these were not natural and were tasteless. Some consumers also mentioned that the ready-to-eat boiled corn dishes sold in the market were American and GM.
- Consumers gave the highest priority on the safety of the food, followed by nutrition and taste in that order. They would not accept any modification that would affect the safety of food.
- Consumers too trusted the government the most in terms of providing information.
- Consumers were clear that they wanted the government to exercise control over regulation and monitoring of new technologies, seeds, etc. Consumers did not distrust scientists as much as farmers did.

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Aims and Objectives of the Study

As public controversies grow around GM crops, countries have made attempts to study the underlying reasons for the acceptance/rejection of this technology by the public. There is a reasonable understanding of the attitudes and perceptions to GMOs in developed countries where studies are ongoing, but not so in developing countries. Until now, there has not been a single authentic, scientific study assessing the public's attitude to agricultural biotechnology in India. It is uncertain to what extent the concerns articulated by activists and the promotions launched by advocates of GM technology in government and outside, are shared by the public or reflect their views, since no systematic public perception study has been done.

A study of public perceptions and awareness of GMO's will act as a powerful empirical index of this lacuna. It will serve as a pointer to, and a reality check on, the nature of cultural and ethical taboos, beliefs and customs relating to food. The attitudes of consumer/public attitudes to food or nutritional supplements are different and will be highlighted in the study in order to highlight to policy-makers that there are concerns that are prior to questions of risk, biosafety and other technical parameters. Moreover, consumer attitudes and perceptions are often quite different from those of experts such as economists, scientists and technologists, even when relating to the same data. The study will highlight these and in turn inform policy-makers that consumers themselves are a stratified group ranging, for instance, from the poor farmer to the rich, consuming class, from young girls and boys to feeding mothers. The study will help to understand how policy and regulation should be sensitive to these differences in a stratified, unequal society.

The GMO governance systems in India are inadequate in their representation of consumers, women, the farming community and other representatives. Expert Committees and Panels, conferences and discussion forums, do not include these constituencies nor are there any formal channels to communicate with them to incorporate their views in government decision-making. The lack of transparency in governance in this and other sectors has been a focus of activist struggles for several years. The mismatch between peoples' and expert thinking on issues such as food consumption, quality and security cannot easily be attributed to the lay person's "ignorance" or tradition-bound world view. Nor can it provide a convenient basis for his/her exclusion from decision making on the latter grounds alone.

So-called stereotypical and prejudicial thinking about GM products is a function of genuine concern about a wide range of issues and not just the absence or suppression of information. This is particularly so in a society like India, where commonly held beliefs recommend different levels of access to information for different sections (e.g., castes, gender) of society. Peoples' expectations from and evaluation of the 'legitimate' sources of information regarding the new technologies that they select and whether they are given a genuine choice in the latter, are already conditioned by culture and inequality and the institutional contexts within which agriculture has operated historically.

In this climate of unequal participation, it is really important to uncover the voices and perspectives of those marginalized by the policymaking regime. This is all the more urgent given that both the public and private sector in agriculture are starting to develop GM products for commercial application.

India's biotechnology program has been going on for almost two decades without a proper public policy instrument, despite demands from civil society and even a PIL before the Supreme Court filed by Gene Campaign. The process of formulating a policy, undertaken as a response to civil society demands, is ongoing. The overall goal of this *first ever study in India* is to contribute towards formulation of a meaningful and transparent public policy around biotechnological innovations in India, which takes into account public perceptions and attitudes. It should be seen as the first effort in an ongoing process of longer term monitoring of attitudes to agricultural biotechnology, tracking changes in such perceptions and attitudes over time, and assessing public acceptance/ rejection of new biotechnology products.

The specific objectives of the current study were to:

1. Assess the level of awareness about the use of biotechnology in the agriculture sector among farmers, consumers and their attitudes and perceptions to GMOs.
2. Assess the attitudes and perceptions to GM technology among key stakeholders.
3. Derive policy conclusions from the study

Farmers' View of GMOs

In the pre-dominant narrative spun not just by advocates of GMOs but also by much of the media, particularly the pink press, and the Government of India, farmers have overwhelmingly adopted Bt cotton. The fact that over 95% of cotton acreage is under Bt cotton has settled the debate, goes the argument, and nothing further need be said. It is also frequently claimed that the experience with Bt cotton clearly indicates that farmers are willing, even hungry, for transgenics.

Our study refutes this entire narrative. Instead of trying to confine farmers' perspectives to one cold statistic – the adoption rate of Bt cotton – we went to farmers and asked them what they thought about Bt seeds and GM seeds and analyzed their answers. Against the prevailing view, which allows farmers only the binary logic of either accepting or rejecting GM seeds, we found farmers to have nuanced views depending on their own heterogeneous circumstances. Their responses also reflected a range of issues that emerge - from disappearing varieties and nutrition, to corruption and income and food security. The responses are a glimpse into the complex socio-economic and cultural setting within which farmers live and work, and which policymakers must take into account while debating decision-making around GM issues.

In brief, we found:

- There was widespread ignorance and confusion among farmers about what Bt seeds are and how they are produced, even within states where Bt cotton is cultivated for at least five years. Related to this, accurate and credible sources of information were rare and hard to come by.
- There was widespread opposition to cultivating Bt seeds for food crops, but farmers were more open to cultivating Bt seeds for cash, non-food crops.
- The more educated the farmers, the greater their reluctance to cultivate Bt food crops.
- There was an overwhelming opposition to Herbicide Tolerant or HT crops.
- Long term effects on soil fertility and health were areas of grave concern among farmers.
- Farmers were very reluctant to consume food derived from GMOs.
- Farmers felt that technical fixes like GMOs were inadequate for complex problems like food security and income.

Survey Methodology

We surveyed farmers in two phases. In the first phase, we surveyed farmers in two districts each of Maharashtra (Yavatmal and Amravati), Gujarat (Ahmedabad and Gandhinagar) and Andhra Pradesh (Guntur and Warangal) - these three states have seen Bt cotton cultivation since 2002-03. In the first phase, we used a structured questionnaire to collect information. Data was collected from over 700 farmers on size of land holdings, crops cultivated, sources of agricultural inputs, credit, yield and awareness about agriculture technology. Summary results are compiled Appendix B1.

The second phase was conducted in the five states of Andhra Pradesh (Mahboobnagar and Guntur districts), Maharashtra (Amravati and Yavatmal districts), Punjab (Bhatinda and Patiala districts), Jharkhand (Ranchi and Dumka districts) and Assam (Golaghat and Jorhat districts) - spanning the North, South, East and West India. Assam was included from the northeast of India, a region which is considered somewhat isolated from the mainstream. These states also provided diversity in terms of experience with cotton and Bt cotton: Jharkhand and Assam do not cultivate cotton and hence have no exposure to Bt cotton, and Maharashtra and Andhra Pradesh cultivate Bt cotton. Punjab is considered the quintessential "agriculture state" of the country. Known for its early adoption of the green revolution and intensive agriculture practices, it has both regions growing cotton and those growing other crops.

We also conducted three Focus Group Discussions (FGDs) in each district of each state. Two FGDs were held among two different farmer groups in villages belonging to different mandals (blocks). One FGD in each district was held with private shop owners who sell seeds, fertilizer and pesticide. Each FGD among farmers had about 15 members. About ten shop owners/dealers constituted the other FGD.

How farmers think about Bt crops

Worldwide, insect-resistance Bt crops and Herbicide-tolerant or HT crops dominate the landscape of transgenic agriculture. In India, Bt cotton is the only transgenic to have received permission since 2002, while several other Bt and HT crops are moving through the regulatory pipeline. Despite the country seeing Bt cotton cultivation for at least six years, there is enormous confusion and lack of awareness about what Bt seeds are and how they are produced. In fact, even within the Bt cotton growing states of Andhra Pradesh, Gujarat and Maharashtra, 84% of the farmers surveyed overall reported not knowing what Bt cotton was or how it was produced (see Table 1). Some farmers thought Bt was a brand name while others thought Bt stood for Biotechnology.

Table 1 - Awareness about Bt cotton

Response	Andhra Pradesh	Maharashtra	Gujarat	Total
	%	%	%	%
Yes	9.6	4.7	27.2	13.9
No	86.7	95.3	72.8	84.3
No response	3.7	-	-	1.8
Total	100	100	100	100

In the second phase of our inquiry, since farmers had very hazy and confused ideas about what Bt meant, we asked them about seeds in which a poison had been put to control pests so that the use of external pesticides could be reduced, as a roundabout but intelligible way of talking about Bt seeds. On the whole farmers were opposed to cultivating such seeds, but the opposition was much stronger for food crops – 79% of farmers were opposed to cultivate Bt food crops as opposed to 53% for cash crops (see

Table 2).

Table 2: Preferences for cultivating Bt seeds

Response	Yes	No
	%	%
Cash crop from seed with insect poison for pest resistance	47	53
Food crop from seed with insect poison for pest resistance	21	79

The opposition did not stem from lack of education and literacy. In fact, the more educated the farmer, the stronger the opposition to Bt crops (see Table 3). The correlation of the opposition with size of land-holding revealed a familiar pattern. The larger the land-holding, the greater the willingness to try out Bt crops, reflecting the capacity of large land-holders to absorb the risk of failure. However, the willingness among large land-holders to try out Bt crops was again much more for cash crops than for food crops. For food crops, less than 30% of farmers across different (irrigated) land-holdings expressed willingness to cultivate Bt crops. The willingness of rain-fed farmers across land-holdings to try out Bt crops was correspondingly lower than those with access to irrigation.

The opposition seemed to stem from deeply felt concerns about the long-term impact on soil and human health. Indeed, farmers expressed similar apprehensions about pesticides and herbicides which might in the long run damage the soil or have adverse impact on human health. There was a clear preference for pesticides that may control the pest only partly, while leaving the soil fertility intact (69% in favor) over pesticides that may control pests fully but which will adversely affect soil fertility over the long run (21% in favor). The aversion to anything which might impact soil fertility or health over the long run was much more pronounced among dry-land farmers (less than 18% in favor).

Table 3: Willingness to cultivate modified cash and food crops across education levels

	Cultivate cash crops from modified seeds with insect poison to control pests		**Cultivate food crops from modified seeds with insect poison to control pests**	
Education	**Yes**	**No**	**Yes**	**No**
	%	%	%	%
Illiterate	59.4	40.6	33.8	66.2
Primary education	46.7	53.3	18.0	82.0

Secondary education	39.1	60.9	16.6	83.4
Beyond secondary education	45.9	54.1	15.7	84.3
Total	**47.0**	**53.0**	**21.2**	**78.8**

How farmers think about HT crops

The case of Herbicide Tolerant (HT) plants is usually made on the grounds that labor in India is in short supply and weeds like Parthenium are a serious menace. However, rural and farming communities in India use biodiversity in a number of ways. "Weeds" are not necessarily, not always useless plants. They constitute either leafy green vegetables for the family or green fodder for the livestock that the family keeps. Surrounding flora also yields the valuable medicinal plants on which the community depends for health and veterinary care.

We tested responses to new age chemicals that would confer advantages like weed control but had other disadvantages, to see the nature of risks farmers were willing to take. We found that the majority of farmers across all age groups would not use effective herbicides that would damage surrounding plants, medicinal plants or edible leafy greens. Even among younger farmers (below 30 years), only slightly over 20 per cent indicated that they would be willing to use herbicides that were effective, even if they were harmful to useful plants. Farmers generally attached great value to the useful and edible plant species in and around the farms as they contributed to their food and health security.

The importance of mixed cropping (as an output maximizing strategy) in the Indian farming system is evident from the finding that the majority of farmers (about 80%) across all age groups would not use herbicides that were effective but made mixed cropping impossible (see Table 4). The finding was more or less consistent across education levels among farmers, though illiterate farmers were slightly more disposed towards broad spectrum herbicides than others. When we focused only on dry-land farmers, we realized that the overwhelming majority of farmers did not want to control weeds by using chemicals that would exterminate surrounding plants (95%), medicinal plants (97%), fodder plants (97%) and leafy greens (97%).

Table 4: Response to broad-spectrum herbicides: "Will you use chemicals that will kill all weeds but also kill…?"

	Surrounding Plants		**Medicinal Plants**		**Fodder Plants**		***Saag* and leafy greens**		**Make mixed cropping impossible**					
Age	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**

	%	%	%	%	%	%	%	%	%	%
Less than 30	23.4	76.6	10.3	89.7	22.7	77.3	22.6	77.4	24.4	75.6
30 – 50	17.8	82.2	5.7	94.3	13.8	86.2	12.1	87.9	17.1	82.9
51 and over	16.6	83.4	5.5	94.5	13.4	86.6	9.7	90.3	16.5	83.5
Total	18.4	81.6	6.5	93.5	15.2	84.8	13.3	86.7	18.2	81.8

How farmers think about consuming foods derived from GMOs

We also explored whether farmers approved of consuming food cultivated from seeds modified with parts of plants, insects and animals. We found that the majority of farmers across all ages did not approve of consuming food grown from seeds that is modified with parts of insects (82%) and animals (82%). However, we registered greater tolerance for seeds modified with plant parts (55%). A small group (10%) remained unsure.

The perception, that food grown from seed that is modified with animal or insect parts is different from food grown from normal seeds, was seen across all age groups and educational status. This kind of food is viewed as “tampered”, not natural and not desirable. These findings were more or less consistent across education levels and size of land-holding.

How farmers think about seeds, farming, technology and food security.

To understand the broader outlook towards life among farmers, we probed them about the attractiveness of farming, including as an occupation for the future, and came across a great deal of stress and insecurity in the minds of the respondents. 54 percent of the farmers said they continued farming because they had no option and 26 percent said they did not wish to practice farming. Farmers in both Andhra Pradesh and Maharashtra do not see farming as an attractive choice for their children and over half did not want their children to farm.

The picture was more supportive of farming in Gujarat but the overwhelming endorsement for agriculture is missing everywhere. When asked what they wanted in order to continue with agriculture, farmers across the board said they wanted good quality seed and timely availability of credit as well as fertilizer at low cost. In order to understand their views about seeds, technology, and their very future, we conducted a focus group discussion (FGD), whose analysis we present below.

The FGDs with farmers showed broad consistency across regions. We clustered the discussion around five key themes.

Technologies old and new

Farmers did not believe that technology always leads to improvement in life. Its impact depends on many factors like the socio-economic status of farmers, literacy levels and their exposure to external agencies and information. For instance, literacy will influence the ability to understand complicated instructions given on seed packets or pamphlets that are distributed by seed companies explaining the technology adoption process. This happened in the case of Bt cotton, where instructions about the pesticide sprays and management of insect refuges were given to farmers on pamphlets and leaflets.

Illiterate farmers were not able to follow such instructions which affected their ability to understand or adopt the technology. Big farmers were better positioned to understand and adopt a new technology as compared to small farmers. Even about chemical inputs, the legacy of the Green Revolution, farmers had markedly ambivalent feelings. All farmers agreed that food like rice and vegetables did not have the same taste as they had had in the past. They also agreed that the high level of chemicals used in agriculture had spoiled the taste of food.

Nobody in the focus groups had heard of GM seeds. When the discussions progressed and GM foods were explained as those in the development of which parts of animals or insects or plants could be used, farmers responded that if such crops were more nutritious and also cheap, they would consider eating it. At the same time, the farmers felt that unless they saw such “altered” foods themselves and heard about their impact on health, they would not be able to say anything definite. Farmers did not have a clear view on whether cultivation of such food would be harmful or not.

On the topic of food, most farmers expressed marked dissatisfaction with rice and wheat-based diets. Especially in Andhra Pradesh, farmers ate millets every day because it was their traditional food. If they were not able to cultivate it, they would buy it. They felt that millets gave them strength for manual labour, which they could not get from rice or wheat. In the hot summers of Andhra Pradesh, farmers valued watery gruel of millets which kept them cool during the intense heat of summer. Most farmers regretted the fact that millet cultivation was going down and that their children did not value it as much as they did.

Most in the group had heard about high yielding varieties but none had heard about GM seeds and could not give any example of these - this in the region where Bt cotton has been cultivated for the last seven years. Few members of the group said they read the labels on seed packets, while many said they depended largely on the seed dealer and sometimes on other farmers for information. This was the case whether farmers were literate or illiterate. Farmers were not aware that Bt cotton was substantially different to the normal cotton that they had used in cultivation. According to them it was just a new seed.

When asked where Government should focus its attention in agriculture, farmers said they wanted investment to develop high yielding seeds. This was their top priority. As costs of agricultural inputs spiraled without any corresponding increase in prices of agricultural produce, increasing the yield was the predominant way farmers hoped to increase their incomes. The earlier preference among the farming community for traits like disease-resistance, drought-salinity tolerance had been relegated to the background.

Farmers were also keen to explore new kinds of pesticides but preferred pesticides that did not kill natural insects which ate pest larvae. The group said that they tried to avoid food harmful to health but that was not always possible because in times of shortage, they ate the food they got, sometimes even it was partly spoiled!

Responses from all farmers showed the strong cultural context of food. Crops and foods developed by using animal parts may be considered nutritious, but they are considered impure. Farmers uniformly responded that they could not even contemplate offering such food to God or use it for festivals and marriage ceremonies.

Agricultural Inputs:

When we asked farmers to tell us about the most pressing problems they faced with existing agricultural technologies, farmers said that by and large seeds were not available on time, their quality was poor, and costs high. Fertilizers from Government outlets were almost never available on time, and farmers had to run around for four or five days to get fertilizers. They also said that fertilizers were almost never available in the required quantity. However, they said the quality in government outlets was satisfactory and the price was not high, but since they had to scramble around for the fertilizers, wasting money in the process, ultimately the fertilizers from Government shops turned out to be more expensive than what was available in the private shops.

Farmers also said pesticides were available easily in the market but the quality was very uneven. Some companies produced sub-standard and spurious pesticides.

They felt that credit from public institutions like banks was difficult to access, the process was complicated and they had to pay “commissions” to get a loan. For these reasons, they were forced to take credit from seed dealers at high interest rates, or on occasion borrow money from private money-lenders. Majority of the farmers grew cotton under rain-fed conditions. Although electricity was provided free to pump water from bore-wells, the supply of electricity was erratic and irrigation could not be arranged for easily. The farmers said that the Government procurement of cotton was problematic. They had to go to designated areas, wait for four to five days to deliver the cotton and receive the payment only forty days after. In comparison, the traders procured the farmers’ cotton at their doorstep. Farmers preferred this even though they got a lower price. The farmers said they felt free to choose the seed they want, while simultaneously maintaining that they followed the advice of the seed dealers in terms of what seed to buy.

The dependence of the farmers on the seed dealers was very high since they were the source of credit and inputs; they were also the only source of information and advice to solve day-to-day problems of cultivation. After the break-down of the Government's agricultural extension service, the influence of the seed dealers has become substantial and farmers followed their recommendation in most matters related to agriculture. This has given private seed companies indirect access through seed dealers to influence the choices that farmers make. By way of commissions and profit sharing, companies can influence which seeds the dealers stock and which brands they promote. Even though farmers reported freedom in terms of choice of seeds, in reality their choices were likely to be influenced by seed dealers, with whom they existed in a relationship of dependence.

Awareness of Bt Cotton:

Farmers had virtually no idea about genetic modification. But they did say that Bt means cotton which gave high yield without correspondingly high expense on pesticides. Farmers said Bt cotton meant putting poison in the cotton seeds so that the cotton would not be affected by pests. They did not know how Bt cotton seeds are produced.

Farmers laid out their experience of differences between BT and non-BT cotton as follows: Bt cotton had bigger pods, which were not affected by the pests and the seeds were different from conventional hybrid seeds which required a lot of pesticides. With conventional seed, even with heavy use of pesticides, control of pests was not guaranteed whereas with Bt cotton seeds, the pests could be controlled with 3 to 4 sprays of pesticides. None of the farmers knew whether Bt cotton was tested by anybody before it had been released.

The farmers did not think that new kinds of seeds could solve the problem of hunger. They felt that hunger was a complex problem that resulted from many causes and cited caste and land as important determinants of poverty and hunger.

The farmers felt that if they got agricultural inputs in time and a good price for their agricultural produce, they would be able to feed their families. Today, they argued, the biggest problem was that they cannot make a profit from agriculture because the cost of producing a crop was very high and the Government had placed restrictions on the price at which their produce could be sold. The farmers felt that given the right conditions (good seeds, enough water, timely and good quality inputs) they could banish hunger from their villages.

Farmers did not believe Bt cotton was tested properly. Farmers did not think that there were any mechanisms in place to monitor the safety or the quality of seeds. They did not think anyone was doing any studies to see the impact of Bt cotton on soil health or friendly insects. They did not know if anybody had been consulted before Bt cotton had been introduced. They did not think farmers were asked for their experience with cultivating Bt cotton. They said that the seed of Bt cotton was produced by the seed industry. They felt that the role of Government departments and agricultural universities

was less and less visible now. Farmers felt that even if Government set up strong safety testing protocols for seeds and agro-chemicals, this would not be implemented rigorously because of corruption in the system.

We also heard that both goats and sheep were dying after eating tender leaves of Bt cotton plants. Farmers said Bt cotton contained poison to kill the pests and this poison was dispersed through the flower and leaves. Hence leaves were poisonous and harmful to animals. The position also affected soil fertility when leaves and flowers fell into the fields. They said that people ate the meat of goats and sheep that became sick after eating Bt cotton leaves, so Bt cotton poison had also entered their bodies.

The group also expressed the view that Bt cotton would not solve their problems and that Bt cotton was not essential to improve productivity of cotton or food crops because hybrids were doing the job quite well. The also related their changing experiences of cultivating Bt seeds over time. Compared to non-Bt cotton, Bt cotton seeds were more expensive and they required more water. The productivity of Bt cotton was going down year after year due to loss of soil fertility because of the poison coming into the soil from the Bt cotton plants. Bt cotton was more susceptible to other pests than non-Bt cotton and the crop yield went down steeply where rainfall was not adequate.

Conclusions

Farmers constitute a heterogeneous group - they belong to different castes, classes, cultural-religious communities, and cultivate different sizes of farms. Rather than passive receptors of science, rationality and technology, they are thinking social beings who reflect on their condition in light of their experiences and information available to them, and respond to science and technology from their particular standpoints.

The fact that farmers were by and large unaware of genetic modification or of what separates Bt cotton from other cotton varieties and hybrids indicates the extent of their exclusion from policies and technologies promoted in their name. More importantly, it indicates how disconnected the realm of agricultural policy is from the lives of farmers. Across the board, farmers care deeply about the ecological viability of agriculture, they worry about the implications of chemical inputs on their healths and the health of their soils. They would rather work with pesticides that gets half the job done while keeping their soil and their health intact, than pesticides, including genetically induced toxins like Bt, that may damage the soil and adversely impact health in the long run. No surprise that farmers by and large rejected Bt crops as food crops, and were willing to consider Bt crops only for non-food, cash crops. It is important to re-emphasize that their opposition did not stem from lack of education but from long term ecological concerns.

On the question of HT crops, farmers with near-unanimity opposed HT crops for its destruction of valuable biodiversity and mixed cropping systems. In policy circles, HT crops are touted for their alleged benefit in terms of “reducing drudgery” and are being

promoted as a boon for rural women in particular. The loss of biodiversity - surrounding flora, seen as weeds by those practicing industrial agriculture - was not acceptable to the farming community. This flora brought many kinds of benefits to farm families which they were not willing to sacrifice for effective weed control on their farms.

The perception that food grown from seed that is modified with animal or insect parts is different to food grown from other, normal seed, was seen across all age groups and educational status. This kind of food was viewed as “tampered”, not natural and not desirable. Scientists and proponents of GM technology who claim that DNA is the same everywhere and that insect DNA was no different than other DNA, will have to acknowledge the perception that it perhaps is! Policy makers must be sensitive to the findings that food grown from seed that is viewed as “modified” in some fundamental way was not acceptable to rural communities.

The “science based evidence” approach was clearly inadequate for addressing people’s concerns, especially in an agrarian society like India with deep seated cultural and religious ideas about food. The sanctity of food is underlined by the clear articulation in rural communities that any food that had been transformed in the way that GM foods had been, would be unacceptable for special ceremonies and religious festivals. People said they would not offer such food to God during religious festivals or serve it on special occasions like a wedding feast. The attitude to food is overwhelmingly guided by cultural –religious factors, irrespective of educational and economic status. This, rather than a rational analysis of the benefits of a particular food determines food choice. There is a striking lesson here for policymakers – they have to make policies for people as they are with their modes of thinking and feeling, and not for people as if they were automatons of scientific rationality.

Consumers' View of GMOs

A key aim of this study also was to decipher attitudes among consumers towards GMOs, as well as the level of awareness about the same, given consumers form a crucial market for genetically modified food. To that end, consumers were posed a range of questions from basic information about GM food to issues of testing, monitoring and buying habits. That there is very little awareness or credible information among the public about GMOs emerges as a clear finding of the study, and again points towards the failure of authorities to play their role as a credible source of awareness and education in this crucial area of public policy ..Attempts to introduce GM foods into a market where the majority of the population is not aware of the nature of GM foods or how they are produced, nor of their benefits and risks is hardly a democratic or sensitive way of dealing with the subject. It is significant to state here that unlike several Western countries, in India, consumers are a category rarely spoken about in policy debates about GMOs.

Methodology:

500 consumers each in Hyderabad, Nagpur, Ranchi, Jorhat, and Chandigarh (one city in each of the states being studied) formed the respondents for the quantitative study. This sample of 2500 respondents was drawn from homemakers, scientists, professionals and students. For additional qualitative insights around perceptions and attitudes, Focus Group Discussions were also held.

Food buying patterns:

We attempted to get some contextual information on food purchasing patterns among the respondents. 87% of the respondents said they purchased packaged food, though this overwhelmingly indicated food sold in pre-weighed packages e.g. pulses and spices, and did not refer to processed food. Seventy eight percent of the respondents in the study said that they looked for manufacture and expiry dates of the product. Under a quarter said that they looked for quality and ingredients, while close to 80% were guided by expiry dates and the manufacturer while making their purchases. Over half of the respondents were buying imported food, perceiving them to be well packaged and of better quality, a trend that is likely to spread. A small minority responded saying they purchased such foods for lack of an Indian alternative.

GMOs: Awareness and attitudes

A startling finding of the survey was that a majority of the respondents – as many as 8 out of 10 – had not even heard of GM foods, let alone how it is produced. This is all the more revealing given the respondents came from relatively educated sections of society, who were exposed to more channels of information. The lack of awareness was further revealed by the fact that 17% of the respondents thought GM food was already being sold in the Indian market and pointed to semi-processed corn as a possible example of this. Of these, a majority said they were unaware if GM foods were labeled as such, while close to a quarter said GM foods were labeled.

Against this deep gulf between facts and perceptions, our study tried to map the sources of information which consumers drew upon to form their opinions about GMOs. Fewer than 20% of the respondents answered the question about sources of information on GMOs – among those who did, the media and friends were cited as sources. Similarly, fewer than 15% of the respondents said they had heard about the benefits of GM foods, and cited them as better for health and nutrition. A whopping 96% of consumers polled had not heard of any risks associated with GM food – an important revelation in the context of the increasing trend to buy packaged food.

We also posed some hypothetical scenarios to the respondents to gauge attitudes. Thus about half of those surveyed said they would purchase more nutritious food, even if it was more expensive. But only 10% said they would purchase more nutritious food that harmed the environment. A similar number said they would purchase food that was cheaper even if it carried health risks for them.

As to who benefitted from GM foods, consumers placed themselves at the very end of the table, after food production and distribution corporations (named by about 56% of the respondents), farmers and the government (see Table 5).

Table 5: Who benefits the most from GM foods?

Beneficiary	%
Corporations and Companies	56
Farmers	30
Government	31
Scientists	16
Consumers	9

Posed by questions on different aspects of GMOs, a majority of respondents expressed an inability to respond (see Table 6):

Table 6: Consumer understandings of GMOs

Awareness	Agree %	Can't Say %	Disagree %
Modified crops tamper with nature	28.5	60.1	11.4
More research needed	64	30.2	5.9
Unsafe for health	19.5	65.6	14.8
Harmful to environment	16.5	66.4	17.1
Violate social values	18.1	67.6	14.3

In contrast, respondents were aware of their rights as consumers – over 3/4th of those surveyed said they had a right to know what ingredients their food consisted of. A majority of them said that the government should assume the primary responsibility for labeling of foods, while some said consumer forums could also be involved in this task.

We also attempted to ascertain the perceptions of consumers regarding adequacy of testing GM foods. Thirty one per cent said that GM foods were being tested adequately, 11 per cent said they were not. However, the majority could not say if testing was adequate. About half the respondents thought that scientists and government were doing the testing. Some thought that the companies were doing the testing. As with labeling, a majority of respondents said they would trust government and scientists with testing, while corporations and NGOs were shown very little confidence in, on this count. But as a reminder of lack of information on the issue, a third of the respondents said they could not answer who would be a credible testing agency of the choices presented in the questionnaire. Most respondents (77%) felt that long-term monitoring of GM foods was essential, and under half felt that government should be entrusted this task (see Table 7).

Table 7: Who should monitor GM food?

Agency	%
Government	46.1
Scientists	20.7
Companies	4.8
NGOs	4.5
Combination of the above	23.9
Total respondents	100% = 2176

Focus-Group Discussions:

Two focus group discussions (FGDs) held in Ludhiana and Nagpur provided some additional insights into consumer perceptions about food, including GM food, as well as their experiences of a slowly but surely altering food landscape. One of the

groups consisted only of women, while the other included both genders and a mix of homemakers, professionals and students. During these discussions, the respondents flagged a range of issues from price to safety to taste and nutrition, giving an indication of the complex policy goals that authorities have to achieve.

Most of the participants opined that while food today looked better (e.g. rice, fruits and vegetables), it was lacking in flavour, texture and aroma. Many expressed a sense of loss with respect to these shifts. An example of this view came from N, a woman from a rural background who cooks for the families of the complex: "the *chinoor* rice, a local variety grown in Maharashtra, is very tasty. Even that does not taste the same now! It is quite expensive compared to other rice available in the market. But despite the high price, it is not as good! It is not the real *chinnor.*" Similarly, a 45-year-old lecturer recounted that when she was a child, her father used to cultivate a local variety of rice called *karikammod,* (in Maharashtra's Bhandara district) which was very tasty and nutritious. According to her, its seeds were no longer available and that variety was lost forever.

Other respondents thought fruits and vegetables lacked taste because of an overdose of pesticides and chemical fertilisers, and an attempt to hasten the growth cycle of the produce, or artificially ripen fruits such as papayas. Some participants contrasted the flavourful produce they had eaten in the villages with poorer counterparts that they were purchasing in their cities. Most said they would willingly buy organic produce if it was made available to them.

The focus group discussions reinforced the findings of the quantitative study that indicated the dire need for consumer awareness about GM foods. In Ludhiana, only four of ten participants said that they had heard about GM technology. Ms. S.P.K., a young lecturer and Dr. D. who also teaches at a local college says that it is "related to" Biotechnology and they gave the example of Bt cotton. Ms. P.B. said that she had heard about it but did not have any idea what it specifically was. She asked the moderator to enlighten her about the technology. On the other hand, Ms. M.K. opined that it had something to do with "putting something artificial in vegetables like the pumpkin to make them grow big. They do the same with melons". Mrs.M.S. also said that she had heard that melons were injected through GM technology to give them their colour and sweetness. Her reaction to such fruits is that they were "unnatural" and she expressed concern "I feel so sad that my grandchildren have to eat such food, where will they get their strength from?"

In Nagpur, most of the respondents said that they were aware about this technology and some of them said (falsely) that the tomatoes available in Nagpur city were genetically modified. Mr. B.N said, "Earlier, we used to get small tomatoes, but now we get GM tomatoes, which are much bigger in size and look good, but do not taste as good." M.R. also says that "the local variety of tomatoes called 'gaurani' tomatoes is very good! The GM tomatoes are very nice looking, but no taste at all".

In both Ludhiana and Nagpur, the moderator explained to the discussants the basic principles of GM technology, with examples and then sought their views on this kind of technology. In response to the question whether they will consume GM food if such foods have a gene from another organism, respondents gave varied answers. In Ludhiana, some respondents said that "natural food" is the best and they were worried that such GM foods would have negative side-effects. However, two respondents said that they would be willing to consume such foods, provided all tests for safety have been conducted. In the opinion of Dr. D, "in the region of Bhatinda (in Punjab), due to overuse of pesticides, there are lots of cases of blood cancer. If GM food could give me freedom from pesticides, I will eat it".

Safety and price were also considerations in the minds of the participants. In Nagpur, Mr. B.N. expressed a worry about the toxic effects of GM food on human beings. According to R, "We wear cotton (referring to Bt cotton), but what about fruits, vegetables and rice etc. That we eat! Would such products be safe for us?" However, despite this concern, Mrs. R said that she will consume GM food if it is cheap. In her words, "the urban middle class, people like us, who work so hard to make ends meet, look only at the cost. Nobody bothers about any long-term effects. If GM vegetables are produced in large numbers, cost will come down. Prices of vegetables are going sky-high. *Gaurani* tomato is so costly! Who can afford it?"

Vegetarianism also brought a set of concerns around religion, impurity and taboos. Respondents who are vegetarians were opposed to eating GM foods that have a gene from organisms like insects and animals. According to Ms. K. from Nagpur who is studying to be a doctor, "I will absolutely not take any GM food which has non-veg genes in it (from insects and animals). My mother is very strict about it; she will not allow such food into our kitchen, as it will make our kitchen impure." Ms. R. also said that "I will cook such food for my husband who is fond of non-vegetarian food, but will not eat it myself if I know it has non-veg genes in it". In Ludhiana, Ms. M. K. says that "If I eat such food, maybe I will get nightmares imagining insects running inside my stomach".

Non-vegetarians also expressed some concerns on similar grounds. For example, they were also opposed to consuming GM food which might have a gene drawn from animals like cows and pigs. They felt that their religion would not permit them to do so. Others thought that the contentious issues surrounding GM foods could be used in political campaigns. For example, Dr. D. apprehended that rather than religion, politics would not allow such foods to come into the market, with political leaders using the opportunity to create communal tension. Ms. S.P. however, felt that for the poor in India, it was not religion but hunger that was the deciding consideration. If such foods were sold cheap, she argued, that the poor in India will not have any hesitation to consume it.

Regarding the risks of GM foods to human health and the environment, most of the discussants felt that there might be risks in the long-term, and speculated about what these could be, drawing insights from other technology which had also promised to be a panacea only to later reveal darker sides. Ms. M.K pointed out: "When the Green

Revolution began, did we think that it would come at such a heavy price? Same can happen with this technology. You will come to know only after the effects are visible. No use saying sorry then". Ms. R.M also said "As regards long term effects, who knows? Life is very insecure these days. Such rise in cases of cancer! Who knows what unknown evils this new technology will bring?"

One participant in Ludhiana expressed the fear that genetic engineering could lead to genetic disorders. Mrs. M.S. said that while she and her family would not each such food, she was worried about the illiterate farmer and consumer, whose family might consume it, and later have to suffer its ill-effects. In her words, "If his children have side-effects from eating it, who would bear the medical expenses?"

Mr. B.N. said that any technology for India must have minimal risk but should be affordable as well. He also feels that specialized knowledge is required while making far-reaching policy decisions in this area, and rigorous tests need to be conducted to rule out risks from GM foods. Despite all this, he said that one could not rule out the possibility that there might be long-term effects, but that it does not deter one from using any technology.

Almost all respondents expressed the view that any new technology comes with its own hazards and hence, caution should be the key guiding principle in adopting any technology, especially with regard to something as important as food. Thus Ms. H.S. in Ludhiana felt that technology had both positive and negative effects. In her words, "The bottom-line is we should not tamper too much with nature." Ms. M.K. was of the opinion that "technology cannot envisage problems ahead. You keep on hearing of one disaster and then another due to failure of technology. Technology is a man-made thing; how can it ever be superior to the processes of nature, which are slow but sure".

Conclusion

In recent years, the Government of India, especially the Prime Minister's Office and the Ministry of Agriculture, has been promoting GM food in the name of food and nutritional security for the country. Yet again, the views, thoughts, and concerns of the beneficiaries of food and nutritional security have been largely ignored and dismissed. Our quantitative and qualitative survey clearly reveals that consumers have grave reservations about what they see as "tampering too much with nature." We noticed a strong preference for natural food with minimal application of chemical inputs. What is of even more importance is consumers' concern that GM food may, without their knowledge, flout food taboos, e.g, vegetarians unwittingly consuming food with insect/animal genes. Consumers also felt deeply risk-averse when it came to food and were skeptical of technology to be able to anticipate its consequences adequately, an intuition that regulators and policymakers may well learn something from – given the failures to contain GMOs in different parts of the world, e.g., the GM wheat contamination in Oregon recently.

In the backdrop of these attitudes, is a general, overpowering sense of ignorance and lack of information which results in consumers not being able to articulate a clear stand towards GMOs. Like farmers, consumers too repose maximum trust in the government and look upon the government to protect their interests, cultural practices and rights. Is the government willing to shoulder this responsibility? So far, the answer is a discouraging but firm NO.

Scientists' view of GMOs

We are told that the negative evaluation of GMOs stem entirely from people's ignorance, Luddite reactions and are not grounded in science. To test these claims, frequently made by GM promoting companies and the Government of India including Prime Minister Manmohan Singh, we interviewed scientists to assess how they thought about biotechnology. Our findings were startling, for as can be seen below, there was no clear consensus among scientists of the safety and efficacy of GM food, especially in the long run. We found that:

- Scientists felt that India had good laws but very poor implementation and this was reflected in the case of Bt cotton as well. Bt cotton was pushed through under corporate pressure without proper and adequate evaluation.
- Many Bt seeds being sold in the market were inefficacious and sometimes even fake and spurious, but the government had no mechanisms for surveillance and to check such practices.
- Hunger was much more an outcome of inequality in society and could not be addressed by technology alone. GM technology was more likely to benefit rich farmers who could afford inputs.
- GM seeds were going to remain expensive so long as the private sector, which released GM hybrids, dominated the market. GM seeds were also more expensive because they required more inputs.
- Bt protein had already entered the human food chain through edible oil and cakes for animal feed.
- Some scientists were not convinced about the long-term safety of GM foods and were not willing to eat GM food themselves.

Methodology

In **Punjab**, three in-depth interviews were conducted with the following senior scientists:
(i) Dr. S.S.G, Head of the School of Agricultural Biotechnology, Punjab Agricultural University (PAU)
(ii) Dr. J.S.S., Assistant Biotechnologist in the School of Agricultural Biotechnology, Punjab Agricultural University (PAU)
(iii) Dr. K. S., Retired Scientist of PAU and Member of the Punjab Farmers' Commission.
In **Maharashtra,** in-depth interviews were conducted with the following four scientists:
(i) Dr. M.S. K., Former Director, Central Institute for Cotton Research, Nagpur
(ii) Dr. R.T. G., Chairman, Arag Biotech Pvt. Ltd., Ex. Tech. Advisor, FAO
(iii) Dr. R.B. T., Chairman and M.D., Agro-Ind and Eng. Sev. (Pvt.) Ltd., Technical Advisor to World Bank, USAID, IARI (India) etc.
(iv) Dr. R.D. G., Agro-Ind and Eng. Sev. (Pvt.) Ltd.

The scientists interviewed expressed varied opinions, attitudes and perceptions about GMOs. A standard set of questions were asked; with different responses from each.

We have organized the responses into the following areas:

Adequacy of Biosafety Testing of Bt cotton

The scientists were asked about their individual responses to the question whether Bt cotton was properly tested for safety before being released in India, with surprising variability in the responses. Dr. S.S.G., PAU said that there was no need for this in India. In his view, “the Americans have been using Bt technology for the last ten years and they must have done so only after thorough evaluation. So I don’t think our scientists needed to perform additional tests”. Dr. J.S.S. was emphatic that he had knowledge that Bt cotton was tested for safety before release. According to him, “the general principles for testing were developed when Bt maize was tested in the U.S. A similar process has been followed for Bt cotton in India; where it has been tested for safety for human beings, livestock etc”.

In Maharashtra, Dr. M.S.K., former Director of the Central Institute of Cotton Research said that all experiments as well as regulatory requirements were fulfilled and the MNCs were asked to complete all requirements-tests for human safety, animal health, residue effect, effects on other species through cross- pollination etc. The Department of Biotechnology (DBT) ensured that all these requirements were fulfilled and presented this in a meeting, after which approval was given. Dr. R.B.T., disagreed with Dr. M.S.K. saying that the quantity of seed required for testing, both for effect on milk, soil etc., were not made available. According to him, the government department gave the approval, despite the fact that the required samples were not available for testing.

Dr. M.S.K. then changed his view and agreed with Dr. RBT and admitted that only the formal requirements on paper were complied with. In his words, “‘Formalities’ were completed, but whether the formalities were performed in the manner they should have been done, is a matter of question. Procedure has been followed, but not the spirit of it.” Dr. R.B.T. was of the view that in all probability, there was pressure from the companies, to expedite the process. He said that there have been instances in other countries where MNCs bribe the government to approve their products. The scientists hinted that such a thing could also have happened in India.

Though most of the scientists believe that the government has set up a standard system to ensure post- release monitoring and surveillance *(which does not actually exist),* almost all of them are in agreement that in India, this is very difficult to achieve.

Bt protein in human bodies and diets

The scientists expressed concern that there are chances that in India, the Bt gene might have entered the human food chain. According to Dr. M.S.K., it has started entering the food chain through cotton oil and seed cake. The oil is consumed by human beings and the cake used as animal fodder. In his view, there is strong likelihood that it is

entering the human food chain through milk, meat etc.

In Punjab, Dr. S.S.G. said that Bt cotton must have entered the human food chain, but he does not see any harm in it. According to him, “the Bt gene is not toxic to human beings and the acidic PH in our bodies will stop the toxin from working” *(there is no proof of anything like this)*. His colleague Dr. J S.S. also expressed a similar view that Bt cotton would express toxicity only in alkaline guts, while the human gut is acidic. He, however, admitted that it could cause allergic reactions.

GM crops and food security

Dr. J.S.S., a molecular biologist working on GM crops, pointed out that the claim that GM crops can increase food productivity and be a solution to the world’s hunger is a tall claim. According to him, GM technology helps improve the quality but does not increase yield. He strongly feels that hunger is more the result of inequities in society and not availability of food. Dr. K. S. felt GM crops target only a specific issue; for example, pest resistance. Beyond that, they might also have a detrimental effect. The scientists from Maharashtra felt that Bt cotton or any other GM crop would be beneficial only for the big farmers, particularly in Maharashtra, who could afford all the inputs.

Dr. M.S.K. pointed out that 90% of farmers in Maharashtra grew cotton on rain-fed land; they would not benefit from this technology. The scientists from Punjab, however, had a different take on the issue. According to Dr. K.S, “in a state like Punjab, it is possible even for a small farmer to reap the benefits of new technology. Agriculture in Punjab is totally mechanized, despite the fact that not all farmers own tractors. In Punjab, there is one tractor for two and a half farmers; those who do not own one, hire one”. Dr. J.S.S., however, pointed out that for marginal farmers to benefit, there ought to be some mechanism to ensure control over the pricing mechanism.

Affordability of GM seeds

All scientists were in agreement that GM seeds were very expensive, which they believed to be an outcome of private monopoly over Bt cotton. Dr. S.S.G., of the School of Agricultural Biotechnology/PAU, felt that the day this technology came to public universities, it would be affordable to all. Also, companies were using the Bt gene only with hybrids, forcing the farmers to buy fresh stock of seeds every season. In his words, “If this gene comes to the University, we will try to put it into varieties and not hybrids, thus saving the farmer the expense of buying seed every year”.

However, according to Dr. R.B.T., and Dr. M.S.K., GM technology would always remain an expensive technology – because not only were the seeds more expensive on account of private sector hybrids, but also because GM seeds required more chemical inputs than normal seeds. Dr. S.S.G. maintained that there was no difference in water consumption in case of GM crops, but Dr. J.S.S., from the same department felt that Bt cotton was more bushy and took more nutrients from the soil and also required more

water.

In Maharashtra, Dr. M.S.K., was also of the opinion that Bt cotton required more water; since Bt cotton plants had a very shallow root system. According to him, it was very sensitive to water stress (drought). High dosage of fertilizers and assured irrigation were required to get the full benefit of Bt cotton.

Government policy on GMOs and stakeholder participation in policymaking

Most scientists did not have a clear idea about India's policy on agricultural biotechnology. According to Dr. M.S.K. "so far as our information goes, the government policy has not been spelled out in clear terms." Most of them also felt that no stakeholders had been consulted in the process. Dr. M.S.K. also narrated his own experiences as Director of CICR when Bt cotton was being approved. According to him, at that time, stakeholders were not consulted, particularly farmers as the government was in a hurry to push the technology. Dr. S.S.G, was the only one who thought that stakeholders were consulted in the process, however, expressed a note of pessimism when he said that "in India, we have good laws and policies for everything, but implementation and enforcement is very poor".

All scientists were in agreement that GM technology all over the world was promoted by the industry as it is a proprietary technology with patents over it. Many felt that the public sector in India, especially the Indian Council of Agricultural Research, had lagged behind in this technology by many, many years, helping Monsanto – Mahyco gain in the process. According to Dr. R.B.T., the MNCs were about 25 years ahead of ICAR in terms of technology due to their vast capital resources. In his view, Indian scientists who were involved in the process of Bt cotton adoption have not gone to the farmers' fields to see for themselves Bt's performance in the field, as there were no government funds for travel & monitoring.

Risk profile of GM crops

In Maharashtra, the scientists felt that there might be risks associated with GM crops and hence, effect on the plant itself, soil health, water, residue effect, impact on animal health, impact on other species, food chain, environment and impact on secondary pests – all these parameters ought to be taken into account before approving GM crops. Dr. M.S.K. claimed that the incidence of other pests and diseases have increased after Bt cotton has been introduced. He predicted, "You will see the real effect of Bt in the days to come. There will be more pests and diseases in times to come!"

Dr. J.S.S. and Dr. S.S.G. believed that GM food/crops carried no immediate risks. However, Dr. S.S.G. did not give a direct reply to the question about long-term effects. He chose to respond that "As far as long-term effects are concerned, who knows? I think X-Rays carry more risk than GM technology, but aren't we using it?"

All scientists were of the opinion that if stringent measures were put in place to

assess risk and safety before permitting release of GM crops, the introduction of GM crops will not be possible! According to Dr. S.S.G., India was good at making laws, with a miserable track record of implementing them. Dr. R.T.G. and Dr. R.D.G. felt that the government did not have the infrastructure for such monitoring. Dr. M.S.K. responded with an example. According to him, as a cotton scientist, he knows that except for a few companies, the Bt seeds of most companies were sub-standard, and gene expression was not complete or stable. Despite this, the seed of these companies was being sold in the market. Along with this a large amount of spurious and fake seed was being sold to farmers. This was a reflection of the government's monitoring and surveillance capacity.

On being asked whether they would consume GM foods themselves, Dr. S.S.G. and Dr. J.S.S. gave an emphatic yes; Dr. S.S.G., said that it would be a better option than consuming vegetables with lots of pesticide residue, as was the case in Punjab. Dr. K.S. was hesitant saying he did not wish to be a guinea pig for strange foods. Dr.M.S.K. and Dr. R.T.G. said that they would have to be convinced with scientific data that the GM food is absolutely safe. Dr. R.B.T. said that he would not eat such food.

Conclusion

The Prime Minister of India insists that the opposition to India was irrational and unscientific. However, this assessment is belied by scientists including those heading biotechnology labs and India's cotton research institute. There are doubts even within the scientific community about the long-term safety of consuming GM crops and scientists are themselves not persuaded by the bio-safety assessment system of the Indian Government – indicating that there is much room for pressure and money power to ride roughshod over careful testing and evaluation.

What is perhaps most disconcerting about what we heard from the scientists was the fact that consumers – who are quite firmly opposed to GM food as we have already seen – have already been exposed to GM food unwittingly through Bt cotton, which is consumed as edible oil and in the form of cakes for animals who are then consumed by non-vegetarians. There are thus two completely unregulated routes for cotton as GM food to make its way into consumers' bodies. Scientists are clearly aware that people are already consuming GM food yet the Government neither feels the need to inform consumers nor feels the responsibility of consulting them when it promotes GM crops. Could there be a greater mockery of democracy?

Interview – Government Officials (Agriculture)

Finally, we decided to speak to officers manning India's vast agricultural bureaucracy. Below we report findings from an interview with AKG, Assistant Director of Agriculture, who holds an M.Sc. in Agronomy and had, at the time of the interview, 17 years of professional experience. His primary professional responsibilities were supervising about 100 villages, monitoring the implementation of the Government's agricultural schemes, monitoring the quality of seeds and pesticides through inspection of

seed storages and providing advisory services to farmers in his area.

The conversation with AKG revealed a few things that we have already heard from other constituencies, and then some new and disturbing things. We learnt:

- AKG felt that Bt cotton had not been tested properly, nor were farmers informed properly about the technology that they were being sold.
- He was not aware of any proper assessment of the impact of Bt cotton seeds on biodiversity and the health of humans and animals.
- The Bt toxin had in all probability already entered the human food chain.
- Bt cotton had had adverse impact on cattle and livestock.
- Stringent mechanisms were needed for assessment of GM crops, and these mechanisms had to be protected from the powerful influence of multinational corporations.
- GM crops were unlikely to solve the problem of hunger.

Key Findings

AKG felt that Bt cotton was not tested properly before release because it was introduced by private companies. These companies had taken short-cuts to make more profits in a short period. The government machinery was not involved in any way in the release of Bt cotton to farmers. The companies had not provided any demonstrations of Bt cotton to the farmers before releasing the seed into the market. AKG did not think that mechanisms had been put in place to monitor the impact of this seed on the health of humans and animals or on the soil or environment or friendly insects. He had not heard any such monitoring mechanism in his area. AKG said that the Bt poison had already entered the diets of human beings through the meat of goat and sheep which became sick after eating Bt cotton leaves. Sick animals were slaughtered and the meat sold at cheap rates. This meat (since meat is usually very expensive) was eaten by a number of local people and AKG felt that the Bt poison had entered the food chain in this way. It should be noted here that AKG hailed from a community of shepherds and was very sensitive to issues concerning goats and sheep. He also claimed that he had not paid much attention to news reports linking deaths of cattle to Bt cotton leaves – which suggests that his views on sickness in animals were based on his own observations.

He did not think that GM crops could solve the problem of hunger and he did not believe that genetic engineering was capable of improving the productivity of food crops. According to him, the risks posed by GM food were high and there were no mechanism to evaluate this risk or to monitor them post-commercialization. According to AKG, GM crops could only benefit big land-lords who can invest in irrigation with adequate chemical inputs. Bt cotton needed more water than non-Bt cotton, which was a critical water resource, to deliver a good yield. He pointed out that the productivity of Bt cotton was going down every year in the rain-fed areas of his district.

AKG regretted that India did not have a policy on agriculture or on agbio-technology. He stated that there was no policy, so there was no question of assessing the

need of Indian agriculture or farmers. He thought that no stake-holders were consulted on the issue of Bt cotton; he was not aware of any consultation with the farmers in Andhra Pradesh or anywhere else. According to him, GM technology was promoted by the industry in India and in the world. Public institutions like the Indian Council for Agricultural Research (ICAR) and agricultural universities had no role in the development of GM crops in India. According to him, the risks associated with GM foods are primarily related to the health of human beings and animals. The impact of Bt cotton leaves on big animals like cows and buffaloes is slow, but small animals like goat and sheep fell sick within days of eating Bt cotton leaves. They then slowed down and soon died.

If there were to be a negative impact from the cultivation or consumption of GM crops, there was no agency where one could register a complaint and none of the personnel in the existing Government structure were either educated about what to do in such circumstances or empowered to take any action. Nobody knew where a complaint of this type should be registered. AKG felt that Indian mutton exports could be seriously jeopardized if goat and sheep died from eating Bt cotton leaves and valuable foreign exchange would be lost.

According to AKG, certain factors must be taken into account before approving GM crops.

- The special property of the crop variety and its impact on the environment must be researched more systematically before releasing the seed into the market.
- The safety of the crop for human and animal health must be ensured before marketing.
- Training programs should be conducted for farmers and companies must pay for this training. Demonstrations should be conducted by unbiased, autonomous agencies like universities and some good NGOs.
- An autonomous cell should be established with arbitration powers to monitor the impact of GM crops to animal and human health. The cell should be free from political interference and the members of the cell must be people with the highest integrity and commitment to the public.

AKG said that stringent measures must be in place for evaluating GM crops. However, he was skeptical about existing mechanism and their ability to implement stringent assessment because of the influence of multinational corporations determined to promote their seeds at any cost. He felt that multinational corporations could buy off anyone in the system. An autonomous cell/structure like the Election Commission was the only way to implement measures stringently, he opined. Meanwhile, AKG would not eat GM food because of the risks involved and he would never advise his family to eat such food.

Conclusion

We have heard from farmers, from consumers, and from scientists. Now we have

heard from the public sector agricultural bureaucracy too. GM food is unlikely to solve the problem of hunger and the only GMO commercialized in India – Bt cotton – is showing an adverse impact on livestock and is threatening the livelihoods of resource-poor farmers i.e., the vast majority of Indian farmers. Finally, existing safety assessment mechanisms had fallen prey to the influence of multinational corporations in the business of GM seeds and neither were stakeholders consulted during the process of approval of Bt cotton, nor did India have a good policy on GMOs. Leave aside farmers and consumers, it seems there is little support for GMOs from even within the public sector agricultural establishment!

Conclusion

Food is embedded deeply in a cultural and religious context in India. There are cultural and religious taboos that still manifest, irrespective of educational and economic status. Government policymakers and seeds companies subscribe to the view that people oppose GM foods because they are ignorant about them and that a good 'awareness' program will rectify this. This presumes that knowledge and awareness about the benefits of GM crops will automatically convince farmers and consumers alike of their attractiveness and provide an incentive to accept them. This view also came up in some of our FGDs with scientists and professionals. The study results however show that the context of food is so clearly cultural that better knowledge about it is unlikely to change fundamentally held perceptions. Vegetarians for instance will not eat chicken soup however clear the scientific evidence that it is good for health. Similarly, people of a particular religious persuasion that have food taboo , will not eat taboo flesh, irrespective of the scientific evidence that protein is more or less the same, regardless of its source.

The overwhelming sentiment with respect to food is guided by cultural –religious factors, rather than a rational analysis of the benefits of a particular food. No surprise then that attitudes to cash crops were more relaxed than to food crops but even there, the notion of 'tampering' in some way with the seed, met with resistance and farmers had reservations.

The sanctity of food is underlined by the clear articulation in the rural

communities that any food that had been transformed in the way that GM foods have been, would be unacceptable for special ceremonies and religious festivals. People said they would not offer such food to God in religious festivals or serve it on special occasions like a wedding feast when guests were served the best. With such strong cultural beliefs and sentiments about food, the introduction of GM food without the approval of communities, will amount to a betrayal of their cultural rights and values. The government must take note that validating the safety and appropriateness of GM foods by pure science ('science based evidence') may work for robots but is meaningless in the context of the human beings, the products of culture, community and history. Such an approach negates all the complex and nuanced attributes of food that exist for communities. It violates the civilizational and cultural rights of communities to have a complete say over the food they wish to eat…and reject.

Consumers grappling with an overdose of pesticides and its deleterious effects have developed a cynicism in a situation which is out of their control. Homemakers, who were largely women, placed a greater emphasis on the safety and nutrition of food and displayed a reluctance to bring home foods that were not natural. But women and men were equally cynical when they said that if they could survive pesticides in their food, they could survive GM foods too. This is most strongly seen in Punjab, a state known to be suffering from very high incidences of cancer, physical deformities and other ailments, resulting, it is likely, from the heavy pesticide load in its agriculture and food. Their statements that 'if we can survive pesticides, we can survive GM foods' is not indicative of any acceptance but of deep cynicism and dejection at the degradation of their food.

In the farming community, age appeared to most influence decisions and attitudes to seed, fertilizer and pesticide, with younger farmers being more willing to take risks or exhibiting less conservative attitudes to eating tampered food. The other determinant was poverty. Resistance to food that was considered tampered, was lower among smaller, poorer farmers, who mentioned they would eat the food that was available, even if it was not optimal.

The perception about the place of government and the trust and reliance placed in it, probably has many skeins. According to the study, it is the agency in which the most number of people have placed the greatest amount of trust; they see it as an agency that can be relied on to protect their interests, and an agency that should monitor safety of foods. The attitude to government can probably be split into what is actually received from government in terms of benefits and the recognition/expectation that it is the government's job to perform the function of ensuring the well being of citizens. In rural India, it is the government that brings in all the major benefits, whether it is irrigation, food aid, more recently the National Rural Employment Guarantee Act or any of the many food and other support systems like Mid Day Meal Schemes, Take Home Rations for mothers etc. However imperfect the delivery, rural Indians see the government as the agency that provides benefits. At the same time there is the acknowledgement that the levels of corruption are high and this eats into citizen entitlements.

The government must be humbled by the trust placed in it by the country's farmers and consumers with respect to agriculture and food technologies. This trust should propel government agencies to be that much more conscientious in discharging their duties and responsibilities, as is expected from them, to safeguard the public interest. There is a lesson here for the NGO community too, that seems to be losing the trust of substantial sections of people. Across all the states studied, the NGO community seemed to enjoy the least amount of trust from among government agencies, companies, scientists and media. This is worrisome since there are several excellent NGOs doing outstanding work, particularly in rural areas and especially in the sector of food and livelihoods. Despite this, a perception seems to be gaining ground in many places that NGOs are not necessarily providing authentic information or working actively to protect the community's interests. In the case of urban consumers, the discussions threw up a divergence of views about information on GMOs. Many felt that NGOs provide useful, reliable information; others felt that NGOs doctored their information, like the companies did, to suit their ideology. If the NGO community is to recapture its relevance for the communities it seeks to serve, it must introspect and develop ways to do things differently, to regain the trust that it must continue to have.

Our study shows a reluctant, confused population anxious to protect the safety and cultural value of its food, its agriculture and in the last instance, its very survival as a culture and community. While the population looks towards the government to protect its interests and address its concerns, the government is busy pushing GMOs onto a poorly informed, unsure citizenry. If democracy is government for the people and of, then the people's perceptions and views cannot be dismissed as simply irrational – they have to be taken into account in policymaking. This is not just about inclusive policymaking, but also policymaking that does not harm the citizenry and is in tune with the realities of Indian agriculture. While the government is making a case for HT crops, farmers are saying they value "weeds" because it comes in the form of fodder, medicinal and other beneficial plants.

Thus it cannot be emphasized enough, that we need policy-making that addresses the needs, the actual circumstances, and the concerns of our society. Instead of a yes/no approach to GMOs, we need nuanced understandings of where they may be of benefit to the country, and where they are likely to hurt. Above all, we need an approach that is democratic and that involves the participation of people as they are and not as they ought to be. We hope that this research will contribute to improved dialogue, and promote rational, culturally sensitive, inclusive decision making in the field of agricultural biotechnology and GM crops and food. We also hope that this study leads to further research to understand how to make technology choices responsive to public needs and public opinions.

Appendix A: Research Design & Methodology

Designing the empirical research began with discussions with a range of scholars, experts and diverse stakeholders. Academics and social science research scholars not associated with the study were invited to comment, critique and vet the methodology as it evolved. Our discussions emphasized the need to make sure that the methodology and the research process was not only sound but also completely transparent. All research partners are agreed that our approach was not based on *a priori* concepts, opinions and attribution of meanings to GM food. Our research methodology would be one which allows us to privilege individuals as active agents capable of reflecting on events and objects and document their perceptions that are mediated by their socio-economic status and their systems of meanings, values and attitudes.

A draft methodology was shared with a round of commentators and reworked after getting feedback from scholars from both inside and outside India, particularly from those who have had experience of conducting similar studies in the US and Europe. In addition to the advisory group associated with the research project, we have benefited from discussions with Prof Brian Wynne of Lancaster University and the principal author of the study of the Commission of European Communities on Public Perceptions of Agricultural Biotechnologies in Europe (the PABE study), Prof Ian Scoones at the Institute of Development Studies (IDS),UK, and Prof Sheila Jasanoff from Harvard University, USA. While we have benefited from feedback and suggestions from these and other people, **we alone remain responsible for this report.**

A methodology to understand perceptions about GM crops and foods needed to keep in mind the context in which the study was proposed and issues related to agriculture. This study had to be conducted in a heterogeneous population differentiated along economic, cultural and political endowments and stratified along lines of class, caste and gender. There exists a significant proportion of marginalized communities who could have different perceptions about technology as well as differential access to technology. There are irrigated regions and rain-fed regions in the country. In most

irrigated regions, farmers have the experience of using green revolution technologies. In rain-fed areas there is uneven use of green revolution technologies. Farmers also vary in the amount of land they possess. Most farmers have small land holdings, below 5 acres. Consumers, another category studied here, are a stratified group also ranging, for instance, from the poor farmer to the rich, high-consuming class, from young girls and boys to homemakers and professionals.

The study was conducted in two phases. Phase I attempted to understand the perceptions and attitudes to current agriculture and its associated problems in India and to embed the understanding of risk and modified foods within this. Questions elicited awareness about new technologies like hybrids, High Yielding Varieties (HYV), and new generation seeds with radically new properties. The study also asked what stakeholders thought of food - its cultural and religious moorings. It also asked questions to assess what risks people will run with agriculture (soil health, impact on biodiversity) and food, including its potential impact on health. Questions were framed about agricultural inputs, soil health and credit as well as about farming and its future.

Attitudes to food and cash crops were assessed and attitudes to food that was natural and food was grown from radically different seed formed part of the investigation. The research study also explored the perception about the need to regulate new seeds and technologies and the preferred agencies that should do this. An important set of questions dealt with the perceptions about trust. Which agencies do stakeholders trust as sources of information and whose advice do they prefer.

For the Phase I study, three states – Andhra Pradesh, Maharashtra and Gujarat were selected. In all three states Bt cotton has been adopted since the crop season 2002-03. Two districts were selected per state: From Andhra Pradesh, Guntur and Warangal, (total 354 farmers) from Maharashtra, Amravati and Yavatmal (total 146 farmers), and from Gujarat Ahmedabad and Gandhinagar (total 217 farmers). A structured questionnaire was used to collect information. Data was collected from over 700 farmers on size of land holdings, crops cultivated, sources of agricultural inputs, credit, yield and awareness about agriculture technology.

The study with consumers included perceptions of safe food and willingness to take risk with foods. The first phase of the study employed survey method, which used a questionnaire, and a qualitative method that employed FGD and interview techniques. The insights gained from the phase I of the study helped us design the second phase of the study.

Phase II

Phase II of the study examined the perceptions of and attitudes to risk , for instance with respect to altered/ modified crops and food , new concepts of agriculture and new agriculture technologies including new agrochemicals with advantages and risks in the highly differentiated farming context. In most parts of the country, farmers have the

experience of using chemical fertilizers, pesticides, and high yielding varieties introduced as a part of the green revolution. The green revolution brought farmers into the matrix of relations involving the state and input producers and dealers.

Consumers are a stratified group in terms of rural and urban consumers. Rural consumers consist of farmers, who produce food and also consume the food they produce. In areas where farmers largely cultivate cash crops they depend on the market for food. Landless labor and those involved in non-farm occupations constitute a significant section of rural consumers. In relative terms, urban consumers tend to have more disposable income compared to rural consumers.

As this study is the first comprehensive study in India, our aim was to capture perceptions and attitudes towards food of a broad and somewhat representative section of the farmers and consumers in rural and urban areas given the diversity in agriculture and socio-economic backgrounds. For this, we adopted the survey method to achieve a broad, representative coverage. Similarly we adopted the survey method to capture the perceptions and attitudes of urban consumers on modified food. Perceptions and attitudes relate to what meanings people attach to food and what features in food are considered desirable for maintaining and promoting health, whether modified food would have such qualities and what kind of risks could be associated with such modified foods.

A combination of quantitative-statistical surveys and qualitative methods like Focus Group Discussions (FGD) and interviews were used to understand the experiences regarding existing agricultural technologies and perceptions of risks associated with new technologies and modified crops and foods.

The Risk Approach

Essentially, the approach of this study was to understand the attitude to risk and how risk is perceived by diverse stakeholders, with respect to the production and consumption of food and their view on the regulation of risk. Theories of risk have historically neglected food issues but in the wake of 'food scares' since the eighties, public confidence in the food industry and government regulatory bodies has been undermined, giving rise to serious thinking on the issue. At the same time, since risk is an important determinant of food choice, risk has become increasingly attached to consumer attitudes and perceptions in general. The mathematical approach to risk analysis fails to embody the social and cultural context of decision-making with the result that the approach has proved to be of little utility for the prediction of behavior in matters relating to food risk. Today, issues of control and trust have entered the discourse on food risk. For instance, potential risk from food biotechnology is characterized by low perceptions of control, while lifestyle and dietary health risks are associated with greater perceptions of control.

Similarly, some approaches have been favored politically, because of their potential to explain the apparent irrationality of lay risk perceptions, and the implication

that the public can be educated to overcome perceptual bias and to accept more rational assessments of risk. In the face of all these approaches, qualitative approaches are gaining favor as more able to provide the neutral context for understanding public perceptions and attitudes to food and agriculture issues. In the western world particularly Britain and Europe, consumer concern over food safety has steadily increased since the 1970's, yet in India risk perceptions have not been explored at all in relation to food. Some emerging attention on the part of industry only reflects the growing realization that the success of new food and agriculture technologies like GMOs will largely depend upon public acceptance.

This study presumes risk is influenced by a wide range of qualitative factors rather than statistical rationales and probabilities alone. Social meanings surrounding risk perceptions render the mere quantitative assessment of risk impossible. The public's approach to authority such as government, science and industry which backs technological innovation in food and agriculture is conditioned by their culture and history, and hence such cultural-historical factors cannot be neglected. Equally, it not only the farmers and rural consumers whose responses are conditioned by history, the same is true of the educated urban-dweller and even the scientist and the government officer. This is why the perceptions of the educated and the S&T elite also needed to be examined. The perceptions of the scientific community and government officers also consequently form part of this study

. And finally, food holds tremendous symbolic significance. In particular, vegetarianism and religious taboos hold a great degree of significance in Indian culture and yet cannot be said to determine the entire population's attitudes. Food choices and food risk perceptions are culturally and identity driven. Food related risk is therefore construed in India in a way that is unique and may vary by food type. This study has attempted a cross-regional analysis not only for enhancing the representative value of its findings but to try and capture this important yet elusive dimension of public attitudes and perceptions to risk in food and agriculture practices.

Operationalising Concepts

We operationalised the key concepts employed in the study by developing empirical indicators of the concepts. Indirect questions like whether farmers would use chemicals that were effective herbicides and would control weeds, but would also destroy surrounding vegetation were posed, to approximate (herbicide tolerant) GM seeds. As an empirical indicator to assess if people would like to eat GM foods, we asked whether they would eat food that was cultivated from new types of seeds in the development of which parts of animals or insects had been used . In order to see whether farmers would make a distinction between cash crops and food crops, we asked whether they would use the kind of seed described above, to grow cash crops and food crops.

The concept of GM crops and foods was presented as those crops and foods that were different to conventional crops and food because they had been changed in some

fundamental way. 'GM" seeds were presented as new varieties produced by a process which involved introducing parts of plants, animals or insects to provide some useful attribute such as improved ability to fight pests. Bt cotton was presented as a seed in which a modification was made by introducing parts of insects to minimize the use of pesticides.

Instruments of data collection:

Standardized questionnaires were used for the quantitative study of farmers and urban consumers. For FGDs, thematic questions were used to promote and guide the discussion in the group.

- Quantitative data was collected through household interviews using questionnaires from two types of key stakeholders; rural farmers and urban consumers
- Qualitative data was collected through Focus Group Discussions (FGDs) from key stakeholders like farmers, consumers, scientists and seed dealers.
- People who would not be amenable to an FGD setting were interviewed independently.

Selection of states:

The study on farmers and consumers was conducted in five states:

- Andhra Pradesh
- Maharashtra
- Punjab
- Jharkhand
- Assam

These states are geographically distributed to represent North, South, East and West India. Assam was included from the northeast of India, a region which is considered somewhat isolated from the “mainstream”. Andhra Pradesh and Maharashtra have been cultivating Bt cotton since 2002-2003. Jharkhand and Assam do not cultivate cotton and hence have no exposure to Bt cotton. Punjab is considered the cradle of the green revolution in India. Punjab is considered the quintessential “agriculture state” of the country. Known for its early adoption of the green revolution and intensive agriculture practices, Punjab has both cotton and non-cotton growing regions. Maharashtra and Andhra Pradesh have pockets of intensive agriculture as well as conventional agriculture. Jharkhand and Assam have largely conventional agriculture.

Sampling for Farmers Survey

Two districts were chosen in each state. The sampling was purposive. In each district, two villages were selected randomly using the census list. In each village 200 farmer households were selected randomly for survey. This brought the total sample per district to 400 farmer households and the total sample size per state to approximately 800

farmer households.

The following districts were selected: Andhra Pradesh- Mahboobnagar and Guntur; Maharashtra - Amravati and Yavatmal; Punjab - Bhatinda and Patiala; Jharkhand - Ranchi and Dumka; Assam - Golaghat and Jorhat.

Summary Statistics for Phase II

Table No.1 Distribution of farmers in the sample across the five states:

State	Sample size	
	Frequency	Percent
Andhra Pradesh	812	20.0
Maharashtra	836	20.6
Assam	804	19.8
Jarkhand	800	19.7
Punjab	800	19.7
Total	4052	100

Table No. 2. Distribution of farmers in the sample across districts

District wise Sample Size in each state								
	Andhra Pradesh	Maharashtra	Assam	Jharkhand	Punjab	Total		
District	%	%	%	%	%	%	Freq	
Guntur	50.2	-	-	-	-	10.1	408	
Mahabubnagar	49.8	-	-	-	-	10.0	404	
Yavatmal	-	50.4	-	-	-	10.4	421	
Amaravathi	-	49.6	-	-	-	10.2	415	
Golaghat	-	-	38.1	-	-	7.6	306	
Jorhat	-	-	61.9	-	-	12.3	498	
Ranchi	-	-	-	50.1	-	9.9	401	
Dumka	-	-	-	49.9	-	9.8	399	
Bhatinda	-	-	-	-	50	9.9	400	
Patiala	-	-	-	-	50	9.9	400	
Total	100	100	100	100	100	100	4052	

Sampling for Urban Consumers

In each state one city was chosen for this survey viz., Hyderabad in Andhra Pradesh, Nagpur in Maharashtra, Chandigardh in Punjab, Ranchi in Jharkhand and Jorhat in Assam. The sampling was purposive. A stratified random sample of about 500 urban

consumer households was surveyed in each city. This sample consisted of the following five different consumer groups, of approximately 100 each, selected randomly:

- Professionals (lawyers, chartered accountants, doctors, scientists etc.),
- Students
- Government employees
- Housewives
- Academicians

The professionals surveyed were identified through professional associations, lawyers from the Bar Association, list of doctors from leading hospitals, etc. The list of academics surveyed was identified from universities and from teachers associations. The government employees surveyed were identified through major government offices in the city. The housewives surveyed were identified on random basis drawn from the voters list. The students surveyed were identified from hostels and colleges.

Methodology for FGDs

Three FGDs were held in each district in each state. Two FGDs were held with two different farmer groups in villages belonging to different mandals (blocks). One FGD in each district was held with shop owners who deal in seeds, fertilizer and pesticide. Each farmer FGD had about 15 members. About ten shop owners/dealers constituted the other FGD. FGDs with urban consumers were organised in groups of 15-18.

Analysis of Data

As an initial step in the analysis, frequency tables were generated on the basis of the data collected through the sample survey from farmers' households from urban consumers. Contingency analysis was carried out to examine association, between demographic variables (independent variables) and the variables that are empirical indicators of experiences, perceptions, attitudes towards risks associated with agriculture and food.

While the survey results provide statistics regarding the association between the dependent and independent variables measured on nominal, ordinal and interval/ratio scales, the results that we obtained from the FGDs and interview were used to understand the meanings that people attach to agriculture and food in different contexts. Meanings cannot be measured; they can only be interpreted and understood. We employed a combination of methods to explore the diversity of experiences and diversity of perceptions and the factors that account for the variations in perceptions. Thus, this study was an attempt to use more than one source of data to produce a narrative that captured the perceptions of farmers, consumers input dealers, who represented the interests of industry, scientists and professionals, policy makers, and attempted to explicate the anxieties and tensions that new technologies generate.

Appendix B1: Phase I Survey among Farmers

Socio-economic profile of farmers surveyed

Caste has been categorized in terms of the popularly used categories by the government OC (Other castes generally understood as higher castes), BC (Backward castes which are intermediary cultivating castes), SC (Scheduled Caste) and ST (Scheduled Tribe). In terms of religious categories, in addition to Hindus who are categorized into caste groups, Muslims also practice agriculture but to a lesser extent. Class background is ascertained indirectly by variables such as the size of land holdings and extent of irrigated and un-irrigated land. Educational achievement was measured in terms of levels of education – illiterate, primary school, high school and undergraduate level etc.

Table No. 1 Caste composition of the farmers in the two states:

	Andhra Pradesh	**Maharashtra**
Caste	%	%
OC	44.63	26.03
BC	46.33	32.19
SC	3.67	29.45
ST	2.82	4.79(GEN)
Muslim	2.54	7.53(NT)
Total	100	100

Table No. 1 indicates that the majority of the farmers belong to the OC and BC categories. In the case of Maharashtra nearly 30 per cent of the framers are from SC background. In both states, few farmers belong to the ST category. The pattern indicates that the upper castes and intermediary caste groups are predominantly involved in agriculture.

Table No. 2 Educational qualification farmers

	Andhra Pradesh	**Maharashtra**	**Gujarat**
Education	%	%	%
Illiterate	42.37	35.62	11.1

Upto V Class	20.62	18.49	32.7
Class VI - X	27.40	30.82	44.7
Intermediate	5.65	7.53	9.7
UG Degree and above	3.95	7.53	1.8
Total	100	100	100.0

Table No. 2 indicates the levels of educational achievement of the farmers. The majority of the farmers have educational achievement ranging from primary school to high school or 10th standard. In the case of Andhra Pradesh, 42.37 per cent of the farmers were illiterate.

Table No.3 Highest education level attained in the household:

	Andhra Pradesh	**Maharashtra**	**Gujarat**
Individual	%	%	%
Self	29.38	23.97	55.3
Spouse	2.82	3.42	08.3
Others	67.80	72.60	36.4
Total	100	100	100.0

Table No. 3 indicates who attained the highest level of education in the household. Only in Gujarat the majority of farmers themselves had achieved the highest level of education, whereas in Andhra Pradesh and Maharashtra the proportion was less than 30 per cent. In such households, the children were better educated or family members who held jobs outside.

Table No. 4 Distribution of Farmers in terms of the category of land landholding

	Andhra Pradesh	**Maharashtra**	**Gujarat**
Landholdings	%	%	%
Land Owner	93.79	96.58	93.5
Share Cropper	3.95	1.37	2.8

Land owner and share cropper	2.26	2.05	3.7
Landless Agri Labour	2.26	----	----
Total	100	100	100.0

Table No. 5 Area of irrigated land owned by farmers

	Andhra Pradesh	**Maharashtra**	**Gujarat**
Irrigated land	%	%	%
Upto 5 Acres	32.75	57.78	34.1
5 - 10 Acres	31.88	20.00	51.2
11 - 15 Acres	19.59	6.67	14.7
16 - 20 Acres	7.89	6.67	---
20 Acres & above	7.89	2.22	---
Total	100	100	100.0

Table No. 6 Area of un-irrigated land owned by farmers

	Andhra Pradesh	Maharashtra
Un-irrigated land	%	%
Upto 5 Acres	77.78	56.78
6 - 10 Acres	22.22	31.35
11- and above acres/bighas		10.17
Total	100.0	100.0

Table No. 7 Area of leased out land by farmers

	Andhra Pradesh	Maharashtra
Leased out land	%	%
Upto 5 Acres	50.00	16.67
7 – 10 Acres	42.86	16.67
10 – 15 Acres	7.14	16.67
No response	--	50.00
Total	100.0	100

Table No. 7 shows that the proportion of farmers who leased out land is very small. Table No. 8 below indicates that the leasing-in of land is more frequent.

Table No 8 Area of leased-in land cultivated by farmers

	Andhra Pradesh	Maharashtra
Leased in land	%	%
Upto 5 Acres	34.91	58.06
5 - 7 Acres	12.07	12.90
7 - 10 Acres	18.53	3.23
10 – 15 Acres	19.40	3.23
15 – 20 Acres	9.05	6.45
20 Acres & above	6.03	3.23
Total	---	3.23
		9.68
Total	100.0	100.00

Table No. 8 indicates that in Andhra Pradesh of those who have leased in land, nearly 35 per cent are marginal and small farmers owning below 5 acres. A similar trend is seen in Maharashtra, of those who leased in land 58 per cent were small and marginal farmers. Other farmers leased in land also for various reasons. The leased land may be blocking entry to their land or the leased land may have better access to water for irrigation.

Input Sources - Seed

Table No 9 . Sources from which farmers procure seeds

	Andhra Pradesh	Maharashtra	Gujarat
Procure seeds from	%	%	%
Govt. agency	1.41	5.48	64.1
Private dealer	92.09	88.36	26.3
Both govt and private dealer	0.28	4.79	17.1
Fellow farmer and other sources	0.28	1.37	2.3
No response	5.93	--	--
Total	100	100	100.0

Table no. 9 shows that the majority of farmers in Andhra Pradesh and Maharashtra depend on private seed dealers for their seed (88-92 %). In Gujarat however, 64 per cent of the farmers procure seed from government agencies, while only 26.3 per cent depend on private seed dealers. A smaller percentage sources seeds from other farmers.

Criteria for selecting seed

Table No. 10A. Andhra Pradesh

Reasons	%
High yield	94.35
Pest resistant	0.56
Subsidy seed	0.85
Demand in market	1.98
Others	0.56
No response	1.69
Total	100

In Andhra Pradesh, high yield is the most dominant reason for selecting a particular seed, followed by other factors. Almost 95 % of farmers chose seed for high yield. The same trend is reflected in Maharashtra.

Table No. 10B Maharashtra:

Reasons for choosing seeds	
	%
Increased production	56.16
Pest resistant	0.68
Other farmer advised it	19.18
Demand in market	0.68
Suits to land	2.05
Told by the shopkeeper	2.05
Average production is good & more profit	4.79
Ordinary seed do not give good yield	4.11
It is new seed & krishi kendra person advised to go for it	0.68
It is new seed in market & is used by others	1.37
These seeds do not need pesticides & insecticides	1.37
It requires less water	0.68
We are now familiar with it	0.68
Farm last year experience	1.37
No Response	4.11
Total	100

In Maharashtra, whereas yield was favored, it was not as overwhelming as in Andhra Pradesh. Farmers were influenced by the advice of other farmers and their experiences of

crop survival and yield.

Table No 11 Perception of the farmers regarding good quality of seeds:

	Andhra Pradesh	Maharashtra
	%	%
High yield	67.51	78.46
Based on last year yield	4.24	----
Pest resistant	0.28	0.68
Demand in market	20.34	4.74
Size of the grain	0.28	----
No response	7.34	22.60
Total	100	100.0

Table No.11 shows that for the majority of farmers, good quality seed is one that gives high yield. Farmers in Andhra Pradesh give importance to seed that has a high demand; farmers in Maharashtra do too, but to a lesser extent. *Surprisingly, pest resistance does not feature as an important criterion for selecting seed.*

Farmers also look for certification of the seed by government agencies such as Agmark (Table 12), but most farmers (68 % and 38 %) in Andhra Pradesh and Maharashtra are not conversant with branding and certification of seed.

Table No. 12 Farmer's method of recognizing good quality of seeds:

	Andhra Pradesh	Maharashtra
	%	%
Ag mark	22.03	6.85

BSI	1.13	5.48
Can’t recognize	0.56	6.85
Relatives and fellow farmers	----	5.48
Shop keeper and the seed company	----	4.10
From experience	--	17.81
Krishi Kendra	--	2.74
Don't Know	68.36	37.67
No response	7.63	4.11
Total	100	100.0

Table No. 13 Percentage of farmers who saved hybrid seeds for next season:

	Andhra Pradesh	**Maharashtra**	**Gujarat**
	%	%	%
Yes	1.98	4.11	26.3
No	91.24	95.21	73.7
No response	6.78	0.68	--
Total	100	100	100.0

Table No. 13 showed that the majority of the farmers did not save hybrid seed for the next season. This trick question was to assess the extent to which an agricultural technology, with a catch, was adopted correctly. Farmers in Andhra Pradesh and Maharashtra seemed much more conversant with hybrid technology, understanding that you cannot save seed for the next season. Surprisingly, in Gujarat (with more literate farmers) farmers were more likely to use seed of hybrids for the next season. Hybrids do not yield true breeding seed so seed cannot be saved for the next season. This question was an indicator of the farmer’s ability to comprehend the hybrid technology.

Fertilizers:

Majority of the farmers in the three states used chemical fertilizers. They reported that they used chemical fertilizers for increasing yield and ensuring the good growth of crops. Some farmers, especially in Maharashtra mentioned that enough quantity of organic fertilizers is not available. Farmers depend on various sources for procuring fertilizers. The predominant source was the private dealer: 95 percent of farmers in Maharashtra and 96 percent of farmers in A.P. mentioned that they procured fertilizers from private dealers whereas in Gujarat 76.5 per cent mentioned that they obtained fertilizers from government agencies while 18 per cent reported that they got the fertilizers from private dealers. The remaining farmers in Gujarat mentioned that they got fertilizers from fellow farmers, farmers' associations or government outlets. About 59 percent of farmers in Andhra Pradesh and 52 percent of farmers in Maharashtra and 63 percent of the farmers in Gujarat reported that fertilizers were expensive and they could afford to buy as much fertilizer as they needed.

Over 90 percent of the farmers in Maharashtra and Gujarat bought fertilizers by paying cash out right. However, in Andhra Pradesh about 64 percent bought fertilizers by paying in cash. The rest procured fertilizers on credit. Private seed dealers and fellow farmers were the most frequently consulted for advice on selecting seed and fertilizer, although many farmers also relied on their own experience. This indicated the complete breakdown of the agriculture extension system through which scientists interacted with farmers to help them make choices and to solve their problems. Farmers rarely mentioned that the public extension system played any role in advising them. Although upto 50% of farmers reported that chemical fertilizers increased yield, they also felt that the continued use of chemical fertilizers will decrease soil fertility

Pesticides:

We noticed a similar trend to fertilizers in the procurement of chemical pesticides in the three states. 98 percent and 96 percent of farmers in Andhra Pradesh and Maharashtra respectively reported that they bought pesticides from private shops and retailers, but in Gujarat the majority (about 70%) bought pesticides from government agencies, and the rest procured pesticides from private pesticide dealers.

Irrigation:

In India at present only about 30 percent of the cultivated land gets assured water for irrigation. Bulk of the pulses and coarse grains are cultivated in rain-fed areas. In this context irrigation assumes significance. In some parts of India like Punjab, Haryana and Western Uttar Pradesh, the irrigation system is based on big dams and canals. In the present study the sources of irrigation water are presented in Table No. 14.

Table No. 14 Sources of irrigation water

Source	Andhra Pradesh	Maharashtra	Gujarat
	%	%	%
Canal	20.06	19. 18	52.5
Tube well	19.77	14.47	52.1
Both canal and tube well	4.52	1.37	5.1
Tank	7.63	0.68	--
Rain-fed	42.66	15.75	---
Lift irrigation	4.24	---	---
No response	1.13	10.96	0.5
Total	100.0	100.0	100.0*

Table No. 14 shows that farmers in the three states depended on multiple sources of water for irrigation. Over 50 percent of farmers in Gujarat mentioned that they depended on canal irrigation while in Andhra Pradesh and Maharashtra about 20 percent reported that they depended on canal irrigation. In Andhra Pradesh a significant proportion of farmers (42.66 percent) depended on rains for cultivation. In Andhra Pradesh one sees a variety of irrigation systems in use. Regarding the adequacy of water supply for irrigation, a large proportion of farmers (82.19 per cent in Maharashtra) mentioned that they did not have adequate water supply for irrigation. The percentage of farmers who reported inadequacy of irrigation water were 35.88 percent in A.P. and 19.8 percent in Gujarat.

The majority of farmers in Andhra Pradesh (77.12 per cent) and Maharashtra (94.52 per cent) reported that the quantity of water available for agriculture had decreased over the years while in Gujarat (78.8 per cent) reported that there had been no decrease. Irrigation facilities were closely related to the supply of electricity, especially in states where farmers depended on ground water (tube wells, open wells with pumping sets powered by electricity or diesel) for irrigation. In Andhra Pradesh, in regions where farmers depended on ground water, the state government had introduced a subsidy on electricity. The price of diesel was always kept lower than the price of petrol keeping in view the needs of farmers. In spite of these measures energy was not always readily available for irrigation.

Sources of credit:

With the Green Revolution package requiring the use of inputs such as chemical fertilizers, pesticides and irrigation, the cost of cultivation has been continuously rising. This has led to farmers taking recourse to credit to augment their financial resources to procure the necessary inputs. The sources of credit included institutional credit from nationalized banks and other government agencies. The institutional credit was made available to farmers subject to farmers fulfilling certain conditions and complying with formal procedures. The compliance procedure often caused delays in accessing the institutional credit in time for the agricultural season. When this happened, farmers tended to approach private money lenders for credit at high interest rates. In several states, the private dealers who supplied fertilizer, pesticide and seed, also provided credit. Taking loans from private moneylenders and seed dealers did not involve the complicated compliance and guarantee procedures and even though interest charged was high, farmers preferred these sources since the credit was available in time. In this study, the majority of farmers in Maharashtra (85.62 percent) and Andhra Pradesh (94.63 percent) had taken loans, whereas in Gujarat the only 12.4 percent farmers had taken loans. In all three states, the majority of the farmers said they raised loans for meeting expenditure relating to agriculture - 66.40 in Andhra Pradesh and 87.16 percent in Maharashtra. 96.3 percent of the 27 farmers in Gujarat who took loans, also used it for agriculture. Farmers depend on multiple sources of credit such as commercial banks, district cooperative banks and moneylenders.

Aspirations for the future

Table No. 15 Whether farmers want to continue farming?

	Andhra Pradesh	**Maharashtra**	**Gujarat**
	%	%	%
Yes	92.94	23.29	91.2
No	3.67	22.60	6.9
No other option	---	54.11	---
No response	3.39	--	---
Undecided		---	1.8
Total		100.0	100.0

A crucial set of questions, regarding the attractiveness of farming as an

occupation for the future, showed bleak results. Whereas farmers in Andhra Pradesh and Gujarat wanted to continue farming, those in Maharashtra did not. 54 percent of the farmers said they continued farming because they had no option and 26 percent said they did not wish to practice farming. This reflects the crisis of farming in Maharashtra, reflected most tragically in the spate of suicides.

Table No. 16 Whether farmers want their children to do farming?

	Andhra Pradesh	**Maharashtra**	**Gujarat**
	%	%	%
Yes	33.62	26.71	52.5
No	59.89	54.69	24.4
No alternative	---	10.88	-
Depends on their choice	---	4.11	--
No response	6.50	--	--
Undecided	---	3.40	6.9
Total			

Farmers in both Andhra Pradesh and Maharashtra do not see farming as an attractive choice for their children and over half did not want their children to farm. The picture was more supportive of farming in Gujarat but the overwhelming endorsement for agriculture is missing everywhere. When asked what they wanted in order to continue with agriculture, farmers across the board said they wanted good quality seed and timely availability of credit as well as fertilizer at low cost.

Appendix B2: Phase 2 Survey among Farmers

In this chapter we present the attitudes and perceptions of farmers with respect to seed that has been modified in some fundamental way, and new pesticides and chemicals. In addition we present their willingness (or not) to consume modified food, sources of information they trust and their perceptions regarding regulation of new agriculture technology. We analysed the responses by relating them to their demographic, social and economic background. The data collected from Andhra Pradesh, Maharashtra, Assam, Jharkhand and Punjab, are presented at all India level in aggregate and in individual states in the study. The socio-economic and demographic background and experiences with the existing technology constituted a set of variables that influenced the perception/awareness and attitudes towards a radically different, new generation of seeds and agriculture inputs.

Seed that has been "modified"

Modified seed was presented as seed in the development of which parts of plants, animals or insects had been incorporated. An approximation of Bt seed was presented as seed in which a poison had been put to control pests so that the use of external pesticides could be reduced.

Figure No. – 1 Would you cultivate cash crops from seed having insect poison in it to control pest

Fig 1 shows that over 50 per cent of the farmers across all age groups did not accept the idea of cultivating a cash crop from seed that had an in-built pesticide. In the case of food crops, we found that the majority of farmers would not cultivate food crops from seeds containing a poison to control pests. The older farmers (over 50 years) were more inclined to reject food crops that were grown with inbuilt pesticides.

Figure No. 2 Would you cultivate food crops from seed having insect

poison in it to control pest

Table 1 Using modified seed containing poison as in built pesticide: Cash crops/ food crops

	Cultivate **cash** crop from seed having insect poison in it to control pest		Cultivate **food** crop from seed having insect poison in it to control pest			
Age	Yes	No		Yes	No	
	%	%	Freq	%	%	Freq
Below 30 yrs	45.7	54.3	709	23.1	76.9	709
30 - 50 yrs	47.3	52.7	2202	22.1	77.9	2202
51 yrs and above	47.2	52.8	1141	18.5	81.5	1141
Total	47.0	53.0	4052	21.2	78.8	4052

Correlation with Education

We explored whether there was an association between the level of education and the perceptions of farmers. Responses presented in Table 2 show that as the level of education increased, there seems to be greater rejection of growing modified cash crops and food crops. However in the case of illiterate farmers a greater proportion (59.9 per cent) appeared to approve of the idea of cultivating modified cash crops compared to those with higher levels of education. In the case of food crops farmers with higher education did not approve of the idea, but one third of the illiterate farmers were open to the cultivation of food crops that had been modified. Given the adverse economics of small farmers, (small holding farmers are more likely to be illiterate), this finding may

have reflected the willingness of small farmers to take higher risks to improve their farm productivity, even if the seed was “tampered” or “modified”.

Table 2 Education level and cultivation of modified cash and food crops

	Cultivate cash crop from seed having insect poison in it to control pest	**Cultivate food crop from seed having insect poison in it to control pest**				
Education	Yes	No		Yes	No	
	%	%	Freq	%	%	Freq
Illiterate	59.4	40.6	1060	33.8	66.2	1060
Primary Education	46.7	53.3	838	18.0	82.0	838
Secondary	39.1	60.9	1562	16.6	83.4	1562
Above Secondary	45.9	54.1	592	15.7	84.3	592
Total	47.0	53.0	4052	21.2	78.8	4052

Association with size of land holdings:

Agriculture in India is practiced in irrigated and unirrigated areas or rain-fed areas. Farmers in the irrigated areas tend to be more enterprising as they are better off, have an assured source of irrigation and have relatively easier access to credit and agriculture inputs. They also have better access to information from various sources as compared to farmers in rain-fed areas. When we looked at the perceptions and attitude of the farmers with different size of land holdings, we saw that two third of farmers who had less than 5 acres did not seem to be interested in cultivating cash crops that were modified whereas equally two-third among whose had above 5 to ten acres seemed to be more open to the idea of cultivating cash crops with modified seed.

In the case of food crops grown with modified seed we noticed that the majority of farmers (ranging from 70 percent to 79.1 percent) across all sizes of land holdings did not approve of the idea of cultivating such food crops. If we took the size of land holding as one of the indicators of social class, it was clear that the farmers belonging to different classes in the study did not seem to endorse the idea of cultivating food crops from seed that had inbuilt pesticide, even if it had an advantage. Those who approved of the idea of cultivating modified food crops ranged between 20 to 30 percent across all sizes of land holders.

Table 3 Cultivation of cash crops and food crops from modified seed- by size of land holding (irrigated areas)

	Cultivate cash crop from seed having insect poison in it to control pest	**Cultivate food crop from seed having insect poison in it to control pest**				
Area in acres	Yes	No		Yes	No	
	%	%	Freq	%	%	Freq
Less than 5 Acres	38.5	61.5	1695	20.9	79.1	1695
5 - 10 Acres	63.9	36.1	559	29.7	70.3	559
10 Acres and above	63.7	36.3	273	27.8	72.2	273
Total	46.9	53.1	2527	23.6	76.4	2527

Land holding - Un-irrigated land

The majority of smaller farmers (70 %) did not seem to be positively disposed to cultivating from modified seed cash crops. In the case of food crops, we found that above 80 per cent of the farmers among all categories did not have a favourable disposition to cultivate such food crops. A greater proportion of farmers with rain-fed farms did not approve of cultivating crops with modified seed compared to those who had irrigated land. Food crops that were grown from tampered/modified seeds were by and large not

acceptable to farmers across farm size and irrigation facilities.

Table 4. Cultivation of cash and food crops from modified seed - by size of land holdings (unirrigated areas)

	Cultivate cash crop from seed having insect poison in it to control pest	**Cultivate food crop from seed having insect poison in it to control pest**				
Area in acres	Yes	No		Yes	No	
	%	%	Freq	%	%	Freq
Less than 5 Acres	29.3	70.7	1616	13.2	86.8	1616
5 - 10 Acres	58.7	41.3	407	19.9	80.1	407
10 Acres and above	48.2	51.8	168	13.1	86.9	168
Total	36.2	63.8	2191	14.5	85.5	2191

New kind of pesticides and chemicals:

Age is an important variable in shaping the perceptions and attitudes of people as different age groups differ in terms of exposure to ideas and practices. Today the younger population is exposed to a variety of media which tend to shape their perceptions and attitudes. In agriculture based on chemical pesticides and fertilizers, the experience of farmers shows that chemical fertilizers have affected soil fertility and that chemical pesticides have been affecting harmless organisms and getting deposited in the soil and on food grains as residues. In the study we explored the perception of the respondents regarding the degree of risk they would take in using agricultural inputs that had implications for soil and biodiversity.

Table 5 shows the attitude of people towards chemical pesticides in terms of the potential effects of pesticides on health and soil fertility. The majority of farmers would

not use pesticides that can control pests well but at the same time have harmful effects on human health. Similarly, the majority across all age groups would not use pesticides if it was going to affect soil fertility in the long run. There seemed to be a clear trade-off. They wanted pesticides that would not adversely affect the soil fertility, even if they controlled the pests only partially. However, younger farmers (below 30 years) seemed somewhat more willing than older farmers to try pesticides that controlled pests fully even if they had implications for human health and soil.

Table 5 Response to new kind of pesticides

	Control pests well but be risky for health	**Control well but reduce soil fertility in long run**	**Only partly control pests but will not affect soil fertility**						
Age	Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq
Below 30 yrs	26.4	73.6	273	26.4	73.6	273	50.5	49.5	273
30 - 50 yrs	15.2	84.8	836	20.8	79.2	836	70.5	29.5	836
51 yrs and above	11.0	89.0	518	17.0	83.0	518	76.6	23.4	518
Total	15.7	84.3	1627	20.5	79.5	1627	69.1	30.9	1627

Table 6 Response to new kind of pesticides that will…

	Control pests well but be risky for health	Control well but reduce soil fertility in	Only partly control pests but will not affect soil fertility

		long run							
Education		Yes	No		Yes	No		Yes	No	Total
		%	%	Freq	%	%	Freq	%	%	Freq
Illiterate		22.2	77.8	261	29.9	70.1	261	49.0	51.0	261
Primary Education		14.8	85.2	384	24.5	75.5	384	68.5	31.5	384
Secondary		15.1	84.9	676	16.0	84.0	676	74.0	26.0	676
Above Secondary		12.7	87.3	306	17.6	82.4	306	76.1	23.9	306
Total		15.7	84.3	1627	20.5	79.5	1627	69.1	30.9	1627

The majority of farmers across all levels of education, including those who were illiterate, were not positively disposed to use pesticides which were effective and killed all pests but were harmful to health. We also found a similar response to the question: whether or not farmers would use pesticides that killed pests but reduced soil fertility. Farmers placed a high premium on soil fertility. Farmers wanted pesticides that protected crops against pests but did not damage soil fertility, even if the pesticides protected crops only partially.

Farmers in Irrigated areas

Most farmers with access to irrigation facilities would not like to use pesticides that would kill all pests but would be harmful to human health, but about a fourth of the respondents across all size categories were open to using pesticides that would kill all pests even if they turned out to be harmful to health. Pesticides/chemicals that damaged soil fertility were not acceptable to the majority.

Table 7: Irrigated land by new kind of pesticides

	Control pests well but be risky	Control well but reduce soil	Only partly control pests but will not affect soil fertility

	for health	fertility in long run							
Area in acres	Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq
Less than 5 Acres	22.1	77.9	526	25.7	74.3	526	61.8	38.2	526
5 - 10 Acres	29.6	70.4	179	20.1	79.9	179	56.4	43.6	179
10 Acres and above	28.4	71.6	95	14.7	85.3	95	49.5	50.5	95
Total	24.5	75.5	800	23.1	76.9	800	59.1	40.9	800

In the case of un-irrigated land (see Table No 9), we found that the majority (94.5 percent) of farmers across all categories of land holdings would not use pesticides that were effective and would kill all pests but also caused harm to human health. Within the categories we saw a similar trend. Farmers who had un-irrigated land were more concerned about soil fertility compared to farmers who had irrigated land. This reflected the fact that farmers who had irrigated land generally uses high yielding varieties along with chemical fertilizers. They felt they could “manage” the fertility of their soils. Farmers with un-irrigated farms were generally resource poor. They could not afford investments in chemical fertilizers and were therefore more careful about nurturing soil fertility.

Table 8: Un-Irrigated land by new kind of pesticides

	Control pests but risky for health	Control pests but reduce soil fertility in long run	Only partly control pests but not affect soil fertility						
Area in acres	Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq

Less than 5 Acres	3.7	96.3	784	15.2	84.8	784	85.8	14.2	784
5 - 10 Acres	13.6	86.4	169	23.7	76.3	169	72.2	27.8	169
10 Acres and above	5.4	94.6	56	33.9	66.1	56	66.1	33.9	56
Total	5.5	94.5	1009	17.6	82.4	1009	82.5	17.5	1009

Biodiversity and Weeds

Rural and farming communities in India use biodiversity in a number of ways. “Weeds” are not useless plants. They constitute either leafy green vegetables for the family or green fodder for the livestock that the family keeps. Surrounding flora also yields the valuable medicinal plants on which the community depends for health and veterinary care. We tested responses to new age chemicals that would confer advantages like weed control but had other disadvantages, to see the nature of risks farmers were willing to take.

Figure No. 3 Will you use chemicals that would kill all weeds but also kill…?

Table 9 Will you use chemicals that would all kill weeds but also kill…?

	Surrounding plants	Medicinal plants	Fodder plants	Saag and leafy greens	Make mixed cropping impossible									
Age	Yes	No		Yes	No		Yes	No		Yes	No		Yes	No
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq	%	%

Below 30 yrs	23.4	76.6	709	10.3	89.7	709	22.7	77.3	709	22.6	77.4	709	24.4	75.6
30 - 50 yrs	17.8	82.2	2202	5.7	94.3	2202	13.8	86.2	2202	12.1	87.9	2202	17.1	82.9
51 yrs and above	16.6	83.4	1141	5.5	94.5	1141	13.4	86.6	1141	9.7	90.3	1141	16.5	83.5
Total	18.4	81.6	4052	6.5	93.5	4052	15.2	84.8	4052	13.3	86.7	4052	18.2	81.8

From Table 9 we see that the overwhelming majority of farmers (over ninety percent) did not want to control weeds by using chemicals that would kill surrounding plants (95 percent), medicinal plants (97 percent), fodder plants (97 percent) and leafy greens (97 percent). The loss of biodiversity as in surrounding flora, seen as weeds by those practicing industrial agriculture was not acceptable to the farming community.

We found that the majority of farmers across all age groups would not use effective herbicides that would damage surrounding plants, medicinal plants or edible leafy greens. Slightly over 20 percent of younger farmers (below 30 years) indicated that they would be willing to use herbicides that were effective, even if they were harmful to useful plants. Farmers generally attached great value to the useful and edible plant species in/around the farms as they contributed to their food and health security.

The importance of mixed cropping (as an output maximizing strategy) in the Indian farming system is judged from the finding that the majority of farmers (76-84%) across all age groups would not use herbicides that were effective but made mixed cropping impossible. Farmers having un-irrigated land responded similarly – see Table 10.

Table 10 Un-irrigated land by using chemicals that would kill all weeds

	Sur	**Med**	**Fod**	**Saa**	**Make mixed cropping impossible**

	rou ndin g plan ts	**icin al plan ts**	**der plan ts**	**g and leaf y gree ns**											
Area in acres	Yes	No		Yes	N o		Yes	No		Yes	No		Yes	No	To
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Fr
Less than 5 Acres	4.1	95.9	1616	2.6	97 .4	1616	2.0	98.0	1616	2.2	97. 8	1616	7.4	92.6	16
5 - 10 Acres	5.9	94.1	407	4.4	95 .6	407	3.2	96.8	407	2.2	97. 8	407	2.2	97.8	40
10 Acres and above	7.7	92.3	168	3.6	96 .4	168	3.0	97.0	168	5.4	94. 6	168	3.6	96.4	16
Total	4.7	95.3	2191	3.0	97 .0	2191	2.3	97.7	2191	2.5	97. 5	2191	6.2	93.8	21

Consumption:

Figure : - 4 Would you eat new foods that were highly nutritious but were grown from seed containing animal or insects parts?

In the study we explored whether farmers approved of consuming food cultivated from seed modified with parts of plants, insects and animals. It is clear from Table 11 that the majority of farmers across all age categories did not approve of consuming food grown with seed that was modified with parts of insects (82.1 per cent), and animals (81.9 percent). There was greater tolerance to “tampering” with other plant parts. Only

half (55.2%) did not approve of consuming such food. A small group (10 percent of the farmers) expressed the view that they did not know or could not say.

The perception, that food grown from seed that is modified with animal or insect parts is different to food grown from other, normal seed, was seen across all age groups and educational status. This kind of food was viewed as “tampered”, not natural and not desirable.

Table 11 Would you eat food that was highly nutritious, that was grown from seed containing animal and insects parts.

Age	**Yes**	**No**	**Don't know/Can't say**	**Total**
	%	%	%	Freq
Below 30 yrs	5.1	94.9	0.0	709
30 - 50 yrs	5.0	94.2	0.7	2202
51 yrs and above	4.5	95.0	0.5	1141
Total	4.9	94.6	0.5	4052

Education

We explored if there was an association, between education and perception and attitude towards consuming modified food. Table no. 11 indicates the responses to the questions. The majority (82.1 per cent) indicated that they would not consume food that was grown from seed that had been modified with insect parts. However, over 10 per cent among those with primary education and above said ‘they cannot say’. Comprehending such a novel food confused some people. We encountered less reluctance to consuming food that was grown from seed modified with plant parts. Over 30 percent among those who had primary education and above said they would consume such food. Overall 55.2 percent said they would not consume such food. Fifteen per cent said that they “cannot say”. The rejection of food cultivated from seed modified with animal parts was much higher. 81.9 per cent of the respondents said they would not consume such food. The involvement of insect and animal parts even in the seed used to cultivate food was not accepted by rural communities.

Table 12 Would you eat food that was highly nutritious, that was grown from seed

containing animal and insects parts.

Education	Yes	No	Don't know/Can't say	Total
	%	%	%	Freq
Illiterate	5.2	94.3	0.5	1060
Primary Education	4.2	95.2	0.6	838
Secondary	4.7	94.8	0.5	1562
Above Secondary	5.7	93.6	0.7	592
Total	4.9	94.6	0.5	4052

Size of landholdings:

We found that 85.8 percent of farmers across all categories of landholdings said they would not eat food grown from seeds that contained parts of insect. Sixty-one percent of the farmers across all categories did not approve of consuming food from seed that contained plant material. Eighty-five per cent across all size categories did not have a positive disposition towards consuming food grown from seed containing material from animals.

Table 13: Would you eat food that was highly nutritious, that was grown from seed containing animal and insects parts.

Area in acres	Yes	No	Don't know/Can't say	Total
	%	%	%	Freq
Less than 5 Acres	4.2	95.4	0.4	1695
5 - 10 Acres	4.7	93.9	1.4	559
10 Acres and above	4.8	93.8	1.5	273
Total	4.4	94.9	0.7	2527

To examine if the perceptions differed among the farmers who have un-irrigated land we cross-tabulated the response to the question on disposition to consume food

grown that contained from seed material from insects/ plants and animals (see Table No.14). The pattern of responses is similar to responses of farmers who have irrigated land. However, the proportion of those who are not favorably disposed to consume food that contained material from insects/plants and animals was less compared to those who have irrigated land. One thing that comes out from the analysis is that there seems to be a greater degree of positive disposition to consume food if it contained genetic material from plant sources rather than from insect and animal sources.

Table No. 14 Un-irrigated by disposition towards eating food that contained parts of insects/ plants/ animals

	Material from insects	**Material from plants**	**Material from animals**									
Area in acres	**Yes**	**No**	**Don't know/Can't say**		**Yes**	**No**	**Don't know/Can't say**		**Yes**	**No**	**Don't know/Can't say**	**Total**
	%	%	%	N	%	%	%	N	%	%	%	N
Less than 5 Acres	2.9	86.1	11.0	1616	43.6	45.4	11.0	1616	2.7	86.1	11.2	1616
5 - 10 Acres	5.9	67.1	27.0	407	11.8	60.9	27.3	407	5.9	65.1	29.0	407
10 Acres and above	5.4	73.2	21.4	168	8.3	70.2	21.4	168	6.0	72.0	22.0	168
Total	3.7	81.6	14.7	2191	35.0	50.2	14.8	2191	3.6	81.1	15.3	2191

Trust:

This concerns the analysis of who farmers consider reliable, trustworthy sources of information. The responses of farmers in different age groups are tabulated in Table No. 15 & 16. We find that the majority of farmers (87.3 percent) across all age groups placed a high level of trust in the government compared to any other institution. Seed dealers came next and scientists came third. Seventy-one percent of the farmers across all

age groups placed little trust in the NGOs and the media. The government agencies played a crucial role in disseminating information about new technology during the green revolution. In the perception of farmers the state agencies continued to be the most trust worthy institution. The state was not only seen as a structure but also as an agency and was expected to play a pro-active role in providing necessary information, timely and adequate credit, adequate irrigation, quantity and quality of power, subsidies, and remunerative price for the produce after harvest. The significance of seed dealers lay in the fact that they had become the major source of credit and information at the village level. Because national banks were not efficient providers of credit, farmers had learnt to rely on the local shop from where they could access credit along with seed, fertilizer and pesticide. The input dealer was also the most readily available source of information and problem solving (trouble shooting) since the agriculture extension service had broken down and scientists were not available to farmers for information and advice. Because farmers were so dependent on the seed dealer for credit, they were more or less forced to take his advice on seeds since the dealer tied up the credit to his recommendation on seed and agro-chemicals.

Table No. 15 Who do you trust as a reliable source of information?

Age Group	Government Agencies		Seed Dealer		NGOs		Scientists		Media		Total Freq
	Low	High	Low	High	Low	High	Low	High	Low	High	
	%	%	%	%	%	%	%	%	%	%	
Below 30 yrs	11	89	14.4	85.6	78.1	21.8	70	30	44	56	709
30 - 50 yrs	13.1	86.9	18.9	81.1	69.9	30	62.3	37.8	52.3	47.7	2202
51 yrs and above	13.1	86.9	21.4	78.6	68.6	31.3	54.6	45.4	56.4	43.6	1141
Total	12.8	87.3	18.8	81.1	71	29	61.5	38.6	52	48	4052

Table No. 16 Who influences your choice of input?

	Government Agen	Seed Dealer	NGOs	Scientists

	cies											
Age	Yes	No		Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq
Below 30 yrs	72.1	27.9	709	78.3	21.7	709	14.7	85.3	709	15.1	84.9	709
30 - 50 yrs	62.1	37.9	2202	68.5	31.5	2202	16.3	83.7	2202	15.2	84.7	2202
51 yrs and above	58.8	41.2	1141	61.9	38.1	1141	17.2	82.8	1141	17.3	82.7	1141
Total	62.9	37.1	4052	68.3	31.7	4052	16.3	83.7	4052	15.8	84.2	4052

Despite the overt influence which farmers even admit, the majority of farmers across all age groups (94.9 per cent) seem to feel that they are free to make choices on seed !

Table No. 17 Farmers' perception of freedom in making choices.

Age	Yes	No	
	%	%	Freq
Below 30 yrs	95.5	4.5	709
30 - 50 yrs	94.9	5.1	2202
51 yrs and above	94.5	5.5	1141
Total	94.9	5.1	4052

The high trust in government was found across all age groups and levels of education. Equally the distrust of NGOs was also seen across age groups and levels of education. Scientist had lost the trust of farmers. There was no extension system and scientists from agricultural universities in the region seldom went to the field. For the farmer, the scientist had lost the pre-eminent position he enjoyed during the days of the green revolution.

Table No. 18 Who do you trust as a reliable source of information?

Education	Government Agencies		Seed Dealer		NGOs		Scientists		Media		Total Freq
	Low	High	Low	High	Low	High	Low	High	Low	High	
	%	%	%	%	%	%	%	%	%	%	
Illiterate	13.2	86.8	12.2	87.9	64.9	35.1	72.6	27.3	54	46.1	1060
Primary Education	10.9	89.1	24.3	75.6	71.4	28.6	53.3	46.7	51.7	48.3	838
Secondary	14.2	85.8	19.3	80.7	74.1	25.8	59.9	40.1	52.8	47.2	1562
Above Secondary	10.8	89.2	21.6	78.4	73.1	26.8	57.1	42.9	47.1	52.9	592
Total	12.8	87.3	18.8	81.1	71	29	61.5	38.6	52	48	4052

As a corollary of trust the farmers placed in government agencies, farmers reported that their decisions regarding choice of inputs was most influenced by the government. The government had been playing an important role both directly and indirectly in agriculture. We found that as the level of education increased, the influence of various agencies declined. A greater proportion of illiterate farmers mentioned that their actions were influenced by the government agencies and seed dealers compared to farmers with higher levels of education.

Table No. 19: Whose views are you influenced by?

	Government Agencies	Seed Dealer	NGOs	Scientists

Education	Yes	No		Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq
Illiterate	72.9	27.1	1060	78.3	21.7	1060	12.4	87.6	1060	12.4	87.6	1060
Primary Education	57.9	42.1	838	63.2	36.8	838	20.0	80.0	838	19.7	80.3	838
Secondary	58.7	41.3	1562	66.8	33.2	1562	17.2	82.8	1562	15.0	85.0	1562
Above Secondary	63.2	36.8	592	61.7	38.3	592	15.5	84.5	592	18.4	81.6	592
Total	62.9	37.1	4052	68.3	31.7	4052	16.3	83.7	4052	15.8	84.2	4052

Regarding the association between size of land holdings and the sources of trust worthy information (Table No. 20), we found that the majority of farmers across all sizes of land holdings in both irrigated and un-irrigated conditions, placed high level of trust in government agencies (86.8%) followed by seed dealers (82.1 %), scientists or academia (30.6 %).

Table 20 Who do you trust as a reliable source of information?

Area	Governme	Seed Deale	NGO	Scien	Medi	Total Freq

in acres	nt Agencies	r	s	tists	a						
	Low	High	Low	High	Low	High	Low	High	Low	High	
	%	%	%	%	%	%	%	%	%	%	
Less than 5 Acres	15.3	84.6	23.1	77.0	73.9	26.2	65	35	49.6	50.4	1695
5 - 10 Acres	9.7	90.3	8.6	91.4	84.6	15.4	76.2	23.8	34.9	65.2	559
10 Acres and above	7.3	92.7	5.1	94.9	90.1	9.9	82.4	17.6	33.3	66.7	273
Total	13.2	86.8	17.9	82.1	78	22	69.4	30.6	44.6	55.4	2527

Table No. 21 Whose views are you influenced by

	Government Agencies	Seed Dealer	NGOs	Scientists								
Area in acres	Yes	No		Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq
Less than 5 Acres	61.5	38.5	1695	72.2	27.8	1695	17.8	82.2	1695	14.3	85.7	1695

5 - 10 Acres	74.2	25.8	559	85.9	14.1	559	7.0	93.0	559	8.2	91.8	559
10 Acres and above	76.2	23.8	273	88.3	11.7	273	10.3	89.7	273	9.2	90.8	273
Total	65.9	34.1	2527	76.9	23.1	2527	14.6	85.4	2527	12.4	87.6	2527

Table 22 Do you feel free to choose your seed

Area in acres	Yes	No	Total
	%	%	Freq
Less than 5 Acres	97.6	2.4	1616
5 - 10 Acres	96.8	3.2	407
10 Acres and above	97.0	3.0	168
Total	97.4	2.6	2191

Table No. 23 Un-irrigated land by sources of influence

	Government Agencies		Seed Dealer		NGOs		Scientists					
Area in acres	Yes	No		Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq
Less than 5 Acres	49.5	50.5	1616	47.1	52.9	1616	24.8	75.2	1616	18.7	81.3	1616
5 - 10	60.0	40.0	407	75.9	24.	407	21.	78.9	407	16.7	83.3	407

Acres					1		1					
10 Acres and above	64.3	35.7	168	79.2	20.8	168	29.2	70.8	168	17.9	82.1	168
Total	52.6	47.4	2191	54.9	45.1	2191	24.4	75.6	2191	18.3	81.7	2191

Regulation:

Figure – 5: If new seeds are created that have benefits but also risks, who should regulate/ monitor these seeds?

In the survey farmers were asked who, according to them, should regulate new technology, new seed. Again the majority of farmers reported that public institutions must be involved in regulation – Government agencies (78.7 per cent), universities (59.9 %) and local governments (43. 2 %). Farmers did not seem to favor the involvement of NGOs in regulation. Only 26.7 per cent mentioned that NGOs should be involved in regulation. There was no significant variation in responses in different age groups. A similar response was seen across all age groups and educational levels.

Table 24: Who should regulate/monitor new seeds?

	Government Agencies		Universities		NGOs		Village Panchayat					
Age	Yes	No		Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq
Below	83.6	16.4	709	50.6	49.4	709	22.0	78.0	709	52.8	47.2	709

30 yrs												
30 - 50 yrs	76.1	23.9	2202	51.1	48.9	2202	27.2	72.8	2202	51.3	48.7	2202
51 yrs and above	78.7	21.3	1141	59.9	40.1	1141	28.7	71.3	1141	43.2	56.8	1141
Total	78.1	21.9	4052	53.5	46.5	4052	26.7	73.3	4052	49.3	50.7	4052

Seventy eight per cent of the farmers across all levels of education felt that the government should regulate the new technology. Within the groups with different levels of education, 80% of the farmers with primary education and 82.2 % of those with above secondary level felt that the government should be responsible. This was followed by academia (53.6 percent) and local governments (49.3 percent).

Table No. 25: Who should regulate/monitor new seeds

	Government Agencies		Universities		NGOs		Village Panchayat					
Education	Yes	No		Yes	No		Yes	No		Yes	No	Total
	%	%	Freq	%	%	Freq	%	%	Freq	%	%	Freq
Illiterate	76.7	23.3	1060	35.5	64.5	1060	19.3	80.7	1060	58.7	41.3	1060
Primary Education	80.3	19.7	838	60.4	39.6	838	29.4	70.6	838	46.7	53.3	838
Secondary	76.2	23.8	1562	55.6	44.4	1562	29.8	70.2	1562	45.9	54.1	1562
Above Secondary	82.6	17.4	592	70.4	29.6	592	28.2	71.8	592	44.9	55.1	592
Total	78.1	21.9	4052	53.5	46.5	4052	26.7	73.3	4052	49.3	50.7	4052

Appendix C – Results of Survey among Consumers

One of the objectives of the study was to understand the perception and attitudes of urban consumers towards genetically modified. India is known for the diversity of its cuisine and diverse food habits across regions, and communities which have developed and differentiated. Food has a strong cultural significance and its use, in social and religious rituals, is complex and differentiated. For example, different kinds of cooked and uncooked food are offered to deities as part of religious worship and rituals and then consumed as food blessed by the Gods. Different types of food are cooked for different occasions – ceremonies associated with marriages, ancestral worship and festivals. In terms of food habits there are strict vegetarians and those, who shun even the use of onions and garlic in food, and others are meat eaters.

Even among meat eaters there are differences in terms of the animal meat that is permitted for consumption. Meat eaters, belonging to some caste groups among the Hindus do not consume meat on religious occasions because meat cannot be offered to deities as a sacred offering. Other religious groups will abjure this or the other kind of meat. Food is one of the markers of cultural identity of communities and groups. In other words, food is an integral part of a system of cultural symbols. Food that has been modified in some fundamental may, as in the case of genetically modified food, have implications for social and cultural beliefs, values and practices in the society.

In this background, quantitative surveys were conducted in five cities of the five states where farmers were also studied. 500 consumers each from Hyderabad, Nagpur, Ranchi, Jorhat, and Chandigarh were included in the survey. The sample was drawn from homemakers, scientists, professionals and students. To gain insights into micro-level processes were organized FGDs to understand the perception and attitudes of urban consumers towards genetically modified food .

Food preferences:

Pertinent to the study are food preferences and habits. In the survey out of 2550 households drawn from five cities 75.9 per cent mentioned that they are not strict vegetarians and consume non-vegetarian food at least some times (see Table 1).

Table No. 1 Food preferences

Food preferences	Freq	%
Vegetarian	614	24.1
Non-vegetarian	1,936	75.9
Total	2,550	100.0

About 87 per cent of the urban consumers bought packaged food. When we asked this question, it was intended to get a sense of what percentage of consumers bought canned foods, snacks, processed foods, etc. However the survey revealed that the high percentage of consumers buying packaged food largely reflected the fact that ordinary staples like rice, wheat flour, oil, legumes, spices were being sold in pre weighed packages even in government-run subsidized food stores. Fewer people bought their food from old style grocery stores where food was individually weighed and delivered to the consumer. This trend marked a shift in favour of the industrialization of food as also the standardization of food. Studies done by consumer groups however have revealed that such packaged food may suffer from two drawbacks; both from poor quality and under-weight. Part of the finding also reflected the situation of the urban middle class household where, since both partners work, semi processed foods, ready to eat foods and home delivered foods have become more prevalent. The emergence of super markets in the bigger cities since the mid 1990s, coinciding with the beginning of the economic boom and the availability of credit cards has also encouraged buying of packaged food.

Consumers have become more discerning buyers and look for information on the labels of packed food. Seventy eight percent of the respondents in the study said that they looked for manufacture and expiry date of the product. Only 21.7 percent said that they looked for quality and ingredients.

Table No. 2 Information sought on labels

Expiry & Manufacture date	1,735	78.3%
Quality & Ingredients	481	21.7%
Total	2216	100%

Urban consumers in our study also mentioned buying imported food. With the increasing number of super markets which have become retail outlets for food products produced by foreign companies and more disposable income in the urban middle class, this trend is likely to increase. It was not uncommon to see semi-processed food like pasta, cereals, sauces, canned fruit and vegetables displayed in these stores. Nearly 55 per cent mentioned that they buy imported food. (Table 3)

Table No: 3 Buying imported food

Imported Food	**Freq**	**%**
Yes	1,375	54.6

No	1,144	45.4
Total	2,519	100.0

In the perception of the urban consumer, imported foods were of better quality. They cited that as the main reason for buying imported food (66.8 %). This was followed by attractive packaging (26.6 percent) and lack of an alternative (6.7 percent).

Table No. 4 Reasons for buying imported food

Why Imported Food	Freq	%
Better quality	1,532	66.8
Attractive package	610	26.6
No Indian alternative	153	6.7
Total	2,295	100.0

In the present study we explored if consumers had ever heard of GM foods. It is quite revealing that even among the middle class population, which is educated and exposed to the media, about 80 percent of the respondents had not heard of GM food. This means that the majority of the population, including educated sections, was not aware of what GM food meant, and how it was produced.

Table No 5 Have you heard of GM food

	Freq	%
Yes	517	20.3
No	2,033	79.7
Total	2,550	100.0

We enquired whether the respondents thought GM food was already in the market. The majority of the respondents did not think that GM food was available in the market but about 17 percent of the respondents thought that they were already in the market (Table No. 6). Some people felt that the semi-processed corn sold in the market may be GM corn.

Table No 6 Knowledge about GM food availability in the market.

	Freq	%
Yes	440	17.3
No	1,466	57.5
Don’t know	644	25.3
Total	2,550	100.0

The study also asked which sources did the consumers depended on for information on GM food. Responses are tabulated in Table No 7. Only 415 responded to the question. This group is a subset of those who said that they had heard of GM food. Nearly 56 percent got their information from the print and electronic media, the other source was friends. About 18 percent mentioned that they got information from more than one source.

Table No 7 Sources of information about Modified food

	Freq	%
Friends	73	17.6
Newspaper	57	13.7
Magazines	99	23.9
Television, radio	62	14.9
Some of the above	50	12.0
All the above	74	17.8
Total	415	100.0

The lack of awareness that there was such a thing as genetically modified food was seen in responses set out in Table 8 & table 9. Nearly 84 percent of the respondents had not heard about any benefits of GM food.

Table No 8 Have you heard about the benefits of GM food

	Freq	%
Yes	418	16.4
No	2,132	83.6
Total	2,550	100.0

When asked what kind of benefits they had heard, of the 388 (out of 2550) who responded positively, nearly 70 percent mentioned that the benefit that they heard of was that GM food is nutritious followed by 23.5 per cent who said something similar viz., that it is healthy.

To the question whether they had heard of any risks associated with GM food, 96 per cent of the respondents mentioned that they had not. This finding revealed a very high level of ignorance among urban consumers about GM foods.

Table No 9. Have you heard about risks of GM food

	Freq	%
Yes	102	4.0
No	2,448	96.0
Total	2,550	100.0

Table No 10. Would you eat food that is…?

Would you eat food that is	Freq	%
More nutritious but expensive	1,301	51.0%
Nutritious but harmful for the environment	262	10.3%
Cheaper but health risks	262	10.3%
Not attractive	168	6.6%
Never	849	33.3%
Total	2,550	

When asked to indicate how they evaluated food and the relative importance of factors that they thought are significant to the choice of food, 51 percent mentioned that they would choose food if it was more nutritious, even if it was expensive. Only ten percent said that they would choose food that was nutritious even if it caused harm to the environment, reflecting a larger awareness generated from the environmental movement. Another ten percent mentioned that they would choose food if it is cheaper even it could cause health problems (Table No 10).

The classical association of food with nourishment is seen here, overlaid perhaps by the growing emphasis on “nutrition” as the property promoted by purveyors of packaged foods.

The majority of the consumers were clear that GM foods largely benefit the corporations and companies that are involved in the production and distribution of such food (Table 11). Farmers and the government were also cited as beneficiaries. Only 9 per cent of the consumers mentioned that they would benefit from GM food. It is clear that in their perception they themselves are the last ones to benefit.

Table No 11: Who benefits most from GM foods?

Beneficiary	Freq	%
Corporations & Companies	1,423	56%
Farmers	761	30%
Government	791	31%
Scientists	416	16%
Consumers	237	9%
Base Total	2,550	

We attempted to understand the perceptions of consumers regarding the properties of GM food. They were asked to respond to some categorical statements in the questionnaire. The responses are shown in Table No 12. The lack of engagement is seen in the majority response which is “can’t say”. Barring a high level of consensus (64%), that there is not enough knowledge about GM foods and more research was needed, consumer perception was fairly confused about these new foods. In the sample, 28.5 percent mentioned that the modified food crops tampered with nature and 64 percent said that more knowledge based on research was needed. The majority mentioned that they could not say anything regarding the safety and the effect on the environment, but a little less than 25% of the respondents were concerned that GM foods violate social values associated with food.

Table No 12: Perception about properties of GM food

Awareness	Agree %	Can’t Say %	Disagree %
Modified crops tamper with nature	28.5	60.1	11.4
More research needed,	64	30.2	5.9

Inadequate knowledge			
Unsafe for health	19.5	65.6	14.8
Harmful to environment	16.5	66.4	17.1
Violate social values	18.1	67.6	14.3

Consumers were very conscious of their right to know about the ingredients in food. Nearly 76 percent mentioned that the consumers had this right. 16% were not clear and about 8 percent did not know that they had such rights (Table 13)

Table No 13 Do consumers have the right to know about the ingredients of food

	Freq	**%**
Yes	1,930	75.7
No	208	8.2
Cannot say	412	16.2
Total	2,550	100.0

We saw that some of the respondents in the survey believed that GM food is already available in the market. To the question, whether they thought that GM food is labeled in India, the majority mentioned that they could not say whether it was. About 23 percent of the respondents thought GM foods were labeled. The consumers' lack of awareness about what was happening with GM foods is quite divorced from the reality.

Table No 14 Do you think GM food is labeled in India

	Freq	**%**
Yes	577	22.6
No	566	22.2
Can't say	1,407	55.2
Total	2,550	100.0

Table No 15 shows that out of 1796 respondents who answered the question, the majority wants the government to take responsibility for the labeling of food; their next choice, being consumer forums. About 7 per cent mentioned that a combination of agencies must be involved in labeling.

Table No 15 Who should do the labeling

Labeling agency	**Freq**	**%**
Government	1222	68.0
Consumer forum	244	13.6

Companies	209	11.6
Combination of above	121	6.7
Total	1796	100.0

The study also attempted to find the perceptions of consumers regarding adequacy of testing GM foods. Thirty one per cent said that GM foods were being tested adequately, 11 per cent said they were not. However, the majority could not say if testing was adequate. (Table No 16)

Table No 16 Do you think GM foods/ crops are being tested adequately

	Freq	%
Yes	796	31.2
No	280	11.0
Can't say	1,474	57.8
Total	2,550	100.0

About half the respondents thought that scientists and government were doing the testing. Some thought that the companies were doing the testing. (Table 17)

Table No 17 Who do you think is doing the testing?

	Freq	%
Government	612	24.0
Scientists	630	24.7
Companies	185	7.3
NGOs	40	1.6
Combination of these	122	4.8
Can't say	961	37.7
Total	2,550	100.0

To the question which agency or organization the respondents would trust to do the testing for safety, we find that 40 per cent mentioned that government was trustworthy followed by scientists. Less than 5 percent mentioned that companies were trustworthy and only 1.3 percent mentioned that NGOs might be trusted (Table No. 18)

Table No 18 Whose testing would you trust most?

Agency	Freq	%
Government	1026	40.3
Scientists	523	20.5
Companies	98	3.8
NGOs	33	1.3
Combination of these	19	0.7
Can't say	848	33.3

Total	2547	100.0

Respondents were asked to indicate whether long term monitoring of GM food was required and if so, who should be entrusted with monitoring. The majority (77.3%) expressed the view that long term monitoring was required and that the government should do the monitoring along with scientists. Less than 5 % believed that companies and NGOs should do the monitoring.

Table No 19 Is long term monitoring of GM food needed?

	Freq	**%**
Yes	1,971	77.3
No	579	22.7
Total	2,550	100.0

Table No 20 Which agency should monitor GM food?

Agency	Freq	%
Government	1004	46.1
Scientists	450	20.7
Companies	104	4.8
NGOs	97	4.5
Combination of these	521	23.9
Can't say	1	0.0
Total	2177	100.0

On what constitute the most important properties of food, safety was rated highest, followed by nutrition and taste.

Table No 21: The most important features of food

Feature of food	Freq	%
Taste	543	21.3%
Nutrition	786	30.8%
Safety	988	38.7%
Appearance	73	2.9%
Cost	160	6.3%
Total	2,550	100.0

The respondents (80%) felt that the most reliable information on GM foods was provided by the government, followed by the media, then scientists. Companies were not thought to provide reliable information and the information provided by NGOs was thought to be the least reliable.

Table No. 22: Who provides the most reliable information on GM foods?

Agency	Frequency	%age
Government	2046	80.2
NGOs	699	27.4
Media	1618	63.5
Companies	1376	65