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Attitudes of small Farmers towards Bt cotton in Warangal, India.



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Author:

Kundanam Gayatri
LUMES
Post Box No. 170
SE-221 00, Lund
Sweden.
E-mail:
Kundanam.gayatri.114@student.lu.se
Kundanam_g@yahoo.com

Supervisor:

Mikael Klintman
Associate Professor,
[Research Policy Institute \(RPI\)](http://www.fpi.lu.se),
Lund University,
Scheelevägen 15, IDEON Alfa 1
SE-223 63 Lund, Sweden
Tel: +46 046-2223897,
Mobil arbete: +46 0702-845 548,
Fax: +46 046-146986
Mikael.Klintman@fpi.lu.se

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ABSTRACT:

Bt Cotton, the first GM crop accepted for commercialization in India in 2002, which is publicized as pest resistant and high yielding. The Bt Cotton seed was commercialized in 6 states of India, one of them is Andhra Pradesh. In Andhra Pradesh, major cotton growing district is Warangal. This district is well known for the suicides of small farmers due to cotton crop loss. In 2002, three Bt cotton varieties are commercialized; they are Mech-12, Mech-162 and Mech-184 varieties of Mahyco-Monsanto Biotech Company.

Though there are huge debates going on around the world regarding Environmental, Economic and Social risks, benefits and uncertainties of GM Crops, the area of Bt Cotton cultivation is growing year by year at a drastic rate. Though Warangal farmers tasted the bad experiences with the failure of company seed, 1200 farmers in Warangal planted Bt Cotton over 1500 acres in kharif 2002-2003.

The purpose of this study is to understand and analyze the Bt Cotton and Non Bt Cotton farmer's attitudes towards the Environmental, economical and social issues, as they are the ones who are growing. Primary data is collected from semi-structured interviews conducted in Warangal district and secondary data is collected from book references, articles, journals, and internet surfing. The results show that all the farmers have no knowledge regarding GM Crops and their production. Most of the Bt cotton farmers and few Non Bt farmers trust government authorities to take care of environmental and human risks and most of them (both Bt and Non-Bt farmers) don't have enough knowledge regarding the environmental effects of pesticide use and Bt cotton crop. The refuge crop importance and area of refuge crop sowing is not clear to any of the farmer. Most of the Bt cotton crops lost due to Mech-12 Bt variety of Monsanto-Mahyco company, so they don't want to go again to Mahyco company seed but accepting local Bt cotton variety RCH-2 Bt from Rasi company as it is yielding more and the quality is good. Non Bt farmers also showing interest to grow RCH-2 Bt variety thinking that Bt seed is an incentive and they are losing there Non Bt Cotton crop as it needs more pesticide but the worm infestation is not reduced. None of the farmer is interested to back to age old practice of saving seeds as they feel; its seed quality is not so good. As the farmers still trust mostly on government authorities, it should take care of this farmers and environment by encouraging sustainable agricultural practices, awareness programme to farmers regarding the new technology Bt (Cotton) and its maintenance, and strict regulations in the market to avoid contamination of seeds.

Key words:

Bt Cotton, Non Bt Cotton, Small farmers, Attitude, Environmental issues, Economic issues and Social issues.

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List of Abbreviations:

GMF	Genetically Modified Food
Bt	Bacillus thuringiensis
NGO	Non Government agency
MNC	Multinational Company
JDA	Joint Director of agriculture
ICAR	Indian Council of Agricultural Research
GEAC	Genetic Engineering Approval Committee
RCGM	Review Committee of genetic manipulation
RCH	Rasi Company Hybrid

1. Introduction

Bt Cotton is a transgenic variety of cotton genetically modified to contain a gene of *Bacillus thuringiensis* (Bt) foreign to its genome. Bt Cotton was first developed by Monsanto – a US registered Multinational Corporation. The company claimed that the seeds are resistant to bollworm infestations, thus reducing insecticide use and resulting in a higher yield.

Though some of the top cotton-growing countries are adopting Bt Cotton, there is a huge amount of international debate regarding the sustainability of the crop. Along with certain benefits, there are various risks and uncertainties regarding Bt Cotton. These may be categorized according to the three pillars of sustainability – environmental, economical and social issues. The most significant environmental risks of Bt Cotton use are a loss of biodiversity, the development of pest resistance, impacts on non target beneficiaries and human risks, such as toxicity and allergenicity. The economic risks mainly accrue from the high seed costs as a result of royalty fees which must be paid to Monsanto (this is because the seed is patented by Monsanto). Negative social impacts may arise indirectly through these economic risks – where higher levels of investment are lost as a result of crop failures. In Warangal, India, this has often resulted in high incidences of suicide (Iyengar and Lalitha, 2002).

On the other hand, supporters argue that Bt Cotton is beneficial as it is pest resistant. This means that pesticides are not required – reducing costs and giving higher yields. This will increase farmers' profit, as well as increase food security in developing countries.

The acceptance or rejection of genetically modified (GM) crops mainly depends upon farmers and consumers – the growers and end users respectively. Many studies concerning this question have been conducted in developed nations. However, only a few studies have been carried out in developing nations regarding the attitudes and perceptions of farmers, consumers, relevant stakeholders and the general public concerning GM Crops or GM food. This study, then, aims to analyse small farmers' attitudes and perceptions towards Bt Cotton crops in Warangal, India. The analysis

takes into account levels of understanding and attitudes of small farmers towards Bt Cotton crops in the context of environmental, economical and ethical issues. The specific research aims are outlined below.

1.1. Research Aims:

- To study and compare the attitudes of Bt Cotton small farmers versus Non Bt Cotton small farmers regarding the Economic, Social and Environmental issues.
- To analyze the factors responsible for small farmers' decisions to accept either Bt or Non Bt cotton as their main crop.

The research conducted focused on Warangal in India. A description of the study area follows.

1.2. Description of study area

India has a pride of place in the global cotton scenario with the largest growing area. In India cotton is grown in 9 states, one of them is Andhra Pradesh where the study area – Warangal – is situated. Andhra Pradesh stands third in cotton cultivation in India and utilizes the greatest amount of pesticide. The total area of cotton cultivation is 8, 87,000 ha (hectares) of which approximately 9500 acres were sown by Bt cotton in 2002-2003 year (CSA, 2005). In Andhra Pradesh, Warangal is a major cotton growing district which has 0.18-0.16 million ha of cotton area. From the introduction of hybrid varieties the use of fertilizers and pesticides has increased. As the time passed, pest developed resistance, so the quality of pesticides increased. In 1998, the costlier pesticides which are of good quality didn't control the worm infestation and many farmers got huge losses. As the source of investment is mostly the debt for small farmers. The Warangal district is well known due to the fact that many small farmers attempted suicide as they are unable to repay the debts taken for cotton cultivation (Iyengar and Lalitha, 2002)

Bt cotton seeds in India are marketed by Mahyco Monsanto biotech Ltd. The government had permitted three Bt cotton varieties – MECH 162, MECH 12 and MECH 184 – for commercial cultivation in 6 states (Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Gujarat, and Tamilnadu), from March 2002 (Iyengar and Lalitha, 2002). Bt Cotton is the only government approved GM crop in India, with clearances only for specific varieties. It is estimated that out of 0.16 million hectares of cotton sown in the Warangal, around 0.025 million hectares are sown with Bt Cotton. In 2003-2004, the total acreage of Bt Cotton increased by around 6 times from the previous year. These were of 4 varieties – including a very popular local hybrid from a local company (Rasi), with the Bt gene (CSA, 2005).

In November 2004, the agricultural officials in Warangal admitted that out of 0.02 million hectares of Bt cotton grown in the district, 65% of the crop was damaged. According to the joint director of agriculture (JDA), Monsanto-Mahyco seed created losses in all the places surveyed, the reason was wilt where the flower, bolls and the plants dried up resulting in very low yields(CSA, 2005).

Mahyco Monsanto Bt cotton farmers fought against dealers, raided shops and imprisoned seed company employees and they demanded compensation ranging from 10000 to 25000per acre due to losses incurred. Some farmers (mostly small farmers) decided to Suicide as they can't pay back the invested amount (CSA, 2005). The government and seed industry people afraid that paying compensation to even one farmer opens up a floodgate of demands from others, so they didn't give compensation to farmers. The scientists said that the weather fluctuations have caused the damage but other non Bt Cotton hybrids in the neighboring fields are not damaged (CSA, 2005).

1.3. Structure of Research

The small farmers (less than 5 acres of land) are selected from three villages – Gopanpalli, Burgumalla and Parvathagiri of Parvathagiri Mandal. This was done with the help of a local NGO. The small farmers are categorized in to Bt and Non Bt cotton growing farmers. To know the attitudes of farmers, a qualitative research

methodology was selected. Interviews were carried out with a minimum number of small farmers in each group until data saturation was reached. As the sample size is small it cannot be generalized statistically to any population or any other geographical area.

Sources of information are primarily through interview responses. Additionally, secondary data is collected from book references and peer-reviewed articles. Analysis of the data is carried out through a comparative analysis of Bt and non Bt cotton farmers. Results are interpreted together with the theoretical data.

The study shows that the farmers interviewed have minimal knowledge regarding genes and genetic modification. Their perceptions of risk are also low as they trust the government of India for protection from risk. Regarding benefits – they are seeing only economic benefits rather than environmental and social benefits. The main reason for their acceptance is to get good yield and they don't know the risks, benefits and uncertainties from the Bt cotton crop.

The study concludes that it is necessary to educate farmers regarding the risks, benefits and uncertainties of Bt Cotton. As both Bt and Non Bt Cotton (with pesticides) are unsustainable – it is necessary for the government to encourage sustainable agricultural practices and tighten the monitoring and evaluation system. Future research is needed to study consumer attitudes towards Bt Cotton product use by the government and seed companies.

2. Theory, concepts, certain previous data

Under this section the basic concepts regarding the attitudes and values are discussed. It is divided in to four sections, in the first section the views of different authors regarding the attitudes and values are studied and how the different attitude act. In the second section, the attitudes and values of environmental issue from all over the world are discussed. The third section covers the attitudes regarding economic issues of GM crops and in the fourth section the attitudes regarding social issues of this new agricultural biotechnology are discussed.

2.1. Studying attitudes and values

Psychologists define attitude as “a tendency to evaluate a particular entity with certain degree of favor or disfavor”. The internal structure of attitudes consists of feelings, cognitions or prior experiences which evaluate the individual responses. Attitudes are used to explain the differences why certain people will accept certain technology where as others don't. The building blocks of attitude are values and beliefs of a person. An attitude focusing on a relatively abstract concept is termed a value. The values which are part of person's self concept, and that are activated within a specific behavioral context have an impact on attitudes. Attitudes and choice of behavior can be changed by activation of specific values. By some authors values are seen as “the most abstract cognitions or extreme global attitudes, as goals to provide general orientation and organization for life”, some authors express value as ‘standards’ or models for attitudes, beliefs and behavior (Dreezens et al, 2005). Values, attitudes, and beliefs form a hierarchical structure with values higher in the hierarchy (general level) and beliefs and attitudes at the base (specific level). By using Schwartz Value scale, Dreezens et al, (2005) analyzed the values behind acceptance of GMF and OGF, they found that the respondents who are positive towards OGF scored high on the value universalism (welfare for all people and protection of nature) and where as the respondents who are positive towards GMF scored high on the value power (dominance and submission) and negatively towards OGF. Dreezens paper also discusses that opposing attitudes may have connection with distinct values, one may have negative feeling on GMF but it might be the ultimate way to master natural processes that they could not master in past (Dreezens et al., 2005)

As mentioned by Aerni, (2002) an individual perception is determined by personally selected sources of information, values, interests and individual experience towards the risks and benefits of a new technology. He mentions that in case of agricultural biotechnology, most people rely on information distributed through the mass media and the selection of sources of information is strongly influenced by socially communicated values, social status, professional affiliation and his or her personal worldview and interests (Aerni, 2002).

Curtis et al., 2004, argues that the risk perceived by a consumer is subjective. As scientific studies show that there are some risks prone to human beings and environment through the genetically modified crops and their products, the consumer perception of risk differed as he weighs the expected benefits and expected costs depending on his or her risk tolerance (Curtis et al, 2004).

For instance in developed world, most of the consumers are willing to take the risk if they are offered at a discount price than the Non GM products, and in UK, consumers are willing to pay an extra 26% by males and 49.3% by females to avoid animal and plant GM technology, where as in developing world, like China, the consumers are willing to a pay 16% premium for GM soybean oil and 38% for GM rice over the non-GM alternatives. Similarly in Colombia, consumer's willingness to have GM foods is high as they felt that they didn't have enough or good quality food at home. Curtis et al, (2004), concludes that the generally positive perception towards GM foods in developing nations stems from more urgent needs in terms of food availability and nutritional content. Additionally, perceived levels of risk may be smaller due to trust in government, positive perceptions of science, and positive media influences. This is contrary to the smaller benefits and higher perceived risks found in many developed countries, and hence, the rational for low or non-acceptance of GM foods in those countries (Curtis et al, 2004).

2.2. Attitudes surrounding Environmental issues (risks, benefits, uncertainties)

Some of the attitudes surrounding environmental issues of Bt cotton are it reduces the pesticide use, where as the risks comprise probability of increase in resistance of pest, effect on local beneficiaries/ wild varieties, and human health effects like allergenicity and toxicity.

Philipp Aerni (2004; 2005) has studied stakeholder attitudes of Mexicans, Philippines and South Africans towards the risks and benefits of GM Crops. He found that Mexicans and Philippines believe that agricultural biotechnology will benefit them and do not feel that consumption is a human risk. They are however concerned about a loss of biodiversity (Aerni, 2004). In South Africa, academia, government, producers, consumer organizations and industrialists believe that GM crops will benefit them, while contradictory views were expressed by NGOs and churches (Aerni, 2005). In Argentina, consumer perceptions towards GM Foods are mostly negative. Intention to purchase is high in consumers who have low levels of education level and have not heard of GM foods before (Mucci et al., 2004). In northern China Yang et al, (2004) found that attitudes of farmers towards the adoption of the Bt Cotton crop is that it will reduce labour, produce higher yields and require less use of pesticides. However, the results show that the majority of farmers thought that Bt cotton seed oil is safe to consume (Yang et al., 2005). A study focusing on consumer study in China by Ho and Vermeer, (2004) shows that most of the consumers are not having adequate knowledge regarding the genes and GM foods, majority of them are unwilling or neutral to GM foods until the risks and benefits are not revealed, once they informed about GM foods their acceptance sharply went down (Ho and Vermeer, 2004).

Coming to the attitudes of farmers towards growing refuges*, some studies show that, in India all farmers are willing to plant refuges as per the norms set by the GEAC (David and Sai, 2002). Where as, Travis coan expresses that Indian farmers who have less than 2 hectares of land are unable to set aside land for refuges. Scientific studies show that eliminating or decreasing the size of Bt free refuges increases the probability of increase in pest resistance (Coan, 2004).

Note: **REFUGES: Proponents of agricultural biotechnology have suggested that farmers set aside land for non-Bt “refuges.” Planted with conventional or traditional varieties of the same crop in 20% of the area, these refuges provide Bt-free food for cotton pests, thus slowing the speed with which pests develop resistance to Bt.**

Agricultural entomologists also predicted that pest resistance to Bt could appear in the field within 3 to 5 years of widespread use (Choudhary and Laroia, 2001). If the resistance is developed by insects then long term benefits of Bt Cotton are not seen which is not sustainable and farmers are would loss heavily. Coming to the impact of Bt toxin on non target beneficial species, Genecampaign, an NGO claims that some farmers in India experienced poor yields with chilli (Mirchi) crop on the field which was previously cultivated Bt cotton crop (CSA, 2005).

2.3. Attitudes surrounding Economic issues (risks, benefits, uncertainties)

Cotton is the most important commercial, leading and oldest of all fibers by human beings, as it plays a key role in the economy of the world. The developing countries account for 50 per cent of the exports of raw cotton textiles to industrialized nations like Western Europe, and USA. Cotton is an employment oriented industry. It is estimated that all over the world nearly 250 million people are dependent on production, processing and marketing of cotton (Bharathan, 2000). Further cotton seed is also rich source of food since edible oil and cotton seed meal are the products of the cotton seed.

It is largely cultivated under rain fed conditions and nearly 70 percent of the area is entirely dependent on rainfall, while supplementary irrigation existed for about 30 per cent. Cotton is cultivated in 8.9 million hectares in varied agro-climatic conditions across nine major states of India (Morse et al, 2005). It employs directly and indirectly more than 60 million persons in its production, processing and marketing. Cotton is an important cash crop and more number of small farmers grows Cotton (Bharathan, 2000).

The farmers will see the stability, sustainability and cross crop effects while selecting the crop, though it's a long term process. Poor farmers also value stability of a crop along with yield of the crop as they cannot afford to take big risks (Lybbert, 2004).

In general, the agronomic performance (yield) of a crop is given priority rather than the environmental impacts it carries. So mostly the farmers will investigate regarding the performance of a crop and not the unintended effects. According to David and Sai, (2002) the farmer's reaction towards Bt cotton, showed that the Indian farmer thinking is oriented towards the output, and yield is given preference over quality,

propaganda is the major force in decision making and seed dealers act as effective crop counselors. None of the farmers opposed Bt cotton cultivation on technical reasons. (David and Sai, 2002)

One of the risks to organic farmers is loss of Bt as an effective pest management tool which threatens the economic success and livelihood of organic farmers due to development of resistance by pests (Coan, 2004).

The near systemic economic failure of cotton in India has left many farmers with increased debt and virtually no means of support for their families. Reports from states such as Punjab, Andhra Pradesh and Karnataka indicate that farmers have resorted to selling their kidneys to repay loans and protect family honor; suicide rates have increased significantly (Iyengar and Lalitha, 2002) The economic benefits are tasted by only few farmers most of the farmers got severe losses in 2002 with Bt cotton varieties, and the scientists claimed that Bt varieties are not drought resistant, they can't survive in moisture stress conditions where as local varieties does well in that year compare to Non Bt cotton. These huge losses made the farmers indebted (Qayum and sakkhari, 2003). Another study by Morse et al showed that in Maharashtra state Bt cotton has provided benefits to the farmers from the last 2 years (Morse et al, 2004). An NGO, Gene Campaign claims that, RCH2 Bt is giving better yields than the Monsanto varieties and Conventional varieties (Sahai, 2005). Above studies show that Bt cotton is economically good for the farmers temporarily but there is uncertainty regarding the long term benefits i.e., sustainability of the crop. The bad experiences in developing countries like the suicides of farmers due to debts from cotton production and some of the studies from developed countries which show that many GE farmers in North American are facing problems due to loss of export market as the productivity is decreased. The rapid increase of area of GE crops in developing countries may create a major risk.

2.4. Attitudes surrounding Social issues:

There is much debate going on regarding ethical issues of biotechnology like how the developing countries are benefited and how the benefits are distributed to farmers of different socio economic strata and how the environmental or health risks will be distributed and mitigated. Regarding the commercialization of Bt cotton in India, there was a controversy between the professional elite groups such as government hearings, and the social spheres of non-elite mass groups, such as farmers' groups that

have demonstrated and burned test plots showing their angry to avoid Bt cotton entry in to India. Supporters of biotechnology claim that it will help to reduce the world hunger, which is a benefit for many people and not a risk where as the opposite group worry about the domination of new technology over the traditional agriculture, and they feel that its unethical to go opposite with nature, as all the living species and ecosystems have intrinsic value and should be preserved as they are, without human interference.

The public poll in southeast-Asia regarding the opinion towards GMOs showed that they are willing to grow GM crops if they get more yields and help them to prevent starvation. In order to with stand in the global market one should produce high yield with low production cost.

The entry of MNC's in to the local market like , leads to an increase in the seed cost due to royalty fee, end's the age old tradition of saving seeds by the farmer and decreases the biodiversity. The increasing dependence on industrial seed may also affect the social structure of a country as in the case of Argentina where most of the farmers have migrated to the cities due to indebts resulted from the agriculture (Coan, 2004). Though there are some bad experiences, the area of Bt crop is increasing year by year. The farmers in Makathini Flats, South Africa, responded that they would go for Bt seed if they have enough financial resources to buy the seed and they felt no other barriers for adoption like agronomic or other technical reasons. And the area of Bt variety adoption increased to over 90% of the farmer's adoption till 2001-02 (Thirtle et.al, 2003). The rapid adoption of GM crops in developing countries can be explained through Roger Clarke's Innovation Diffusion theory, where he says that a new technological idea in a social system communicated through particular channels over a period of time among the society members. It is explained through different stages, in the first stage, knowledge, the one who is educated well or has high social status exposed to the innovation through mass media and then the innovation revolves around the society through interpersonal communication channel which is named as persuasion, the second stage. In the second stage the member acquires a favorable attitude towards it. The third stage is Decision where one decides to adopt the technology. Implementation of the innovation is the fourth stage and based on the outcome he will confirm it as a good or bad technology. This process of adaptation is quick where as if the innovation does not meet the needs of the society it will create a negative feeling and the society resists the spread of innovation (Clarke, 2005).

Zhong et al, (2002) study in Nanjing, China shows that consumers have very little knowledge regarding GM foods and media plays an important role in source of information (Zhong et al, 2002). Similar results were shown by Li et al, (2002) in a consumer survey in Beijing, China, and their attitude towards product enhancing GM foods is positive whereas older age respondents showed negative response towards GM rice (Li et al, 2002). Ho and Vermeer, (2004) study showed that majority of the urban residents were neutral or unwilling to consume GM food before they were informed about risks and benefits and after giving the information regarding risks and benefits of GM food their willingness dropped sharply (Ho and Vermeer, 2004). A study in Northern China showed that, most farmers have enough confidence regarding the safety of Bt Cotton as one fourth of the farmers preferred Bt cotton thinking that it is safe, 65 farmers out of 92 responded that Bt Cotton oil is safe to eat, and 72 didn't feel uneasy to use blankets and quilts made from Bt cotton lint (Yang et al., 2005)

Contamination of seeds is often seen in the Indian market. This phenomenon of contamination and growing of GE varieties illegally without approval even while some varieties are in the pipeline for approval has not been uncommon in recent times. Even in other countries like Brazil and Thailand such an approach was attempted (CSA, 2005).

3. Methodology

The main purpose of the study is to understand the attitudes of Bt Cotton and Non Bt cotton small farmers towards Environmental, Economical and Ethical concerns. The study is focused on in-depth assessment of small farmers' attitude to know the detailed information which is not constrained by predetermined categories. For this study the Interview Technique was selected, as it allows the researcher to inquire in-depth and in detail of the concerned issues with no constraints as it creates openness in the inquiry. It encourages knowing "the essence of a phenomenon rather than any quantitative component or frequency" (Patton, 1990).

This method allows to know in-depth of information for a small group of farmers which increases the understanding of farmer's attitude and to capture the views of farmer with out any constraints. As every method has strength and weaknesses, the qualitative research methodology can not be standardized statistically and cannot be applied to a generalized population or geographical population.

3.1. Sample

The target population comprised of farmers selected from Warangal district, Andhra Pradesh, India. Local NGO, MARI, in Warangal district helped to identify the farmers for the interview. NGO worker from MARI, Parvathagiri Mandal, introduced some of the Non Bt and Bt farmers in 3 villages namely Parvathagiri, Gopanpalli, and Burgumalla of Parvathagiri Mandal, of Warangal district, Andhra Pradesh.

3.2. Sampling method and its limitations:

Purposeful sampling method was used to select the farmers, which allows selecting the sample to study in depth. As the study focuses on small farmers, which may create focus in depth on understanding the needs, knowledge and attitudes of a minimum number of small farmers (Patton, 1990). In this sampling method, stratified purposeful sampling method was chosen as the two groups of farmers, namely Bt cotton growing and Non Bt cotton growing farmers are selected, to analyze major variations among the two groups.

All the farmers who have less than 5 acres of land were selected. The drawback of this sampling method is it cannot be generalized statistically to a particular group of population or whole geographical area or other regions due to minimum sample size.

Minimum sample is based on “expected reasonable coverage of the phenomenon given the purpose of the study and stakeholder interests” (Patton, 1990)

3.3. Questionnaires

The study was conducted through semi-structured interviews. Self designed questionnaires are prepared separately for Bt and Non Bt farmers (Appendix II and III). Both questionnaires have same pattern which are mainly divided in to four sections. First section covers the background information of the farmers regarding age, family background, educational background, land holding, and income. The second, third and fourth sections cover the attitudes of farmers’ towards the Environmental & Health risks and benefits, Economical risks and benefits and Social risks and benefits respectively.

3.4. Source of information:

The source information for the study is taken from the interview responses and secondary data is collected from book references, articles and journals, booklets of NGO’s studies in India, internet sources from Elin Network site, Science Direct web site, and Google search engine.

3.5. Procedure

Bt cotton growing farmers are those who planted Bt cotton in the previous years and the Non Bt cotton farmers are those who never planted Bt Cotton till April 2005. The date of interviews were fixed based on the farmers choice and some of the farmers are interacted with the issues regarding interview questionnaire, so that local usage of different words like environment, Bt cotton were known.

The interviews were conducted in the month of July. Interviews were conducted in the local dialect (Telugu) either at the farmer’s field or farmer’s house. I interacted formally with them and introduced myself and the purpose of study and on which sections I am going to ask questions. And the farmer was asked before the interview, whether to record the interview or not and he was told that recording is just to listen afterwards when ever I need. All the interviews were recorded and photographs were taken. The duration of the talks was between 30min to 50min. As they were recorded, I fully concentrated on the interview, without taking notes at the same time. The

farmer was not interrupted while he was answering. While listening to the recording afterwards, I took notes of passages that were relevant to me.

3.6. Analysis of Data:

The data was analyzed through personal intuitive interpretation by using multiple data sources available regarding farmers'/ consumers'/ public/ stake holder attitudes and researchers opinion from farmers' side.

4. Analysis:

The analysis of data is done under three different sections, namely farmer's attitude towards Environmental issues, Economic issues and Ethical issues based on the interview responses and literature review.

4.1. Farmer's attitudes towards Environmental issues:

The attitudes of Bt cotton and Non Bt cotton farmers towards environmental issues are briefly shown in the Table 4.1.1.

Table 4.1.1 Attitudes of Bt and Non Bt cotton farmers on Environmental issues.

Environmental issues	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7
Bt cotton	Trust on Government. No pesticides. Mixing of both Bt and Non Bt cotton before marketing. Refuge crops are not grown.	Trust on Government and seed shop owners. No pesticide use. Refuge crops grown.	Good variety and good yielding. Refuge crops not planted. We don't know risks from it.	No worms, no pesticides, refuge crops are taking land, need pesticides. Trust on government. Mixing of both Bt and Non Bt cotton.	Less pesticide use. Mixing of Bt and Non Bt before marketing. Trust on government.	Refuge crops grown. Mixing of Bt and Non Bt before marketing. No idea about Environmental Impacts, no one told us.	Refuge crops grown. Low pesticide use. We mix both Bt and Non Bt before marketing.
Non Bt cotton	We don't know, government should know.	Less pesticide use, and not aware of human effects	High seed cost so it might be good to all.	less pesticide use, It is not risky as government approved it.	Benefits through less pesticide use	Through pesticide use for non Bt cotton, the land has effected so Bt is good option.	Bt toxin affects humans and land in long run. Government should take care

The results show that both Bt and Non Bt cotton farmers who have interviewed have enough knowledge regarding genes and genetic modification though they are using GM crop (Bt Cotton) in their fields. They are thinking Bt Cotton as a new variety rather than a transgenic variety. They felt as if they are hearing this type of words for

the first time. All the farmers' response was "No" to this question. Some of them continued to say that they were not told by anyone regarding this GM seeds production. The information about the varieties is known from the seed distributor and some times from other farmers. Though the farmers experienced huge losses from Monsanto Bt seeds the marketing of Bt seeds was increased in 2003-2004 due to media hype saying that its high yielding, and they offered free pesticides and gave feast parties where they have took the booking for seeds (Kuruganti, 2005)

When the farmers were asked regarding the Environmental and Health risks of Bt Cotton, most of them have no answer for few minutes, many of the Bt cotton farmers and some of the Non Bt cotton farmers expressed their trust on Government by stressing that 'it is the duty of government officials to see the risks of Bt cotton on environment' (fig 1). The fourth Non-Bt farmer felt that 'GM crops are not risky to humans' as they have confidence that risky crop is not allowed by the government. Unlike other farmers seventh Non Bt farmer responded that Bt toxin in Bt cotton Crop will affect the quality of land in the long run, and effects human being through consumption of Bt cotton seed oil for cooking purposes and cattle milk, which was fed with Bt cotton seeds (fig 2). The attitudinal behavior of seventh farmer can be explained through Dreezens et al (2005) study. They explain this type of behavior as 'opposing attitudes with distinct values', where one can have negative feeling on Bt Cotton but it might be the ultimate way to master natural processes that they could not master in past.

Regarding the knowledge of consumers regarding genes and GMO products, Ho and Vermeer (2004) found that, in China, consumers have scarce understanding regarding the genes and GMO products mainly due to lack of information, as many respondents are "neutral or even unwilling" to consume GM food but after informing regarding the risks and benefits, the willingness of consumption of GM foods dropped sharply (Ho and Vermeer, 2004).

Mexican and Philippine stakeholders also felt that GM crops are not risky to humans but where as Mexicans feel it might have environmental risks like, loss of biodiversity and out crossing of GM Maize with local varieties. Philippine stakeholders are also concerned about loss of biodiversity and impact of pest resistant rice on non target organisms (Aerni, 2004). In Africa the NGO's and church people feel its risk and

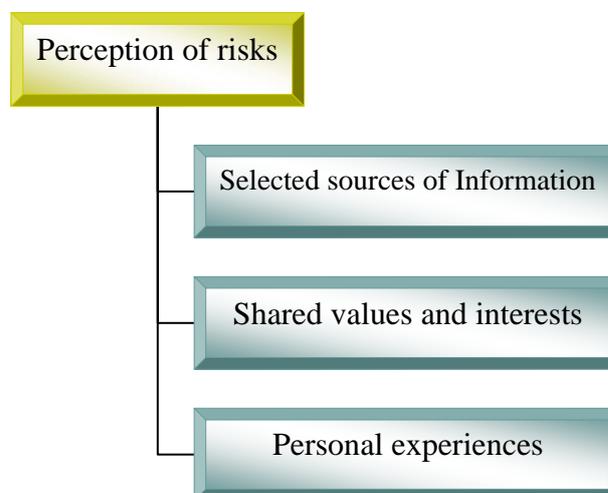
where as other group of stakeholder feel it benefits through food security (Aerni, 2005).

Regarding Environmental benefits, most of the farmers responded that Bt cotton is good as it needs less pesticides and the others (3rd and 6th farmers) told that they have no idea as they don't know regarding the negative effects of pesticides on environment. Their ideology is to find out economic benefits rather than environmental benefits. When the farmers asked about the environmental benefits, they responded as 'it needs less pesticides' but their view is in terms of economic terms as they reduce cost of pesticide rather than environmental. Regarding human risks, they felt that pesticides cause human risk so they take care well while spraying the pesticide and storing in house.

One of the Bt Cotton farmer revealed that the Bt crop has gone because the root died where as normally the stem dies in Non Bt Cotton crop; the researchers also reported that the Bt cotton variety from Monsanto company is not drought resistant, as root wilt is seen in times of severe moisture stress (CSA, 2005). A three year study by Qayum and sakkhari, (2005) showed the farmers are concerned that they were unable to grow any other crop as the Bt has infected soil badly due to root wilt (Qayum and Sakkhari, 2005). But in interviews, some of them told that, after Mech 12 Bt failure they want to grow maize but due to insufficient water at that time they were not able to grow.

Quite a few studies of consumer knowledge of GMOs are available, it can be said that there is a need to improve the knowledge of public, so that they can make informed choice of crop or food. From the responses of the farmers it can be seen that the farmers are not having perception/awareness regarding the risks of Bt cotton over environment and humans. Aerni (2004), explained the low awareness of GM Crop risks among the general public in developing countries may be due to complexity of formation of perception of risks. The perception of risks is formed by shared sources of information, shared values, interests and personal experiences which are shown in Fig 1.

Fig 1: The model showing different ways of perceiving risks.



Among the Bt cotton farmers, 2, 4, 6, and 7 are growing refuge crops. The reason behind growing of refuges as revealed by the farmer is ‘to avoid the worm infestation from other crops’, as informed by the seed distributor. Where as the actual reason behind growing refuge crops is to increase the resistance of pest for some more time. The second and fourth Bt farmers want to stop growing refuge crops as, the second farmer felt that though the refuges are grown their crop was spoiled by worm infestation so they don’t want to grow any more and the fourth farmer found the worm infestation for refuge crops and they need to spray pesticides. The remaining farmers are not growing the refuge crops as they were not told by the seed distributor. Out of the seven non Bt farmers, six farmers except the first one are growing Bt crop this year. Four farmers planted refuges in the current crop and the remaining are not aware of this as they were not told by anyone. The results show that the farmers don’t have clear understanding regarding the use of refuge crops (Table 4.1.2).

Stone, (2004) emphasizes that farmers need “Agricultural skilling” to grow and understand about refuge crops, where he means skill as “The skill at the heart of smallholder farming is not simply knowledge of plants and agronomic processes, or proficiency at agricultural tasks, but more generally the farmer’s ability to execute a *performance* based on agronomic knowledge, farm management strategy, prediction of a range of factors, and manipulation of socially mediated resources” (Stone, 2004).

Table 4.1.2 Opinions of farmers regarding refuge crops.

Opinions of farmers on growing Refuges	Bt farmers	Non Bt farmers
Refuge crops are grown to avoid worm infestation	Second, fourth, sixth and seventh farmer	Second, fifth, sixth and seventh farmer
With refuge crops the worm infestation doesn't stopped	Second farmer	-
Refuge crops need pesticides and occupies space	Fourth farmer	-
We don't know about refuges as no one told.	First, third and fifth farmer	First, third and fourth farmer

Almost no farmers have maintained the 20% refuge of non Bt cotton. Even now no farmer education is taking place on the correct use of refuge crops. Most farmers are not aware about the rationale and necessity of maintaining a refuge nor do they have a clear idea of how this is to be implemented.

As refuge crop growing idea is not working may be the probability of getting insect resistance may be inevitable which may lead to several suicides of farmers due to heavy losses. If the refuge crops are grown accordingly then there is a chance of reduction of bollworm population in Bt fields but the probability of other pest population may increase. So the countries with high diversity pests suspect the sustainability of crop (Shah and Banerji, 2005).

All farmers who grow both Bt and Non Bt cotton crops in their fields responded that they mix both Bt and Non Bt cotton before selling to market, as they were not aware of risks and there is no regulation by the government. This may create economic and social costs for transparency issues and labelling in the future. In Philippines the stakeholders showed their concern regarding market inefficiency and inadequate implementation of Biosafety guidelines, worried about as it may obstruct the equitable distribution of benefits and risks (Aerni, 2004).

4.2. Farmers attitudes towards Economic issues:

The Table 4.2 shows the main views of Bt and Non Bt farmers regarding economic issues.

Table 4.2.1 Attitudes of BT and Non BT cotton farmers on Economic issues.

Attitudes on Economic issues	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7
Bt farmer	No yield, loss from MECH 12 BT, quality not good.	Loss from MECH 12 Bt, due to worm infestation. More pesticide use. Quality is normal.	Loss, no market value. MECH seed not good. Pesticide use is not lessened.	Loss, due to worm infestation. Quality is good. More market value.	Good yielding for others, but we lost due to mixing with non Bt. Non Bt is good	High seed cost could be an incentive. Loss due to MECH 12 Bt. No diff in pesticide use compared to non Bt. Quality is good.	More yield, good quality, Less labour. Less pesticide
Non Bt Farmers	Bt seed cost high, not Reachable . We don't want to go in debts	Good yielding. Low pesticide use. High market value.	Good yielding. We should try by taking debts incase needed	Quality is good, worm infestation is low. High investment on seed is ok if we get back investments	Bt seed is an incentive. High market value. High yielding.	Less pesticide use, more market value. Due to high quality, high seed cost is there	Yield is good. High market value. Low labour expenses.

Almost all Bt Cotton farmers felt that Mahyco Bt Cotton Variety (MECH-12) is totally failed and they were totally lost, which left the farmers with debts. As the promise of Monsanto the Bt cotton should not be infested with pests, but most of the farmers lost their crop due to pest attack. This may be due to seed fault which couldn't resist the worm infestation. All farmers told that they won't go for Mahyco Bt cotton variety again. The first farmer lost his crop as the crop died, though there is no worm infestation. Most of the Bt cotton farmers got less yields below 6 quintals per acre and only seventh Bt farmer got 8 quintals per acre of yield which is a normal amount.

Most of the non Bt farmers also experienced loss due to conventional Non Bt cotton crops only few (5th and 6th farmers) got normal yields. Though they used costly

pesticides they got loss might be due to seed fault, pest resistance or ineffective pesticides. They feel that pesticides are no more effective in controlling the bollworm infestation. As from the past 10 years the use of pesticides is increasing, so they need more and more pesticides and costlier pesticides to kill bollworms and the Warangal market is known for sale of ineffective pesticides (Stone, 2002). So they want to try new variety Bt cotton which is giving good yields to other farmers, so they want to try their luck with Bt seed.

As the results show varied performance of the crop with the same type of seed, these clearly shows that some farmers got good seeds and others didn't this might be due to adulteration of seeds in the market. Stone, (2002) expressed that in Warangal the crops fail mostly due to spurious seeds, which are of inferior quality packed under a popular brand name. He feels that there is an urgent need for strict regulations at the point of seed sales (Stone, 2002).

There were huge losses in 2003-2004 year with Mahyco Bt seed; The reports of gene campaign also show that, farmers have suffered with heavy losses with Mahyco-Monsanto's MECH-12 and MECH-184 varieties. These varieties are not found to be worm resistant (Sahai, 2005).

Farmers are trying another Bt seed from the local company Rasi, known as RCH-2 Bt, as it gave good yields to other farmers in 2003-2004 year. But the fifth Bt farmer interviewed lost his crop through RCH-2 Bt seed, due to failure of germination of some seeds. This may be due to contamination of seeds as other farmers who grown RCH-2 Bt last year got good yields as heard by the other farmers. Though there are huge losses for the farmers the sale of Bt Cotton seed increased from the year of commercialization may be due to false claims, huge publicity, feast parties and bookings, free pesticides offer with Bt cotton seed, and free bags were on offer to people who participated in village level publicity meetings (Kuruganti, 2005) and the fast adaptation of farmers can also be explained to Roger Clarke's model of innovation diffusion (Roger Clarke, 2005).

Due to these unexpected yields the fourth Bt farmer says that "if any variety is good in the market then it will be adulterated in the coming years" so he won't trust on the seed distributors, though many of them trust seed distributors as he is the only advisor for the poor farmers in the selection of seeds, as they believe that he knows from the other farmers who have got good yields and he is the one who gives seeds on debt. It

was also claimed that the seeds are adulterated with the old ones by Mahyco-Monsanto as confirmed by Local agricultural Scientists (Sahai, 2005).

The loss of amount ranged from 10000-12000 INR/acre/annum, when compared with normal yield with conventional cotton. As revealed from other reports in Andhra Pradesh, with MECH 12 variety the farmers got fewer yields of about 4 qt/acre and the average losses amount to over Rs 4000 per acre. This low yields are due to premature falling of the cotton bolls and wilt leading to drying up of the roots (Gene campaign, 2005). Entirely different figures were shown by A.C. Neilson (2003), where he shows that farmers earned higher revenues by Rs. 97 crores (\$ 21.5 M) (Neilson, 2003).

Qayum and sakkhari, (2005) worked extensively for the last 3 years, they found that yield benefit was just 5% more for the Bt seeds and the net loss is of 252 Rs per acre, while non Bt farmers got more net benefit of 597 per acre. The results were contradictory to Monsanto industry claim that Bt will give 30% more yield and 70% less pesticide, they found there was only 8% less pesticide use (Qayum and sakkhari, 2005; Kohli, 2005).

4.2.2 Opinions of Bt and Non Bt farmers regarding the Bt and Non Bt varieties:

Cotton hybrid varieties	Opinion of Bt farmers	Opinion of Non Bt farmers
Mech-12 Bt	Totally failed, as there were no expected yields	Totally failed as many farmers lost with this variety
Rch-2 Bt	Giving good yields.	This variety is good as it yields more.
Non Bt cotton varieties	Loss, as it needs more pesticides and more worm infestation.	Loss, as the debts are increasing but we are not getting any revenue.

Though the Bt cotton farmers were told that there will be no worm infestation to Mech 12 Bt, some (2nd, 3rd, and 6th) of the Bt cotton farmers found worm infestation. The Bt cotton farmers used pesticides to control the worm but the crop failed. So the amount of pesticide used is not different from their previous/other non Bt crops. All the Non Bt farmers lost their crop due to worm infestation in spite of using costlier pesticides. Similar results were shown by Indian and Chinese researchers where they

found that for Bt cotton crop the pesticide use is high or equal to Non Bt cotton crop (Yang et al., 2004; Morse et al., 2005) where the farmers are still using high amounts of pesticides to control the pests in Bt cotton (Yang et al., 2004). Where as some researchers in India and China claim that the pesticide use is decreased for Bt cotton crop (Huang et al, 2002; Huang et al, 2003; Nielsen, 2003 and Qaim, 2003). In Northern China, two-third farmers responded that there is still pest (CBW) problem for Bt cotton. The average number of sprays was 12.7 times which range from 6 to 22. The cost for pesticides were still high as for non Bt coming up to 111.8 US\$/hectare on average (Yang et al., 2004).

The first and seventh Bt cotton farmers who didn't have worm infestation for their crop, the labour expenses are slightly less as the boll is easy to pick up. Some of the Bt farmers and most of the Non Bt farmers thought that as the seed cost is high the quality of Bt cotton seed should be very good. the first Non Bt farmer don't want to go for Bt seed as it is high cost and no other technical or agronomic or environmental factor impede him to choose Bt cotton seed, which was also shown by David and sai study in India (David and Sai, 2002).

All the small farmers want to try Bt cotton in their fields though the seed cost is high. As they are not getting their investment back for Non Bt crop they want to switch to other crop which is mostly grown by other farmers. High seed cost is not a risk for them until they get back their investments, because pesticides also cost higher.

The market value of cotton is based on the cotton quality, if there is no worm infestation and the boll is white color then the market value is high. For Bt cotton farmers, some got good market value whose crop is not infested with boll worm, as the color of cotton is white. The other Bt cotton farmer's crop got less market value as the cotton boll color is not white due to worm infestation. The Non Bt Cotton quality is also not good, So they got still less market value for the cotton (half of the Bt cotton market value) for their crop compared to Bt cotton, some of the farmers didn't sale their cotton till July 2005 as there are no good rates in the market. Most of the Non Bt farmers felt Bt Cotton quality is good and have good market value.

Recent report in September 2005 reported that the Bt crop got Tobacco Streak Virus which has spread to more than one lakh hectares in different districts like Adilabad, Khammam, Guntur and Warangal. The monitoring team found that RCH2 Bt (of Rasi Seeds Company, in its second year of commercial cultivation) seeds were defective/adulterated (GM Watch organization, 2005).

Farmers are beginning to realize that Bt Cotton hybrids are presenting peculiar problems in terms of diseases and sucking pests year after year and many are beginning to question the way the government permitted the commercial release of the technology.

4.3. Farmers attitude towards Social issues:

The Table 4.3 shows the main views of Bt and Non Bt farmers regarding social issues.

Table 4.3 Attitudes of Bt and Non Bt farmers on Social issues

Attitudes towards social issues	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7
Bt cotton	Lost trust on MECH 12 Bt (Mahyco company), But accepting RCH2 Bt, is Rasi company. Others got good yields No Compensation for loss Traditional seed is not high yielding	Lost trust on Mahyco Bt company. And shifted to NPM (Non pesticide Management) of cotton crop. No compensation Traditional seed is not of good quality	Lost trust on Mahyco Company. As RCH2 is good for other farmers. I trust on Rasi company, so going for RCH 2 Bt. Not against to Non Bt but we don't find yield with that.	As all growing we also grew. Trust on relatives. Not against to Non Bt cotton. No trust on company seed, as it may be adulterated. No compensation	Trust on relatives. Most of the farmers are trying and saying RCH 2 is good. Traditional seed is not good quality. Company seed is not reliable.	Accepting Bt as a very good variety as it is high cost. Risky, not reliable with company seed. No compensation	Trust on fertilizer. As all people are using. Traditional seed is not good quality, hybrid seeds are good, and Bt seeds are very good.
Non Bt cotton	We can't pay royalty fee, we don't accept Bt as it is a new variety. Never used Bt cotton Before	As all farmers going for Bt cotton. Non Bt cotton is waste. Never used Bt cotton Before	Other farmers got good yields. High pesticide use for Non Bt. Instead of cotton other crops like maize are better Never used Bt cotton Before	As all are buying Bt seeds. Non Bt Cotton is waste. Never used Bt cotton Before	Other farmers, trust on market people. Growing some area with NPM Never used Bt cotton Before	Relatives influence. Non Bt Cotton is waste. Never used Bt cotton Before	Not accepting Bt seed. Switching to other crops is better. As all farmers going for Bt cotton. As we find only this option Never used Bt cotton Before

The reasons behind the acceptance of Bt cotton are its high yield, good quality and low worm infestation. Similar perceptions are seen in Northern China where various reasons for different farmers are less labour expenses, less pesticide use, higher yields and higher profits (Yang et al., 2004).

All Bt cotton farmers accept RCH-2 Bt Cotton, which is from local Rasi company and they don't want to accept Mahyco Bt cotton variety which left them huge losses. The main reason behind acceptance is to get high yield with high quality. Genecampaign, an NGO, showed that RCH-2 Bt cotton variety is performing well compared to other Bt cotton and Non Bt cotton varieties (Sahai, 2005).

Out of the seven Non Bt cotton farmers, two farmers are not willing to grow the Bt cotton crop. The first farmer doesn't want to go as he can't pay royalty fees and they are not confident on Bt variety. The seventh farmer is aware of the environmental and human risks of Bt cotton so he didn't accept it as a good seed, but he finds Bt seed is the only option to get yields.

The farmers are interested in yields as their daily life became expensive with expensive vegetables, rice and dhal. The first Bt cotton farmer said, "If this time I will get good yields with Bt crop I have to do my daughters marriage". Some farmers want to educate their children well. As the money plays a critical role in their personal life and agriculture is the main occupation they depend on agricultural yields. They are not getting good yields with Non Bt varieties since few years so they want to switch to Bt varieties, thinking that it's a new variety with good quality. All the Bt farmers told that they will see the yield of RCH 2 Bt variety, if they get good yields Bt cotton they don't want to go again for Bt cotton.

The main reason to go for Bt Cotton is to get good yield as mentioned in other studies (David and sai, 2002) as with Non Bt cotton crop they are not getting their investment back and it needs high pesticide use and the worm is not controlled so loss is inevitable with Non Bt cotton crop. Farmers are pursuing the Bt Cotton as a good alternative as they were told that it gives good yields and low use of pesticides.

The study in Northern China showed that the reasons for the adoption of Bt cotton by the farmers were, it saves labour (95%), less spraying of pesticides (91%), yields are higher (88%) and its profitable (85%). Most of the non Bt farmers responded that they were not confident regarding the resistance of Bt Cotton to pests, some said that the seed cost is high and few responded that BT Cotton seed is not available for not adopting Bt cotton.(Yang et al, 2004).

As RCH-2 Bt cotton has given good yields to some of the farmers in the village who grown it, so other farmers who got loss through Mahyco Bt cotton and with Non Bt varieties are interested to grow RCH-2 Bt cotton. Most farmers rely on other farmers experience than their own experiences, and the rumors are the sources of information in the villages (Aerni, 2001). Along with RCH-2 Bt crop some farmers (second farmer from Bt cotton growing group and fifth farmer from Non Bt cotton growing group) are growing conventional cotton through NPM (Non Pesticide Management) strategy, with the influence of local Non Government organizations.

Source of investment for the farmers is mostly from debts, where as the farmers who got good yields last year saved some amount for the investment of the crop. The farmers who lost their crop in last year, they have added debts. This situation makes some of them to attempt suicides as the debts will increase over a period of time (Iyengar and Lalitha, 2002).

As the seed distributor is the source of information regarding good varieties and he can wait for the seed packet money until they get their yields, they mostly trust him. Some of them also trust fertilizer distributor and relatives to select a seed variety for their crop. Regarding risks of Bt Cotton most farmers in Bt cotton group and few farmers in Non Bt cotton group trust Government. As they feel government plays an important role to manage the risks effectively in order to safe guard the public (Frewer, 2004). Where as the Mexican stakeholders feel that academia is trust worthy (Aerni, 2004). The main trust of Indian farmers on government authorities might be due to subsidies they get from the government.

Coming to the farmer's views on company seed versus traditional seed, they feel that Mahyco company seed is not at all good, it totally failed. Most of the Bt cotton farmers regarded company seed is not reliable as some times it gives good yields and some time huge losses, Some seeds won't germinate, and some won't yield well. Regarding non Bt cotton seeds they felt that the pesticides are not working on the crop waste, as it is not resistant to worm infestation though pesticides are applied. Regarding traditional seeds the view of the Bt and Non Bt cotton farmers is same, they told that the traditional seed is reliable but we don't get good yield, quality is not good and are not resistant to worm infestation. From the entry of hybrid seeds, we depend on Seed Company only.

Shiva, an international figure who is against to GM technology, argues that through Green revolution the traditional culture of storing the seeds by themselves has been

changed to dependency on private company seed which is protected by patents and intellectual property rights (Lambrecht, 2001). According to her the dependency on private companies has resulted in deaths or suicides of farmers. Where as Stone expressed that the traditional agricultural practices are continuously changing as the new innovations enter in to system and the farmer has to be skilled enough to adopt the new technology (Stone, 2004).

Though the Indian law says that the failure seeds are to be compensated, no Bt Cotton farmer got compensation amount from the seed company, Mahyco-Monsanto biotech. Who grown Mech Bt-12 last year and got loss, went to government officials asking for the compensation. The government officials told that they will see to compensate but they didn't have any compensation. Monsanto reaction is, they will ensure compensation if the seed fails to germinate but not for loss. So the poor farmers are not compensated by either the seed company or the Government which can further lead to unexpected suicides if the Bt Cotton pest resistance increases.

5. Discussion:

From the analysis it can be seen that the Bt and Non Bt farmers have very limited knowledge regarding GMOs and how the GM seeds are produced. Some of the previous studies also show that the farmers, consumers or general public particularly in developing countries have no enough knowledge regarding GMOs and GM crops (Ho and Vermeer, 2004). Concerning the environmental risks, they trust on the government that it will not allow any risky crop to the fields of farmers. Though few farmers know about the risks, they want to try Bt cotton to get good yields as other farmers got. Regarding human risks most of them feel it's not risky. When Bt farmers and non Bt farmers compared, then we can say that Bt cotton farmers are more interested to try new varieties for getting the yields where as the non Bt farmers see the stability of the new variety for other farmers and if they are confident about the variety then they will try on their fields. As the Mahyco variety Mech 12 Bt is totally failed for the Bt farmers they didn't try that variety but where as RCH 2 Bt is giving more yields to others so they want to try RCH 2 Bt variety.

Regarding the safety practices like growing refuge crops, is not as effective as the purpose of growing these crops is not clear to the farmers; there are more chances of refraining from growing refuge crops. As mentioned by Stone, (2002) agricultural skilling is necessary to the farmers. The government doesn't kept any regulation regarding the selling of Bt and Non Bt cotton, most of the farmers are selling by mixing both. This can affect future exports or transparency issues if the consumers are unwilling towards Bt cotton.

We know from the Green revolution, technology alone cannot solve the structural inequalities in any society, as the development of pest resistance to hybrid varieties left the farmers to go for suicides.

The main environmental risk is the development of pest resistance, as it will influence the farmer's lives a lot. As in case of green revolution, the farmers initially got good yields but as the pest resistance is increasing the crop needs more pesticide and costlier pesticides. Though the farmers used costlier pesticides they didn't got yields so the farmers has no choice to repay the debts so they are choosing the way of suicides. From 1998, many farmers are attempting suicides. The climate variations are also unpredictable and not suitable to farming, making farmer more worried. So if

now farmers tend to use Bt cotton, if they didn't get their crop, they might attempt suicides. As small farmers source of investment is debts, if they lost their crop their debts will add up and leave them only choice of suicide. Recent news in the local news paper shows that every month around 20 farmers are attempting suicide, in the month of October 23 farmers are attempted suicide and in the month of November 17 farmers attempted suicide as reported on November 26th, 2005 (Eenadu News paper, November 27, 2005). The farmer's attitude is driven by yield of the crop. Bt Cotton farmers are going for other good yielding Bt variety, where as non Bt farmer is following the Bt cotton farmer. From the commercialization of Bt cotton the area of planting is increasing quickly where as the farmer's perceptions and knowledge of the risks, benefits and uncertainties of this technology have not kept pace with grower demands for the new tools.

Regarding the sustainability of this Bt cotton crop, the environmental, economical and social issues are studied in view of the small farmer. The sustainability is defined as follows,

“Bruntland Commission's definition of Sustainability has been referred to by diverse bodies as constituting a basis for policies and practices designed to support a society being economically, ecologically and culturally sustainable: Humanity has the ability to make development sustainable- to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (Sverdrup and Stjernquist, 2002, page 21).

As the environmental/economical/social risks increases the sustainability of Bt crop will decrease and affects the farmer who uses Bt cotton crop. The Bt cotton is giving Environmental, economical and social risks to the farmer in the present and future, so the Bt cotton is not a sustainable option for the farmers. To reduce the environmental risks to certain level the farmers must be educated enough regarding the risks, benefits and skill needed to adopt Bt cotton. The government should encourage farmers to adopt sustainable agricultural practices rather than new unsustainable technologies.

In the recent news, it has shown that in September 2005, the Bt crop has got an uncommon virus attack named tobacco streak virus, which is going to give huge losses to Bt farmers. Now farmers are realizing this Bt cotton crop as something different which is behind their understanding and asking government how they have approved this technology.

Coming to economic issues, Mahyco Bt gave fewer yields to Bt farmers less than the non Bt cotton yields. Some farmers lost due to worm infestation and others found no worm infestation but the crop died soon. The quality of cotton was good without worm infestation. Where as non Bt cotton farmers didn't get back their investments and the debts increased more. The quality of the cotton is also not good; the market value was very less for non Bt cotton so some of them didn't sold their cotton.

As the Bt cotton is not economically stable it is not a sustainable option for the farmers. As the farmers main occupation is agriculture, their family is dependent on the yield of the crop. If the farmer won't get stable yields then the farmer has to face huge losses. Further it can lead to economic insecurity and loss of trust on government and cotton cultivation, which may further affect the social structure of the system (Coan, 2004).

The main reason to accept this new technology is to get good yields but the farmer is getting loss every year, and the seeds are adulterated in the market the very next year of the successful variety. The Bt farmers are following the farmers who got good yields and non Bt farmers following Bt cotton farmers. So the farmers are adopting as all farmers are using it. But the trauma of suicides and heavy losses every year opening the eyes of farmers and questioning the performance of government regarding the approval of Bt cotton.

So there is a need to educate farmers and improve their knowledge regarding the technologies they are using in their fields, the authorities should encourage farmers to take up sustainable agricultural practices rather than approving Bt cotton varieties. Additionally, the regulatory infrastructure, monitoring and evaluation of system should be enforced tightly. As farmers believe that they are protected by the government authorities from the risks of new technologies, the government should take necessary precautions to regulate market structure from seed to selling, conduct awareness programme to the farmers and make sure that until the farmers are fully aware of risks and benefits of new technology they should not be commercialized. The end users of agricultural products are the consumers, so the government and the seed companies should study the consumer preferences towards GM Products before the approval of new technology.

The role of a farmer to achieve sustainable agriculture as defined by Dick Levins (2005), as

"...farmers in sustainable agriculture are concerned about feeding their families and paying their bills, but those are not their only goals in life. They set out to protect the land, improve their quality of life, and enhance the communities in which they live. Their day-to-day decisions are not guided by a single minded search for profit, but by a delicate balancing act among many goals" (Levis, 2005)

In order to implement his role the farmer must be aware of all the risks and benefits and uncertainties regarding GM crops which are not yet proved scientifically. As the farmers trust on government, the government should take necessary action to improve the awareness level of farmer and see that the farmers are getting good seeds.

6. Conclusions:

The conclusions of the study are given below:

- The farmers interviewed are not having enough knowledge regarding genes, Genetic modification and the risks so there is a need to educate farmers regarding the risks, benefits and uncertainties of the new technologies.
- The responses show that either Non Bt cotton with pesticide use and Bt cotton crop are not sustainable so there is a need to encourage farmers to take up sustainable agricultural practices.
- The regulations in the market are not enough to protect the farmer from adulterated seeds, ineffective pesticides. So the regulation system should be strict enough. The new varieties like Bt Cotton need to be monitored and evaluated whether it is giving good results or not.
- Further research area can be to study the attitudes of consumers towards GM Products.

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APPENDICES

APPENDIX-1

Small farmer's attitude towards Bt cotton in India.

Interview Questionnaire for Non Bt Cotton farmer

Name of the farmer:

Age:

Occupation:

Name of the Village:

Mandal:

District:

Section I: Background Information:

1. How much land you posses?
2. Which type of crops you grow?
3. How many people are their in your family? Is your entire household involved in farming?
4. Do you know about GM Crops? And how they are produced?
5. Did you grown Bt cotton crop before?

Family details:

Sl. No.	Name of the family member	Gender	Age	Relation with Head of the family	Education	Occupation
1						
2						
3						
4						
5						

Section II: Farmer's attitude towards Environmental issues

1. What do you think regarding Bt cotton impact on environment? Is it good or bad? Why you think its good/bad?
2. Do you think Bt cotton causes any human risks/ benefits? Why do you think it's risky/ benefit?
3. Do you think pesticides have any effect on the environment?

4. Do you know about refuge crops? Why they are grown? In how much area they should be grown?

Section III: Farmers attitude towards Economic issues:

1. How do you feel regarding your crop yield? Good/bad? Why it is good/bad?
2. What is the cost of seeds you buy?
3. According to your view which variety is good? And why?
4. Do you like to grow Bt cotton variety in future? Yes/ No, and why?
If yes, what is the source of your investment money if you go for Bt Cotton seed? What do you think is it a risk or benefit?
5. How many times you sprayed the pesticide? Do you think the worm died due to pesticide use?
6. How is the market value for the cotton yield?

Section IV: Farmers attitude towards Social issues:

1. Do you accept Bt cotton crop? And why?
2. Who suggested you to go for Bt cotton crop?
3. Whom do you trust most?
4. How do you feel about the company seed?
5. What is your opinion on traditional farmer saving seed?
6. Do you feel any other agricultural practice as more efficient than Non- Bt and Bt cotton varieties?
7. What are the problems you faced with Non Bt cotton crop?
8. Do you have any other comments you would like to make about the issues discussed in this survey?

APPENDIX-II

Small farmer's attitude towards Bt cotton in India.

Interview Questionnaire for Bt Cotton farmer

Name of the farmer:

Age:

Occupation:

Name of the Village:

Mandal:

District:

Section I: Background Information:

1. How much land you posses?
2. Which type of crops you grow?
3. How many people are their in your family? Is your entire household involved in farming?
4. Do you know about GM Crops? And how they are produced?
5. Did you grow Bt cotton crop before? Which type of varieties you grow?

Family details:

Sl. No.	Name of the family member	Gender	Age	Relation with Head of the family	Education	Occupation
1						
2						
3						
4						
5						

Section II: Farmer's attitude towards Environmental issues

1. What do you think regarding Bt cotton impact on environment? Is it good or bad? Why you think its good/bad?
2. Do you think Bt cotton causes any human risks/ benefits? Why do you think it's risky/ benefit?
3. Do you think pesticides have any effect on the environment?
4. Do you know about refuge crops? Why they are grown? In how much area they should be grown?

5. Do you find any changes in the growth of crop? And did you saw any effect on your field?
6. Do you grow Bt and Non Bt crops in your field? Do you mix both cottons before marketing? Do you have any regulations regarding this issue?

Section III: Farmers attitude towards Economic issues:

1. How do you feel regarding your crop yield? Good/bad? Why it is good/bad?
2. What is the cost of seeds you buy?
3. According to your view which variety is good? And why?
4. Do you like to grow Bt cotton variety again in future? Yes/ No, and why? If yes, what is the source of your investment money if you go for Bt Cotton seed? What do you think is it a risk or benefit?
5. How many times you sprayed the pesticide? Do you think the worm died due to pesticide use?
6. How is the market value for the cotton yield?

Section IV: Farmers attitude towards Social issues:

1. Do you accept Bt cotton crop? And why?
2. Who suggested you to go for Bt cotton crop?
3. Why you preferred Bt cotton rather than Non Bt cotton?
4. Whom do you trust most?
5. How do you feel about the company seed?
6. What is your opinion on traditional farmer saving seed?
7. Do you feel any other agricultural practice as more efficient than Non-Bt and Bt cotton varieties?
8. What are the problems you faced with Bt cotton crop?
9. Do you have any other comments you would like to make about the issues discussed in this survey?