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GENETICALLY MODIFIED TECHNOLOGY AND AGRICULTURE: ETHICAL AND LEGAL ISSUES WITH SPECIAL REFERENCE TO FARMERS IN INDIA

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Introduction

Genetically Modified (GM) technology is a scientific innovation with enormous social, economic, environmental, ethical and even legal implications. The development of GM products raises perhaps the broadest and most controversial array of legal issues concerning food and agriculture today.[1] Countries producing GM products must have a clear and responsive regulatory policy and authoritative body to ensure that scientific risk analysis is carried out and that all possible safety measures are taken through testing before the release of biotechnology products and afterwards through close monitoring.[2]

For developing countries, agro-biotechnology is a particularly challenging phenomenon. They could be the main beneficiaries of it if indeed agro-biotechnology keeps its promises, but they could also be the main losers if agro-biotechnology negatively affects biodiversity or if patented biotechnology disrupts traditional practices among farmers and makes access to seeds more difficult. Countries are free to decide how to deal with agro-biotechnology and bio-safety at the national level, but domestic legislation has to be World Trade Organization (WTO) consistent for international trade.[3] For developing countries, reconciling their trade interests with their responsibility for improving the quantity and quality of agricultural and food products made available to the population and with their commitment to environmental preservation is proving to be a difficult task.[4]

Proponents of agricultural biotechnology like transnational corporations such as Monsanto, Du Pont and Novartis, argue that planned and careful introduction of GM crops would help in feeding the world's growing population, eliminate the enormous crop losses due to weeds, insects, pests and pathogens, combat diseases, be more nutritious and enable use of more environmentally sound agricultural practices like significantly reducing the use of agrochemicals etc[5]. However, so far there is no conformity that it would actually be a remarkable human innovation for the betterment of the society.

Ethical and Legal Implications of GM Cultivation on Farmers

Threat to Bio-Diversity

In 1960's, green revolution fathered by Norman Borlaug brought major agricultural developments with improved varieties and increased use of fertilizers and pesticides but it is known to have many potential negative effects on public health and environment. This led to the introduction of GM technology to reduce application rates of targeted pesticides with lower toxicity.[6] However, these future advances in biotechnology although promise spectacular benefits but also bring with them additional potential risks.

Biological diversity depicts the variety of life forms on earth, at all levels of biological systems and is known to boost ecosystems productivity, provide greater variety of crops, ensures natural sustainability for all life forms

[1] FAO Information Division, "Genetically Modified Organisms, Consumers, Food Safety and the Environment", Ethics Series 2, FAO of UN (2001), available at: http://ftp.fao.org/docrep/fao/003/x9602e/x9602e00.pdf.
[2] Ibid.
[3] Ian M. Sheldon, "Regulation of Biotechnology: Will we ever "freely" trade GMOs?",77th EAAE Seminar/NJF Seminar No. 325, August 17-18 (2001), available at: http://ptt.fi/eaaenjf/papers/sheldon.pdf.
[4] SimonettaZarrilli, "International Trade in GMOs and GM Products: National and Multilateral Legal Frameworks: Policy Issues in International Trade and Commodities Study Series No. 29, UN Conf. on Trade and Dev (2005).
[5] S. Krimsky and R.P Wrubel, Agricultural Biotechnology and the Environment: Science, Policy and Social Issues, (University of Illinois Press, Urbana, 1996).
[6] Gregory N Mandel, "Gaps, Inexperience, Inconsistencies, and Overlaps: Crisis in the Regulation of Genetically M(2004).odified Plants and Animals", Vol.45, Wm. & Mary L. Rev. 2167

etc. On the other hand, there are known to be many types of human activities behind the massive extinction of biodiversity, and the GM technology seems to be furthering this loss[7]. For instance, the accidental spread of an engineering gene to an undesirable plant species, giving the latter the specific transgenic characteristics for resistance or for enhancing the yield thereby disrupting the biodiversity in the wild species ecosystem.[8] Biological diversity can further be destroyed with the creation of "super-weeds" like with the spread of herbicide tolerant genes from engineered crops to nearby weeds, "super-weeds" not susceptible to herbicides may be created.[9]

This risk is one of the major causes of worry to the organic farmers and conventional breeders as it can have negative impact on the economic crops.[10]

Genetic Pollution

The genetic modification can be done on microorganisms, plants, trees, animals and even humans. Therefore, the apprehensions involved are that the newly introduced genetic material may move into environments or organisms beyond those intended or may result in the establishment of the transgene in the wild gene pool and in the natural plant populations. This gene flow could occur through the dispersal of GM seeds; vegetative prop gules (escape); by pollination of a GM plant through wind, animal, bees or insects also known as "hybridization" or "vertical gene flow".[11]For instance creation of super-weeds by transfer of transgenes to the weeds and these transgenic weeds may be preserved for many years in spite of the efforts to exterminate it. Therefore, the transgene weeds may present economic risks to farmers and the biotechnology industry.[12]

Horizontal gene flow occurs between unrelated organisms like between plants and bacteria, animals and bacteria by soil, fresh water, marine and aerial microbes, fungi, insects and other vectors. The possibility of transgenes moving from a GM plant to plant associated or soil inhabiting microorganisms has raised public and regulatory concerns, particularly in view of the use of bacterial antibiotic resistance genes as selectable makers in crop transformation.[13] Such gene flow can also because potential extinction of wild species through hybridization.[14]

Creation of Super Weeds

Species that are considered weeds could become more difficult to control if they acquire certain transgenic traits.[15] This may even cause the creation of "superweeds". This development of transgenic super weeds may require further application of pesticides, herbicides etc due to which weed control costs may increase as much as one hundred percent in some cases.[16]

Increased Use of Pesticides

The transgenic crops earlier identified with the benefit of reducing pesticide residue in the environment are ironically containing the pesticides throughout the growing season. This makes the pesticides more persistent in the environment, particularly in soils, than sprayed pesticides that decay rapidly and are only used at times or during years when certain insects are exposure in the soil is new, and the effects on microorganisms are

[7]AnupamGoyal, "Harmful Biotechnological Innovations-Led Genetic Erosion: Legal Chioce between "Precautionary Principle and "Necessary Principle", Vol.42, IJIL 44 (2002).
[8] Supra note 6 at 2196-2197.
[9] National Research Council, Report: Genetically Modified Pest Protected Plants: Science and Regulation (2000); National Research Council, Report: Environmental Effects of Transgenic Plants (2002).
[10] David R Moeller, "GMO Liability Threats for Farmers-Legal issues Surrounding bthe Planting of Genetically Modified Crops", Biotechnol(2001).
[11]Supra note 9.
[12]Supra note 6.
[13]Syvanen, "Horizontal Gene transfer: Evidence and Possible Consequences, Vol. 28, Ann. Rev. Genet. 261 (1994); Syvanen, "In Search of Horizontal Gene Transfer", Vol. 17,Nature Biotechnol833(1999).
[14]Supra note 9.
[15]Ibid.
[16] Andrew Pollack, "Widely Used Crop Herbicides is Losing Weed Resistance" N.Y Times, Jan. 14, 2003.

unknown.[17]Further, greater exposure to a pesticide increases the probability that pests will evolve to overcome the protection mechanism, rendering the pesticide useless. Instance of pest adaptation to conventional Bt products have been documented, and insect resistance to Bt crops is considered inevitable. Growers may thus increase herbicide application knowing that the crops are not affected by the herbicide. The transgenic crops therefore can further increase contamination with increased application.[18] For instance, case study of Bt cotton shows that in the State of Karnataka, the US company Monsanto, in the name of fighting the bollworm pest in cotton, took a gene from a soil bacterium called Bacillus Thuringiensis (Bt) and inserted it into the cotton plant. The purpose was to convert it into a constantly insecticide producing plant from within its cells. No thought was given to the fact that although it would thwart the existing strain of bollworm pests, it would poison all oethr insects, bees and birds.[19] Simultaneously, it will pave the way for far greater mischief by providing advantage to pests to develop resistance to it. Inevitably, cotton became vulnerable again and new strain of Bt tolerant super pests have become capable toattack other crops like potato maize, creating an agricultural crisis all around.[20]

Monsanto's Roundup Ready Soybeans, the most extensively grown GM crop have led to an increase in herbicide use.[21] Independent reports from the US show that since 1996, GM maize, soya and cotton have led to an increased use of pesticide.[22] It is also associated with a decline in soil fertility and soil erosion.[23]

Unstable Gene Expression: Stability of transgene expression overtime is of particular relevance for long lived plants or crops as they undergo numerous dormancy cycles and are exposed to a range of environmental conditions during a normal rotation.

Genetic Erosion and Monoculturization of Crops

The spread of transgenic crops threatens crop diversity by promoting monocultures which lead to environmental simplification and genetic erosion. It would lead to greater uniformity and conversely less biodiversity making the country more susceptible to widespread crop failures and other crop disturbances.[24] The uniformity characterizing agricultural areas sown with smaller number of varieties is a source of increased risk for farmers, as the genetically homogenous fields may be more vulnerable to disease and pest attack.[25] For instance, Irish Potato Famine, 1845 is an example of widespread crop failure. One million people died of starvation as a result of a potato blight that destroyed the genetically uniform monocultures of Irish potato crop; similarly in 1970, there was a widespread failure of the American corn crop due to Southern Corn leaf blight, which affected multiple varieties of corn with an identical gene.[26]

Improper Treatment of Local Farmers by Biotech Industries

Monsanto is, by far, the largest producer of genetically engineered seeds in the world, dominating 70%-100% of the market for crops such as soya, cotton, wheat and corn. The company is also one of the most conspicuous

[17] Royal Society of Canada, An Expert Panel report: Future of Food Biotechnology: Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada 110 (2001), available at: http://www.canadians.org/food/documents/rsc_feb05.pdf.
[18]Supra note 9.
[19]SailendraNath Ghosh, "Abuses of Biotechnology Posing threats to Survival", Vol. XLVIII, No. 9, Mainstream (2010).
[20]Ibid.
[21] Charles Bebbrook, "Evidenceof the Magnitue of the Roundup Ready Soybean Yield Drag from University Based Varietal Trials in 1998", Ag Bio Tech Info Net Technical paper No. 1(1999)
[22]Seehttp://www.ers.usda.gov/briefing/biotechnology.
[23] Ethan A. Huff "GMO soy bringing Poverty, Poor Health to South America "Natural News Sunday, Nov. 14, 2010, available at:http://www.naturalnewSs.com/030390_GMO_soy_poverty.html#ixzz1WUZsPRbA.
[24] Holly Saigo, "Agricultural Biotechnology and the Negotiation of the Bio-Safety Protocol", Vol. 12, Geo. Int'l Envtl. L. Rev.779, 793-96(2000).
[25] Raoul A. Robinson, Return to Resistance: Breeding Crops to Reduce Pesticide Resistance (agAccess, USA, 1996), available at:http://gentechvrijvoedsel.nl/wp-content/uploads/2013/02/ReturntoResistance.pdf.
[26]Supra note 9.

abusers of the human rights of food sovereignty, access to land and health. Over the years, Monsanto has run the gamut of improper treatment of local farmers to immoral promotion of GM foods.

Trespassing due to Transmission of GM seeds into Organic or Conventional Fields Resulting into Lawsuits against Farmers

The genes of GM varieties may cross over into non modified crops planted next to GM plants. If once such contamination occurs it can spread rapidly to other crops and areas and is irreversible. The possibility of interbreeding is shown by the defence of farmers against lawsuits filed by Monsanto. The company had filed patent infringement lawsuits against farmers who may have harvested GM crops. Monsanto claimed that the farmer obtained Monsanto licensed GM seeds from an unknown source and did not pay royalties to Monsanto. Whereas the farmers claimed that their unmodified crops were cross pollinated from someone else GM crops planted a field or two away.[27]

After Oluf Johnson and Jacobs Farm Del Case[28] a precedent has now been set for organic farmers to sue biotechnology companies whose GMOs contaminate their crops. Genetic traits are highly transmissible, whether it is through pollen transfer or seed spread, organic and non GMO farmers have every right to seek damages for illegal trespassing when such transmission takes place. The issue of contamination will have serious implications to the standards of organic and conventional crops with possible negative impacts on their markets. At the same time, it is increasingly becoming dearer that co-existence of GM and non GM crops is not possible. This raises many serious issues, including unresolved issues of liability for contamination, coupled with lawsuits by the companies for patent infringement for 'use' of their patented seed.[29]

In India, common law tort actions relating to GM contamination present numerous difficulties, including the fact that it may be very difficult to recover losses, or even to persuade the Court that the losses are economic.[30] Legal action is also likely to be very expensive and the outcomes doubtful. But as a consumer of a GM plant or product could have remedies under the Consumer Protection Act, 1986. In a significant judgement[31] a farmer was compensated for poor quality BT cotton seeds in the State of Punjab.[32] In this case both the consumer forum and the Commission held that the bad quality of seeds was given to the farmer. Both the dealer and the manufacturer of the seeds were held liable for and were asked to compensate for the loss caused to the farmer.

Increasing Corporate Control of the Food Chain

There are approximately 1500 seed companies worldwide, about two dozen control more than 50 percent of the commercial seed heritage of our planet. In 1998, the top five soy producers controlled 37 percent of the market (Murphy Family Foods; Carroll's Food, Continental, Seaboard). The top five controlled 51 percent with corn seed production and sales, the top four seed companies controlled 87 percent of the market in 1996. In 1999, the top three controlled 88 percent. In the cotton seed market, Delta and Land Pine Company now control about 75 percent of the market. This is indicative of dwindling of price competition and fewer distribution outlets as disfavouring and threatening the small family farm. Average annual income per farm has come down throughout the last decade.[33]In India, many farmers have committed suicide due to debt liability.[34]

[27] Ethan A. Huff, "Court Rules Organic Farmers can sue Conventional, GMO Farmers whose Pesticides 'trespass' and Contaminate their Fields" Natural News, Aug3, 2001, available
[28]Oluf Johnson et. al., V. Paynesville Farmers Union Cooperative Oil Company 802 N.W. 2d 383(2011).
[29]Jacobs Farm Del CaboInc V. Western Farm Service Inc, Court of Appeal, Sixth District, California, 2010.

[31]Garg Pesticides and Rallis India Ltd. V. Baljinder Singh F.A No. 611 of 2008 decided on 19-04-2012.
[32]ShaileeDogra, "Farmer Compensated for Poor Bt Cotton Seeds Loss Consumer Body agrees, Muktsar man's crop adversely affected" The Hindustan Times, Apr 27, 2012.
[33] M Lappe and B. Bailey, "Against the Grain: Biotechnology and the Corporate Takeover of Your Food", LPC(1998).
[34]Ibid.

Intellectual property and Ownership

GMOs are the intellectual property of the company or organization that created it. This has led to market dominance of the agriculture by a few powerful companies. The farmers are required to pay the company who genetically modified the seeds. Additionally if terminator technology is commercialized they may severely hurt small landholder farmers who might not have the resources to pay biotechnology companies for seed each season.[35]

Reduction in the Autonomy and Privacy of Farmers

As the life industry dictates more and more of the farm level management decisions, the farmers become little more than a 'renter' of the proprietary germplasm and information, a step in the food/industrial manufacturing process. Farmers thus increasingly lose control over what products they grow and consume and which food production processes they chose to support.[36]

Impact on Farming System and Bio serfdom

A strong system of patents in agriculture is likely to promote corporate dependence rather than sustainable farming. It is also feared that like the Green Revolution, new technologies will perpetuate or worsen inequalities of wealth by benefitting large and wealthy farmers.[37]

Seeds (Pirated and Sterile)

The increasing removal of genetic material and plant resources form the natural world through privatization of plant genetic research and control of biotech crops exacerbates the disparity between public and private access to these resources. As an added dimension, the germplasm of developing countries has generally been thought of by these countries as "a free good, part of the cultural commons and the common heritage of humankind".[38] Secondly, farmers traditionally have saved seeds from part of their crop for breeding, trading, and planting the next season. The practice is more common among poor farmers in less developed countries.

"Between 15-20 percent of the world's food supply is grown by poor farmers who save their seed. These farmers feed at least 1.4 billion people".[39] Biotechnology companies have strived to wield control over seeds and their "new" variations as company property.[40] Large businesses such as Monsanto require farmers who purchase their GM seeds to sign contracts that prohibit their reuse of the seed so that they must repurchase additional seed each year.[41]Monsanto has aggressively pursued farmers who follow the traditional farming practice of saving and replanting seeds, accusing them of "pirating" its patented varieties.[42]

Under patent law, these rubric companies usually sue farmers for unintentional seed drift into their field, which is more of a contamination and warrants a counter suit by farmer.[43] There are however notable exceptions[44] to this but generally, however, the strategy of the biotech companies prevails despite its lack of logic in terms of public policy.

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[35] M. Vandenbosch, in S. Sterckx, (ed.), "Biotechnology, patents and Morality" (Brookfield VT, Ashgate,(1997).
[36]Ibid.
[37] Funk Bros Seed Co. V. Kalo Inoculant Co., 333US 127(1947).
[38] Lara E. Ewens, "Seedwars: Biotechnology, Intellectual property, and the Quest for High Yield Seeds", Vol.23, B.C. Int'll& Comp.L..Rev.289 (2000).
[39]Supra note 34.
[40]Debra M. Strauss, "Defying Nature: The Ethical Implications of Genetically Modified Plants", Vol. 3 no. 1 J. Food.L. &Pol'y 8-9, 21-23 (2007).
[41]Gallo A. Andres and Kesan P. Jay, "Property Rights Legislation in Agricultural Biotechnology: United States and Argentina", Vol.7, Minn. J.L. Sci. & Tech. 166-168 and 565, 580 (2006).
[42]Brian Tokar, "Resisting Biotechnology and the Commodification of Life", Vol. 18, Synthesis/Regeneration, (1999), available at:http://www.greens.org/s-r/18/18-01.html.
[43]Monsanto Canada Inc v.Schmeiser(2004) 1 S.C.R 902.
[44]Liberty Link[R] Rice (LL601).

Impact of Technology Protection System (TPS) on Agriculture and Farmers

TPS seed was developed by the USDA and Delta and Pine Land Company. These seeds are also known as "the termination seed", "suicide seeds" or "traitor "technology". These are genetically modified with an extra gene that seeds Co. can "turn on before selling the seeds", so that second generation seeds are sterile. In other words, the plants effectively self-destruct at the end of their cycle, requiring farmers to purchase new seeds every year and override nature's germination of future generations.[45]

Sterile seeds pose particular problems for small farmers in developing countries, who rely upon the tradition of saving seeds to replant for the next year. Moreover, if the spread is through common cross-pollination, these seeds could have a catastrophic impact on the global food supply.[46]

Recognizing this danger, the United Nations through the CBD in 2000 has maintained international defacto moratorium on Terminator technology under the term "Genetic Use Restriction Technologies" (GURTs).

Impact of Implementation of Restrictive Licensing Agreements

Restrictive licensing agreements attempt to ensure that seeds will not be saved and replanted without payment of royalties. It converts the most important duty in agriculture to share seed into a crime. It recognizes corporations as "owner" of seed through IPRs and coverts farmers into "thieves" when they save or share seeds.

Cultivation of GM Varieties in India and Implications

Bt Cotton

Bt(Bacillus thuringiensis) cotton is the first and the only commercially cultivated and patent protected GM crop in India.[47] The first application for commercialization of a GM crop was accepted in 1996, but it was actually in 2002 that the first GM crop, Bt cotton was introduced after being rejected in 2001. In 2005, more application for Bt cotton were cleared.

Illegal Cultivation of Bt cotton seeds

Farmers used Bt cotton seeds in India before the first official Bt hybrids were approved in 2002. During 2001, the Bt cotton hybrid NB-151 of the Navbharat Co. was cultivated on more than 4000 hectares in Gujarat State. This hybrid had not undergone testing and trials mandated by bio-safety regulations and had not been approved by the Genetic Engineering Approval Committee (GEAC) hence, the term illegal seeds. Though GEAC recommended that the NB-151 cotton crop be destroyed, farmer opposition prevented this. As a result, illegal Bt cotton seeds were multiplied and sold under various names on a growing black market in different Indian States.[48]

In March 2003, Monsanto released three Bt cotton hybrids with Bollgard I (BG I) trait for cultivation with GEAC approval and in collaboration with its Indian partner, Mahyco. Marketed by a 50-50 joint venture called Mahyco-Monsanto Biotech (MMB) the Bt hybrids were sold commercially to farmers in the central and southern Zones. A good monsoon season in the year increased the popularity of insect resistant cotton among farmers. MMB licensed the Bt gene to regional seed companies that were market leaders in their location and that were selling popular hybrids. These regional companies incorporated the Bt gene into their own hybrid varieties and began selling them after meeting necessary regulations.[49]

In May 2006, MMB produced hybrids with two domestic seed companies-JK Agri Genetics Ltd. And Nath Seeds Ltd released approved events of Bt cotton. The first indigenous Bt cotton variety, BikaneriNarma was granted approval in 2008.

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[45]Supra note 38.
[46]Supra note 37.
[47]Reji K Joseph, "Is Geneticslly Modified Technolgy Desirable? The Law and Economics of Bt Cotton" in K.D raju (ed.), Genetically Modified Organisms Emerging Law and Policy in India (TERI Press, New Delhi, 2007).
[48] P. Sadashivappa and M. Qaim, "Bt Cotton in Indai: Development of Benefits and the Role of Government Seed Price Intervention", Vol. 12 no. 2, AgBioForum172-183(2009).
[49] Ibid.

Economic Viability of the Bt Cotton Technology

As per the claim made by companies favouring Bt technology, the farmers will have increased income in the form of savings from the reduction in pesticide usage. However, in contradiction the studies reveal that the economics of Bt technology is not in the favour of farmers.[50] It was found that price of Bt cotton seeds was higher by approximately Rs 1200 per acre as compared to non Bt-hybrid varieties while the savings on pesticide was meagre Rs 217 per acre. Another study in Andhra Pradesh[51] estimated that on an average for 3 years from (2002-2005), farmers had spent Rs 1090 more per acre. The ANGRAU (Acharya Na Ranga Agricultural University) 2005 study[52] found that the pesticide sprays used for Bt cotton was only one spray less than that used for non Bt hybrids.[53]

To depict the yield, studies[54] estimated higher Bt cotton yields by 27 kg and 34 kg per acre in 2003-2004 and 2004-05 respectively. But the yield benefit was not sufficient to cover up the losses due to the higher expenses on seeds and hence the net income benefit was negative. As per the findings[55] the major source of growth in productivity in Indian agriculture is the adaptation to location and its interaction effect with the environment. Hence, revival of agricultural growth in India crucially depends on the creation of new knowledge adaptable to local conditions. It was also revealed that Bt does not provide protection against pink bollworm that attacks the plant at later stages of the plant life. For Bt cotton to be lethal to bollworm, the critical minimum expression level for Cry1Ac should be 1.9 mg/g in the plant tissue. Levels below this would not seriously harm the cotton bollworm (Helocoverpaarmigera). The study clearly showed that 110 days after the cotton seed was sown, Cry1Ac expression declined below this critical lethal level.[56]

Prof. Ashok Dhawan, former head of the Entomology, Punjab Agriculture University, Ludhiana stated that "the whitefly attack can lead to 30-40 percent drop in average yield in the affected areas. Spraying pesticides is not the best solution. Farmers need to follow a composite plan. We need varieties that are resistant."[57]

In the neighbouring State Haryana, which also grows Bt cotton, Dr. S.S Siwach, the Director research, Haryana Agriculture University stated that the whitefly attack has damaged only Bt cotton varieties. However, desi cotton (Indian variety) has not been affected. It has been recommended by the agricultural scientists to develop good varieties of desi cotton and urged farmers to sow this instead of Bt cotton.[58]

Adverse Implications of the Bt Cotton Cultivation on Organic Farming

The farmers who engage in the methods of organic farming are subject to direct and immediate adverse implication of GM technology. Pollen from the GM crops could blow onto the fields of organic farmers, contaminating their crops and their seed supply. This risk of contamination od organic products is more severe in India where majority of landholdings are very small and fragmented. If the trait is contaminated, the farmers will no longer be able to sell the seed under the banner 'organic' and driving away the market for their produce.[59]

[50] S. Sahai and S. Rahman, "Performance of Bt Cotton: Data from First Commercial Crop" EPW3139-3140(2003).
[51] A Qayum and K Sakhari, Bt Cotton in AP: A Three Year Assessment (Deccan Development Society, Hyderabad, 2005).
[52] K.D Raju (ed.), Genetically Modified Organisms: Emerging Law and Policy in India1-12 (TERI Press, Delhi, 2007).
[53]Ibid.
[54]Ibid.
[55] K. Pushpangadan, Agricultural Policy and Performance in India: A Post Reform Analysis (2005) (Unpublished Paper, Centre for Economic and Social Studies).
[56]Kasturi Das, "Bt Cotton Cultivation: Facts and Fiction" InfoChange News and Features, Sept. 2005.
[57]IkhhlaqAujla, "Black Clouds Loom over Bt Cotton as Whitefly Runs Amok" The Times of India, Sept. 9, 2015.
[58] Deepender Deswal, "Whitefly Present in Guar, Sugarcane" The Tribune, Sept. 19,2015.
[59]Supra note 52.

Bt Brinjal

In 2009, GEAC gave its approval for the environmental release of GM BtBrinjal for commercial use. But this effort resulted into a controversy.[60] It led to a protest by a conglomeration of environmentalists, farmers, consumers, women and academicians' groups in India.[61] The main concern had been that "if the government carries forward the environment release of BtBrinjal, flood gates will be opened for other GM crops like rice, corn, okra which was unacceptable.

Herbicide Resistant GM Rice, Aerobic Rice (IR-8,20,26), Bt maize, GM Mustard (DMH-11) etc.

In case of Herbicide Resistant GM Rice it was found that the intent of the promoters were to encourage the rice farmers to grow GM rice resistant to this herbicide and also get the farmers to purchase herbicide sprays for their rice fields.[62] Similarly, Aerobic Rice, Bt Maize failed the required tests. For GM Mustard, recently a high powered panel on Doubling Farmers' Income (DFI) has recently released a report saying that Genetic Engineering is a "powerful" tool for developing future crop, but for now it should be adopted only for non-food crops. For transgenic food crops, questions on its safety must be addressed and settled first before their accepting commercial cultivation.[63]

Conclusion

India's experience with GM cotton so far has revealed that the experience with this technology does not present one harmonious truth that can be implicitly relied upon; but rather that there are different experiences and voices to be heard based on local realities faced by farmers, consumers, environmentalists etc. As regards desirability of GM crops viz-a-viz food requirement, depends how public policy shapes the direction of the technology and its products. There are many challenges especially in the areas of safety testing, regulations, international policy and food labelling. As has been observed by the United Nations Development Programme (UNDP) in its Human Development Report, 2001, "For the introduction of genetically modified crops, every country needs to create a bio-safety system with clear and coherent guidelines, skilled personnel to guide decision making, an adequate review process and mechanism for feedback from farmers and consumers"[64]

[60] Zia Haq, Chetan Chauhan, "BtBrinjal gets the Green Signal" Hindustan Times, Oct 15, 2009.
[61] Vibha Sharma, Rajay Deep, "Green Lobby Ups Pressure on Government" Tribune, Oct. 16, 2009.
[62] RT Gahukar, "Issues Relating to the Patentability of Biotechnological Subject Matter in Indian Agriculture", Vol. 8, JIPR12-13(2003).
[63] "More Tests Required for Release of GM Mustard: GEAC" Current Affairs Today, May 15, 2018.
[64] UNDP, Report: Making New Technologies Work for Human Development (UNDP, 2001).