



The Next Generation Agricultural Revolution of Genetically Modified Crops: Pros & Cons

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Genetic Modification, Agriculture, Food Crops, Biotechnology.

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ABSTRACT Genetically Modified crops are plants used in agriculture that have been transformed using biotechnology. This technology has been widely adopted by more than 28 countries from 1996 to 2014 because of the increasing potential benefits of high yield, insect resistance, land-saving technology and conservation of bio-diversity. However, despite the various advantages this technology has faced a lot of criticism and controversies. The paper discusses the growth of genetically modified food crops globally as well as in India and highlights the various advantages and disadvantages associated with it. An attempt has also been made to provide suitable policy suggestions.

1. Introduction

Wild tomatoes are not as sweet as its other improved version available in the market. Likewise papayas used to taste bitter, unlike its current version which is sweet. To get good returns farmers have been crossing various varieties of plants from a long period of time. One such latest development is genetic modification. Genetic modification is a part of applying biotechnology to plants, animals and microorganisms. Roughly 30 years ago it was discovered that soil bacteria could transfer genes bacteria to plant cells. Genetic engineers used this to introduce new genes into plant cells. Thus, genetic modification is described as a science whereby the characteristics of organisms are deliberately modified by the manipulation of the genetic material, especially DNA and transformation of certain genes to create new variations of life.² Genetic modification is also called genetic engineering, gene manipulation or gene technology and also recombinant DNA technology.

The first commercially grown transgenic or genetically modified food crop was a tomato (called FlavSavr) which was modified to ripen without softening in 1996. The process started in 1996 with 6 countries starting its application to 25 in 2008 and the number rose to 28 in 2014.³ The strong growth since 2008 lays the foundation for a stable & broad future growth of GM food and crops. In fact, more than half of all processed foods in the USA already contain genetically engineered soy, corn, canola, cotton or potato products as revealed by the table 1. It shows the different grocery store food and products that contain GM ingredients.

Table 1 Grocery Store Foods and Products Containing GM Ingredients

S.No.	Grocery store food/product	GM component
1	Pickles	Dextrose from corn, corn syrup
2	Milk	Recombinant bovine growth hormone
3	Soda/soft drink	Corn syrup
4	Catsup	Tomatoes, corn syrup
5	Fruit drinks	Dextrose from corn, corn syrup
6	Bread	Yeast, corn syrup, soya bean oil, cornstarch
7	Aspirin	Corn syrup
8	Honey	GM enzymes
9	Beer	Corn, yeast, enzymes

10	Some antibiotics	Corn starch
11	Tomatoes/peppers	Genes from bacteria and viruses
12	Breakfast cereal	Corn, corn syrup, soya bean oil
13	Peanuts	Longer shelf life peanuts
14	Peanut butter	Peanuts, cottonseed oil, soya bean oil,
15	Food tenderizers	Food enzymes
16	Candy and gum	corn syrup, corn starch
17	Cookies	Corn syrup, cornstarch, corn flour
18	Breakfast pastries	Corn syrup, soya bean oil, soy flour

Source: Uzogara, Stella G, (2000), The Impact of Genetic modification of human Foods in the 21st Century: A Review.

2. Trends and Pattern of Growth of Genetically Modified Crops

In 2008, the global area under cultivation of GM food and crops was 125 million hectares and it has continued to grow stronger and reached a record of 181 million hectares of biotech crops grown globally by 2014. It is noteworthy that Biotech crops are the fastest adopted crop technology in the world. The global hectareage of biotech crops has increased more than 100-fold from 1.7 million hectares in 1996 to 181.5 million hectares in 2014.

Table 2 Top Ten Countries Global Area of Biotech Crops in 2014 (Million Hectares)

Rank	Country*	Area (Million Hectares)	Crops
1	USA	73.1.	Soybean, Maize, Cotton, Canola, Squash, Papaya, Sugar beet
2	Brazil	42.2	Soybean, Maize, Cotton
3	Argentina	24.3	Soybean, Maize, Cotton
4	India	11.6	Cotton
5	Canada	11.6	Canola, Maize, Soy bean, Sugarbeet
6	China	3.9	Cotton, Tomato, poplar, Petunia
7	Paraguay	3.9	Soybean
8	Pakistan	2.9	Cotton
9	South Africa	2.7	Maize, soybean, cotton
10	Uruguay	1.6	Soybean, maize

Source: James, Clive, (2014), Global status of commercialized Biotech/GM Crops, Executive Summary, ISAAA

In India this technology was introduced in the year 2002 with Bt cotton (*Bacillus thuringiensis*). Also in the pipeline are Bt Brinjal, development of insect resistant rice, late blight resistant potato, pro-vitamin A enriched rice for which various research's are going at different research institutes in the country. It has been observed that in July 2014, 21 new varieties of GM crops such as rice, wheat, maize and cotton have been approved for field trials in India. However, this issue faces a lot of opposition from activists on various grounds and as result only Bt cotton is allowed to be grown commercially in India till date.

Despite the fact that GM foods are so increasingly being adapted by different countries there is a lot of criticism against these foods. In the backdrop of this issue, this study highlights the growth of genetically modified food crops globally and particularly in India. It also lays emphasis on the details of pros and cons of these crops. The paper focuses primarily on the economic aspects of GM crops.

3. Arguments for Genetic Modification:

3.1 Performance advantage of GM food in terms of yield, revenue as well as profits:

India cultivated a record 10.8 million hectares of Bt cotton with an adoption rate of 93%, whilst 7.2 million small resource poor farmers in China grew 4.0 million hectares of Bt cotton with an adoption rate of 80%, cultivating on average, 0.5 hectare per farmer. India enhanced farm income from Bt cotton by US\$12.6 billion in the period 2002 to 2011 and US\$3.2 billion in 2011 alone. Through genetic modification it is possible to reduce the losses of the farmers by making the plants tolerant to pests, insects, weeds, herbicides etc. Such a technology also reduces the fertilizer use thus increasing the profits of the farmers. Genetic engineers are also trying to make these plants drought resistant which will enable most of the developing countries to increase their production by reducing their dependence on the natural rain.

3.2 Contributing towards sustainability and conserving biodiversity: It is observed that GM crops are a land-saving technology. They are capable of high productivity from the same piece of land used by normal crops and help preclude deforestation and protect bio-diversity.

3.3 Provide a solution to the eradicate hunger, poverty and the growing food insecurity concerns in India as well as globally. According to the latest Food and Agriculture Organization estimates indicate that about 805 million people (about one in nine of the world's population) are estimated to be chronically undernourished in 2012-14. However, this figure is lower than 100 million from the previous decade. According to the Global Hunger Index of 2014, India ranks 55th out of 76 countries, before Bangladesh and Pakistan, but lags behind Nepal (rank 44) and Sri Lanka (rank 39). While it is known to have improved this status and is no more at an "alarming" state, it is still considered to be serious according to GHI.⁴

Although critics point out that the real problem is not of supply but of the availability. But since majority of the problem is in the developing countries and in these countries streamlining the availability of food is a long and difficult task. Therefore, genetic modification provides an an-

swer to this problem as the world experience has reflected the increase in output by the adoption of GM food/ crops. This argument can be supported by throwing light upon the performance of Bt cotton in India.

In India cotton contributes 30% to the gross domestic product of agriculture and it ranks 2nd after China in 2009-10 estimates of the global production of cotton. As per the agriculture ministry, India is now an overwhelmingly a Bt Cotton country, almost 90 per cent of the cotton cultivation in under Bt cotton. The data, based on estimates for the year 2010-11, shows that out of total area of 111.42 lakh hectares under cotton cultivation, 98.54 lakh hectares are under Bt Cotton, of which Gujarat, Maharashtra and Andhra Pradesh are the top producers of cotton with 105, 88 and 53 lakh bales cotton respectively, and 81%, 92% and 98% of their total cotton cultivation area under Bt cotton⁵. However despite all the benefits genetic modification has generated a lot of controversy. Some of these arguments are discussed below.

4. Arguments against Genetic Modification:

4.1 First and the foremost, critics point out that through genetic modification we are altering the nutritional contents of the food. Therefore the traditional food items are now undergoing a fast change thus redefining the food items. To understand and keep pace with this fast changing technology the consumers need information which is not available.

4.2 There are threats of increasing allergy through this new technology food. Let us say that a new GM food has been introduced with its genes from a particular plant source A and some individuals have allergy to the original plant source A. Therefore, when these individuals consume the new GM food then there are chances that they might develop allergic reactions to the new GM food as well.

4.3 This technology also raises various religious and ethical issues especially in countries like India.

4.4 The GM foods and seeds are introduced by multinationals which have invested huge sums of money into their research. They would charge a price which might not be within the reach of poor farmers particularly belonging to the developing countries. Therefore, this technology has raised several issues because of which we cannot reject such a technology but we can definitely work on them.

5. Policy Suggestions and Conclusion

5.1 Ensuring flow of profits to the farmers: The high seed prices reduce the profit margin of the farmers. If the seed costs are substantial then the farmers are not in a situation to make profits. To ensure the flow of profits to the farmers either the seed prices are to be set low, which might not be acceptable to the multinational companies supplying the seeds. Or the final prices of the agricultural products are set high. And such issues call for government interference. Also one must keep in mind the role of the middlemen which tend to reduce the share of farmers.

5.2 Control over Unofficial Genetically Modified food/ Seeds: It has been observed that there is another area which requires the immediate intervention of the government & legal experts which is the growth of the parallel unofficial market of the genetically modified seeds. The high yields of GM seeds attracts the farmers but due to the lack of money the poor farmers look for alternatives and this has given rise to the increased supply of unofficial

genetically modified foods/seeds in the economy. These GM seeds are cheaper as compared to their counterparts. But these are not tested, not legal and hence have far reaching implications for the government, for the companies selling official GM seeds and for the consumers. Therefore, the legal experts/ government should devise a mechanism in order to control such unofficial market.

5.3 Labeling of the Products: Food companies should demonstrate through scientific data that the allergens are not contained in any of their GM foods. However, if some allergens are present then proper labeling of the products should be done. Labeling should mention wherefrom the gene has been taken and what could be the possible allergic reactions from it along with the improved benefits of these foods. Moreover the proper implementation of labeling requires the intervention of law to take care of the religious and ethical concerns of the individuals.

From the above analysis it is evident that there are far reaching implications of genetic modification but at the

same time one cannot overlook the potential benefits derived from it as well. So in order to reap these benefits we must ensure that the problems of the technology are addressed through the intervention of government and legal experts along with the support of the MNCs. They should work towards protecting the interests of the farmers, consumers alongside improving the state of our agriculture.

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