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Regulations And Challenges For Genetically Modified Crops In India

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Abstract
The growing production of transgenic crops has prompted debate on a number of topics, including food safety, environmental impact, socioeconomic concerns, and moral dilemmas. The main issues with GM foods and goods from a food and health standpoint revolve around their potential toxicity and allergen city. The introduction of transgenes into the environment, the effects of gene flow, the effects on non-target organisms, the evolution of pest resistance, and the loss of biodiversity are among the environmental concerns associated with GM crops. The Indian government must base its decisions regarding GM technologies on facts supported by science. To bring together all parties and create regulatory norms, it ought to use a participatory approach. By doing this, the process as a whole would be trusted. This research paper intends to analyze Status of Gm Crops worldwide, in India, Challenges and way forward through hefty odds concerning Genetically Modified Food Organisms.

Keywords: *GM Crops, GEAC, Bt brinjal, GEAC, GM technology, Right to Food*

Introduction
Since India underwent the Green Revolution in the 1970s, we are now self-sufficient in the production of food grains. Due to climate change and mounting population pressure, the situation has substantially changed in the twenty-first century. It will be difficult to end hunger and malnutrition by 2030, but it can be done via sustainable agriculture and the combined efforts of all stakeholders. World hunger is once again on the increase (FAO, IFAD, UNICEF, WFP and WHO 2017). The needs for food and nourishment cannot be met by current technologies. When combined with conventional plant breeding methods, recent advances in biology, particularly biotechnology and molecular biology, offer several benefits.

The last ten years have seen a tremendous acceleration in the scientific and technological advancement in these fields on a global scale. Using laboratory procedures, GM crops are created by transferring genes between organisms for particular features. These plants are referred to as transgenic plants, genetically engineered plants, or GMOs (Genetically Modified Organisms). The well-known "FlavrSavr" tomato, which had been modified to include lower amounts of the cell wall-softening enzyme polygalacturonase, was the first transgenic fruit crop developed and sold effectively during the course of the last three decades (Bruening and Lyons 2000)[1].

Following this, a number of other GM food and non-food crops were created and put on the market globally. Pest-resistant cotton, maize, canola (mostly Bt or Bacillus thuringiensis), soybean, cotton, and viral disease-resistant potatoes, papaya, and squash are some of these. In addition, numerous other GM crops with the features of phytoremediation, biofortification, and pharmaceutical manufacturing are being developed, tested in the field, and not yet released for commercial use.

Insect resistance, disease resistance, herbicide tolerance, improved nutritional quality, and other novel traits expressed in genetically modified crops have led to their widespread cultivation. According to the most recent data, 18 million farmers in 28 countries planted GM crops on 181.5 million hectares in 2014, an increase of 3-4% from the year before.Tomato, corn, soybean, cotton, canola, rice, potato, squash, melon, and papaya are among the GM crops that have been commercialized in the past 20 years. However, due to their widespread cultivation and role in the agricultural economies of many nations, soybean, corn, cotton, and canola are of particular significance.

[1]Status of research, regulations and challenges for genetically modified crops in India*available at https://www.tandfonline.com/doi/full/*

The top producers and exporters of GM crops and products are the United States of America, Argentina, and Canada, Argentina, Brazil, China, and India are the top developing nations for transgenic crop production. The cultivation of GM foods yields significant social, economic, and environmental benefits across the globe, although many farmers and citizens in various nations are sceptics of GMOs. Most debates about transgenic plants center on their effects and results, whether they are on farmers, human health and the environment, or economic performance. Among the top concerns for scientists and decision-makers throughout the world are the food crisis and climate change.

Due to the worrisome rate at which the population is rising and the difficulty of maintaining agricultural productivity at the same rate, scientists are looking to modern biotechnology to offer food security.

Compared to many other technological achievements and developments in a number of other scientific domains, the road to the creation and commercialization of GM crops was not as straightforward. Since its introduction and commercialization, there has been a great deal of discussion, as well as numerous protests and rallies by NGOs, farmers, and the general public, as well as prohibitions by several governments throughout the world. With the exception of a small amount of intermittent opposition to some specific GM foods, the USA, Canada, and Japan have marketed a number of food and non-food GMOs that were mainly well received by the public[2].

Recently, a large majority of Americans backed firmly the labelling of genetically engineered foods. Do they want to eat foods that are genetically modified or not? and the presence of GMOs should be fully disclosed on all food packaging (The New York Times 2013; PBS News 2014). GM foods are opposed strongly in the UK and throughout Europe, but the UK government is working hard to persuade the public that GMOs are safe and that it is urgently necessary to use them to feed the approximately one billion starving people in developing countries. In the UK and Europe, GMOs are only permitted for specific non-food uses.

Recently, the UK's environment secretary issued a public plea, urging people to promote the use of genetically modified food (The Guardian 2013). Argentina and Brazil in particular adopted GMOs more quickly, with little opposition from the general populace. Since the past ten years, major portions of Brazil and Argentina have been covered by GM. Out of the 29 countries in the world, roughly 10 were in Latin America. Of those, about half adopted genetically modified organisms (GMOs) in developing nations (Katovich 2012). After the first GM crops were commercialized in the USA roughly 20 years ago, the issue about GM food spread from the developed world to the developing world. Nearly the same group that had fiercely opposed the advent of GMOs in Europe is now campaigning against it in Africa.

A small number of NGOs and local civil society organisations are fighting Uganda's development of GM bananas to combat banana leaf wilt. They contend that other early accessible approaches can manage banana leaf wilt and that transgenic technology has not yet been demonstrated to be safe (The Independent 2015).

Even though numerous scientific studies have demonstrated the safety of genetically modified crops, India has yet to see its first GM item go on sale. A restriction was placed on the deregulation of Bt brinjal in 2010, but Bt cotton was deregulated in India in 2002. Despite vociferous objections from certain farmers connected to NGOs regarding the safety of GM crops for human health and their effects on biodiversity, many GM crops, both food and non-food crops, are still in the laboratory or in restricted field trials phase and ready for commercialization. In many poor nations, irrational beliefs, political motivations, and a lack of scientific knowledge are the main barriers to GMO adoption, but in rich nations, these barriers include psychology, emotions, and politics.

According to ABLE INDIA 2013, the biotechnology industry in India grew by 15.08% between 2012 and 2013. Agricultural biotechnology is the third largest sector in the biotechnology industry in India

[2]Status of research, regulations and challenges for genetically modified crops in India*available at https://www.tandfonline.com/doi/full/*

(Business Standard 2013). This sector is regarded as one of the most important ones that will support the nation's socioeconomic development. A number of state governments are sincerely working to foster an atmosphere that will entice entrepreneurs to establish their businesses there and take use of the abundant talent and diverse biodiversity's found there. Every year, more infrastructure is added to support research and development on genetically modified crops. Through the Department of Biotechnology (DBT) within the Ministry of Science and Technology, the Government of India took significant action to enhance the biotechnology infrastructure.

Numerous university and research institutions from all around India participated in the DBT-funded research studies on the creation of GM crops. The Indian Council of Agricultural Research (ICAR) is funding research on the functional genomics of seven crops and the genetic modification of 14 crops (Mishra and Shukla 2013). India has a robust biosafety regulatory framework in place and is actively conducting research on genetically modified crops. Seven Biotechnology Parks and Incubation Centers were established by the DBT, Government of India (DBT, Government of India 2017, 2017) in various states, and they play a significant role in the investigation, development, and commercialization of genetically modified crops in India as well as in assisting in the dissemination of biotechnology knowledge to Indian farmers[3].

Large sums of money were also spent on transgenic agricultural research and development by numerous private enterprises. Without a question, GMOs now make up a significant portion of many agriculturally based commodities sold throughout the globe, contributing billions of dollars annually to the global economy and serving as a key source of income for both developed and developing nations, including India.

There are many genetically modified (GM) crops available for commercial agriculture production, including both food and non-food crops with unique features. The main crops being grown for commercial purposes around the world include soybeans, maize, canola, and cotton for their ability to withstand herbicides and show insect resistance. Numerous more GM crops are also in development and have not yet been made commercially available. The Food and Agriculture Organization (FAO) emphasizes the severity of the food security and malnutrition crisis in the majority of Asian and developing nations in its report, The State of Food Security and Nutrition in the World 2017. In order to improve nutrient content and raise crop yields for main crops and address the issues of malnutrition and food security, GM crops may be an alternative.

In the past two decades, India has made great strides in the study, evaluation, and monitoring of GM crops, but the regulatory system has been severely hampered by a lack of coordination and a shared stance on the technology among various administrations, ministries, and agencies. Concerns about food safety, environmental effects, and socioeconomic challenges have all been exacerbated by the growing production of genetically modified crops.

Status of GM Crops in India

The Genetic Engineering Appraisal Committee is India's leading biotech regulatory body (GEAC). The Environment Protection Act of 1986 of the Ministry of Environment & Forests establishes the committee as a legislative entity (MoEF). The Genetic Engineering Approval Committee was its previous name. According to the EPA's 1986 "Rules for Manufacture, Use, Import, Export, and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells," the GEAC is in charge of approving the commercial release of biotech crops as well as experimental and extensive open field studies.

Additionally, five competent authorities are listed in the Rules of 1989: the Institutional Biosafety Committees (IBSC), the Review Committee of Genetic Manipulation (RCGM), the Genetic Engineering Approval Committee (GEAC), the State Biotechnology Coordination Committee (SBCC), and the District Level Committee (DLC) for resolving a variety of rule-related issues.

[3]Biosafety concerns of Bt crops. In: *Randhawa GJ, Bhalla S, Chalam VC, Sharma SK, editors. Cartagena protocol on biosafety: decisions to diagnostics.* New Delhi, India: National Bureau of Plant Genetic Resources.

The Government of India, through the GEAC (Genetic Engineering Approval Committee), approved the commercial cultivation of genetically modified cotton (commonly known as Bt cotton) for insect resistance in India in 2002. This marked a turning point in the country's GM crop research, its deregulation, and even the country's cotton industry. Since then, Bt cotton cultivation and output have increased dramatically, with India now becoming the world's second-largest cotton producer and top exporter (Choudhary and Gaur 2010).

The GEAC approved Bt brinjal for commercialization in October 2009, but after concerns from some farmers, anti-GM activists, and scientists, the Government of India formally announced a moratorium on 9 February 2010. At that time, Environment & Forest Minister Mr. Jairam Ramesh stated that there is no pressing need to introduce Bt brinjal in India and reaffirmed that the government had only imposed a moratorium on the release of transgenic brinjal hybrid, a plant that has been (MoEF 2010). After raising a number of concerns regarding the potential and actual effects of GM crops on our food, farming, health, and environment, the Parliamentary Standing Committee on Agriculture's report "Cultivation of Genetically Modified Food Crops - Prospects and Effects," which was presented in Lok Sabha on August 9, 2012, came to the conclusion that "GM crops are just not the right solution for our country" (Lok Sabha 2012)[4].

After consulting with numerous stakeholders across the nation, this committee also emphasised that the government should not support the views of the biotechnology and seed industries, as Bt cotton has not improved the socioeconomic situation of cotton farmers in the nation but has actually made things worse, especially in the rainfed regions.

Compared to merely 51 million tonnes in 1950, India's production of food grains climbed to 241 million tons in 2010–2011. Nearly 70% of the working population in India depends on the agricultural industry for employment and subsistence, yet despite all of these successes, the conditions of farmers are appalling.

The story of Bt cotton producers is not as positive as some scientists have claimed, and since there is not yet conclusive proof that GM crops can increase yields, there is no pressing need to move forward with their commercialization in India. Instead, new policies must be developed to ensure food security in the future without jeopardizing the safety of human and livestock health or the rich biodiversity (Chaturvedi 2012). The most contentious topic to far has been Bt Brinjal's development, prospective advantages, and deregulation in India.

For the sole aim of gathering biosafety data, the GEAC (Genetic Engineering Appraisal Committee, established on July 22, 2010) has approved limited experimental field trials of GM rice, brinjal, mustard, cotton, and chickpea on July 18, 2014. (The Hindu 2014). In February 2015, Mr. Prakash Javadekar, a former environment minister who now supports GM crops, told Reuters that "Field trials are already underway since our mandate is to find out a scientific study, a scientific evaluation" (Reuters 2015). The GEAC recently recommended to the environment minister that the commercial growing of GM mustard be approved (Indian Express 2017, however the final decision has not yet been made).

The current Indian government is attempting to reverse its position on GM field testing, and last year it approved for the field testing of a small number of GM crops. However, numerous State governments are still hesitant to adopt this technology. In order to facilitate their implementation in the next months, the Economic Survey for 2015–16 called for further discussion and testing of genetically modified (GM) and hybrid seeds. This study also noted that the regulatory framework has to change to address concerns about the safety of GM crops (The Hindu 2016). In order to provide food and nutrition security for the world's population, which is expanding quickly, it is vital to increase agricultural output.

India should therefore embrace GM technology to create higher yielding crops that are pest resistant or thrive in tough circumstances like drought. Even though India is adopting this technology

[4]Status of research, regulations and challenges for genetically modified crops in India*available at* https://www.tandfonline.com/doi/full/
Singh, D., & Tilak, D. (2022). A Study on diffusion rate of micro-irrigation (Drip and Sprinkler) systems in India.

extremely slowly, the fact that a few crops have resumed their field testing is encouraging for the many researchers and producers of transgenic crops.

After Bt cotton was deregulated, there was a significant increase in cotton production, and the socioeconomic circumstances of cotton growers in several Indian states have improved. This tells a quite different tale. Promoters and numerous experts who support the commercialization of GM crops frequently emphasise this point. In India, the commercialization of transgenic Bt cotton in 2002, the embargo on Bt brinjal in 2010, and the large gap between farmers, scientists, and policymakers are all indications of the slow pace of progress. Farmers that plant Bt cotton have benefited greatly, and their socioeconomic circumstances have improved.

With the rapid advancements in biotechnology, a variety of GM crops or transgenic crops expressing unique features have been created and released for commercial agriculture production. Since the last 20 years, numerous institutes in India have been developing GM crops at various stages of development with a variety of features. ICAR scientists are engaged in research, field trial monitoring, and regulatory assessment of GM crops as part of the Networking Project on Transgenic Crops (Meridian Institute 2003). More than 20 crops, including Cotton, Rice, Wheat, Maize, Brinjal, Potato, Sorghum, Mustard, Groundnut, Cauliflower, Okra, Chickpea, Pigeon pea, Castor, Sugarcane, etc., are undergoing various stages of research and field trials for genetic modification in India for the traits insect resistance, herbicide tolerance, drought tolerance, salinity tolerance, virus resistance, and quantitative traits , better nutrition, etc.

The growing production of transgenic crops has prompted debate on a number of topics, including food safety, environmental impact, socioeconomic concerns, and moral dilemmas. The main issues with GM foods and goods from a food and health standpoint revolve around their potential toxicity and allergenicity. The introduction of transgenes into the environment, the effects of gene flow, the effects on non-target organisms, the evolution of pest resistance, and the loss of biodiversity are among the environmental concerns associated with GM crops.

Challenges and Way Forward

Critics claim that the existing safety studies are insufficient to identify the majority of the negative consequences of GM crops. The regulatory framework for GM crops in India has never been adequately evaluated in terms of GM risk assessment in Indian conditions.

The necessary equipment to test imported GM crops is lacking. In Kolkata, there is only one Food Lab run by the Ministry of Health, and it is ill-equipped. Competing interests: The same party that submits an application for the commercialization of GM crops also conducts all safety tests for regulatory clearances in India. Government officials and those who support genetically modified crops are widely despised due to their propensity for secrecy.

The development of low-input, high-output agriculture is a significant challenge today. Without technology, this is impossible to accomplish. However, thorough research is required to ensure that technology does not jeopardize human and environmental health.

The Indian government must base its decisions regarding GM technologies on facts supported by science. To bring together all parties and create regulatory norms, it ought to use a participatory approach. By doing this, the process as a whole would be trusted.

Any new technology used in the agricultural industry must be beneficial to farmers without impairing consumer rights.

The main task for proponents of GM technology is to persuade consumers, environmentalists, and farmers that GM technology is one of the best options for enhancing crop yields and addressing India's food security out of all the alternatives available for sustainable food production.[5]

Science cannot certify any technique as fully risk-free, as the Food and Agriculture Organization (FAO) correctly noted in 2004. While genetically modified crops can lessen some of the

[5]GM Crops in India: Issues and Challenges*available at https://blog.forumias.com/gm-crops-in-india-issues-and-challenges/*

environmental concerns associated with conventional agriculture, they also present new problems that need to be solved.

Conclusion:

It is commonly known that transgenic crops have numerous benefits for societies looking to address challenges with food or nutrition security. A fruit's increased shelf life, together with other features including improved nutritional value, herbicide tolerance, virus resistance, and tolerance to a variety of abiotic stresses, can lead to a healthy market for farmers. India must immediately continue its GM crop research programme if it hopes to meet its goals for food and nutrition security. Even though there is hardly any compelling scientific data to argue against the safety of GM foods, the debate over whether GM crops are safe or harmful will never stop.

Surprisingly, only a small number of public sector organisations expressed reservations about GM food. The GOI-funded intuitions should adhere to the same general principles as the Indian government and join forces with it to combat poverty and malnutrition. This important issue has been brought up because the members of the Technical Expert Committee, which was established by the Supreme Court of India to advise on the safety and guidelines for GM crop research and provide suggestions for its future, hold opposing viewpoints. Although it is true that India lacks fundamental infrastructure and strict regulations for GM crop research and risk assessment, we cannot suspend this programme due to India's pressing need.

India should ideally keep up its research on GM crops and their deregulation while also constructing necessary infrastructure facilities and creating strict biosafety and marketing regulations. There is an urgent need to create a single window system and online portal for assessment, control, regulations, and approval of GM crops even though portals like GEAC, IGMORIS (Indian GMO Research Information System), and Biosafety Clearing House are performing their roles for assessing biosafety and their regulation of GM crops. Every corporate and public sector organization should be required to register with this portal anytime they produce any event for the development of transgenics and begin their field testing before submitting for permission.

Every novel transgenic event in development is required to display their registry number and date of registry on a website or online portal created expressly to get marketing authorization in any jurisdiction. A publication list linked to the development of any particular genetically modified crop should also be included on this site so that anyone interested in the development of a GM crop can find out all the pertinent information in one location, along with the crop's current state. This kind of website will be very beneficial and user-friendly for spreading awareness about GM food research, the safety of GM foods, and its current status among the general population. Food Security is the severe threat in coming years and in order to curb these menaces it is vital to enhance mechanism which will maintain nutritional security.

India is facing bulky population crisis since ages. There were 189 million people undernourished even before pandemic and facing food shortage crisis. Along with this agricultural efforts are going in vain due striking climate change causing severe long lasting repercussions on food industry. Even though WHO has declared that genetically modified food crops are safe India is still hesitant about increasing field trials of GM Crops.

Panoramic regulatory framework of GM Crops plus misconception and myths about Gm crops creates gloomy future to the genetically modified food crops in India. All laws are discussing about regulating the use and release of GM food but there is no provision about increasing and managing field trials. Apart from this threat to food security is direct threat to fundamental right of “Right to Food” and there is inefficient machinery which will implement national and International laws, Convention to adhere to the spirit of fundamental right.

Therefore it is vital to understand that there is need of laws to regulate and propagate the field of biotechnology in order to attain food security.