Balanced Approach to GM Crops

This editorial is based on "Need for pragmatism, not ad hocism, on GM" which was published in Hindustan Times on 24/07/2024. The article brings into focus the Supreme Court's split decision on GM mustard and underscores the critical need for a comprehensive national biosafety policy for genetically modified crops in India.

For Prelims: Genetically modified (GM) mustard, Genetically modified crops, Bt cotton, Drought-tolerant maize varieties, Golden Rice, C4 rice, Genetic Engineering Appraisal Committee , StarLink corn, Flavr Savr tomato.

For Mains: Benefits and Issues Related to GM Crops, Regulatory Framework for GM Crops in India

The Supreme Court has recently put a temporary **hold on the cultivation of** genetically modified (GM) mustard. The court was divided in its opinion on whether to allow the release of GM mustard. Despite the differing views on GM mustard, the court unanimously agreed that India urgently needs a **clear and comprehensive policy to regulate genetically modified organisms**. This policy should ensure the safe and responsible development and use of GM technology in agriculture while also addressing potential risks.

While caution is essential when introducing new technologies, the **government's indecision on GM crops has hampered agricultural progress** and food security. The absence of clear regulations has also led to uncertainties about the GM content in imported food products. To address these challenges, India must adopt a **science-based approach,** establishing rigorous safety protocols and monitoring systems for GM crops and food items.

What are Genetically Modified Crops?

- **About:** Genetically modified crops are plants whose DNA has been altered using genetic engineering techniques.
    - This process involves introducing new genes or modifying existing ones to produce desired traits.
- **Global Adoption and Use:**
    - **Introduction:** GM crops were first introduced in the USA in **1994** with the **Flavr Savr tomato,** which had been genetically modified to slow tomato's ripening process, delaying softening and rotting.
    - **Current Status:** Recent data from the **International Service for the Acquisition of Agri-biotech Applications (ISAAA**) shows that more than 18 million farmers in **29 countries**, including India, planted over 190 million hectares (469.5 million acres) of GMO crops in 2019.
- **GM Crops in India**

- **Approved Crop:** Bt cotton is the only GM crop approved for cultivation in India.
    - **Cultivation Area:** Grown on approximately 11 million hectares.
- **Research and Trials:** Other crops such as **mustard, chickpea, pigeonpea and sugarcane** are in various stages of research, field trials and deliberations.
- **Regulatory Framework in India:** Governed by the "Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms, Genetically Engineered Organisms or Cells" (Rules, 1989) under the Environment (Protection) Act, 1986.
    - Competent authorities notified under Rules, 1989:

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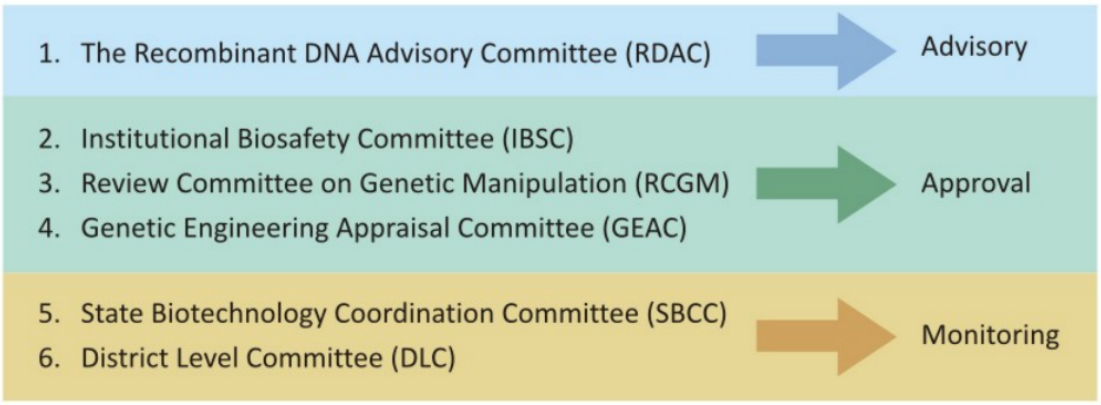

What are the Benefits of Genetically Modified Crops?

- **Battling Pests and Diseases:** Genetically modified crops can be engineered to resist pests and diseases, reducing the need for chemical pesticides.
    - For example, Bt cotton **produces its own insecticide,** effectively controlling bollworm infestations.
        - This not only increases yield but also decreases the environmental impact of farming.
        - In India, the adoption of Bt cotton has led to **significant increases in cotton production**, making the country a leading global producer.
        - This pest resistance can be particularly crucial in regions **where crop losses due to pests are a major concern.**
- **Weather-Proof Farming**: GM crops can be designed to withstand extreme weather conditions, a critical advantage in the face of climate change.
    - Drought-tolerant maize varieties, for instance, can maintain yields under water-stressed conditions.
    - This resilience can help ensure food security in regions prone to erratic rainfall or prolonged dry spells.
    - In countries like **Kenya,** drought-tolerant maize has shown promise in improving yields during dry seasons.
- **Nutritional Powerhouses- Fighting Hidden Hunger:** Biofortification through genetic modification can enhance the nutritional value of crops.
    - Golden Rice, **enriched with beta-caroten**e, aims to address Vitamin A deficiency in developing countries.
    - Other examples include **iron-rich rice and zinc-fortified wheat.**
    - These nutritionally enhanced crops have the potential to combat malnutrition and **micronutrient deficiencies,** particularly in regions where diversified diets are challenging to achieve.
- **Green Revolution 2.0**: GM crops often boast higher yields and improved resource efficiency.
    - Herbicide-tolerant crops allow for more effective weed control, reducing competition for nutrients and water.
    - Crops modified for **enhanced photosynthesis or nitrogen use** can produce more with less input.
        - For example, **research on C4 rice aims to significantly increase rice yields.**
    - These advancements could be crucial in meeting the growing global food demand while

minimizing the expansion of agricultural land, thereby protecting natural habitats.

- **Eco-Friendly Farming- Reducing Agriculture's Footprint:** GM crops can contribute to more sustainable farming practices.
    - Herbicide-tolerant crops often enable no-till farming, which reduces soil erosion and carbon emissions.
    - Insect-resistant crops reduce insecticide **use**, benefiting non-target organisms and improving overall ecosystem health.
- **Shelf-Life Superstars**: GM technology can be used to develop crops with extended shelf life, significantly reducing post-harvest losses.
    - The **FlavrSavr tomato,** though no longer in production, was an early example of delayed ripening.
    - Extended shelf life could also reduce the carbon footprint associated with frequent **transportation and refrigeration of perishables.**
        - This could be particularly impactful in developing countries where lack of refrigeration and poor transportation infrastructure lead to significant food waste.
- **Crops as Medicine Factories:** Plants can be genetically modified to produce vaccines, antibodies, and other pharmaceutical compounds.
    - This approach, known as "biopharming," could potentially reduce the cost and increase the accessibility of certain medicines.
    - For instance, research is ongoing on **producing edible vaccines in crops like bananas and potatoes.**
    - While still largely in the research phase, this technology holds promise for revolutionizing vaccine and drug production.
- **Phytoremediation Champions:** Some GM plants are being developed for their ability to absorb and concentrate specific pollutants from the soil, a process known as **phytoremediation.**
    - Plants have been modified to better absorb heavy metals or break down organic pollutants.
    - For example, **modified poplars** have shown enhanced ability to clean up contaminated sites.

Why has India not Approved Commercial Cultivation of any GM Crop Since Bt Cotton?

- **Regulatory Hurdles and Policy Inconsistency:** India's regulatory framework for GM crops has been marked by complexity and frequent changes, creating an uncertain environment for approval.
    - The Genetic Engineering Appraisal Committee **(GEAC),** responsible for approving GM crops, has often been caught between scientific recommendations and political pressures.
    - For instance, in 2009, **GEAC recommended the commercialization of Bt brinjal,** but the then-environment minister **imposed a moratorium**, citing the need for more studies and public consultations.
    - This pattern of scientific bodies giving approvals followed by political intervention has created a **regulatory deadlock.**
- **Public Opposition and Activist Influence**: Strong opposition from environmental groups, farmer organizations, and some scientists has significantly influenced the GM crop debate in India.
    - These groups have raised concerns about **biosafety, biodiversity loss, and socio-economic impacts** on small farmers.
    - The case of **GM mustard, which received GEAC approval in 2017** but remains unapproved for commercial cultivation due to ongoing legal challenges, exemplifies this influence.
- **Economic and Trade Considerations**: India's position on GM crops is also influenced by economic and trade factors.
    - There are concerns that widespread adoption of GM crops could **affect India's agricultural exports,** particularly to GM-sensitive markets like Europe.
    - Moreover, the experience with Bt cotton, while increasing yields, has raised issues **about seed prices and market concentration.**
    - The dominance of multinational companies in the GM seed market has led to concerns about **seed sovereignty and the impact on domestic seed companies.**
- **Political and Federal Complexities:** India's federal structure adds another layer of complexity to GM crop approvals.

- While the **central government sets overall policy, agriculture is a state subject,** allowing state governments to have significant say in agricultural decisions.
    - This has led to situations where states have banned GM crop trials even after approvals.
    - For instance, in 2018 states including **Rajasthan, Madhya Pradesh, Bihar and Delhi, Punjab, West Bengal and Kerala** had stated their opposition to GM mustard.

What are the Major Challenges Related to Genetically Modified Crops?

- **Environmental Concerns**: GM crops raise significant ecological questions. There's concern about potential gene flow to wild relatives, which could create "**superweeds" resistant to herbicides.**
    - The impact on non-target organisms is another worry, while Bt crops reduce overall pesticide use, they may affect beneficial insects.
    - Moreover, there's debate about **whether GM crops contribute to biodiversity loss by promoting monoculture farming.**
- **Health and Safety Uncertainties:** While numerous studies have found **GM foods safe for consumption**, concerns persist about potential long-term health effects.
    - Critics argue that **current safety assessments may not capture subtle or long-term impacts.**
        - There are worries about the potential for new allergens or changes in nutritional content.
    - For example, the **StarLink corn controversy in 2000,** where a GM corn variety approved **only for animal feed entered the human food supply,** highlighted the challenges in preventing cross-contamination.
- **Socio-Economic Impacts:** The adoption of GM crops can have complex socio-economic repercussions.
    - While they can **increase yields and farmer incomes,** as seen with Bt cotton in India, there are **concerns about market concentration** and farmer dependence on seed companies.
    - The **high cost of GM seeds and associated inputs** can be prohibitive for small-scale farmers.
    - The global dispute over GM crop patents, exemplified by cases like **Monsanto's legal battles with farmers,** highlights issues of intellectual property rights in agriculture.
- **Regulatory Challenges:** Establishing effective regulatory frameworks for GM crops is complex.
    - Different countries have varying approval processes and labeling requirements, creating trade complications.
    - The **EU's stringent regulations contrast** with the **U.S.'s more permissive approach**, leading to trade disputes.
    - Developing countries often lack resources for comprehensive biosafety regulations.
    - The challenge of monitoring and enforcing regulations, especially in regions with porous borders, adds to the complexity.
- **Ethical and Cultural Considerations:** GM crops raise ethical questions about the extent of human intervention in nature.
    - There are concerns about "**playing God"** and the moral implications of crossing species barriers.
    - The issue of GM crops also intersects with **broader debates about food sovereignty** and the **right of communities to determine their own food systems.**
        - These ethical dimensions add layers of complexity to the scientific and economic considerations surrounding GM crops.
- **Coexistence and Contamination Issues:** Managing the coexistence of GM and non-GM crops presents practical challenges.
    - Cross-pollination can lead to unintended presence of GM material in non-GM or organic crops.
    - In 2013, an Oregon farmer found **unauthorized GM wheat in his field**, leading to temporary import bans by some countries.

    - Establishing effective segregation practices throughout the supply chain is complex and costly.
    - This issue is particularly problematic for organic farmers, **who risk losing certification if their crops are contaminated.**
- **Resistance Development:** The evolution of resistance in target pests and weeds poses a significant threat to the long-term efficacy of GM crops.
    - **Bt cotton,** initially highly effective against bollworms, has seen **decreased efficacy in some regions** due to pest resistance.
    - Similarly, the widespread **use of glyphosate-resistant crops has led to the emergence of glyphosate-resistant weeds** in many areas.
    - This creates a "**technological treadmill**" where farmers become dependent on ever-evolving GM technologies to maintain yields.

What Measures can be Adopted to Promote the Balanced Use of GM crops in India?

- **Transparent Trials-Sowing Seeds of Trust:** Implement a system of **transparent, publicly accessible field trials for GM crops.**
    - Establish an online portal where all **trial data and results are published in real-time**.
    - Encourage independent scientists and stakeholders to observe and verify trials.
    - This transparency can help build public trust and provide a robust evidence base for decision-making.
- **Biotech Bridges-Fostering Public-Private Partnerships:** Create a framework for collaborative research between **public institutions and private companies.**
    - This can help **balance profit motives with public interest** and ensure that GM technology addresses local agricultural needs.
    - Establish **clear guidelines for sharing intellectual property and benefits.** Such partnerships can leverage private sector innovation while maintaining public oversight.
    - This approach can also help in developing GM crops specifically tailored to Indian agricultural conditions and nutritional needs.
- **Green Gene Bank-Preserving Agricultural Heritage:** Establish a comprehensive **national gene bank** to preserve indigenous crop varieties.
    - Allocate funding for **collection, documentation, and storage of traditional seeds.**
    - This initiative can **safeguard biodiversity while allowing for GM crop development.**
    - By preserving genetic diversity, this measure **addresses concerns about genetic erosion** and maintains options for future crop development.
- **Farmer-First Policies-Empowering the Grassroots:** Develop policies that **prioritize small and marginal farmers in GM crop adoption.**
    - Create farmer committees at district levels to participate in decision-making processes.
    - Provide comprehensive training and **support systems for farmers adopting GM technology.**
    - Implement **insurance schemes to protect farmers against potential failures of GM crops.**
    - This approach ensures that the interests of the most vulnerable agricultural communities are central to GM crop policies.
- **Eco-Impact Assessments-Cultivating Environmental Harmony:** Mandate **long-term environmental impact studies** before approving any GM crop.
    - Establish a network of **ecological observatories to monitor impacts on local ecosystems.**
    - Develop protocols for **assessing effects on non-target organisms** and biodiversity.
    - Implement a system of **periodic reviews** to assess cumulative environmental impacts.
- **Nutritional Navigation-Targeting Hidden Hunger:** Focus GM crop research on **addressing specific nutritional deficiencies prevalent in India.**
    - Collaborate with health experts to identify key nutrients needed in different regions.
    - Develop **biofortified crops tailored to local dietary habits** and deficiencies.
    - Implement **pilot programs to assess the effectiveness** of these nutritionally enhanced GM crops.
    - This targeted approach can demonstrate tangible health benefits of GM technology, **potentially increasing public acceptance.**

- Regulatory Reboot-Streamlining with Science: Overhaul the regulatory framework to create a **clear, science-based approval process for GM crops.**
    - Establish an **independent biotechnology regulatory authority** with representation from various stakeholders.
    - Implement **time-bound decision-making processes** to avoid indefinite delays.
    - Develop clear guidelines for risk assessment and management.
    - This streamlined, transparent regulatory system can boost confidence in the approval process and encourage responsible innovation.
- **Label Logic-Empowering Consumer Choice**: Implement a comprehensive, **easy-to-understand labeling system for GM products.**
    - Develop clear guidelines for what constitutes a GM product requiring labeling.
    - Launch public awareness campaigns to **educate consumers about GM labeling.**
    - Establish **strict penalties for non-compliance** with labeling regulations.
    - This measure respects **consumer rights to information and choic**e, potentially alleviating concerns about unknowingly consuming GM products.
- **Coexistence Corridors-Balancing Diverse Farming Practices:** Develop guidelines and infrastructure for the **coexistence of GM and non-GM crops.**
    - Establish buffer zones and isolation distances to prevent cross-pollination.
    - This approach allows for agricultural diversity while minimizing conflicts between different farming systems.
- **Harmonizing International Standards:** Actively participate in international forums to develop harmonized standards for GM crops.
    - Work towards establishing **mutually recognized safety assessment procedures with major trading partners.**
    - Contribute to the development of **global best practices in GM crop regulation and trade.**
    - This engagement can help address trade-related issues and promote a more cohesive global approach to GM crop governance.
    - By taking a leadership role, India can **ensure its interests and concerns are reflected in international GM crop policies.**

Drishti Mains Question:

Discuss the current status of genetically modified (GM) crops in India and evaluate the challenges associated with their adoption. What measures should be taken to address biosafety concerns related to it?

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q1. Other than resistance to pests, what are the prospects for which genetically engineered plants have been created? (2012)

1. To enable them to withstand drought
2. To increase the nutritive value of the produce
3. To enable them to grow and do photosynthesis in spaceships and space stations
4. To increase their shelf life

Select the correct answer using the codes given below:

(a) 1 and 2 only

(b) 3 and 4 only

(c) 1, 2 and 4 only

(d) 1, 2, 3 and 4

Ans: (c)

Q2. Bollgard I and Bollgard II technologies are mentioned in the context of (2021)

(a) clonal propagation of crop plants

(b) developing genetically modified crop plants

(c) production of plant growth substances

(d) production of biofertilizers

Ans: (b)

Mains

Q. How can biotechnology help to improve the living standards of farmers? **(2019)**