Mains Practice Question

Q. Analyze the regulatory framework for genetically modified organisms in India. Discuss the potential benefits and risks associated with genetic modification technology. **(150 words)**

19 Jun, 2024 GS Paper 3 Science & Technology

Approach

- Introduce by defining the Genetic modification technology
- Highlight the regulatory framework for genetically modified organisms in India
- Delve into potential benefits and risks associated with genetic modification technology.
- Suggest a Way Forward
- Conclude suitably.

Introduction

Genetic modification technology, also known as genetic engineering, refers to the process of altering the **genetic material** of an organism by introducing, removing, or modifying specific genes.

- In India, the application of this technology is governed by a comprehensive regulatory framework aimed at ensuring the **safe development, handling, and commercialization of GMOs** while harnessing their benefits.

Regulatory Framework for Genetically Modified Organisms in India:

- **Umbrella Legislation:** The **Environment (Protection) Act, 1986**, provides the overarching framework.
- **Specific Rules:** The **Rules for the Manufacture/Use/Import/Export and Storage of Hazardous Microorganisms, Genetically Engineered Organisms or Cells (1989)** establish a regulatory process for GMOs.
- **Implementing Body**: The **Genetic Engineering Appraisal Committee (GEAC)** functions as the apex body for approving research, development, commercialization, and import/export of GMOs.
    - **Recombinant DNA Advisory Committee (RDAC)** reviews developments in biotechnology at national and international level and recommend suitable and appropriate safety regulations for India in **r-DNA research, use and applications.**
- **State-Level Coordination**: **State Biosafety Coordination Committees (SBCCs) and District Level Committees (DLCs)** support implementation at state and district levels.

Potential Benefits of Genetic Modification Technology:

- **Increased Crop Yields:** Genetic modification can enhance crop yields by introducing traits like **pest resistance, drought tolerance, and improved nutrient utilization**, contributing to food security.
    - **Example: Bt cotton,** genetically modified to resist bollworm pests, has led to significant yield increases in India.
- **Improved Nutritional Quality:** Biofortification through genetic modification can enhance the

nutritional value of crops by increasing essential vitamins, minerals, and nutrients.
    - **Example: Golden Rice, enriched with Vitamin A,** has the potential to address micronutrient deficiencies in developing countries.
- **Reduced Pesticide and Herbicide Use:** Crops genetically engineered for pest resistance or herbicide tolerance can **reduce the need for chemical pesticides and herbicides,** promoting sustainable agriculture and reducing environmental impact.
- **Medical and Pharmaceutical Applications:** Genetic modification can contribute to the production of **therapeutic proteins, vaccines, and other medical products** through genetically modified microorganisms or plants.

Potential Risks and Concerns:

- **Environmental Risks:** The **unintended spread of transgenes from GMOs to non-target species (gene flow)** and the potential impact on biodiversity and ecosystem balance are major concerns.
- **Food Safety and Health Concerns**: There are concerns about the potential **allergenicity, toxicity, and long-term health impacts** of consuming genetically modified foods, although extensive studies have not found significant risks so far.
- **Ethical and Social Concerns**: The patenting of genetically modified organisms and the **potential monopolization of the seed industry** by large corporations raise ethical and social concerns related to access, affordability, and farmers' rights.
- **Regulatory and Biosafety Challenges:** Ensuring robust risk assessment, monitoring, and enforcement of biosafety **regulations remains a challenge, particularly in developing countries like India** with resource constraints.

Way Forward

- **Post-Market Monitoring:** Implementing **stricter post-market monitoring programs** to track the long-term effects of GMOs once released into the environment.
- **Transparency and Labeling:** Ensure clear labeling of GMO products to give consumers the **right to choose.**
- **Leveraging Technological Advancements**: Promote research on newer, more precise gene editing techniques like CRISPR to minimize unintended consequences.
    - Develop **robust risk assessment tools** to comprehensively evaluate potential risks associated with specific GMOs before approval.
- **Promote stewardship and coexistence**: Implementing robust biosafety measures, such as **isolation distances, buffer zones, and containment strategies,** to prevent gene flow of GMO and minimize environmental risks.
    - Encouraging the adoption of sustainable agricultural practices, such as integrated pest management and crop rotation, to **reduce reliance on GMOs and chemical inputs.**
- **Harmonization of Regulations:** Collaborating with other countries to harmonize regulations for GMOs, ensuring a consistent global approach.
    - Promoting information sharing on GMO research and risk assessment findings.

Conclusion

A robust regulatory framework, continuous monitoring, and inclusive stakeholder engagement are imperative for harnessing the potential of GMOs to enhance **food security (SDG 2), promote sustainable agriculture (SDGs 2 and 15),** and **contribute to human health (SDG 3),** while effectively managing the associated risks and addressing ethical, social, and environmental concerns.