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# Legal Framework Governing Genetically Modified Crops in India: Assessing Regulatory Gaps

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## ABSTRACT

The effective legal structure for regulating genetically modified (GM) crops in India is essential to maintain a balance between agricultural advancements and environmental protection. Every individual has the right to live in a healthy and safe environment, but emerging technologies, such as genetic modifications in agriculture, pose new challenges to these rights. GM crops are increasingly recognized as a potential solution to global food shortages, which are exacerbated by climate change, frequent droughts, floods, and nutritional deficiencies. Through biotechnology, particularly genetic engineering, crops can be enhanced to improve yield efficiency, resist pests and withstand harsh climates. India primarily regulates GM crops under the Environment Protection Act, 1986, with oversight from the Genetic Engineering Appraisal Committee (GEAC) formulated under 1989 rules. However, despite these frameworks, regulatory gaps persist in biosafety, transparency, and public engagement, raising concerns about unforeseen environmental effects. Unlike the large-scale monoculture farming seen in industrialized nations, India's diverse and small-scale agricultural system requires a more careful and adaptive approach to GM technology. The interaction between GM crops and native flora presents risks to genetic diversity, especially for species native to India. This paper explores shortcomings in India's GM crop regulation and judicial perspectives.

## Introduction

Every citizen is entitled to certain basic human rights. One of these rights is the right to a healthy and safe environment. This right among other human attributes is also threatened by new experiments and evolution of new technologies. Genetically Modified Crops (Hereinafter referred to as GMC's) is one of the developing areas of research in India and around the world. Food Crises are brewing around the world. Frequent floods, drought and lack of nutrition are further adding to the crisis. One of the solutions to

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this is the emergence of Biotechnology[1]. India's laws on genetically modified (GM) crops are mainly governed by the Environment Protection Act, 1986, along with guidelines from the Genetic Engineering Appraisal Committee (GEAC) under the Ministry of Environment, Forest and Climate Change. However, despite these regulations, there are still major gaps in ensuring biosafety, transparency, and public involvement in important decisions related to GM crops[2] in India.

## Meaning of GM Crops

The World Health Organization (WHO) defines "genetically modified organisms (GMOs) as organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination."[3] A GM crop is a plant whose genes have been changed using special scientific methods. These changes do not happen naturally but are made by scientists to give the plant new abilities.[4] For example, some GM crops are designed to resist insects, survive harsh weather, or grow faster. Scientists have found ways to change plant genes to make crops better for farming and food production. They do this by adding new genes from other organisms or adjusting the plant's own genes to improve certain traits. These changes help crops grow stronger, resist pests and diseases, and survive tough weather. Because of these improvements, GM crops have become more common in agriculture, making food production easier and more efficient.[5]

## Concerns Over GM Crops

Genetically modified (GM) technology has transformed global agriculture, but its effects vary based on the socio-economic, cultural, and environmental factors of each country. While developed nations have embraced GM crops in large-scale, mechanized farming systems, India presents a unique agricultural landscape characterized by small farms, rich biodiversity, and close proximity to natural ecosystems. Given these distinct conditions, careful evaluation is essential before integrating GM technology into India's agricultural framework.[6]

GM technology has primarily evolved in industrialized economies that practice large-scale monoculture farming with advanced mechanization. Countries like the United States and Canada cultivate vast tracts of land dedicated to single crops such as soybean and corn, minimizing interactions between genetically modified varieties and natural ecosystems. In contrast, India's agriculture is deeply interwoven with its natural environment. Small farms often border forests, wetlands, and biodiversity-rich regions, making it more likely that GM crops will interact with native plant species. Additionally, India serves as the "center of origin" for several important food crops. Introducing genetically modified versions of these crops without thorough research could pose risks to their natural gene pool, potentially impacting biodiversity and food security.

The introduction of GM crops in India raises several ecological concerns due to the country's agricultural diversity and natural ecosystem complexity.[7] Some key risks include:

**1. Genetic Contamination of Native Crops :** Cross-pollination between GM crops and traditional or wild plant varieties can lead to unintended genetic modifications, threatening biodiversity.8 This is particularly concerning in India, where small farms are densely packed and increasing the likelihood of genetic transfer.

**2. Emergence of Invasive Weeds :** The unintended spread of

1 Sudha Rani, M., Satish, Y., Rani, C., Prasad, N. V. V. S. D., Bharathi, S., Sri Lakshmi, B., & Ratna Kumari, S. (2018). History, status, and impact of genetically modified crops in India. *International Journal of Chemical Studies, 6*(5), 2735-2739.

2 Maurya, A. K., & Siwal, A. (2021). *Current legal status of GM crops in India with special reference to intellectual property laws*. NUJS Journal of Regulatory Studies, 6(1). Available at : [https://www.nujs.edu/wp-content/uploads/2022/12/File-106.pdf]

3 World Health Organization. (2014).Food, genetically modified. WHO Newsroom. Available at : [https://www.who.int/news-room/questions-and-answers/item/food-genetically-modified]

4 Nyika, J., Yadav, S., Mackolil, J., G, R. P., Workie, E., & Ramasundaram, P. (2022). Genetically modified foods: Bibliometric analysis on consumer perception and preference. GM Crops & Food, 13(1), 65–85. [https://doi.org/10.1080/21645698.2022.2038525]

5 Kumar, K., Gambhir, G., Dass, A., Tripathi, A., Singh, A., Jha, A., Yadava, P., Choudhary, M., & Rakshit, S. (2020). Genetically modified crops: Current status and future prospects.Planta,251(4), 91. [https://doi.org/10.1007/s00425-020-03372-8]

6 Supreme Court of India. (2024). *Gene Campaign & Another v. Union of India, 2024 SCC OnLine SC 1793*

7 Shukla, M., Al-Busaidi, K. T., Trivedi, M., & Tiwari, R. K. (2018) *Status of research, regulations and challenges for genetically modified crops in India,* GM Crops & Food, Vol. 9, Issue 4, 173–188. [https://doi.org/10.1080/21645698.2018.1529518]

8 Hui-Lin Yu, Yun-He Li, Kong-Ming Wu, *Risk Assessment and Ecological Effects of Transgenic Bacillus thuringiensis Crops on Non-Target Organisms. Journal of Integrative Plant Biology,* Vol. 53, Issue 7. 520-538. [https://doi.org/10.1111/j.1744-7909.2011.01047.x]

foreign genes to wild plants may result in the

development of aggressive weeds that are difficult to control, affecting agricultural productivity and ecological balance.[9]

**3. Formation of Herbicide-Resistant Superweeds :** Some GM crops are engineered to withstand herbicides, allowing farmers to use chemicals without harming their crops. However, if resistance genes transfer to wild plants, superweeds could emerge, species that become resilient to conventional herbicide treatments and disrupt farming cycles. 10

**4. Soil Microorganism Disruption :** GM crops containing 'BT genes' produce toxins that repel pests. While this reduces pesticide use, it can also impact beneficial soil microorganisms that play a vital role in maintaining soil fertility. Over time, disruptions in soil health may reduce agricultural sustainability.[11]

Another challenge is the lack of long-term research on GM crop impacts in India. While studies often focus on short-term yield improvements, little research has been conducted on the lasting effects of GM cultivation on soil health, biodiversity, and traditional farming practices. Without comprehensive data, the introduction of GM technology could lead to unintended ecological consequences.

## Legal Framework

Under Indian Constitution farming education, research, pest control, and plant disease prevention are the domain of individual states. This falls under Entry 14 of the State List[12], meaning each state has the power to make rules about these matters. However, trade, production, supply, and distribution of food items,including things like edible oil seeds and oils are covered under Entry 33(b) in the Concurrent List.[13] This means both the central and state governments can make laws about these issues.

Environmental protection laws, including those under the Environment Protection Act of 1986, come under Entry 97 in the Union List.[14] Since environmental protection is not directly mentioned in the State or Concurrent Lists, the central government takes responsibility for making laws about it, except for forests, which are mentioned separately.

The Constitution also emphasizes environmental protection through various provisions. Article 48A[15], which is part of the Directive Principles of State Policy, directs the government to take measures for the protection and improvement of the environment, including forests and wildlife. Similarly, Article 51A(g)[16] places a responsibility on every citizen to actively safeguard and improve natural surroundings, such as forests, lakes, rivers, and wildlife. These provisions are closely linked to Article 21[17], which guarantees the right to life. Courts have interpreted Article 21 broadly to include the right to a clean and healthy environment, recognizing its importance for overall well-being and ecological balance.

Article 21 of the Indian Constitution, which guarantees the right to life, also includes the right to food safety. To ensure that food in India is safe for consumption, the government enacted the Food Safety and Standards Act (FSSA), 2006. This law was passed under Entry 52 of the Union List[18], meaning that food safety regulations are controlled by the central government rather than individual states. Section 2[19] of the

9 Hui-Lin Yu, Yun-He Li, Kong-Ming Wu, *Risk Assessment and Ecological Effects of Transgenic Bacillus thuringiensis Crops on Non-Target Organisms. Journal of Integrative Plant Biology,* Vol. 53, Issue 7. 520-538. [https://doi.org/10.1111/j.1744-7909.2011.01047.x]

10 Hui-Lin Yu, Yun-He Li, Kong-Ming Wu, *Risk Assessment and Ecological Effects of Transgenic Bacillus thuringiensis Crops on Non-Target Organisms. Journal of Integrative Plant Biology,* Vol. 53, Issue 7. 520-538. [https://doi.org/10.1111/j.1744-7909.2011.01047.x]

11 Hui-Lin Yu, Yun-He Li, Kong-Ming Wu, *Risk Assessment and Ecological Effects of Transgenic Bacillus thuringiensis Crops on Non-Target Organisms. Journal of Integrative Plant Biology,* Vol. 53, Issue 7. 520-538. [https://doi.org/10.1111/j.1744-7909.2011.01047.x]

12 Government of India. (1950). *Constitution of India, Schedule VII, List II, Entry 14: Agriculture, including agricultural education and research, protection against pests and prevention of plant diseases.*

13 Government of India. (1950). *Constitution of India, Schedule VII, List III, Entry 33(b): Trade and commerce in, and the production, supply, and distribution of foodstuffs, including edible oilseeds and oils.*

14 Government of India. (1950). *Constitution of India, Schedule VII, List I, Entry 97: Any other matter not listed in List II or List III, including taxes not mentioned in those lists.*

15 Government of India. (1976). *Constitution of India, Article 48A: Protection and improvement of the environment and safeguarding of forests and wildlife.*

16 Government of India. (1976). *Constitution of India, Article 51A(g): Duty to protect and improve the natural environment, including forests, lakes, rivers, and wildlife, and to show compassion for living creatures.*

17 Constitution of India, Article 21. Protection of life and personal liberty.—No person shall be deprived of his life or personal liberty except according to procedure established by law.

18 Government of India. (1950). *Constitution of India, Seventh Schedule, List I, Entry 52: Industries, the control of which by the Union is declared by Parliament to be expedient in the public interest.*

19 Government of India. (2006). *Food Safety and Standards Act, Section 2: Declaration as to expediency of control by the Union*.

Act states that it is important for the Union government

to oversee and regulate the food industry to protect public health and ensure that food products meet safety standards. Section 22[20] of the Act further sets rules for certain types of food to make sure they are safe for people to eat. It includes genetically modified (GM) foods, organic foods, functional foods, and proprietary foods. GM foods must go through checks to ensure they do not harm health, and organic foods need proper certification to confirm they are truly organic.

## The 1989, Rules

The Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro-Organisms, Genetically Engineered Organisms or Cells, 1989[21] framed under the Environment Protection Act, 1986, were created to safeguard the environment, nature, and human health from the possible risks associated with gene technology and micro-organisms. These rules set regulations for the manufacture, use, import, export, and storage of hazardous genetically engineered organisms (GEOs), micro-organisms, and cells to prevent any harmful effects on the ecosystem and public health.

Rule 4 of the 1989 Rules establishes six key regulatory bodies to oversee genetically modified organisms (GMOs) and ensure safety in biotechnology research and applications. They are :

**1. Recombinant DNA Advisory Committee (RDAC) :** It reviews biotechnology developments nationally and globally, recommending safety measures for genetic research and applications.

**2. Review Committee on Genetic Manipulation (RCGM) :** It monitors safety concerns in ongoing GMO-related research projects. It also creates manuals and guidelines for regulatory processes, ensuring environmental safety in controlled field experiments and high-risk projects.

**3. Institutional Biosafety Committee (IBSC) :** It helps research institutions and organizations prepare on-site emergency plans for handling GMOs, following guidelines set by RCGM.

**4. Genetic Engineering Approval Committee (GEAC) :** It approves large-scale activities involving hazardous microorganisms and genetically engineered products. It also oversees experimental field trials and can take legal action under the Environment Protection Act, 1986 if violations occur.

**5. State Biotechnology Coordination Committee (SBCC) :** It monitors compliance at the state level. It has the authority to inspect, investigate, and take action against violations while regularly reviewing safety measures in industries dealing with GMOs.

**6. District Level Committee (DLC) :** It supervises GMO safety at the district level, ensuring installations handling genetically modified organisms follow safety regulations. It inspects facilities, identifies potential risks, and coordinates responses to emergencies.

These committees work together to regulate research, monitor safety, and enforce compliance, ensuring that GMOs and genetic engineering technologies do not pose risks to the environment, human health, or biodiversity.

## Guidelines for the Environmental Risk Assessment of Genetically Engineered Plants, 2016

The 2016 Guidelines for Environmental Risk Assessment of Genetically Engineered Plants[22] ensure the safe development and use of genetically modified (GM) plants by assessing their potential risks to the environment, nature, and human health. These guidelines follow a case-by-case approach, meaning experts analyze each GM plant individually to determine its impact. These guidelines begin with problem formulation, where researchers identify possible risks and define their study objectives. They outline standards for data collection and analysis, ensuring accuracy and reliability. Scientists provide detailed descriptions of the non-GM parent plants and the specific genetic modifications introduced. The guidelines also focus on cultivation practices, assessing how GM plants interact with other plants, animals, and ecosystems. Additionally, they require post-release environmental monitoring to track potential long-term effects once GM plants are introduced into nature.

20 Government of India. (2006). *Food Safety and Standards Act, Section 22: Genetically modified foods, organic foods, functional foods, proprietary foods, etc.*

21 Government of India. (1989). *Rules for the manufacture, use, import, export, and storage of hazardous microorganisms/genetically engineered organisms or cells*. Ministry of Environment & Forests. Retrieved from : http://geacindia.gov.in/resource-documents/biosafety-regulations/acts-and-rules/Rules-for-the-manufacture-use-import-export-and-storage-1989.pdf]

22 Government of India. (2016). *Environmental Risk Assessment of Genetically Engineered Plants: A Guide for Stakeholders.* Genetic Engineering Appraisal Committee (GEAC). Available at : [http://www.geacindia.gov.in/resource-documents/biosafety-regulations/guidelines-and-protocols/ERA_GuideforStakeholders.pdf]

## Regulations and Guidelines for Recombinant DNA and Biocontainment, 2017

The Regulations and Guidelines for Recombinant DNA and Biocontainment, 2017[23], issued on April 1, 2018, provides a framework for handling genetically engineered (GE) organisms and hazardous microorganisms in India. They establish minimum standards for laboratories working with microorganisms, animals, plants, and aquatic species, ensuring safe containment and reducing risks to human health and the environment. The guidelines classify organisms based on their risk levels and require appropriate containment facilities, including certification for laboratories. They also regulate the manufacture, import, export, storage, and exchange of hazardous biological materials, setting strict criteria for their use. Additionally, they emphasize the importance of keeping national authorities, institutions, and researchers well-informed about safety measures, allowing for responsible biotechnology development. The guidelines also highlight the need for public awareness, ensuring that containment strategies in India are transparent and accessible to all stakeholders. These regulations aim to create a structured and science-based approach to biosafety while supporting advancements in genetic research.

Although the Risk Analysis Framework is intended to provide transparency in decision-making regarding genetically engineered (GE) plants, the reluctance to make the biosafety dossier publicly available and address concerns about long-term risks through appropriate toxicity studies suggests that the framework is insufficient. To ensure fairness and public trust, the Risk Assessment and Risk Management (RARM) plan must be communicated in an inclusive and transparent manner. The failure to publish the biosafety dossier online highlights a gap in the 2016 Guidelines for Environmental Risk Assessment (ERA) for GE Plants, raising concerns about the effectiveness of current regulatory practices in addressing biosafety challenges.[24]

## Standing Committee Report, 2017

The 301st Report of the Parliamentary Standing Committee on Science and Technology, Environment, and Forests (2017)[25] examined the country's GM crop regulations, highlighting concerns about transparency, biosafety, and regulatory oversight. It found that the government claims strict regulations, but civil society groups argue that oversight is weak, relying solely on data provided by technology developers without any independent verification. The Committee recommended conducting field trials in controlled environments with agricultural universities to improve biosafety and health safety. The report criticized the Genetic Engineering Appraisal Committee (GEAC) for lack of representation from states and civil society organizations, raising concerns about conflicts of interest in its approval process. It suggested that GEAC should be led by biotechnology experts to ensure scientific accuracy and transparency.

The Committee noted that most developed countries do not cultivate GM crops, citing safety concerns. It also highlighted the limited success of Bt cotton in India, urging a comprehensive study to assess its impact on yields. It recommended that no GM crop be introduced without scientific assessment of long-term effects on human and environmental health through an independent and transparent process.

### Environmental Rule of Law in India

The environmental rule of law makes sure that rules for protecting nature are fair, transparent, and enforced properly. It helps governments make good decisions by following clear processes and allowing people to take part. Even though many laws exist to protect the environment, they often go unenforced or are not used effectively. This weak enforcement harms nature, wildlife, and public health. It also affects basic human rights, like the right to live in a clean environment. Holding authorities responsible for enforcing these laws is important to ensure environmental protection and sustainability. The Indian judiciary has recognised this rule in the plethora of judgments.

In *Vijay Rajmohan* v. *CBI,*[26] it was held by the Apex Court that "Accountability is a key principle in administrative law, ensuring that officials and authorities are answerable for their actions. Judicial review strengthens accountability, making governance more transparent and effective. It is also

23 Government of India. (2017). *Regulations and Guidelines for Recombinant DNA Research and Biocontainment.* Department of Biotechnology. Available at :[https://dbtindia.gov.in/sites/default/files/uploadfiles/Regulations_&_Guidelines_for_Reocminant_DNA_Research_and_Biocontainment,2017.pdf]

24 Supreme Court of India. (2024). *Gene Campaign & Another v. Union of India2024 SCC OnLine SC 1793, Para 44.1*

25 Parliamentary Standing Committee on Science and Technology, Environment, and Forests. (2017). *Genetically modified crops and its impact on environment*. PRS India. Retrieved from : [https://prsindia.org/policy/report-summaries/genetically-modified-crops-and-its-impact-on-environment]

26 Supreme Court of India. (2023). *Judgment in (2023) 1 SCC 329*

a fundamental part of human rights, defining the relationship between those in power and those affected by their decisions. Recognized as a global development goal and a principle of the Citizens Charter Movement, accountability enhances institutional integrity. It consists of three main aspects : responsibility, which defines the duties of those in authority; answerability, which ensures decisions are explained to the public; and enforceability, which allows corrective action against negligence. Accountability serves both a corrective function, addressing grievances and holding officials accountable, and a preventive function, helping to improve failing policies and procedures. By ensuring transparency and fairness, accountability plays a crucial role in effective governance."[27]

In *Hanuman Laxman Aroskar v. Union of India,*[28] the Supreme Court emphasized integrating the rule of law into environmental decision-making to achieve sustainable development. It identified seven key principles, including fair environmental laws, public participation, accountability, clear institutional roles, effective dispute resolution, and recognition of the link between rights and environmental law. The Court stressed that addressing climate change and other environmental challenges requires constitutional values like fairness, transparency, and accountability. Strong institutions, participatory governance, and public access to information are essential for protecting environmental health as part of the right to life under Article 21 of the Constitution. Additionally, environmental governance must ensure fairness and protection against arbitrary decisions, as guaranteed by Article 14.

In *Himachal Pradesh Bus-Stand Management & Development Authority v. Central Empowered Committee,*[29] the Supreme Court expanded the environmental rule of law by reinforcing the State's duty to establish strong legal, procedural, and institutional frameworks for environmental protection. It emphasized the need for a multidisciplinary approach, integrating science, law, and policy to tackle challenges like climate change and habitat destruction. The Court stressed the importance of involving all stakeholders in governance, recognizing the interconnected nature of ecosystems and the global impact of environmental issues. It advocated for principles like sustainable development and accountability while urging judges to act decisively in enforcing environmental laws, even when evidence is incomplete. This framework ensures transparent, participatory, and effective environmental regulation.

## Public Trust Doctrine

The Supreme Court of India has emphasized the need for environmental development that benefits people while maintaining ecological balance through sustainable practices. In *M.C. Mehta v. Union of India,*[30] the Court recognized that legal frameworks and funding alone are insufficient to restore environmental balance; instead, strategic planning and sustained effort are necessary. The Court's rulings affirm that the right to a safe and healthy environment is integral to the right to life under Article 21 of the Constitution. Judgments such as *Charan Lal Sahu* v. *Union of India* [31] and *Subhash Kumar* v. *State of Bihar,*[32] had established that pollution-free air and water are fundamental rights, while the court in *Virender Gaur* v. *State of Haryana*,[33]expanded this to include a hygienic environment. The Court also highlighted the State's duty under Articles 48 and 51A(g) to maintain ecological balance and implement policies that promote environmental protection.

Further, in *M.C. Mehta v. Kamal Nath,*[34] and *Indian Council for Enviro-Legal Action v. Union of India,*[35] the Supreme Court articulated the State's responsibility to enforce environmental laws and take action under the EP Act, 1986. It affirmed that failure to comply could result in judicial intervention.

Environmental law in India seeks to embed ecological consciousness within legal reasoning, ensuring that environmental regulations do not violate the fundamental right to a safe and healthy environment under Article 21. The judiciary remains committed to interpreting laws in ways that strengthen environmental protection and sustainability.

## Precautionary Principle

The precautionary principle originated in the 1970s in West Germany during a period of social democratic planning. It was based on the idea that the state should proactively prevent environmental damage through careful planning.[36]

27 Supreme Court of India. (2023). *Judgment in (2023) 1 SCC 329, paragraphs 34-36.*

28 Supreme Court of India. (2019). *Judgment in (2019) 15 SCC 401*

29 Supreme Court of India. (2021). *Judgment in (2021) 4 SCC 309*

30 Supreme Court of India. (1991). *M.C. Mehta v. Union of India*, (1991) 2 SCC 353

31 Supreme Court of India. (1990). *Charan Lal Sahu v. Union of India*, (1990) 1 SCC 613

32 Supreme Court of India. (1991). *Subhash Kumar v. State of Bihar & Ors.*, (1991) 1 SCC 598

33 Supreme Court of India. (1995). *Virender Gaur v. State of Haryana*, (1995) 2 SCC 577

34 Supreme Court of India. (2000). *M.C. Mehta v. Kamal Nath*, (2000) 6 SCC 213

35 Supreme Court of India. (1996). *Indian Council for Enviro-Legal Action v. Union of India*, (1996) 3 SCC 212

36 Weale, A., O'Riordan, T. and Kramme, E. 1991. Controlling Pollution in the Round. London: Anglo German Foundation.

The German term vorsorge means foresight and responsible environmental management, even in the absence of immediate risk. [37]The German government applied this principle to address acid rain, global warming, and North Sea pollution in the 1980s.[38] As part of environmental regulations, industrial operators were required to use the best available technology to minimize pollution at its source.

The precautionary principle marks a shift from traditional environmental regulation, which reacts to visible hazards, and even goes beyond preventive measures targeting predictable risks. Instead, it emphasizes avoiding potential environmental harm arising from uncertain future events. This principle requires identifying and addressing possible threats, even in the absence of complete scientific certainty. Essentially, precaution reflects a well-founded concern about unknown environmental consequences of human actions, which must be based on thorough risk analysis to safeguard ecological and public health.

In *Vellore Citizens Welfare Forum v. Union of India,*[39] the Supreme Court stressed the importance of preventing environmental damage before it happens. It ruled that the government must take early action to stop pollution instead of waiting for clear proof of harm. If there is a risk of serious damage, uncertainty should not be a reason to delay protective measures. The Court also stated that the responsibility to prove safety should be on those planning activities that might harm the environment. It connected this principle to Articles 47, 48A, and 51A(g) of the Constitution, which focus on environmental protection. The Court confirmed that Indian laws, like the Environmental Protection Act, 1986, already support this approach, along with the *polluter pays principle.*

In *A.P. Pollution Control Board v. Prof. M.V. Nayudu,*[40] the Supreme Court examined whether a hazardous industry could be allowed near reservoirs used for drinking water. It referred to international environmental laws, including the Stockholm Declaration (1972), which introduced the assimilative capacity principle, suggesting that scientific predictability could help manage ecological risks. However, given the uncertainty of environmental impacts, later agreements like the World Charter for Nature (1982) and Rio Conference (1992) reinforced the need for precautionary measures. The Court emphasized that when an environmental threat is identified, action must be taken even if full scientific proof is not available. If an activity could cause harm, it should be restricted unless its safety is proven by the proponents. Environmental decision-makers were urged to acknowledge gaps in scientific data and adopt cautious approaches to prevent serious and irreversible damage.

*The tragedy of the predicament of the civilised man is that, 'Every source from which man has increased his power on earth has been used to diminish the prospects of his successors. All his progress is being made at the expense of damage to the environment which he cannot repair and cannot foresee'.*

*Venkatachaliah, J.*

## Conclusion

India, as the origin of many food crops, must be cautious in adopting genetically modified (GM) technology, which is still evolving. Special attention should be given to transgenic crops native to India, as their commercial cultivation should only proceed after thorough impact assessments. A major concern is the contamination of natural gene pools, which could lead to several risks, including crossbreeding between GM and non-GM crops, the spread of foreign genes creating uncontrolled weed growth, and soil degradation from toxins such as the Bt gene, affecting crop productivity.

Not properly checking the health and environmental effects of genetically modified crops is unfair to future generations. It could put their health at risk and stop them from living a proper life. In the judgment of *Gene Campaign and Another v. Union of India and Others,*[41] Justice B V Nagarathna directed that a National Policy on genetically modified (GM) crops should be developed to address aspects like research, cultivation, trade, and commerce within the country. This policy must be created through discussions with key

Also refer O'Riordan, Timothy, and Andrew Jordan. "The Precautionary Principle in Contemporary Environmental Politics." *Environmental Values* 4, no. 3 (1995): 191–312. Available at : https://www.environmentandsociety.org/mml/precautionary-principle-contemporary-environmental-politics

37 Weale, A., O'Riordan, T. and Kramme, E. 1991. Controlling Pollution in the Round. London: Anglo German Foundation. Also refer O'Riordan, Timothy, and Andrew Jordan. "The Precautionary Principle in Contemporary Environmental Politics." *Environmental Values* 4, no. 3 (1995): 191–312. Available at : https://www.environmentandsociety.org/mml/precautionary-principle-contemporary-environmental-politics

38 Weale, A., O'Riordan, T. and Kramme, E. 1991. Controlling Pollution in the Round. London: Anglo German Foundation. Also refer O'Riordan, Timothy, and Andrew Jordan. "The Precautionary Principle in Contemporary Environmental Politics." *Environmental Values* 4, no. 3 (1995): 191–312. Available at : https://www.environmentandsociety.org/mml/precautionary-principle-contemporary-environmental-politics

39 Supreme Court of India. (1996). *Vellore Citizens' Welfare Forum v. Union of India*, . (1996) 5 SCC 647

40 Supreme Court of India. (1999). *A.P. Pollution Control Board v. Prof. M.V. Nayudu (Retd.) & Ors.*, (1999) 2 SCC 718

41 Supreme Court of India. (2024). *Gene Campaign & Another v. Union of India, 2024 SCC OnLine SC 1793, Para 50*

stakeholders, including agricultural and biotechnology experts, state governments, and farmer representatives. Once finalized, the policy should be widely communicated to ensure public awareness and understanding. The Genetic Engineering Approval Committee (GEAC) needs to undergo significant reform based on recommendations from the Technical Expert Committee (TEC), the Parliamentary Standing Committee (PSC) Reports[42], and the legal principles established in the T.N. Godavarman.[43] The revised structure should ensure that the committee includes a diverse set of experts specializing in agriculture, biotechnology, ethics, sociology, health, and environmental sciences. This will ensure that all critical aspects related to genetically modified organisms (GMOs) are thoroughly assessed before decisions are made. Furthermore, the GEAC must function as an independent and autonomous body, free from external influences, to uphold transparency and credibility in GMO-related regulatory processes. This transformation could be achieved through the enactment of a new statute or by making necessary amendments to the existing legal framework.

Additionally, both Justice B.V. Nagarathna and Justice Sanjay Karol suggested that the Government of India should consider implementing a well-structured national policy on GMOs to provide a unified approach in addressing the concerns associated with genetic modification in agriculture. This policy should be designed to ensure responsible research, ethical cultivation, safe trade practices, and proper commercial regulations surrounding GMOs. Consulting all relevant stakeholders such as agricultural experts, biotechnologists, state governments, and farmer representatives will be essential to formulating a balanced and effective policy. Further it was also suggested that

Beyond policy reforms, the government should invest in building infrastructure that supports cutting-edge research in biotechnology and agriculture. This includes the establishment of modern laboratories equipped with advanced scientific tools to facilitate thorough study and analysis of GM crops. Having state-of-the-art facilities will not only contribute to safer GMO applications but also foster innovation and sustainable development in agriculture. Strengthening research and development in this field will help in achieving food security while minimizing potential environmental and health risks.[44] By implementing these measures, India can ensure that GMOs are developed and used in a responsible and regulated manner while safeguarding public health, environmental sustainability, and long-term agricultural growth.

It could be concluded that while GM technology has the potential to improve crop productivity and food security, its integration into Indian agriculture must be handled with scientific precision, environmental responsibility, and economic fairness. India's agricultural system is deeply connected to its biodiversity and small-scale farming traditions, making it essential to balance innovation with sustainability. Ensuring responsible policymaking and rigorous research will determine whether GM technology can be successfully implemented without compromising ecological and socio-economic stability.

42 Parliamentary Standing Committee on Science and Technology, Environment, and Forests. (2017). *Genetically modified crops and its impact on environment*. PRS India. Retrieved from : [https://prsindia.org/policy/report-summaries/genetically-modified-crops-and-its-impact-on-environment]

43 Supreme Court of India. (2024). *T.N. Godavarman Thirumulpad v. Union of India, 2008 (9) SCC 711*

44 Supreme Court of India. (2024). *Gene Campaign & Another v. Union of India., 2024 SCC OnLine SC 1793*