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NAVIGATING THE LEGAL LANDSCAPE OF GENETICALLY MODIFIED AGRICULTURE IN INDIA THROUGH A REGIONAL EXAMINATION OF FARMER'S RIGHTS AND COMPLIANCE IN THE GWALIOR CHAMBAL DIVISION

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KEYWORDS

Genetically Modified Crops, Legal Compliance, Farmer's Rights, PPVFR Act, Gwalior Chambal Division, Seed Regulation, Agricultural Policy.

ABSTRACT

The aim of the study was to enquire the degree of legal awareness, behavior of compliance and institutional support level by farmers about GM crops in Gwalior Chambal Division, Madhya Pradesh in India. To gather data, mixed methods approach was applied and structured questionnaires were employed to gather information in 200 sample farmers of the locality, whereas, 15 key informants were interviewed. It was also found that most of the farmers knew about genetically modified crops like the Bt cotton but very small number of them were aware of some very significant legislative systems like the Protection of Plant Varieties and Farmer's Rights Act which became applicable in 2001. The inconsistent compliance was found in the course of dealing with seed licensing, verification, and record-keeping. They offered a small level of institutional intervention and the farmers were provided with very little level of legal assistance and technical training. A lot of barriers hindered compliance such as the lack of legal literacy, lack of an adequate system of enforcement, complex policies, and the sheer dominance of the private seed dealers. This study reinforces that more legal trainings, extension, and decentralization of regulations are necessitated to intensify the utilization of genetically modified organisms in the field of agriculture legally and knowledge conventional in the regional districts of India.

1. Introduction

Genetically modified agriculture (GM) is an emerging trend in the last few years that has taken the form of revolutionary and conflicting in the modern Indian farming scenario.[1] Use of genetically modified crop i.e. Bt cotton has brought with it challenging legal, environmental, and social-economic issues at the same time.[2] This is, notwithstanding the fact that such crops have shown potentials in the sense of increasing production and reducing the consumption of pesticides. In India, prominent laws that influence genetically modified agriculture include the Protection of Plant Varieties and Farmer's Right (PPVFR) Act, 2001, the Seeds Act, 1966 and the Environment Protection Act, 1986. Also, the genetic Engineering Appraisal Committee (GEAC) has come up with biosafety guidelines to be

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adopted within the field of genetic engineering agriculture.[3] These laws are meant to secure the rights of the farmers, to regulate the utilization of genetically modified technologies, as well as to ensure biosafety. Conversely, there is a continued inconsistency in the actual enforcement of these frameworks as well as awareness of their existence especially in the rural and semi-arid areas.[4]

With the intention to draw an insight into how these legal systems are being translated into and interpreted at the grass-roots level, Gwalior Chambal Division of Madhya Pradesh, which is predominantly agrarian and social-economically diversified, offers a critical case.[5] The domestic farmers in this township are often functioning with minimal access to any law window, little institutional assistance and insufficient regulatory implementation.[6] This has happened even after the increasing roles played by genetically modified crops, especially the Bt cotton. Due to this, the issues of illegal use of seeds, bad record-keeping, and ignorance when it comes to licensing standards remain persistent.[7]

This paper aims at carrying out local research of the steadiness and awareness of compliance regarding GMO crop governance along with the perceived obstacles that Gwalior Chambal Division farmers are facing.[8] This study aims to determine the ways to enhance legal literacy and decipher the institutional outreach and farmer protection within the context of the emerging biotechnology environment in India[9],[10]. It will achieve this by examining both legal requirements and ground figures which would contribute to pointing out the weak areas in policy implementation.

2. Research Objectives

- To determine the extent of legal awareness and comprehensiveness of part of the farmers to genetically modified (GM) crops and other blueprints such as PPVFR Act, in the Gwalior Chambal Division.
- To study compliance behavior of farmers, access to institutional/legal support and the existence of major impediments that bar the farmers to comply with legal norms regulating GM agriculture.

3. Literature Review

Blakeney (2020)[11] It brought to the fore the significant inefficiencies in the legislative framework of India to facilitate agricultural innovations and more so in the scenario of genetically modified crops of Indian sub-continent. This is because he believed that India had already come a long way in enhancing investigations on bio-technology; however, the consistency in implementing policies and harmonizing regulations often presented as an impediment to the scalable and sustainability of the use of genetically modified technologies at the small-scale level. His work has led to the awareness of the need of a consistent body of law that would make innovation possible even as it protects the rights of farmers.

Navneet (2019)[12] The regulatory system of genetically modified (GM) in India, United States of America, and the European Union was conducted with a comparative illustration. One of the main conclusions that have been made in the

course of the study concerned the regulatory approach in India, which appeared to be considerably less flexible and science-based than the system employed in the United States that was characterized by fewer restrictions and policies that were politically inclined. Meanwhile, the European Union (EU) followed the precautionary principle strictly and it produced an impression that the Indian one appeared ambiguous and often reactive rather than proactive. It had been claimed that regulatory machinery in India suffers several critical flaws with the most critical being the lack of established methods through which risks are assessed and failure to communicate the problems effectively to the people.

Singh (2021)[13] This study involved an examination of the political economics of genetically modified crop in India. He noted that policymaking itself was to a large extent very politicized with even the states and central governments, taking up stances that were mutually conflicting. The study proved that political issues were typically behind the decision made in the approval of the genetically modified crops instead of empirical evidence. Singh also referred to the effect of powerful lobbying groups of agribusinesses which made the role of public institutions even harder in terms of implementing the provisions of law which focused on farmers.

Turnbull et al. (2021)[14] investigated the existing competitive trends of global regulation and marked that the insertion of gene-edited crops had gone ahead of the establishment of the current legal institutions. Notwithstanding the fact that several countries were changing their biotechnology regulations to accommodate the CRISPR and other emerging technologies, the analysis revealed that India was lagging in the process of changing the its regulations. Due to this, confusion and doubt about the regulatory framework existed among a lot of the stakeholders, including farmers, researchers, and seed corporations.

Lakshmi Kumaran (2019)[15] analyzed the connection between intellectual property rights (IPR) and the genetically modified plants regulation in India. According to his findings, it was apparent that even though provisions like the PPVFR Act, Indian legislation were instituted to protect the interest of the farmers, they often collided with safeguards provided by the international companies through the patent system. Due to the legal disagreements that arose, the small-scale farmers were finding it difficult to understand their rights and responsibilities in as far as the genetically modified seeds were concerned.

Azadi et al. (2016)[16] This paper dwelt on the socio-political aspects of the introduction of genetically modified crops to the small-scale farmers. The outcome of their exploration came with several possibilities, which were benefits like productivity and pest resistance on one hand and challenges, like dependence on seed companies and the opaque nature of regulatory procedures, on the other hand. The fact that the farmers remained vulnerable even though the technology had its benefits did not go unnoticed to them; they were not literate in law and could not get the assistance of the institutional bearing in mind that they were

farmers.

Vora et al. (2023)[17] examined the fast-evolving global context moderated by policies on genome editing procedures. The observation they made was that India was still using the process-based performance evaluation, even though other countries had adopted flexible and trait-based methods of evaluating performance. It is due to this fact that the system of India became rather constraining and was often inappropriate when it comes to assessing the risk and advantages of the more recent method of technology like gene-edited crop.

Chauhan, Bhardwaj, and Singh (2024)[18] They have carried out a study of the bigger intellectual property climate in India. They argued that despite the enhancements in the enforcement of the intellectual property rights in urban centers, the rural and agricultural sector remained in the problem of poor execution coupled with ignorance. Their labor made such a gap in knowledge visible and their work also emphasized how such knowledge gaps require capacity-building programs, which specifically target farming communities.

Flachs (2016)[19] researched the contradicting reports of success that accompany genetically modified (GM) and organic cotton farming in India. Thanks to his ethnographic study in Telangana, he managed to show how political, cultural, and ecological factors affected the choices that farmers took. Since the regulatory environment lacked the necessary clarification guidance, he found out that genetically engineered cotton, although, it was financially beneficial in the short term, most often presented farmers with legal threat and long-term environmental challenges.

Raza (2024)[20] provided an objective look into the strengths and weaknesses of genetically modified crops, mostly on the ethics and regulations aspect of the same. He noted that although genetically modified technology could enhance food security and climate resilience, the reality remains that the regulatory system of India is still loose and more often than not, reactive. Raza believes in a policymaking structure that would be more inclusive and transparent and would include people in the participation of smallholder farmers as well.

Sullivan (2015)[21] A review of the Indian discourse works against practically genetically modified organisms revealed that there was a common tendency to inject Gandhianism ideology in a bid to oppose genetically modified crops. The point he was trying to make was that such vocabulary came as a very effective political instrument that could be aimed against the corporate-driven model of agricultural biotechnology and was able to raise mobilizations of farmers against what they perceived to be bio colonialism.

Whittingham, Marshak, and Swanby (2024)[22] The regulatory systems of genetically modified crops in South Africa were explored and it was highlighted that modernist sensibilities with regard to scientific ontologies proved lacking in their ability to capture the socio-cultural dimensions of seed systems. Seed networks led by farmers were shown to have value and the top-down form of scientific regulation based on disregard of

indigenous knowledge systems into question.

Halewood and Lapeña (2016)[23] focused on the point of confluency between taxonomy, agriculture, and the law so that the rights and differences of people who are farmers would be considered. They indicated that the existence of the legal recognition of farmer-developed varieties in a wide range of countries remained underdeveloped thus presenting a serious challenge to the implementation of the farmer's rights under treaties like the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

Peschard and Randeria (2020)[24] used the case of Monsanto litigation in the further conduct of an analysis of the legal activism regarding intellectual property regimes in India and Brazil. The findings of their research indicated that legal methods practiced by civil society members had been instrumental in casting a doubt on the validity of seed patent by corporations and also in advancing seed sovereignty.

Schnurr (2019)[25] In one study which examined the unfolding trends of genetically modified crop acceptability in African countries it emerges that despite the fact that the technology of genetically modified crops was discussed as a remedy to the food insecurity phenomenon, the sociopolitical aspect of adoption often led to conflicts among various stakeholders. In her presentation, she highlighted the fact that the opinions of the farmers were usually ignored in top-down policies, therefore, leading to mistrust and resistance.

Rock et al. (2023)[26] This argument was expanded and the implications of genome editing in the case of Africa were discussed. As per their claims, a sole focus on the genome comes with a possible risk to forget larger structural and ethical aspects, especially those aspects related to the ownership of corporations, access to technology, and the sovereignty of farmers.

James (2024)[27] reviewed the environmental and regulatory issues that are associated with the genetically altered trees hence contributing to the debate by analyzing these dilemmas. His contributions made risk assessment and adaptive approach of management known to be important, yet before then neither of them was systematically adopted across countries.

Jefferson and Padmanabhan (2016)[28] conducted a survey on intellectual property (IP) regimes in agricultural biotechnology covering the globe. Their observation is that disparities among intellectual property laws among nations often resulted in ambiguity both to small-scale farmers and inventors and this hindered the process of technology transfer and compliance more easily.

Peschard (2022)[29] brought out an elaborate discussion on the seed activism and patent politics that is being practiced in the Global South. She felt that the legal opposition to the patents on genetically modified crops has also become one of the greatest exponents of political expression by the farmers especially ethnically in the scenario of invoking higher litigations on the ways of seed saving and reuse. She underlined the significance of this movement.

Holthuis and van der Velden (2019)[30] it explored the tensions between the system of plant variety

rights (PVR) and the system of plant patents where regional differences are of particular concern. Based on the results of their study, the concurrence of the two different intellectual property regimes often caused lawful challenges and scales, mostly concerning the implementation of conventional seed systems and acceptance of such system.

4. Research Methodology

4.1. Research Design

This study employed a research design where various research methods have been combined in order to carry out an in-depth investigation into the awareness, behavior of compliance to legislation, institutional support, and challenges that farmers in India face towards the legislative framework that dominates the genetically modified (GM) agriculture. Two hundred farmers took part in standardized questionnaires whereby data collected was analyzed as quantitative. Conversely, stakeholder interviews through key informants were used to obtain qualitative information on fifteen officials. This approach allowed Gwalior Chambal Division to have a detailed and thorough insight that made it possible to recognize statistical trends and subtle perspectives.

4.2.Study Area and Target Population

This was because the researcher conducted his investigation in the Gwalior Chambal Division of Madhya Pradesh that comprises the towns of Gwalior, Morena, Bhind, and Sheopur. Due to the common prevalence of genetically modified crops like Bt cotton and the relative importance of these areas in the agricultural sector of the area, these districts were chosen. The target group comprised two hundred farmers who were either growing genetically modified crops or growing crops that touch on this, and fifteen key informants. This group consisted of agricultural officers and employees of non-governmental agencies (NGOs) and legal experts involved in rural development and agricultural extension.

4.3.Sampling Technique

Our sampling method was composed of several stages. This entailed the selection of four of the division's districts at the onset of the process with the view that this was guided by the introduction of genetically modified crops. During the second stage, a simple random sample method was used to select fifty farmers from each district. This was done to ensure that the results were representative of the entire region. Snowball sampling was utilized in the third stage of the research process in order to identify fifteen key informants. These individuals were chosen according to their knowledge and institutional responsibilities in the fields of agriculture, law, or farmer advocacy.

4.4.Data Collection Tools and Procedures

a. Structured Survey Questionnaire

A 200-farmer participant survey was carried out via face-to-face interaction, employing a structured questionnaire containing both closed and/or open-ended questions concerning:

- Awareness of the law (example: understanding GM crop regulations and farmer's rights)
- Seed acquisition and licensing conduct
- Engagement with institutional/legal assistance

- Estimated difficulties in adherence

The tool was originally developed in English, but was later translated into Hindi so we could verify the accuracy and conduct a pilot test for clarity and reliability.

b. Key Informant Interviews

Fifteen major participants took part in the semi-structured interviews; those participants spanned across governmental representatives from the farming sectors, the legal field, and farmer groups. The interviews sought to elucidate the issues concerning the implementation of enforcement, the missing pieces in the frameworks of institutional aid, and the systemic obstacles as they relate to the challenges of attaining legal compliance in the grassroots.

4.5. Data Analysis Techniques

Quantitative Analysis

Software like Microsoft Excel and SPSS were used to enter and process the data collected from the survey. For each response category, the frequency distributions and the percentages were calculated for each response. The results were aligned with the primary objectives of the study, which were awareness and compliance with, support from the institution, and barriers to enforcement. This was accomplished through the practice of thematic grouping of the results.

Qualitative Analysis

The questions and answers from the interviews were transcribed by hand and then coded using thematic content analysis. In order to provide support or explanation for the quantitative findings, key themes such as "lack of legal awareness," "institutional absence," and "barriers to enforcement" were identified and utilized.

4.6. Ethical Considerations

With regard to ethical norms, they had been strictly followed. Every participant gave the informed consent before any data collection processes had been conducted. Their participation would be made to be involved fully voluntarily and their identities and confidentiality guaranteed. Guidelines on ethical research techniques were explained by the Indian Council of Social Science Research (ICSSR) which was adhered within the study period.

4.7. Limitations of the Methodology

Since there is only one division in Madhya Pradesh in which the research was conducted it may be possible that the results cannot be applied to other regions in India. The use of self-reported data presented in the study is also reliant on the potentiality of the biases, including social desirability bias and recollection bias. A robust and triangulated understanding of the legal landscape of genetically modified crops at the regional level was produced by the mixed-methods approach, notwithstanding the limitations that were mentioned earlier.

5. Results And Discussion

This section gives and discusses information on Gwalior Chambal Division which was collected on 200 farmers and 15 key informants. The findings are categorized into four distinct categories, which are as follows: legal awareness, compliance behavior, institutional support, and enforcement enforcement problems. The PPVFR Act, the Seed

Act, and environmental biosafety standards are specific examples of the legal framework that India now has in place for genetically modified (GM) agriculture. Each conclusion is explained in light of this framework.

5.1.Awareness of Legal Rights and GM Crop Regulation

One of the primary goals of the study is to understand the extent to which farmers are knowledgeable about the legal aspects of GM seeds, the legal implications of seed licensing, and farmer's legal rights.

Table 1: Farmer's Awareness of Legal Aspects of GM Agriculture

Awareness Parameter	Frequency (n)	Percentage (%)
Heard of genetically modified (GM) crops	62	31%
Aware of the term "Bt Cotton" or "GM Mustard"	58	29%
New GM seeds require government approval/license	36	18%
Aware of the PPVFR Act, 2001	20	10%
Knew they have legal rights as farmers under Indian law	24	12%

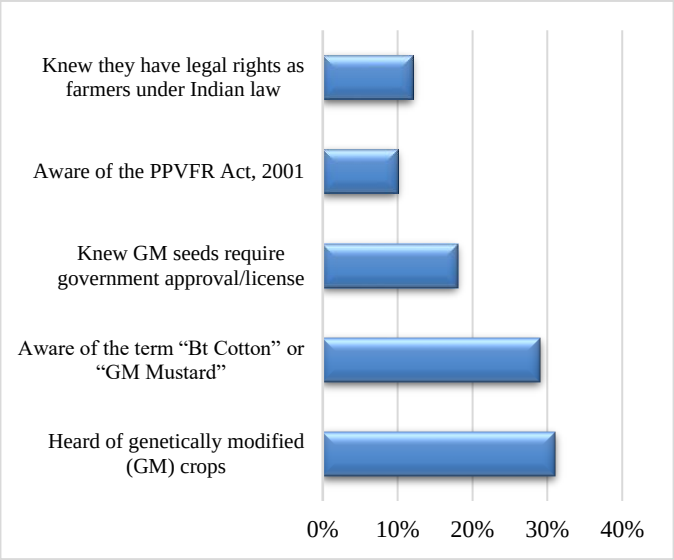

Figure 1: Farmer's Awareness of Legal Aspects of GM Agriculture

Though a majority of farmers were aware of GM crops, fewer than a third knew of the PPVFR Act or the rights they had under it. This captured the significant deficiency of the grassroots legal education and consciousness.

5.2.Compliance Behavior Related to GM Seeds

How farmers acquired seeds as well as their compliance with licensing and labeling regulations were also examined in the study.

Table 2: Seed Procurement and Use Practices

Practice	Frequency (n)	Percentage (%)
Purchased seeds from licensed/registered dealers	71	35%
Verified seed label/license before use	38	19%
Used saved or reused GM/hybrid seeds	50	25%
Maintained records of seed purchase	30	15%
Ever faced legal dispute or issue with seed companies	11	6%

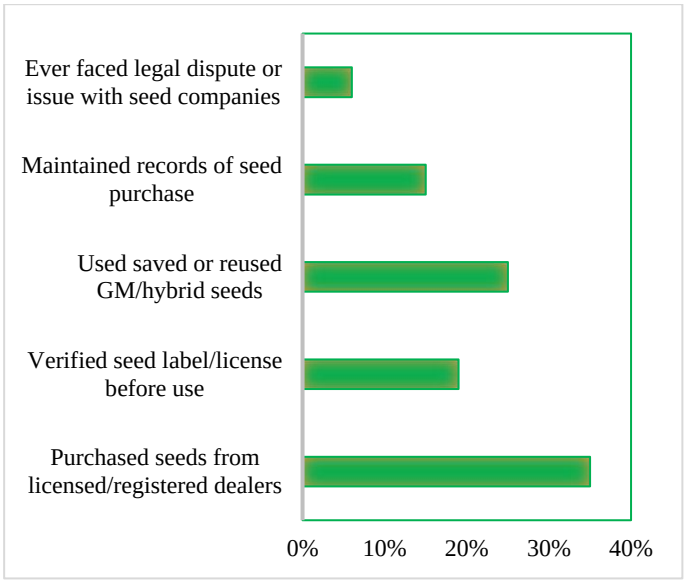

Figure 2: Seed Procurement and Use Practices

Numerous farmers obtained seeds without checking the licensing information, and others reused hybrid seeds, which might be legally and/or agronomically inadvisable. There have also been descriptions of poor record-keeping, which may

impede the ability to pursue legal action were disputes to arise.

5.3.Institutional and Legal Support Received

The objective of the study was to ascertain the extent to which local institutions were involved in the provision of information to farmers and, in the provision of assistance on legal or technical issues pertaining to GM agriculture.

Table 3: Access to Institutional and Legal Support

Type of Support Received	Frequency (n)	Percentage (%)
Visit by agricultural extension officer (past 2 years)	**94**	47%
Attended training on GM seed usage/legal awareness	**49**	24%
Received written material on seed laws or farmer's rights	33	16%
Accessed government helpline or legal advisory service	**24**	12%

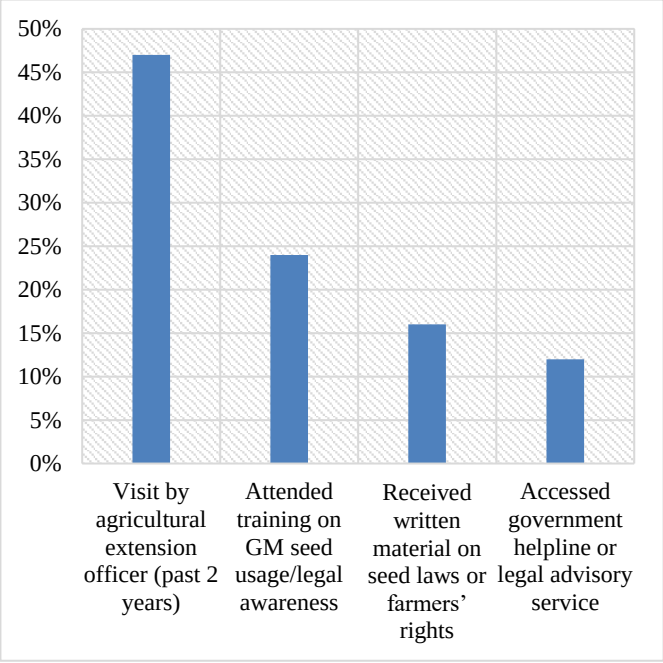

Figure 3: Access to Institutional and Legal Support

The engagement from the institutions was minimal. The farmers had not received any formal instruction on the legal aspects of the cultivation of GM crops. The absence of training and outreach materials, and the prioritization, slow, of legal education within the agricultural extension system, goes to show the negligence.

5.4.Perceived Barriers to Legal Compliance

The farmers were queried about the farm management and agricultural practices governance and GM seeds and farming rights regulations about understanding the challenges and compliance.

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Table 4: Barriers to Legal Compliance

Identified Barrier	Frequency (n)	Percentage (%)
Lack of awareness about laws	45	22%
Inadequate government monitoring or enforcement	41	21%
Language/complexity of policy documents	38	19%
Influence of private seed dealers	36	18%
Lack of trust in government systems	28	14%
Fear of legal complications or penalties	12	6%

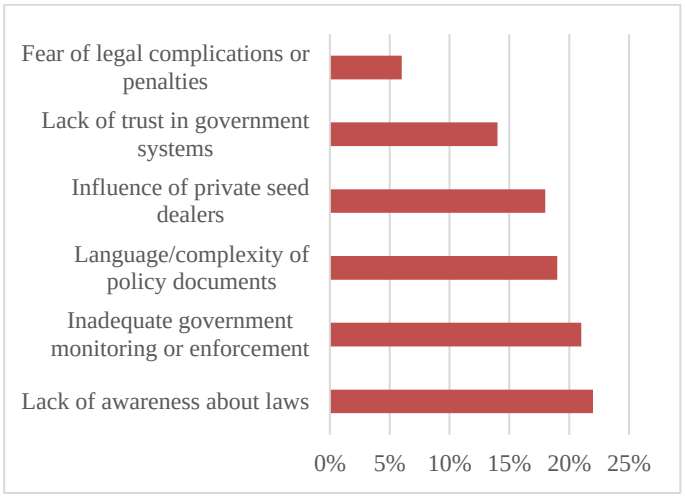

Figure 4: Barriers to Legal Compliance

Predominantly farmers underscored a lack of awareness, insufficient follow-ups, and the presence of commercial seed sellers as principal compliance challenges. Such socio-legal challenges weakened the impact of India's informal regulation and informal seed economies.

Synthesis and Thematic Insights

- **Legal awareness** was significantly lower than agronomic awareness of GM crops.
- **Compliance behavior** was mixed: while a majority purchased seeds legally, few verified license information.
- **Institutional support** was largely absent, with less than a quarter of farmers having any interaction with extension services about legal or regulatory issues.
- **Barriers to compliance** were both informational and structural, including policy complexity, institutional gaps, and lack of farmer-centric communication strategies.

6. Conclusion

Despite the fact that the majority of farmers in the Gwalior Chambal Division were aware of genetically modified crops, the study came to the conclusion that their comprehension of the legal framework that governs genetically modified agriculture, particularly the PPVFR Act and licensing restrictions, remained extremely poor. Due to the fact that many farmers obtained seeds from sources that could not be confirmed and did not follow the appropriate record-keeping procedures, compliance behavior was inconsistent. The level of institutional support was extremely low, with agricultural extension staff doing just a small amount of outreach and providing the least amount of access to legal or informational resources. Moreover, the complexity of the policies, the lack of proper monitoring, and the preponderance of private seed dealers were all structural impediments that made it difficult to accomplish effective legal compliance. The data illustrates the importance of the targeted legal literacy initiatives, strengthened extension services, and decentralized enforcement mechanisms necessary to ensure the protection and legal empowerment of farmers in the context of GM technology.

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