
THE PROTECTION OF PLANT VARIETIES AND FARMERS' RIGHTS ACT, 2001: EVOLUTION, IMPLEMENTATION, AND POLICY IMPLICATIONS

Ankush Bansal, Department of Genetics and Plant Breeding, School of Agriculture,
Lovely Professional University, Phagwara —144 001, Punjab, India

ABSTRACT

The Protection of Plant Varieties and Farmers' Rights Act (PPV&FRA), 2001 represents a landmark in India's agricultural intellectual property framework, designed to balance breeders' innovation rights with farmers' traditional seed sovereignty. This review traces the historical evolution of plant variety protection from pre-TRIPS international agreements to India's sui generis system, highlighting the interplay between global conventions such as UPOV, CBD, and ITPGRFA. It examines the key provisions of the PPV&FRA, including breeders', farmers', and community rights, and evaluates its implementation through mechanisms like DUS testing and the National Gene Fund. Case studies such as *PepsiCo vs. Gujarat Farmers (2019)* and *Nuziveedu vs. Monsanto (2020)* illustrate tensions between corporate control and farmers' rights. The paper analyzes the Act's impact on plant breeding innovation, biodiversity conservation, and seed industry growth, while identifying gaps in awareness, database management, and enforcement. Comparative analysis with global models in the U.S., EU, China, and Kenya underscores India's unique approach in integrating equity with innovation. The review concludes by proposing policy enhancements—digital databases, DNA fingerprinting, clearer EDV definitions, and stronger benefit-sharing frameworks—to strengthen the Act's implementation and ensure sustainable agricultural development.

Introduction to PPV & FRA:

Intellectual property protection has played an important part in stimulating product development in different economic fields. In agriculture, plant 'variety' is a product which holds a special place in terms of its ability to meet productivity challenges of the growing population and changing climatic conditions. As such, a plant variety is a population of plants with a specific set of characters. These set of characters are crucial to its identification and ownership. Having a system to claim ownership over a plant population is instrumental in protecting it as a product and initiating innovations in its development. The specificity and uniqueness of characters of a plant population is a function of their genotypes. A genotype is arrangement of genes which determines a living organisms' phenotype. A phenotype is the expression of characters in a particular environment. The measurement of traits and their values comprising a phenotype is the basic underlying feature of plant variety identification and in turn its protection as a property, given the phenotype is distinct, uniform and stable. Distinct means that the values are unique to a given population, uniform means that all the plants in that population adhere to that distinctness and stable means these distinct and uniform traits remain stable over a period of time and locations. Such an arrangement requires fixed genotypes in different crop plants. Plant breeders have devised various methods conducive to various crops based on their reproductive behaviour to achieve this feat. Also, they have been able to come up with novel genotypes through hybridization and selection procedures. These procedures are scientific in nature and are often documented. As such, these are highly resource intensive in terms of money and time. Moreover, with the advent of biotechnology, rDNA and gene editing the development of new traits has been turbocharged and holds great promise to meet the nutritional, energy and aesthetic needs of the ever-growing population. Hence, the protection of human efforts in curation of such plant 'varieties' becomes important. But protection of lining entities have their own challenges given that they are a result of a natural evolutionary force which has to be taken into account.

Pre-PPV & FRA Era:**Historical background of India's plant variety protection:**

The first significant international agreement to standardize intellectual property laws was the Paris Convention of 1883, which extended protection to industrial property, including agricultural property. (Dhar, 2010) The USA adopted the Plant Patents Act in 1930, promoting agricultural innovation by providing patent protection for asexually reproducing plants. The

TRIPS Agreement was made possible by GATT, which was founded in 1947 to address issues related to international trade after World War II. Although GATT's main goal was to lower tariffs and trade barriers, it also set the foundation for IPR's in international trade (Chawla, 2007). The UPOV Convention of 1961 created a unique IP system for plant varieties, fostering innovation by granting breeders exclusive rights. In 1970, the US expanded plant protection with the Plant Variety Protection Act, which protected sexually reproduced plants, including those propagated by seeds. UPOV was amended in 1972, 1978, and 1991. The 1978 Act, effective in 1981, maintained farmers' privilege, while the 1991 Act, effective in 1998, made farmers' privileges optional, allowing seed use within limits while protecting breeders' interests. (Singh et al., 2011) The World Trade Organization (WTO) was established in 1995 and the TRIPS Agreement was adopted as a result of the Uruguay Round of trade negotiations (1986–1994). Article 27.3b of the TRIPS Agreement mandated that WTO members protect agricultural intellectual property through patents or sui generis systems. Additionally, the Convention on Biological Diversity (CBD), adopted in 1992 and effective in 1993, emphasized national sovereignty over genetic resources, opposing the idea of plant genetic resources as a common heritage of humanity. (Chawla, 2016)

International treaties and agreements influencing Indian agricultural policies

The General Agreement on Tariffs and Trade (GATT), created in 1947, aimed to promote global trade by reducing tariffs and other trade barriers. Following the Uruguay Round, the GATT was signed in Marrakesh in April 1994, which opened the way for the World Trade Organization (WTO) to be established in 1995. India was one of the first members of both the WTO and GATT. The WTO, which has 153 members and 31 observer nations, deals with products, services, intellectual property, agriculture, and other topics. One of the most extensive international accords on intellectual property (IP) is the TRIPS Agreement, which is enforced by the WTO. Intellectual property, including patents and plant varieties, is protected by the 1994 TRIPS Agreement. TRIPS requires that plant varieties in agriculture be protected by patents or a sui generis regime. Plant variety protection is governed by the International Union for the Protection of New Varieties of Plants (UPOV), which was founded in 1961 and revised in 1972, 1978, and 1991. The 1978 and 1991 Acts authorize member nations to modify their legal systems while maintaining a minimal degree of protection. The Convention on Biological Diversity (CBD), formed in 1992, focuses on conserving biodiversity and ensuring fair sharing of benefits from genetic resources. Later, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), adopted in 2001, recognized farmers' rights to save, use,

exchange, and sell seeds. It also promotes sustainable use of resources and benefit-sharing through its Multilateral System (MLS), which supports equal access to information, technology, and commercial opportunities (Gautam et al., 2012).

B) Development & Evolution of PPV & FRA

Challenges Faced by Farmers and Breeders Pre-PPV & FRA

Before the PPV & FRA, 2001, Indian farmers had no formal legal framework to protect their traditional plant varieties. The Patents Act, 1970 excluded plant varieties from protection, leaving farmers to rely on informal seed systems (Raina, 1997). This allowed seed exchanges among farmers, but breeders lacked incentives for investment due to the lack of IPRs (Seshia, 2002). The WTO's and TRIPS Agreement (1995) pressured India to enforce PVP, favoring corporate seed control (Peschard, 2015). The UPOV 1991 framework restricted seed-saving rights, limiting farmers to only reusing their own harvest for personal use (Shiva, 2019). The entry of multinational seed corporations in India during the 1990s led to greater dependence on commercial seeds, creating financial burdens for farmers (Dogra, 2016). Hybrid seeds, unlike traditional varieties, could not be replanted, forcing farmers to buy fresh seeds throughout the year. (Kloppenber, 1988). This corporate dependency increased input costs, pushing many farmers into debt cycles (Ramaswami et al., 2007). The Green Revolution further expanded corporate seed control, as government policies prioritized private seed companies, reducing smallholder autonomy (Newell, 2003). Intellectual property rights (IPRs), patents, and seed certification laws restricted seed access, benefiting large seed firms (Schreinemachers et al., 2017). Companies like Monsanto and Bayer monopolized crop markets, charging high royalty fees (Rabobank, 2006). For centuries, Indian farmers relied on seed-saving practices, where they stored, exchanged, and improved crop varieties based on local environmental conditions (Voelcker, 1893). However, industrial agriculture and seed patents restricted these rights, especially under UPOV 1991 and TRIPS mandates (Peschard, 2015). The Green Revolution displaced indigenous varieties, favoring high-yielding hybrids that required chemical inputs (Richharia, 1977). Additionally, legal actions by corporations against farmers using patented seeds posed a major challenge (Sahai, 2003). The PepsiCo vs. Gujarat Farmers (2019) case revealed how multinational companies enforced intellectual property claims to restrict seed usage (Shiva, 2019). Farmers' movements, such as Beej Bachao Andolan (Save the Seed Movement), resisted these laws, advocating for farmers' legal rights to save and exchange seeds (Singh, 2021). Their protests influenced the creation of PPV & FRA, 2001, ensuring legal

recognition of farmers' seed-saving rights and the preservation of agricultural biodiversity (Schreinemachers et al., 2017). The law acknowledged traditional farmers' varieties, allowing registration and benefit-sharing under the National Gene Fund (Spielman et al., 2014). This move balanced corporate interests with farmers' autonomy and preserved India's agricultural heritage by protecting traditional seed practices against international patent pressures (Schreinemachers et al., 2017). (Singh, 2021)

Evolutionary Stages Leading to the Enactment of PPV & FRA (Key legislative milestones)

The PPVFRA bill's drafting process is particularly complex and controversial. A numerous range of stakeholders, including the public and private sectors, farmers, and intergovernmental organizations, have been successfully involved. The bill aimed to establish breeder's rights and operationalize farmers' rights, which led to significant debate. The FAO's Commission emphasized the importance of protecting farmers' rights from the actions of multinational companies. Early drafts were criticized for their confusing benefit-sharing clauses and disregard for farmers' rights. The 2001 final draft, which equated farmers' and breeders' rights, sparked further debate. Critics claimed that farmers and breeders should not be regarded equally since farmers use open, community-based approaches whereas breeders operate in controlled environments. They also differ greatly in their methods and objectives. (Kochhar & ICAR, 2008)

Stakeholder Involvement and Public Consultations in Drafting the Act

Proponents of the PPV&FR Act argue that it plays a important role in protecting the rights of breeders and promoting innovation in agriculture. They highlight the importance of understanding administrative actions and the civil justice system for effective enforcement. Cooperation mechanisms like the Patent Cooperation Treaty (PCT) are seen as instrumental in reducing costs and improving administrative efficiency, ultimately benefiting both Indian breeders and global agriculture. Critics, however, raise concerns about the limitations of the Act, particularly regarding India's observer status at the UPOV system. They argue that despite efforts to negotiate accession to UPOV, Indian breeders still face challenges in protecting their varieties in other member countries. This viewpoint underscores the need for more comprehensive measures to address these gaps in international protection. Some stakeholders emphasize the need for collaboration between the PPV&FR Authority and other departments, especially India's Intellectual Property, to enhance IPR administration, learning, and data gathering. They believe that such cooperation is essential for effectively implementing the Act

and ensuring its relevance in the rapidly evolving landscape of intellectual property rights. Others advocate more comprehensive policy analysis and research on PPV&FR topics, such as technology transfer and benefit sharing. They argue that in order to create laws and policies that effectively promote agricultural innovation and development, a deeper comprehension of these problems is essential. From a farmer's perspective, there may be varying opinions on the Act's impact. While some farmers may view it positively for ensuring access to top quality seeds and planting materials, others may express concerns about potential restrictions on traditional farming practices or the affordability of protected varieties. (Kochhar & Indian Council of Agricultural Research, 2008)

Government Initiatives and Policies Complementing PPV & FRA

The National Seed Policy (2002) aims to enhance seed quality, ensure food security, and boost agricultural productivity by encouraging both government and private sector participation in seed production. It promotes seed certification and quality assurance through the establishment of the National Seeds Board (NSB), which regulates seed registration, multi-location trials, and market monitoring. The policy supports farmer seed exchange programs, such as the Seed Village Scheme, ensuring the presence of high-quality seeds at the local level. It also facilitates seed import and export, allowing Indian farmers access to global planting materials while boosting India's seed exports through Seed Export Promotion Zones. Additionally, it aligns with the PPV & FRA Act, 2001, safeguarding farmers' rights to save, use, and exchange seeds while recognizing their role in traditional knowledge conservation through National Gene Fund incentives. This policy fosters innovation while protecting indigenous varieties and ensuring sustainable seed systems. (Indian Agriculture, 2002) The Biological Diversity Act, 2002 safeguards India's rich agro-biodiversity and ensures equitable access and benefit-sharing (ABS). It establishes a three-tier regulatory framework comprising the National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs), and Biodiversity Management Committees (BMCs) to regulate genetic resource access and commercialization. Farmers' rights are protected, allowing them to freely save, exchange, and use seeds, while traditional knowledge holders are rewarded through the National Biodiversity Fund (NBF). The Act also prevents biopiracy by restricting unauthorized patenting of Indian genetic resources and mandating fair compensation to farmers and local communities for commercial use of indigenous crops. On-farm and ex situ conservation programs, led by ICAR and NBPGR, ensure the sustainable use of landraces and traditional varieties. By integrating equitable benefit-sharing with conservation efforts, the Act balances economic development and

biodiversity protection. [Kannaiyan, n.d.] The Seeds Bill, 2004 was introduced to strengthen seed quality regulation and complement PPV & FRA, 2001 by ensuring farmers' access to high-quality seeds. It mandates compulsory seed registration, replacing the previous voluntary notification system, and enforces strict standards for germination, purity, and seed health. The Bill explicitly recognizes farmers' rights, allowing them to save, use, exchange, and sell seeds—except under brand names. Additionally, it introduces compensation mechanisms for farmers if registered seeds fail to perform as claimed. To prevent corporate seed monopolies, it bans Terminator Technology (GURT), safeguarding farmers' traditional seed-saving practices. Stricter penalties for seed fraud and improved inspection mechanisms further align it with PPV & FRA's goal of promoting quality seeds while protecting farmers' rights. This Bill, though pending approval, remains a key initiative supporting India's agricultural sustainability. (Government of India, 2004)

Key Legislative Steps, Committees, and Consultations in Formulating the Act

The Protection of Plant Varieties and Farmers' Rights (PPV & FRA) Act, 2001 was formulated through a series of legislative steps, expert committee recommendations, and consultations with various stakeholders. The Seed Review Team (1968), led by I.J. Naidu, played a foundational role by assessing seed production, quality control, and marketing regulations, recommending mandatory seed registration under the Seeds Act, 1966, to regulate seed quality (Government of India, 1968). However, the Act did not fully address intellectual property rights (IPRs) for plant varieties, necessitating further legal developments (Parliamentary Debates, 1999-2001). The WTO's TRIPS Agreement (1995) and UPOV (1991) pressured India to align with global intellectual property norms, but India opted for a sui generis system to balance breeders' and farmers' rights (WTO, 2001). B.S. Sivaraman, Secretary to the Ministry of Food and Agriculture, ensured that India's policy complied with international treaties while safeguarding farmers' rights (ICAR, 1999). Activists like Dr. Vandana Shiva and organizations such as Gene Campaign opposed UPOV's corporate-centric framework, advocating for farmers' seed sovereignty (Shiva, 2001; Gene Campaign, 1998). ICAR and NSC provided technical input, ensuring that both scientific advancements and socio-economic concerns were addressed (ICAR, 1999). The first draft of the PPV & FRA Bill (1999) faced opposition due to unclear benefit-sharing clauses and potential restrictions on traditional farming practices, leading to subsequent amendments (Parliamentary Debates, 1999-2001). After consultations with farmers' organizations, scientists, and legal experts, the final Act was passed in 2001, ensuring farmers were recognized as breeders and entitled to compensation under the National

Gene Fund (Government of India, 2001). The Act remains one of the few legislations worldwide to legally recognize Farmers' Rights, establishing India as a leader in equitable plant variety protection (UPOV, 2001; WTO, 2001). (Kochupillai, 2016)

Indian Legislation on Plant Varieties Protection

International treaties and agreements led India to establish compliant legal mechanisms. Some key legal instruments passed by the Indian government include: The Seeds Act, 1966, India's first central seed legislation, aimed to ensure quality seeds following the introduction of high-yielding crop varieties. It established seed certification through the Central Seed Committee, Central Seed Certification Board, and State Seed Certification Agencies. The Act mandated seed labelling and testing, including pre- and post-marketing quality control. The Essential Commodities Act of 1955 led to the Seeds (Control) Order of 1983, further restricting seed distribution. The 1988 New Policy on Seed Development aimed to enhance seed exports and farmer access to global planting materials. In 2001, the National Seed Policy (NSP) was enacted. Section 6 outlines labelling and expiry requirements, while Section 5 handles variety notification. "Truthfully labelled" varieties (TLVs) meet requirements without notification or multi-location trials. The Patents Act, 1970 replaced the Indian Patents and Designs Act of 1911 and was amended thrice to comply with the TRIPS Agreement. The 1999 amendment introduced exclusive marketing rights and a mailbox system for patent applications. The 2002 amendment extended the patent term to 20 years and reversed the burden of proof for process patents. The 2005 amendment established a product patent regime, excluding plants, animals (except microorganisms), and traditional knowledge from patentability. India is considering a Utility Model Bill to promote incremental innovation, offering protection for mechanical devices (Yadav, 2011). Geographical indications (GIs) are recognized as a part of IPR under Articles 1 (2) and 10 of the Paris Convention for the Protection of Industrial Property. Additionally, they are covered under Articles 22 to 24 of the TRIPS Agreement, which was negotiated during the Uruguay Round of GATT discussions. India passed the Geographical Indications of Goods (Registration & Protection) Act, 1999, which became effective on September 15, 2003, as a member of the WTO. This Act aims to be enacted to protect goods associated with specific geographical regions. This Act, aligned with the TRIPS Agreement, established a registry for GI protection, requiring renewal every 10 years. (The Gazette of India (E), 1999). The Biological Diversity Act, 2002, enacted in line with the Convention on Biological Diversity (CBD), aims to regulate access to biological resources and ensure fair benefit-sharing. The Act establishes a three-tier system with the National Biodiversity

Authority, State Biodiversity Boards, and Biodiversity Management Committees to oversee conservation efforts at various levels. (The Gazette of India (E), 2003) (Kochupillai, 2011)

DIFFERENCE BETWEEN THE SEEDS ACT, 1966 AND PPV&FR ACT, 2001

Aspect	Seeds Act, 1966	PPV&FR Act, 2001
Objective	Controls the quality, manufacturing, and distribution of certain seeds that are sold	Grants proprietary ownership of plant varieties to breeders and farmers
Legal Instruments	Seeds Act, 1966; Seeds Rules, 1968; Seeds (Control Order), 1983	PPV&FR Act, 2001
Beneficiaries	Farmers, seed producers, distributors	Plant breeders, farmers
Focus	Quality assurance of seeds	Ownership and protection of plant varieties
Rights Conferred	Ensures quality control of seeds	Provides intellectual property rights to legitimate owners
Scope of Rights	Regulates production and sale	The sole authority to manufacture, market, distribute, import, and export registered varieties
Type of Rights	Regulatory	Proprietary/Intellectual Property
Impact on R&D	Limited	Encourages investment in research and development
Industry Growth	Controls seed quality and distribution	Stimulates the growth of the seed industry by protecting breeders' and farmers' rights

(Mamgai et al., 141004)

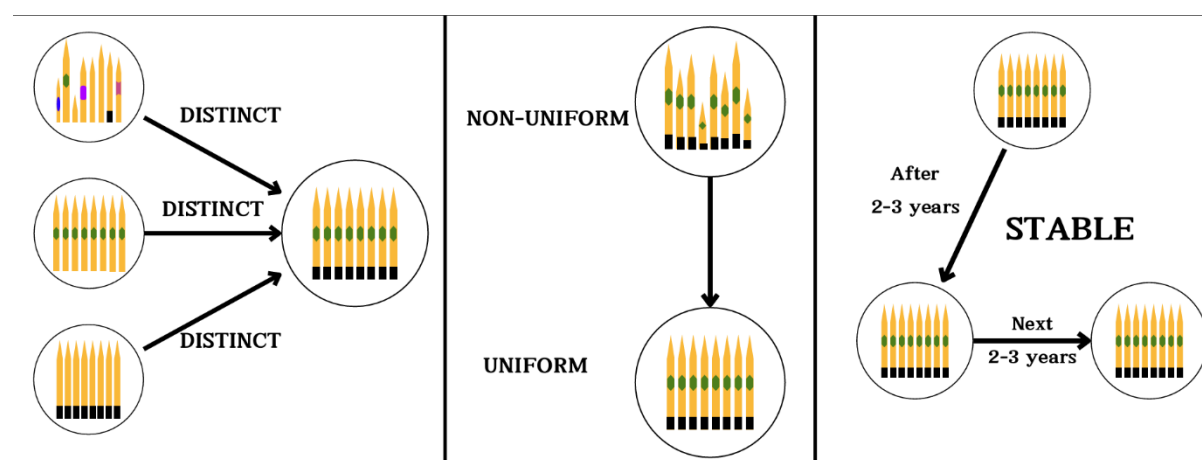
(C) Implementation & Impact of PPV & FRA

Role of DUS Testing in Plant Variety Protection

If a plant variety satisfies the requirements of being New, Distinct, Uniform, and Stable (DUS), it is granted PVP commonly referred to as Plant Breeders' Rights. The PVP system does not require full disclosure of the variety, as opposed to utility patents. Even if the majority of varieties do reach the market, hybrid varieties' parent lines tend to remain confidential while

being protected. Novelty: According to UPOV 1991, the variety's material cannot have been traded for more than a year within the applicant country or for four to six years outside of it prior to the application date. The one-year "grace" period is optional under UPOV 1978, but all national laws based on that agreement require the PVP application to be submitted prior to trading or even before the variety is offered for sale. Distinctness: Identification of a new plant variety depends on how its phenotypic differs from that of existing varieties. The degree of distinctiveness varies based on the testing period, region, and reference varieties utilised. Variety testing is complicated by interactions between varieties, locations, observers, and years; this makes it both interesting and difficult. In comparison, nonliving things such as computers and cars produce consistent outcomes under all testing circumstances. It was believed that the use of molecular fingerprinting in DUS testing would reduce variety/environment interactions. These methods are expensive and only useful for large crops because they are not yet accurate enough to substitute phenotypic features. They may also reduce the range of protection by decreasing variety distance. Nevertheless, by finding varieties that are similar to the new one for field trials, molecular approaches are helpful for organising big reference collections. The 1991 UPOV Convention requires clear differences in at least one characteristic, while UPOV 1978 requires differences in one or more important characteristics. Uniformity: The evaluation of uniformity is determined by the propagation method. Only 1% of self-fertile and vegetatively propagated varieties allow for off-types, requiring outstanding homogeneity. With a tolerance of 0.1%, seed certification is more strict. Concerns that the UPOV homogeneity criteria could harm varied landraces have led to criticism of the standard, especially from developing countries. UPOV 1991 recognizes broad varieties. It states that an existing variety not uniform enough for protection is considered a public variety, impacting the distinctness of new varieties. Protecting non-uniform varieties would make it more difficult to describe, stabilize, and safeguard them. If a characteristic is required to be heterogeneous, it may be eliminated from DUS testing, such as disease resistance. Stability: In order to protect plant varieties, stability is essential for PVP. A variety is considered to be different and loses protection if its essential traits change significantly. Although accurate stability testing is frequently unnecessary and inefficient, stability is essential for defending a PVP in infringement actions. Seed lots are regularly inspected to guarantee that clients receive the true variety. New varieties are subjected to official grow-out tests in European UPOV member nations in order to confirm their DUS prior to listing, seed trade entrance, and PVP awarding. Benefits of this method include effective infringement resistance, great efficiency, and the accumulation of technical expertise, despite its high cost. To standardize and support this

procedure, UPOV has created technical recommendations for DUS testing, which are examined yearly by technical working teams focused on certain crops. Breeders provide detailed variety descriptions for DUS testing in the USA, Latin America, Australia, and Canada. A computer database is used to verify the distinctness of these descriptions. In Australia, a "qualified person" selected by the PVP office supervises breeder trials. Breeders guarantee uniformity and stability; if this is proven to be false, the PVP may be cancelled at any time, making it null and void. Protection is given for 15–25 years (UPOV 1978) or 20–25 years (UPOV 1991), depending on the crop; certain national laws provide protection for 25–30 years. (Ghijssen et al., 2002)



Rights under the 2001 PPV & FRA Act

Breeder's Rights: Under Section 2(c) of the PPV&FR Act, a breeder is anyone who has developed a plant variety, including farmers and organizations. The 2001 Act grants breeders exclusive rights to authorize production, distribution, and marketing of their varieties (Section 28(1)). Breeders also gain temporary protection during registration from misuse by third parties.

The rights of plant breeder's vs other forms of intellectual property: Plant Breeder's Rights give the breeder disposable, transferable, or sellable property rights upon variety registration. These rights can be used without registration, are transferable, and are heritable, in contrast to copyrights and trademarks.

Farmer's rights: Under Section 2(k) of the the PPV&FR Act, 2001, a farmer is defined as one who cultivates crops or supervises cultivation, conserves wild species and traditional varieties, and selects helpful traits. The Act recognizes farmers' roles as users, custodians, and breeders, granting them important rights.

Right	Name	Information	Section
1	Access to Seed	Farmers can use, save, and exchange farm produce, including seeds, except branded seeds of protected varieties.	Section 39(1)(iv)
2	Benefit Sharing	Suppliers and communities get a share of benefits from new varieties; funds are deposited in the Gene Fund.	Section 26
3	Compensation	If a protected variety fails under provided circumstances, farmers may be entitled to compensation.	Section 39(2)
4	Reasonable Seed Price	Registered seeds must be priced fairly; breeders can face compulsory licensing if prices are excessive.	Section 47
5	Acknowledgment and compensation for helping in the conservation of plant genes	Farmers conserving genetic resources can receive awards and cash prizes from the Gene Fund.	Sections 39(i)(iii) and 45(2)(C)
6	Registration of Farmers' Varieties	Farmers' varieties can be registered if they meet specific criteria, granting Plant Breeder's Rights.	Section 39(1)(iii)
7	Prior approval for the sale of varieties that are essentially derived	Breeders need farmers' consent to use their varieties for creating new ones.	Section 39
8	Farmers are exempt from registration fees	Farmers are exempt from variety registration and testing fees and get free legal assistance for infringement cases.	Section 44
9	Farmer's protection from innocent infringement	Farmers are protected from unintentional infringement if unaware of their rights.	Section 42

Community Rights: Under Section 41 of the PPV&FR Act, 2001, communities contributing to a registered variety can claim a share of profits. They may submit a claim for compensation on behalf of a specified individual. Breeders must respond within two months, with compensation deposited into the Gene Fund by the PPV&FR Authority.

Researcher Rights: The Act allows the sale of recognized cultivars as seed and permits research. New varieties require breeder approval for commercial production under Section 30. (Mamgai

et al., 141004)

Implementation and Initial Challenges (Database issues, extant variety registration, clarity on EDVs)

(i) Lack of a Database of Existing/Extant Varieties: Before registering new varieties, the PPV&FR Authority is required by Rule 22(4) to keep a database of all current varieties. However, the Authority has been registering extant and new varieties simultaneously, leading to potential false claims of new plant types without proper verification. This practice undermines the registration process. The Authority should delay new variety applications until a comprehensive database is created. (ii) Registration of Extant Variety: Rule 24 allows breeders three years to register an extant variety after its notification. The current first-come, first-served system risks illegal registration of third-party varieties. To prevent this, all applications should be evaluated after the three-year period, ensuring rightful registration and minimizing disputes. (iii) Poor Understanding of Essentially Derived Varieties: The lack of clarity on EDV registration complicates opposition procedures and may lead to the wrongful registration of existing varieties as new. The Authority should prioritize the registration of existing varieties, build a robust database, and establish DNA fingerprinting centers to resolve disputes and avoid future legal issues. (Brahmi & Dhillon, 2004) (Kumar et al., 2010)

CHALLENGES IN THE REGISTRATION OF EXTANT AND NEW PLANT VARIETIES UNDER PPV&FRA		
PROBLEMS	CONSEQUENCES	SOLUTIONS
NO DATABASE FOR EXISTING VARIETIES Risk: False claims on new plant types.	Increased disputes over variety ownership.	BUILD A COMPREHENSIVE DATABASE FIRST Delaying new variety registrations until verification is done.
ISSUES IN EXTANT VARIETY REGISTRATION Risk: First-come, first-served may allow wrongful registrations.	Weak verification of new registrations.	EVALUATE ALL EXTANT VARIETY APPLICATIONS TOGETHER Avoids first-come, first-served issues.
LACK OF CLARITY ON ESSENTIALLY DERIVED VARIETIES Risk: Wrongful registration and difficult opposition.	Legal challenges in plant variety protection.	DNA FINGERPRINTING FOR DISPUTE RESOLUTION Prevents wrongful claims & ensures proper verification.

Amendments or Modifications Over Time

The PPV & FRA Act has undergone several amendments since its enactment in 2001 to address evolving challenges in plant variety protection, breeder rights, and farmers' welfare. These modifications have strengthened the Act's implementation by refining definitions, registration processes, farmers' rights, and compliance mechanisms. The 2021 Amendment (Act No. 33 of 2021) introduced important changes to key definitions, removing outdated terms such as Clause (d), (n), and (o) to enhance clarity in plant variety registration and align with international standards. Additionally, definitions related to "Essentially Derived Varieties (EDVs)" under Section 23 were refined, specifying the criteria for genetic modification and distinctiveness to prevent minor variations from gaining new registration status. A critical amendment under Section 39 further clarified the rights of farmers to save, use, exchange, and sell farm-saved seeds, ensuring they are not restricted by breeders' claims. The National Gene Fund mechanism was expanded under Section 45, making it mandatory for breeders to contribute to benefit-sharing programs when their varieties are derived from traditional landraces. Under Section 44, exemptions were introduced to ensure farmers are not burdened with registration fees for their traditional varieties, while Section 42 now provides legal protections ensuring farmers cannot be penalized for innocent infringement, recognizing the informal nature of traditional seed-saving practices. To streamline plant variety registration, amendments to Sections 33-38 introduced a more structured process for revocation and correction of registered varieties, and the Registrar-General's authority was expanded to oversee the correction of plant variety records, reducing delays and legal disputes. Additionally, under Section 47, compulsory licensing provisions were reinforced to prevent monopolies in the seed industry, ensuring that if breeders fail to make seeds available at reasonable prices, the Authority can issue licenses to other entities to produce and distribute them. The amendments to the PPV & FRA Act reflect India's efforts to balance breeders' and farmers' rights while complying with global intellectual property frameworks. By refining legal definitions, strengthening farmers' protections, and improving compliance measures, the Act continues to evolve in response to modern agricultural challenges (Government of India, 2021).

Impact on Plant Breeding, Agricultural Innovation, and Biodiversity Conservation

The PPV & FRA act, 2001 has significantly influenced plant breeding in India by encouraging both public and private sector involvement in varietal development (Kochupillai, 2011). The Act has stimulated hybrid crop research, especially in the private sector, leading to the

commercialization of improved varieties with higher yields and pest resistance (Evenson et al., 1999). Additionally, the recognition of farmers as breeders has encouraged traditional farmers to participate in the formal breeding system, ensuring genetic diversity in commercial breeding programs (ICAR, 1999). Despite these positive developments, small-scale breeders struggle to compete with large seed corporations, which have greater access to research funding and legal protection under the Act (Kochupillai, 2011). Moreover, there is a growing shift in breeding priorities toward hybrid crops and cash crops, often at the expense of open-pollinated varieties and landraces, raising concerns about the erosion of genetic diversity (Dhar, 2010). The PPV & FRA Act has also played a significant role in stimulating agricultural innovation, particularly by encouraging private sector through investment in seed research and biotechnology (Kochupillai, 2011). Before the implementation of the Act, the Indian seed industry was predominantly public-sector driven, with institutions like ICAR and SAUs leading varietal development and seed distribution (Evenson et al., 1999). However, post-PPV & FRA, private firms have quadrupled their investment in R&D, particularly in hybrid seed technology, which offers higher profit margins due to restrictions on seed reuse (ICAR, 1999). While these developments have driven technological advancements, they have also raised concerns regarding seed accessibility and affordability for small farmers (Shiva, 2001). Private-sector investment is primarily focused on cash crops like cotton, maize, and vegetables, while staple food crops such as rice and wheat receive less attention, creating potential vulnerabilities in India's food security system (Kochupillai, 2011). The Act has also promoted public-private partnerships in seed research, where ICAR and SAUs provide genetic material to private companies, ensuring a steady flow of innovation in the commercial seed industry (Evenson et al., 1999). However, critics argue that this model creates a dependency on corporate seed firms, reducing farmers' control over seed sovereignty (Dhar, 2010). A major achievement of the PPV & FRA Act is its emphasis on biodiversity conservation, particularly through farmers' rights and traditional knowledge protection (Kochupillai, 2011). The establishment of the National Gene Fund ensures financial incentives for farmers who conserve and develop traditional crop varieties, promoting on-farm conservation of agrobiodiversity (Dhar, 2010). Despite these measures, concerns persist regarding the impact of commercial breeding on agrobiodiversity. The increasing reliance on high-yielding hybrid seeds has led to the decline of traditional landraces and region-specific varieties, reducing the overall genetic diversity of India's agricultural landscape (Shiva, 2001). Additionally, while the Act recognizes community rights over genetic resources, the implementation of benefit-sharing mechanisms remains weak, with many traditional farmers unaware of their entitlements (ICAR, 1999). Gene banks and ex situ

conservation initiatives have played a vital role in preserving genetic resources, but there is a need for stronger policies to support in situ conservation, ensuring that biodiversity remains integrated into active farming systems rather than being confined to storage facilities (Evenson et al., 1999) (Kochupillai, 2011)

Impact on Farmers' Rights and Livelihoods (Case studies like PepsiCo vs. Indian Farmers, Nuziveedu vs. Monsanto)

(i) Case Study: PepsiCo vs. Indian Farmers – A Landmark Legal Battle: In 2019, PepsiCo India Holdings sued Gujarat farmers for allegedly violating its patent on the FL 2027 potato variety, also known as FC5. PepsiCo claimed exclusive rights until 2031, sparking controversy. Despite the company's public support for Indian farmers through contract farming, the lawsuit highlighted the power imbalance between multinational corporations and small farmers. The PPVFR Act of 2001 was created to protect farmers' rights while recognizing plant breeders' efforts. Public outcry led PepsiCo to drop the lawsuit, and in 2021, the PPVFR Authority revoked PepsiCo's patent due to irregularities. This case underscores the importance of protecting farmers' rights and ensuring the integrity of patent applications. (Srivastava & Parna Mukherjee, 2023)

(ii) Case Study: Nuziveedu Seeds Ltd. vs. Monsanto Technology LLC: The legal battle between Nuziveedu Seeds Ltd. and Monsanto Technology LLC centers on patent rights related to Bt cotton, a genetically modified cotton variety. Monsanto licensed this technology to Indian firms, including Nuziveedu, but disputes over trait fees led to a prolonged court case. In 2015, Indian companies demanded lower prices, but Monsanto refused, leading to a termination of contracts and a lawsuit. The Delhi High Court initially allowed Indian companies to use the technology, but a Division Bench later ruled Monsanto's patent unpatentable under Indian law. However, the Supreme Court restored Monsanto's patent rights, emphasizing the importance of protecting biotechnological innovations to encourage investment and research. This case highlights the challenges of balancing intellectual property rights with public interest and the accessibility of technology for local farmers. (Maru, 2020)



(D) Comparative Analysis & Future Directions

Comparative Analysis with Global Practices

The United States, bound by the TRIPS Agreement and UPOV since 1999, protects plant varieties through (Grunberg, 2011) the Plant Patent Act (1930) for asexual plants, Utility Patents for specific traits, and the Plant Variety Protection Act (1970) for sexual plants meeting NDUS criteria. Protection is provided by the USDA that lasts for 20–25 years. Farmers can protect seeds for replanting but cannot sell in the market for reproduction. Australia, a WTO and UPOV member, aligned with the UPOV 1991 Convention to comply with TRIPS. The Plant Breeder's Rights (PBR) Act 1994 grants breeders' exclusive commercial rights over new plant varieties, including hybrids, fungi, algae, and transgenic plants that meet NDUS requirements. These rights last 25 years for trees and vines, and 20 years for other varieties, covering all aspects of production, reproduction, and sale. The European Union developed the Community Plant Variety Rights (CPVR) system based on the 1991 UPOV Convention, offering uniform protection across the EU, superseding national systems. All botanical species, including hybrids, are protected for 30 years (vines/trees) and 25 years (other varieties), provided they meet NDUS criteria. Farmers may use harvested seeds on their own holdings,

but the system excludes researchers' exemptions and benefit-sharing mechanisms. China's 1997 Regulations on the Protection of New Varieties of Plants align with the 1978 UPOV Act, offering 20 years of protection for woody plants like vines and trees, and 15 years for other plants. There is no benefit-sharing scheme, allowing farmers to propagate protected varieties without paying royalties. Indonesia's Plant Variety Protection Law (1997), modelled after the Patent Law, covers all plant species, both new and extant, sexually or asexually propagated, farmers' varieties and essentially derived varieties, for 20 years (crops) and 25 years (forest trees), provided they meet NDUS requirements. Kenya's Seeds and Plant Varieties Act (1972, amended 1991) aligns with the 1978 UPOV Act, protecting new, existing, and farmers', and essentially derived varieties excluding algae and bacteria, for 18 years (trees/vines) and 15 years (other crops). The Act includes a benefit-sharing mechanism and allows farmers to save and exchange seeds. India's sui generis system for plant variety protection balances breeders' rights with farmers' rights, recognizing farmers as breeders, innovators, and conservers. The law uniquely integrates UPOV, CBD, and ITPGRFA principles, addressing the specific needs of Indian agriculture, which contributes 21% to the GDP and supports two-thirds of the population (Kochupillai, 2011). (Gautam et al., 2012)

Country	Legislation/Act	Protection Duration	Scope and Criteria	Farmer Rights	Additional Notes
United States	Plant Patent Act (1930), Utility Patents, Plant Variety Protection Act (1970)	20–25 years	Plant Patent Act for asexual plants; Utility Patents for traits; Plant Variety Protection Act for sexual plants meeting NDUS criteria	Save seeds, but cannot sell for reproduction	Protection by USDA
Australia	Plant Breeder's Rights (PBR) Act (1994)	25 years (trees/vines), 20 years (other varieties)	Covers hybrids, fungi, algae, transgenic plants; NDUS requirements	Exclusive commercial rights; no exemption for researchers	Aligns with UPOV 1991 Convention
European Union	Community Plant Variety Rights (CPVR) system	30 years (trees/vines), 25 years (other varieties)	Uniform protection across the EU; botanical species,	Use harvested seeds on own holdings; no researchers' exemptions	Based on UPOV 1991 Convention

			including hybrids, must meet NDUS criteria		
China	Regulations on the Protection of New Varieties of Plants (1997)	20 years (woody plants), 15 years (other plants)	Aligns with 1978 UPOV Act; covers woody plants, vines, trees, and other plants	Farmers can propagate without paying royalties	No benefit-sharing scheme
Indonesia	Plant Variety Protection Law (1997)	20 years (crops), 25 years (forest trees)	Covers new and extant species, sexually or asexually propagated; farmers' varieties, essentially derived varieties	Not specified	Modeled after Patent Law
Kenya	Seeds and Plant Varieties Act (1972, amended 1991)	18 years (trees/vines), 15 years (other crops)	Aligns with 1978 UPOV Act; covers new, existing, farmers', and essentially derived varieties	Allows seed saving and exchange; includes benefit-sharing mechanism	Excludes algae and bacteria
India	Sui generis system	Varies (generally 15–25 years)	Integrates UPOV, CBD, ITPGRFA principles; balances breeders' rights with farmers' rights	Recognizes farmers as breeders, innovators, and conservers	Addresses specific needs of Indian agriculture

Challenges in Enforcement & Future Prospects

The enforcement of the PPV & FRA faces multiple challenges. A key issue is the lack of a comprehensive database of extant varieties, which leads to delays in registration and disputes over ownership. The high cost and complexity of registration discourage small breeders and farmers from formally protecting their varieties. Additionally, unclear provisions on Essentially

Derived Varieties (EDVs) complicate enforcement and create loopholes for misappropriation. Legal battles, such as PepsiCo vs. Indian Farmers (2019) and Nuziveedu vs. Monsanto (2020), highlight concerns about corporate control over seeds and the need for stronger safeguards for farmers' rights. The low awareness among farmers regarding their legal entitlements under PPV & FRA further limits its impact. Looking ahead, DNA fingerprinting technology and digital databases can improve registration transparency. Increased public-private collaboration and legal clarity on EDVs can enhance compliance. Capacity-building programs for farmers and breeders will be crucial in ensuring effective enforcement. Strengthening dispute resolution mechanisms and aligning national policies with global best practices, such as those under UPOV and TRIPS, will further support the Act's long-term effectiveness.

Stakeholder Perspectives on PPV & FRA

In the PPVFRA, breeders from the public and private sectors are essential because they help to make commercial new plant types and license innovations. Breeders in the public sector think that the PVP system works effectively, encouraging cooperation and providing justification for the testing and registration procedures. On the other hand, lack of a comprehensive variety database makes PVP registration slow and cumbersome for private sector breeders, which restricts innovation. Both sectors believe that PVP promotes R&D and innovation in spite of these barriers. Approximately 90% of farmers who utilize seeds are generally unaware of PPVFRA [Figure 1]. Still, a lot of farmers know about certified seeds, and a few understand notified varieties. Awareness of compensation for failed propagating material is higher, likely due to retailers replacing defective seeds to maintain trust. Genetic material was first freely transferred by public research institutes, which were essential for both breeding and research. This kind of interaction has been prohibited since PVP, which has an impact on cooperation and generates concerns from the public breeders (Venkatesh et al., n.d.). PVP encouraged innovation and commercialization despite its drawbacks. While PVP is beneficial for R&D, private seed firms have worries about the expensive cost of protection and the complexity of registration. For small businesses, DNA marker technology may result in even higher prices (Venkatesh & Pal, 2014). NGOs help genetic resource conservation and fight for farmers' rights and PVP awareness. Whereas government agencies manage registration, encourage public-private partnerships, and control the sector, seed associations guarantee PVP compliance and promote best practices. Private sector respondents criticize the incomplete variety database and complex registration process (Lalitha, 2004), (Venkatesh, 2013). Overall, public sector breeders view PVP positively, while private sector breeders find it problematic. Farmers are

generally unaware of PPVFRA but recognize certain benefits, public research institutes face germplasm exchange challenges (Venkatesh et al., n.d.), private companies struggle with high protection costs (Venkatesh & Pal, 2014), and government organizations play a crucial but sometimes criticized role (Kumar et al., 2010). Seed associations and NGOs support compliance and represent smaller groups. (Venkatesh et al., n.d.).

Future Policy Recommendations & Enhancements

To strengthen the PPV & FRA, several policy enhancements are required. First, establishing a central digital database of registered plant varieties, supported by DNA fingerprinting, will prevent fraudulent claims and ensure transparency. The simplification of the registration process, particularly for small farmers, can encourage greater participation. Second, a structured benefit-sharing mechanism should be enforced to compensate farmers whose traditional varieties contribute to new plant developments. Financial incentives under the National Gene Fund must be made more accessible. Mandatory awareness programs through farmer cooperatives and agricultural extension services will help bridge the information gap. Third, clarifying the legal status of Essentially Derived Varieties (EDVs) will help prevent misappropriation by large seed corporations. Introducing price regulation mechanisms can curb monopolistic pricing in the seed industry, ensuring affordability for small-scale farmers. Finally, fostering international collaborations to align PPV & FRA with global agreements like UPOV 1991 while preserving India's sui generis model will enhance cross-border plant variety protection. By adopting smart regulations that balance innovation with farmers' rights, India can build a more sustainable and inclusive agricultural system.

(E) Conclusion

The Protection of Plant Varieties and Farmers' Rights Act (PPV & FRA), 2001, stands as a landmark legislation balancing breeders' rights, farmers' rights, and agricultural innovation. It has played a crucial role in promoting plant variety protection, enhancing research and development, and safeguarding traditional seed-saving practices. However, challenges in enforcement, such as complex registration procedures, lack of awareness, and ambiguities in Essentially Derived Varieties (EDVs), continue to hinder its full potential. Legal disputes like PepsiCo vs. Indian Farmers (2019) and Nuziveedu vs. Monsanto (2020) highlight the ongoing tensions between corporate interests and farmers' seed sovereignty. While the Act provides exclusive rights to breeders, it also recognizes farmers as custodians of biodiversity, making it one of the few laws worldwide to incorporate both perspectives. To ensure its long-term

success, policy enhancements such as streamlined registration, DNA fingerprinting for verification, mandatory farmer education programs, and international harmonization with UPOV principles are essential. Strengthening enforcement mechanisms and improving benefit-sharing frameworks can further ensure equitable outcomes for all stakeholders. Going forward, India's sui generis system must evolve to keep pace with biotechnology advancements, climate change resilience, and the growing role of private sector investments in agriculture. A balanced approach—fostering innovation while protecting farmers' rights—will be key to ensuring sustainable agricultural growth and biodiversity conservation in the future.

References

1. Chawla, H. S. (2007). Managing intellectual property rights for better transfer and commercialization of agricultural technologies. *J Intellec Prop Rights*, 12: 330 – 340.
2. Dhar, B. (2010). Sui generis system for plant variety protection available at <http://homepages.3-c.coop/tansey/pdfs/sg-coll.pdf>.
3. Singh, A. P., Padmavati M. and Chawla, H. S. (2011). Sui generis IPR laws vis-a-vis farmers' rights in Asia and their implications under WTO. *J Intellec Prop Rights*, 16 (2): 107-116
4. Chawla, H. S., & GBPUAT, P. (2016). IPR and PPV&FR act 2001: An overview. *Fodder Seed Production*, 119.
5. PL Gautam*, Ajay Kumar Singh, Manoj Srivastava and PK Singh: Protection of plant Varieties and Farmers' Rights: A review. (2012). In *Indian J. Plant Genet. Resour.* (Vol. 25, Issue 1, pp. 9–30)
6. Dogra, B. (2016). As Bayer and Monsanto Merge, Watch Out for What Happens to Our Food and Farmers. *The Wire*.
7. Kloppenberg, J. (1988). *First the Seed: The Political Economy of Plant Biotechnology: 1492–2000*. Cambridge University Press.
8. Newell, P. (2003). Globalization and the Governance of Biotechnology. *Global Environmental Politics*, 3(2), 56–71.
9. Pacey, A. (1983). *The Culture of Technology*. The MIT Press.
10. Peschard, K. (2015). *Farmers' Rights and Food Sovereignty: Critical Insights from India*. *Critical Perspectives on Food Sovereignty*. Routledge.
11. Raina, R. (1997). Public Patronage and Political Neutrality in Agricultural Research: Lessons from British Experience. *Economic and Political Weekly*, 32(39), 2473–2485.
12. Rabobank. (2006). *Indian Seed Industry: Market Overview and Outlook*. Industry Note 184-2006.
13. Ramaswami, B., Selhar, M., & Murugkar, M. (2007). Competition and Monopoly in Indian Cotton Seed Market. *Economic and Political Weekly*, 42(37), 3781–3789.
14. Richharia, R. H. (1977). *A Strategy for Rice Production to Ensure Sustained Growth in Madhya Pradesh*. M. P. Rice Research Institute.

15. Sahai, S. (2003). India's Plant Variety Protection and Farmers' Rights Act, 2001. *Current Science*, 83(3).
16. Schreinemachers, P., Rao, K. P. C., & Easdown, W. (2017). The Contribution of International Vegetable Breeding to Private Seed Companies in India. *Genetic Resources and Crop Evolution*, 64, 1037–1049.
17. Seshia, S. (2002). Plant Variety Protection and Farmers' Rights: Law-Making and Cultivation of Varietal Control. *Economic and Political Weekly*, 37(27), 2741–2747.
18. Shiva, V. (2019). The Seed Bill 2019 is a Threat to India's Seed Sovereignty and Farmers' Rights. *Navdanya*.
19. Spielman, D. J., Kolady, D. E., et al. (2014). The Seed and Agricultural Biotechnology Industries in India: An Analysis of Industry Structure, Competition, and Policy Options. *Food Policy*, 45, 88–100.
20. Voelcker, A. J. (1893). *Report on Improvement of Indian Agriculture*. Eyre and Spottiswoode.
21. Singh, P. (2021). *Politics of Knowledge in Development: Explorations in Seed Sovereignty*. *Studies in Indian Politics*.
22. Kochhar, S. & Indian Council of Agricultural Research. (2008). Institutions and capacity building for the evolution of IPR regime in India: protection of plant varieties and farmers' rights. In *Journal of Intellectual Property Rights: Vol. Vol 13* (pp. 51–56).
23. Indian Agriculture. (2002). NATIONAL SEEDS POLICY, 2002. <https://seednet.gov.in/PDFFILES/National%20Seed%20Policy,%202002.pdf>
24. Kannaiyan, S. (n.d.). AGROBIODIVERSITY AND ACCESS AND BENEFIT SHARING. <http://nbaindia.org/uploaded/docs/abs-190707.pdf>
25. Government of India. (2004). *Brief of Seeds Bill, 2004 and its comparison to Seeds Act, 1966*. Department of Agriculture, Cooperation & Farmers Welfare.
26. Food and Agriculture Organization (FAO). (1993). *Commission on Plant Genetic Resources: Proceedings*. FAO Publications.
27. Gene Campaign. (1998). *Farmers' Rights vs. UPOV: Protecting Traditional Seed Systems in India*. New Delhi: Gene Campaign Reports.
28. Government of India. (1968). *Seed Review Team Report: Recommendations for Seed Certification and Quality Control*. Ministry of Agriculture.

29. Government of India. (2001). Protection of Plant Varieties and Farmers' Rights Act, 2001. Gazette of India.
30. Indian Council of Agricultural Research (ICAR). (1999). Policy Papers on Seed Regulation and Plant Variety Protection in India. New Delhi: ICAR Publications.
31. Parliament of India. (1999-2001). Debates on the Protection of Plant Varieties and Farmers' Rights Bill. Lok Sabha Secretariat.
32. Shiva, V. (2001). Protecting Farmers' Rights: The Indian Experience. Navdanya Publications.
33. Union for the Protection of New Varieties of Plants (UPOV). (2001). International Convention for the Protection of New Varieties of Plants (1991 Act). UPOV Secretariat.
34. World Trade Organization (WTO). (2001). Trade-Related Aspects of Intellectual Property Rights (TRIPS): Compliance and Implementation in Developing Countries. WTO Reports.
35. Kochupillai, M. (2016). The Protection of Plant Varieties and Farmers' Rights Act, 2001: A Critical Analysis of its Implementation and Impact.
36. Brahmi, P., & Dhillon, S. S. a. B. S. (2004). The Protection of Plant Varieties and Farmers' Rights Act of India. *Current Science*, 86(3), 392–398. <https://www.jstor.org/stable/24108733>
37. Kumar, S., †, Khan, S. M., Hora, M., Rao, M. P., & Nuziveedu Seeds Private Limited. (2010). Implementation of Indian PPV&FR Act and Rules: Inadequacies leading to avoidable litigation. In *Journal of Intellectual Property Rights: Vol. Vol 16* (p. pp 102-106).
38. Yadav M (2011) Scope of Patentable Subject Matter (Agricultural Biotechnology Inventions): Perspective from India. In: Seminar on protection of plant variety and agricultural biotechnology inventions, 17-18 August, New Delhi
39. The Gazette of India (1999) The Geographical Indications of Goods (Registration and Protection) Act, 1999. Extra pt II, December 30, 1999.
40. The Gazette of India (2003). The Biological Diversity Act, 2002. Extra pt II, 5th February, 2003
41. Government of India. (2021). The Protection of Plant Varieties and Farmers' Rights Act, 2001 (Amended up to Act No. 33 of 2021). Ministry of Agriculture & Farmers Welfare.

42. Dhar, B. (2010). India's Plant Variety Protection Law: An Alternative to UPOV 1991? *Journal of Intellectual Property Rights*, 15(3), 231-240.
43. Evenson, R. E., Pray, C. E., & Rosegrant, M. W. (1999). *Agricultural Research and Productivity Growth in India*. Research Report No. 109, International Food Policy Research Institute (IFPRI).
44. Kochupillai, M. (2011). India's Plant Variety Protection Law: Historical and Implementation Perspectives. *Journal of Intellectual Property Law & Policy*, 16(4), 302-320.
45. Mamgai, P., Murai, A. S., Singh, R., ICAR-Agricultural Technology Application Research Institute, & Protection of Plant Varieties and Farmers' Rights Authority, Ministry of Agriculture and Farmers Welfare, Government of India. (141004). *Conservation of Farmers' Varieties through PPV&FR Act*. In ICAR-Agricultural Technology Application Research Institute & ICAR- Agricultural Technology Application Research Institute, Zone-I, PAU Campus, Ludhiana-141 004, ICAR-Agricultural Technology Application Research Institute. Printing Service Company. <https://www.zpdzone1.org>
46. Ghijsen, H. C. H., University of Bath, & Aventis Crop Science. (2002). Property Rights on Plant Varieties [Journal-article]. *Journal of New Seeds*, 4-4, 195-212. https://doi.org/10.1300/J153v04n01_15
47. Srivastava, R. & Parna Mukherjee. (2023). *PepsiCo v Farmers in India: A Classic Case of Statutory Misinterpretation*. *Australian Journal of Asian Law*, 24(2), 127-131.
48. Maru, V. (2020). *Nuziveedu Seeds Ltd. vs. Monsanto Technology LLC (3SCC 381)*. In *International Journal of Legal Science and Innovation*, *International Journal of Legal Science and Innovation* (Vol. 2, Issue 1, pp. 238-244). *International Journal of Legal Science and Innovation*. <https://www.ijlsi.com/>
49. Grunberg Anne Marie (2011) Overview of plant protection in the United States. In: Seminar on protection of plant variety and agricultural biotechnology inventions, 17-18 August, New Delhi.
50. Kochupillai M(2011) The Indian PPV & FR Act, 2001: Historical and Implementation Perspectives. *J. Intellectual Property Rights*, 16: 88-101.
51. Venkatesh, P., & Pal, S. (2014). Impact of plant variety protection on Indian seed industry. *Agricultural Economics Research Review*, 27(1),

91. <https://doi.org/10.5958/j.0974-0279.27.1.008>
52. Lalitha, N. (2004). Diffusion of agricultural biotechnology and intellectual property rights: emerging issues in India. *Ecological Economics*, 49(2), 187–198. <https://doi.org/10.1016/j.ecolecon.2004.03.022>
53. Venkatesh, P. and Pal, S., Determinants and valuation of plant variety protection in India. *J. Intellect. Prop. Rights*, 2013, 18, 448-456
https://www.researchgate.net/publication/259457096_Determinants_and_Valuation_of_Plant_Variety_Protection_in_India
54. Venkatesh, P., Sekar, I., Jha, G. K., Singh, P., Sangeetha, V., & Suresh. (n.d.). How do the stakeholders perceive plant variety protection in Indian seed sector? In *Current Science* (Vol. 110, Issue 12, pp. 2239–2244). <https://www.jstor.org/stable/24908467>