INTERNATIONAL JOURNAL FOR LEGAL RESEARCH AND ANALYSIS

Open Access, Refereed Journal Multi Disciplinary
Peer Reviewed

www.ijlra.com

ISSN: 2582-6433

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ISSN: 2582-6433

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ISSN: 2582-6433

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ISSN: 2582-6433

FROM CULTIVATION TO COMMERCIALIZATION: INTELLECTUAL PROPERTY RIGHTS AS THE BACKBONE OF AGRICULTURAL INNOVATION

JEGANNATH C[1]

ABSTRACT

This paper seeks to examine the role of Intellectual Property Rights (IPRs) as a catalyst in advancing agriculture from cultivation to commercialization. The author explains how IPRs grant creators exclusive control over their innovations, thereby fostering creativity, encouraging investment, and promoting research in agricultural development. The paper traces the evolution of IPRs in agriculture, beginning with early patent laws that primarily focused on machinery. The author notes that the Green Revolution created a demand for protecting plant varieties, leading to the emergence of plant breeding rights and seed laws. The study further examines the influence of the TRIPS Agreement, which harmonized international IPR frameworks and mandated protection for plant varieties. The author highlights that modern agricultural IPRs encompass plant patents, plant variety protection, and geographical indications, all aimed at balancing innovation with access to genetic resources. In India, a sui generis framework emerged with the enactment of the Protection of Plant Varieties and Farmers' Rights Act, 2001, which seeks to balance breeders' rights with farmers' traditional interests. This paper explains how IPRs stimulate research and commercialization, improve crop resilience and productivity, and contribute to sustainable agriculture and food security by encouraging investment and technological advancement. However, the author critically examines challenges such as unequal access to patented technologies, high licensing fees, and the marginalization of small-scale farmers, particularly in developing countries. These issues may exacerbate inequalities, limit competitiveness, and restrict agricultural diversity. The author concludes that while IPRs significantly enhance innovation, modernization, and global trade in agriculture, they also risk creating market monopolies and inequities. Hence, this paper emphasizes the need for a balanced and inclusive IPR regime that promotes innovation while safeguarding

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equitable access and sustainable agricultural development.

Keywords: *Agriculture, Development, Innovation, Intellectual Property Rights, Plant Varieties, Protection.*

I. INTRODUCTION:

"Effective IPR systems can stimulate agricultural research by ensuring that breeders can reap the benefits of their investments"

-Dr. Peter J. Scott

Intellectual Property Rights (IPR) are the rights given to persons over creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time.[2] These rights provide exclusive control over the *use, distribution, and commercial exploitation of the intellectual property*.[3] The purpose of intellectual property rights is to create an environment that fosters creativity and incentivises individuals to dedicate their time, effort, and resources to developing new ideas and creations.[4] IPRs have grown in significance within the global agricultural sector. As the primary sector faces many challenges, which include the need for *protection, innovation, technology transfer, and the conservation of genetic resources*, the role of IPRs has come under scrutiny. This research paper aims to provide an analysis of the advancement of agriculture from the garden to the grocery market, where IPR acts as a catalyst. The agricultural industry relies on intellectual property for multiple reasons. First and primarily, IPRs provide incentives for researchers and scientists to engage in research and development (R&D) activities in agriculture. By protecting intellectual property, such as new plant varieties, innovative technologies, or processes, IPRs enable researchers and developers to enjoy the exclusive rights and financial rewards, encouraging investment in agricultural R&D. This paper is mainly oriented towards

[2] World Trade Organisation, "What are Intellectual Property Rights?" available at https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm (last visited on October 30, 2025).

[3] J Dratler Jr and McJohn SM, "Intellectual Property Law: Commercial, Creative and Industrial Property", *Law Journal Press* 2023.

[4] Bican PM, Guderian CC and Ringbeck A, "Managing Knowledge in Open Innovation Processes: An Intellectual Property Perspective", *Journal of Knowledge Management* 2017 1384-1405.

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the role of IPRs in the protection, commercialisation and development of varieties of agriculture.

II. DEVELOPMENT OF INTELLECTUAL PROPERTY RIGHTS IN AGRICULTURE OVER TIME:

"Innovation in agriculture requires a robust intellectual property rights framework that encourages investment in research and development"
Dr. Calestous Juma

The evolutionary path of IPRs in the context of agriculture dates back to early developments in patent laws. Early patent laws mainly focused on protecting inventions related to machinery, processes, and industrial applications. However, they did not specifically address agricultural innovations. The ***Green Revolution*** marked an important pivotal moment in agricultural IPRs. With advancements in agricultural science and technology, particularly in plant breeding, the need for protecting plant varieties emerged. This led to the introduction of plant breeding rights and the establishment of seed laws to safeguard the efforts and investments of plant breeders. The Agreement on ***Trade-Related Aspects of Intellectual Property Rights*** (TRIPS Agreement) played a decisive role in international harmonization of IPRs, including those related to agriculture. TRIPS required member countries to protect plant varieties either through patents or through an effective sui generis system. The cutting-edge trends in agricultural IPRs include the development and utilization of various mechanisms such as plant patents, plant variety protection, patents on biotechnological inventions, and the use of geographical indications and trademarks to protect agricultural products. These trends reflect the ongoing efforts to balance the interests of innovators and the need for access to genetic resources and traditional knowledge in agriculture.

III. ROLE OF IPRS IN THE PROTECTION OF AGRICULTURAL VARIETIES:

"Intellectual Property Rights are essential for protecting the innovations in agricultural research that lead to new and improved crop varieties"

Plants have been involved in patent disputes since the inception of the first patent laws. Initially, plants, along with agricultural goods and practices, were not eligible for patent

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protection under the original legal frameworks. Many nations introduced patent laws as early as the 19th century, but these laws restricted patent eligibility to specific types of inventions. From 1790 to 1970, plants were excluded from patent protection because they were considered not to meet the legal criteria for patentability. Products that are eligible for patent protection must satisfy three requirements:

1. **novelty** (i.e., not known in the previous art),

2**. non-obviousness** (i.e., requiring an inventive step), and

3. **utility** (i.e., being applicable to industry).

Every patent gives the patent holder the authority to prevent others from manufacturing, using, or selling the patented product or process. However, patent information must be made accessible to the public through official patent documentation. In Europe and the United States, plant-related inventions failed to meet legal criteria such as conception, novelty, inventiveness, utility, and sufficient disclosure.

In India, the ***Patent Act***[5] was enacted in ***1970***. According to the Act and subsequent Patent (Amendment) Act, 1999 and 2002, patents could be applied mainly for agricultural tools and machinery or the processes for the development of agricultural chemicals.[6] Under the Act, and later amendments in 1999 and 2002, patents could primarily be claimed for agricultural tools, machinery, or methods used in the production of agricultural chemicals. However, methods related to agriculture or horticulture, life forms like plant varieties, animal breeds, strains of fish or birds, as well as products derived from chemical or biochemical processes, were not considered patentable. Additionally, processes for medical, surgical, curative, or prophylactic treatment of animals or plants to prevent disease or enhance their economic value were excluded from patent protection. The Indian Patents Act lacked protection for plant varieties and did not ensure farmers' rights.[7]

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[5] The Patents Act, 1970 (Act 39 of 1970)

[6] Kshitij Kumar Singh, "Intellectual Property Rights in Agricultural Biotechnology and Access to Technology: A Critical Appraisal", *Asian Biotechnology and Development Review,* Volume 18 (No. 3):3 November 2016

[7] Patents and Seed Industry, *The Hindu*, December 2, 2016 available at

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The Act allows for patents in agriculture for processes related to agrochemicals, growth regulators and promoters, medicines, vaccines, hides, wool, dairy science, food technology, biogas and fuel production, bioreactors, laboratory standardisation protocols, and environmental management. Nonetheless, there are restrictions on the patentability of certain agricultural innovations under the Act. Numerous nations have established plant breeders' rights to recognise and reward achievements in conventional plant breeding. These rights enable holders to restrict the commercial use of protected plant material, though such protection is typically less robust than that provided by patents. Since the differences between the new and existing varieties can be small, the standards for granting these rights are lower than those required for patents. This form of protection fosters commercial breeding initiatives, which historically have often come from public sectors or international research organisations in developing countries.

The aftermath of World War II witnessed a widespread loss of agricultural crops around the globe, creating a demand for higher agricultural output.[8] This resulted in the advancement of technology with respect to agriculture. Innovators and individuals with indigenous or traditional knowledge sought to protect their interests throughout the process. Consequently, legal measures were implemented to safeguard the rights of innovators, breeders, and holders of indigenous knowledge. Patents were granted for plant varieties to improve agricultural quality, reward researchers for their contributions, and develop products like pest-resistant crops. An IPR policy aims to encourage scientific advancement by giving inventors exclusive rights to their discoveries for a limited time, fostering creativity and innovation. Plant varieties are developed through years of selective breeding, focusing on traits that lead to better yields, improved quality, and enhanced resistance to various plant variations. To achieve high-performing cultivars, new plant production technologies must be developed. The great gain in agricultural production in various parts of the world is largely due to these upgraded high-performing plant varieties, which are also a critical factor in enhancing

https://www.thehindu.com/opinion/letters/Patents-and-seed-industry/article16077890.ece last visited on Oct 29, 2025)

[8] Neeraj Aravindan and Mamatha Ramapriya, "Intellectual Property Rights In Agriculture: Protection Of Traditional Practices And Modern Innovation", *IPR Journal of Maharashtra National Law University*, Nagpur, Volume I Issue I June 2023.

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agricultural income and general economic development.[9] Since plant breeding requires significant time and financial investment, it is difficult to sustain breeding activities without the prospect of adequate returns. Therefore, it is essential to establish a robust plant variety protection system to encourage the development of new plant varieties for the benefit of society. It is deemed to be equitable to confer on plant breeders the opportunity of a fair reward for their work, effort and investment in breeding and to grant them protection against unauthorized exploitation.[10]

IV. PROTECTION OF PLANT VARIETIES AND FARMERS' RIGHTS ACT, 2001:

"The protection of plant varieties encourages breeders to invest time and resources in developing new varieties that can benefit society"

A plant variety protection system in India may provide certain advantages. In the absence of Plant Breeders' rights, a large number of new varieties developed by Indian breeders would be freely available to others for exploitation. New varieties developed based on these varieties could get protected in other countries without any benefit accruing to the Indian institutions, whereas the availability of varieties developed in countries that provide for plant breeders' rights would be restricted in India. Bringing into force a system of plant breeders' rights would protect the public research system varieties developed by Indian breeders. It is noteworthy that Indian breeders working mainly in the public research system have developed a large number of varieties, and a plant varieties protection system will not only protect such varieties but also encourage agricultural research in India.[11] The Indian government has been concerned with food security, agricultural research, and the production of new plant kinds since time immemorial. According to ***Article 27.3 (b)*** of the TRIPS Agreement, plant

[9] Illika Mallik, "Impact of Intellectual Property on the Agriculture Sector in India", *Black n' White Journal*, February 2022 available at https://bnwjournal.com/2022/02/01/impact-of-intellectual-property-on-the-agriculture-sector-in-india/ (last visited on November 2, 2025)

[10] Raj Chengappa, "Patents: India wins a victory over turmeric but the war is on", *India Today* May 14, 2013 available at https://www.indiatoday.in/magazine/science-and-technology/story/19970908-patents-india-wins-a-victory-over-turmeric-but-the-war-is-on-832438-1997-09-07 (last visited on November 2, 2025)

[11] VK Ahuja, *Law Relating to IP Rights* 617 (Universal LexisNexis Publication, 3rd edn.)

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varieties can be protected through patents, a sui generis system, or a combination of the two.[12] By the year 2000, commercial breeders, farmers, and agrobiodiversity conservationists, in particular, recognised the necessity for Plant Variety Protection to promote food security. A sui generis framework for Plant Variety Protection was essential for India to be able to both defend and safeguard its farmers' interests while also offering rights to plant breeders.[13] In agriculture, IPRs serve to protect goods or services produced in the sector, primarily focusing on patents, plant breeders' rights, trademarks, geographical indications, and trade secrets. The Patents Act of 1970 and its subsequent amendments allowed for patents on agricultural tools, machinery, and processes related to agricultural chemical development. Before 2005, only inventions involving substances made through chemical processes were considered patentable. ***The Protection of Plant Varieties and Farmers' Rights Act***, enacted by the Indian government in 2001, expanded protections to plant varieties and farmers' rights**.** It became the ***world's only IPR legislation on plant varieties*** *that recognised and protected the rights of both breeders as well as farmers maintaining traditional landraces*.[14] India is one of the first countries in the world to enact legislation that effectively guarantees breeders' and farmers' rights under a single Act. It is the only law in this field that recognises plant breeders' efforts in producing new plant types while also providing farmers with statutory rights without jeopardising their freedom.[15] The statute recognises the farmer as both a grower and a conservator of agricultural plant types by preserving the farmer's plant variety.[16]

The protections given under the statute are:

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[12] "A balanced IPR regime - Key to promote technology-driven agriculture", *The Hindu Business Line*, February 20, 2011, available at https://www.thehindubusinessline.com/economy/agri-business/A-balanced-IPR-regime-Key-to-promote-technology-driven-agriculture/article20099424.ece (last visited on Nov 1, 2025)

[13] "The Presence of Patents in the Agriculture Sector", *Global Patent Filing*, November 2021 available at https://www.globalpatentfiling.com/blog/presence-patents-agriculture-sector (last visited on November 2, 2025)

[14] "IPR, Innovation & Agriculture", *Federation of Seed Industry of India*, available at https://fsii.in/ipr-innovationagriculture/#:~:text=IPR%20in%20agriculture%20are%20used,geographical%20indications%20and%20trade%20secrets (last visited on November 2, 2025)

[15] Supra note 7 at 5.

[16] The Protection of Plant Varieties and Farmers' Rights Act, 2001 (Act 53 of 2001)

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Among the key objectives of the Act are creating a robust system for protecting plant varieties, securing the rights of both farmers and breeders, and encouraging greater investment in research and development in the seed sector. It also strives to guarantee that farmers and growers, such as horticulturists, can access high-quality seeds and planting materials of enhanced varieties. Patents and plant variety protection are two types of IPR that both offer exclusive monopoly rights over the commercial establishment of a new plant variety throughout time.[17] The Indian unique system of plant variety protection is also unique, because under this Act, a variety can be registered under one of four categories:

New Varieties, Extant Variety, Farmer's Variety, Essentially Derived Variety (EDV)[18] under *the International Union for the Protection of New Varieties of Plants (UPOV)* member countries do not protect varieties under the last two categories.[19] Under the Protection of Plant Variety and Farmers' Rights Act, the period of protection in the case of registered varieties is *9 years* in case of trees and vines and *6 years* in case of other crops and upon renewal a maximum of *18 years* for trees and vines and *15 years* for other crops while in the case of extant varieties it is *15 years* from the date of registration.[20]

V. ROLE OF IPRs IN THE DEVELOPMENT OF AGRICULTURAL VARIETIES

Intellectual property rights (IPRs) play a vital role in the development of agricultural varieties by:

a) Encouraging investment and giving developers a return on their investment:

IPRs have received increasing attention for supporting agricultural development, including

[17] Akanksha Tiwari, "The Role of Intellectual Property Rights in Agriculture", *Just Agriculture*, Volume 3, Issue 2, October 2022.

[18] Rahul Yadav, "The Role of Intellectual Property Rights in Agriculture", *Research Gate*, May 2020, available at https://www.researchgate.net/publication/341494421_THE_ROLE_OF_INTELLECTUAL_PROPERTY_RIGHTS_IN_AGRICULTURE (last visited on November 2, 2025)

[19] PS Joshi and SV Pathak, "The Role of Intellectual Property Rights in Agricultural Engineering", *International Journal of Current Microbiology and Applied Sciences*" Volume 7 Number 11 (2018)

[20] Supra note 15 at 7.

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foreign direct investment (FDI), technology transfer, trade, access to genetic resources and protection of traditional knowledge.[21] IPRs are crucial in helping businesses attract investors and secure the returns necessary to cover development costs and fund further R&D. The absence of these rights can deter innovators from investing large sums in new technologies. It's important to find a balance that protects breeders' IPRs while ensuring technology can benefit farmers and the wider ecosystem. This is only possible when strict measures are in place to prevent fraudulent activities, which can harm both the technology and vulnerable farmers facing crop failure. Such unethical behaviour presents a significant setback for genuine companies, whose vision of empowering farmers with innovative products may be shattered due to lost trust and revenue. By respecting intellectual property rights, you get new varieties that:

i) Increase resistance to stress conditions

ii) Improve agronomic performance

iii) Meet industrial needs

iv) Provide value-added products

v) Improve competitiveness[22]

It provides the developers of plant varieties an opportunity to recover their investment in research. By doing so, it gives exclusive commercial rights for about 20-25 years to market a new variety or its reproductive material. This protection prevents anyone from growing or selling the variety without the owner's permission. Exceptions may be made, however, for both research and the use of seed saved by a farmer for replanting.[23]

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[21] Supra note 13 at 6.

[22] "Intellectual Property Rights Play Key Role", *Canadian Seed Growers Association*, available at https://seedgrowers.ca/farmers/intellectual-property-rights-play-key-role/#:~:text=Developing%20new%20varieties%20is%20a,Improve%20competitiveness (last visited on November 1, 2025)

[23] "What Role Does Intellectual Property Law Play in Agriculture?", *International Association for Agricultural Sustainability (IAAS)*, available at https://www.linkedin.com/pulse/what-role-does-intellectual-property-law-play-agriculture-#:~:text=Plant%20Breeders'%20Rights,by%20a%20farmer%20for%20replanting (last visited on November 3, 2025)

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"Plant variety protection not only incentivises the development of new varieties but also supports the conservation of genetic resources"
-Dr A. E. Hall

b) Protecting innovations:

Developing effective and environmentally responsible pesticides is a complex and costly endeavour that demands substantial investments in research, testing, and regulatory approval. IPR, notably patents, serve as a vital incentive for companies and innovators to invest in this critical field.

IPR ensures those who pioneer new solutions can protect their crop protection innovations, allowing them to recoup their investments and sustain ongoing research and development efforts, thereby nurturing an effective cycle of innovation. This, in turn, fosters a competitive landscape that encourages continuous improvement and innovation in crop protection, ultimately benefiting agriculture by providing farmers with safer, more efficient, and more sustainable tools to safeguard their crops and ensure food security for our growing global population.[24]

c) Enabling plant genomic research:

Patents, a key component of intellectual property rights, have significantly contributed to the expansion of plant genomics research. By utilizing sophisticated genomics, researchers are able to pinpoint, map, and better understand the gene expression of crops and their link to agriculturally relevant traits.

VI. ROLE OF IPRS IN THE COMMERCIALIZATION OF AGRICULTURAL VARIETIES:

"The commercialization of new agricultural varieties hinges on the strength of intellectual property rights; without them, innovation stagnates"

-Dr. Michael P. Timmins

[24] Intellectual Property Rights in Crop Protection, *Crop Life*, available at https://croplife.org/our-work/protecting-intellectual-property/#:~:text=Intellectual%20Property%20Rights%20in%20Crop,for%20our%20growing%20global%20population (last visited on November 3, 2025)

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IPRs play a significant role in the commercialization of agricultural varieties by providing exclusive rights to developers and protecting their innovations:

a) Rewards innovators

IPRs provide plant breeders and agricultural scientists with the legal protection required to recover the high expenses involved in research, field testing, and developing improved varieties. By granting developers exclusive control over the use and sale of their creations for a defined period, IPRs ensure they can obtain financial returns. This reward mechanism motivates individuals and institutions to continue investing in advanced agricultural technologies.

b) Protects innovations

Through clearly defined exclusive rights, IPRs safeguard newly developed agricultural varieties from unauthorized reproduction, sale, or commercial use. This protection ensures that breeders retain control over how their creations are propagated and distributed. By preventing third parties from exploiting the variety without consent, IPRs preserve the originality and integrity of the innovation while ensuring that benefits reach the rightful creator.

c) Fosters innovation

A strong IPR framework encourages continuous innovation by assuring developers that their efforts will be legally protected. When researchers know their work cannot be freely copied, they are more likely to develop improved varieties, test new genetic traits, and explore advanced breeding techniques. This environment of security and recognition ultimately accelerates agricultural progress and strengthens long-term research and development efforts.

d) Improves crops

IPRs indirectly contribute to crop improvement by motivating breeders to develop varieties with enhanced traits such as drought tolerance, disease resistance, higher yield, and suitability for industrial or nutritional needs. As innovators receive recognition and exclusive rights, they

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are encouraged to focus on addressing emerging agricultural challenges. This leads to the creation of robust varieties capable of meeting modern farming and food security demands.

e) Attracts investors

Investors are more confident in supporting agricultural research when strong IPR protections guarantee potential commercial returns. Exclusive rights over new varieties reduce financial risks and offer clearer revenue prospects, making the agricultural sector more attractive for investment. As a result, companies and research institutions can secure funding, scale their innovations, and successfully commercialize improved agricultural varieties**.**

"The commodification of seeds through intellectual property laws threatens biodiversity and the rights of farmers to save and exchange seeds"

-Dr. Vandana Shiva.

VII. PROMOTING SUSTAINABLE AGRICULTURE

"By securing rights over new plant varieties, breeders are more likely to invest in the research needed to create resilient and sustainable crops"

IPRs play an important role in agriculture and allied sectors. It ensures fair competition between the plant breeders. It is a ray of hope to promote healthy practices for the protection of material in agriculture, along with sustainable development.[25]

Shifting our focus to sustainable food production, intellectual property takes centre stage in addressing SDGs related to hunger and responsible consumption. For example, patents and IP rights encourage researchers and innovators to find better ways to grow crops, invent new farming tools, and practice sustainable farming. These new technologies and practices will help in producing more food, which will result in better food distribution as well *(nurturing SDG 2 and 12)*. The safeguarding of these innovations ensures that we can meet the growing

[25] Siddhanath Shendekar, Arti Ambhore, Nandkumar Kute, Megha Meshram and Arvind Totre," Intellectual Property Rights in Agriculture: An Overview*" Recent Trends in Multidisciplinary Research*, Volume 49, available at https://www.researchgate.net/publication/377108892_Intellectual_Property_Rights_in_Agriculture_An_Overview (last visited on November 4, 2025)

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demand for food while minimizing environmental impact, fostering a more sustainable and resilient food system.[26]

" IPR systems promote the development of agricultural innovations by providing incentives for research and investment in new varieties"

VIII. INTELLECTUAL PROPERTY RIGHTS IN RELATION TO INTERNATIONAL AGRICULTURAL TRADE:

a) Global trade agreements

International trade agreements, such as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement), have had a significant impact on IPRs in the context of global agricultural trade. [27] These agreements promote the protection and enforcement of IPRs, including those related to agriculture, with the aim of fostering innovation, fair competition, and economic growth.

b) Repercussions on access to genetic resources

The implementation of IPRs in agriculture can have implications for access to genetic resources.[28] IPRs may restrict access to proprietary plant varieties or technologies, potentially affecting the ability of certain countries or farmers to utilize genetic resources for crop production and breeding.[29] This has sparked debates about the fair distribution of benefits

[26] Ákos Cserkuti, "The power of intellectual property in achieving the Sustainable Development Goals", available at https://www.patentrenewal.com/post/the-power-of-intellectual-property-in-achieving-the-sustainable-development-goals#:~:text=Agriculture%20and%20Sustainable%20Food%20Production,sustainable%20and%20resilient%20food%20system (last visited on November 4, 2025)

[27] Huala Adolf, "Trade Related Aspects of Intellectual Property Rights and Developing Countries", *The Developing Economics*, March 2001.

[28] Butler LJ*," Conflicts in Intellectual Property Rights of Genetic Resources: Implications for Agricultural Biotechnology. In Economic and Social Issues in Agricultural Biotechnology*", Wallingford, UK: CABI Publishing. 2002;17-29.

[29] Bongo Adi, "Intellectual Property Rights in Biotechnology and the Fate of Poor Farmers' Agriculture", *The Journal of World Intellectual Property*, available at https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1422-2213.2006.00270.x (last visited on November

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from the use of genetic resources.

c) Conflicts and solutions

IPR-related trade disputes can arise when countries have differing interpretations or implementations of IPR obligations.[30] These disputes may involve allegations of patent infringements, unfair competition, or market access barriers.[31] They can be resolved through negotiation, mediation, or through the dispute settlement mechanisms provided by international trade agreements, like the World Trade Organization (WTO).

d) Influences of intellectual property rights on the worldwide agricultural economy

Intellectual Property Rights (IPRs) play a significant role in shaping the global agricultural economy. While they seek to protect and incentivize innovation, their impacts can be complex and multifaceted. Here are some key details on the impacts of IPRs on the global agricultural economy:

e) Nurtures innovative thinking

IPRs, such as patents and plant variety protection, provide a legitimate outline that provides specialised rights to inventors and developers of new agricultural technologies, products, and plant varieties.[32] These protections encourage investment in R&D, driving innovation in the agricultural sector.[33] By protecting intellectual property, IPRs offer incentives for scientists, companies, and farmers to develop and adopt new technologies and improved crop varieties.

f) Drives the process of modernization

IPRs facilitate technology transfer, enabling the diffusion of advanced agricultural tools and

5, 2025).

[30] Akhtar, Shayerah I.; Wong, Liana, "Intellectual Property Rights and International Trade", *Congressional Research Service* available at https://www.congress.gov/crs-product/RL34292 (last visited on November 5, 2025)

[31] Hovenkamp H, Janis MD, Lemley MA, "Anticompetitive settlement of intellectual property disputes", Minn. L. Rev. 2002;87: 1719.

[32] Jean Donnenwirth, John Grace and Stephen Smith, "Intellectual Property Rights, Patents, Plant Variety Protection and Contracts: A Perspective from the Private Sector", *IP Strategy Today* No. 9-2004

[33] Juma C, "The new harvest: Agricultural Innovation in Africa", *Oxford University Press*, 2015.

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techniques across countries.[34] This promotes the modernization of agricultural practices and the adoption of more efficient and sustainable farming methods. The ability to protect intellectual property fosters collaboration between different stakeholders, leading to increased agricultural productivity and competitiveness on a global scale.[35]

g) Strengthens productivity in agriculture

IPRs provide incentives for the development of improved crop varieties with enhanced traits such as disease resistance, drought tolerance, or higher yields.[36] Farmers gain access to these improved seeds, which can significantly enhance agricultural productivity. By protecting the investments made in research and development, IPRs ensure a steady supply of high-quality seeds and promote the adoption of improved agricultural practices, leading to increased yields and enhanced food security.[37]

h) Promotes easier market entry

Intellectual property protection helps create a favourable environment for agricultural trade.[38] It encourages investment in quality control systems, promotes branding, and facilitates market access by ensuring that products meet specific standards and regulations. This promotes trust among trading partners and enhances the exchange of agricultural goods globally, ultimately contributing to economic growth.

i) Obstacles faced by small-scale farmers

IPRs can pose challenges for small-scale farmers in developing countries.[39] By granting

[34] Spielman DJ and Ma X, "Private Sector Incentives and the Diffusion of Agricultural Technology: Evidence from Developing Countries", *The Journal of Development Studies*, 2016;52(5):696-717.
[35] Reichman JH, "Intellectual Property in the Twenty-First Century: Will the Developing Countries Lead or Follow?" *Houston Law Review/University of Houston* 2009;46(4): 1115.
[36] Tripp R," Can Biotechnology Reach the Poor? The Adequacy of Information and Seed Delivery", *Food Policy*, 2001;26(3): 249-264.
[37] Alemu GM, "Intellectual Property Law and Food Security Polices in Ethiopia", *International Food law and Policy* 2016; 1137-1180
[38] Lu Chen, "The Evolution of Intellectual Property Protection in China", *iBusiness journal* Volume 7 No. 1 March 17, 2015.
[39] Manohar Lal Meghwal, Lalit Dhurve, Sumit Raj, Nahida Afreen, Abhijeet, Somdutt Tripathi, Durgesh Kumar Maurya, and Arun Kumar. 2023. "A Comprehensive Review on the Impacts of Intellectual Property Rights on the Global Agricultural Economy". *Asian Journal of Agricultural*

ISSN: 2582-6433

exclusive rights to patented technologies or protected plant varieties, access to these innovations may become limited or subject to high licensing fees, particularly when controlled by multinational corporations. This can result in inequalities, as small farmers may struggle to afford or access modern agricultural technologies, hindering their productivity and competitiveness in a globalised market.

j) Equilibrating public interest

Striking a balance between protecting intellectual property and ensuring access to affordable technologies and seeds for farmers, especially in developing countries, remains a critical challenge.[40] Governments and international organizations work to develop policies and frameworks that safeguard intellectual property rights while also considering the public interest and the need for equitable access to innovations necessary for sustainable agricultural development.[41]

IX. THE BENEFICIAL EFFECTS OF IPRs ON THE GLOBAL AGRO-ECONOMY

"The Commercialization of agricultural varieties is significantly enhanced by a robust IPR framework that facilitates licensing and partnerships"

IPRs serve as incentives for innovation and technological advancements in agriculture.[42] By granting exclusive rights to inventors and creators, IPRs encourage them to develop new and improved agricultural technologies, methods, and products.

IPRs promote investment in research and development within the agricultural sector, ensuring that innovators and companies can recoup their investment and secure returns, which incentivizes more funding for R&D in agriculture.

IPRs facilitate the commercialization of agricultural innovations by offering legal protection and market exclusivity.[43] This allows innovators and companies to monetize their inventions

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Extension, Economics & Sociology 41 (12):160–173.

[40] Chiarolla C, "Intellectual Property, Agriculture and Global Food Security: The Privatisation of Crop Diversity", *Edward Elgar Publishing*, 2011.

[41] Ibid.

[42] Supra note 33 at 12.

[43] HS Chawla, "Managing Intellectual Property Rights for Better Transfer and Commercialization of

ISSN: 2582-6433

and technologies, leading to increased dissemination of these advancements in the agricultural sector.

IPRs can contribute to enhancing agricultural productivity and efficiency. By encouraging and protecting innovation, IPRs enable the embracement of new technologies and practices that can improve agricultural processes, increase yields, and optimize resource utilization.[44] These advancements can ultimately benefit the global agricultural economy by generating higher productivity and more sustainable practices.

X. THE DETRIMENTAL EFFECTS OF IPRs ON THE GLOBAL AGRO-ECONOMY

One concern is that IPRs can restrict access to genetic resources and traditional knowledge.[45] This can limit the ability of farmers and communities to freely access and use genetic materials for breeding and traditional farming practices.

IPRs can also limit farmers' rights and impede traditional farming practices. [46] The enforcement of IPRs may restrict farmers from saving seeds, practicing seed exchange, or engaging in other customary agricultural activities, leading to a loss of agricultural diversity and cultural practices.[47]

Another negative impact of IPRs is the potential increase in costs and reduced affordability of agricultural technologies.[48] Exclusive rights granted by IPRs can result in higher prices for patented seeds, biotechnological advancements, and other agricultural innovations, making them less accessible for small-scale farmers with limited resources.

IPRs can contribute to the concentration of power and market control in the hands of a few

Agricultural Technologies", *Journal of Intellectual Property Rights* Volume 12 May 2017 pp. 330-340

[44] Zilberman D, Ameden H, Graff G and Qaim M, "Agricultural biotechnology: Productivity, biodiversity, and Intellectual Property Rights*", Journal of Agricultural and Food Industrial Organization*, 2004; 2(2).

[45] Grethal Aguilar, "Access to genetic resources and protection of traditional knowledge in the territories of indigenous peoples", *Environmental Science & Policy* 4 (2001) 241–256

[46] Stephen B. Brush, "Farmers' Rights and Protection of Traditional Agricultural Knowledge", *World Development* Volume 35 Issue 9 September 2007, Pages 1499-1514

[47] Ibid.

[48] De Janvry A, Graff G, Sadoulet E, Zilberman D, "Technological Change in Agriculture and Poverty Reduction: The Potential Role of Biotechnology", *Agricultural Biodiversity and Biotechnology in Economic Development* 2005;361- 386.

ISSN: 2582-6433

large corporations.[49] This can create barriers to entry for smaller players, limit competition, and result in monopolistic practices that disadvantage the smaller farmers and hinder agro-development.

XI. CONCLUSION

"Strong intellectual property rights in agriculture lead to better market access for farmers and increased availability of diverse crop varieties"

IPRs have increasingly become a vital component of the agricultural sector, as they play a significant role in improving innovation and technological advancements. By providing legal protections for inventions and creations, IPRs incentivize individuals and organizations to invest time and resources into research and development, leading to the creation of new agricultural technologies, improved crop varieties, and enhanced farming practices. Moreover, these rights facilitate technology transfer, enabling farmers and agricultural enterprises to access cutting-edge advancements that can improve productivity and sustainability in their operations. Importantly, IPRs also safeguard the creators' rights and inventors, ensuring they receive recognition and compensation for their contributions, which encourages ongoing innovation in the field. This article conducts a comprehensive analysis of the effects of IPRs on various facets of agricultural research and development. It examines how these rights impact farmers' access to seeds and genetic resources, which are essential for ensuring food security and adapting to changing environmental conditions. Additionally, the article explores the overall competitiveness of the agricultural market, highlighting how IPRs can influence market dynamics and farmer livelihoods. However, the implementation of IPRs is not without its challenges and controversies. The article delves into potential negative effects on small-scale farmers, who may struggle to afford patented seeds or face restrictions on traditional farming practices. There are also concerns regarding biodiversity conservation, as stringent intellectual property protections may limit the availability of genetic resources crucial for sustainable agriculture.

By systematically analysing scholarly articles, reports, and case studies, this review aims to

[49] Srinivasan CS, "Concentration in Ownership of Plant Variety Rights: Some Implications for Developing Countries*", Food Policy* 2003;28(5-6):519-546.

ISSN: 2582-6433

illuminate the complex and multifaceted nexus between IPRs and the global agricultural economy. In the end, it aspires to deliver valuable insights to policymakers, stakeholders, and researchers, assisting them in manoeuvring through the complex landscape of IPRs in agriculture and encouraging a fairer and more sustainable agricultural future.