Journal of Social Science and Humanities ISSN: 1811-1564
DOI: 10.53469/jssh.2026.8(01).01

Intellectual Property Rights and the Legal Governance of Invasive Alien Species

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Abstract: ***Two important but frequently contradictory areas of law are intellectual property rights and the regulation of invasive alien species. IPRs encourage innovation in genetic engineering, biotechnology, and agriculture, especially patents and plant breeders' rights however, may also make it easier for non - native species to be introduced and commercialized some of these species may become invasive and endanger regional ecosystems, agriculture, and biodiversity. The relationship between IPRs and IAS regulation is critically examined in this study, emphasizing the ethical, legal, and environmental issues that emerge when biological resource property rights clash with environmental sustainability and biodiversity preservation. How intellectual property rights (IPRs) promote the creation and international trade of genetically modified organisms (GMOs), exotic crops, and bioengineered species, In spite of international legal frameworks like the Agreement on Trade - Related Aspects of Intellectual Property Rights (TRIPS) and the Convention on Biological Diversity (CBD), there are still gaps in the effective regulation of the environmental concerns associated with the spread of IAS. The study evaluates how well national and international legal frameworks take into consideration the unforeseen repercussions of awarding exclusive rights over potentially invasive species, This Article also looks at case studies and legal precedents where problems between IAS management and intellectual property protection have surfaced, this study assesses policy suggestions that can balance biodiversity preservation with incentives for innovation. These include improving governmental monitoring of the marketing of alien species, including IAS risk evaluations into patenting procedures, and bolstering global collaboration to stop the introduction of dangerous species. The study emphasizes the necessity of legal changes that balance intellectual property rights with ecological resilience by using a multidisciplinary approach, making sure that advancements in technology do not come at the expense of environmental deterioration. In the end, this study supports a well - rounded strategy that encourages both efficient IAS management and intellectual property protection, making sure that legal frameworks are strong enough to protect ecosystems while encouraging innovation in biotechnology and agriculture.***

Keywords: Biotechnology, Biodiversity Preservation, Genetically Modified Organisms, Environmental Sustainability and Risk Assessment

1. Introduction

Innovation, economic expansion, and the preservation of artistic and technological innovations have all been significantly influenced by intellectual property rights, By giving inventors and creators temporary monopolies, intellectual property rights (IPRs) like patents, trademarks, copyrights, and plant breeders rights have historically been intended to encourage research and development, IPRs have generated a lot of discussion about their possible role in ecological imbalances in the context of biodiversity conservation and environmental preservation[1]. The legal control of invasive alien species (IAS) is one such urgent topic. A complicated and little studied area, the relationship between IPRs and IAS management raises important issues on how intellectual property laws, impact invasive species growth, and management. Non - native creatures introduced into ecosystems where they seriously damage the environment, the economy, or society are referred to as invasive alien species. Whether they be microorganisms, plants, or animals, these species frequently outcompete native species, upset the ecological balance, and endanger biodiversity. IAS is commonly associated with human activities, including trade, forestry, aquaculture, and agriculture, all of which are influenced by intellectual property laws. For instance, invasive species have unintentionally spread as a result of the creation and commercial use of genetically modified organisms (GMOs) and plant types protected by plant breeder's rights. Patents awarded for biotechnological advancements, such as the creation of crops resistant to pests, may also promote the introduction of species into non - native habitats, which could have unanticipated ecological repercussions. International and national legal frameworks for IAS regulation are in place with the goal of preventing, controlling, and reducing the risks connected to these species. The necessity of regulatory measures to regulate IAS is emphasized by international accords like the Convention on Biological Diversity (CBD) and the International Plant Protection Convention (IPPC). However, intellectual property systems, which put financial rewards and incentives for innovation ahead of ecological concerns, frequently clash with these environmental protection regulations. This dispute brings up important moral and legal issues, This critical analysis explores the legal, economic, and environmental aspects of the connection between intellectual property rights and the management of invasive alien species. The impact of patent laws, plant breeders' rights, and biotechnology regulations on the spread of IAS will be addressed in this paper. It will also analyse the efficacy of current legal measures for invasive species control in the light of market dynamics driven by intellectual property rights. This study seeks to illustrate the difficulties and suggest possible changes that would bring intellectual property laws into line with ecological sustainability. the connection between IPRs and IAS regulation highlights a larger discussion about the necessity of a more ecologically responsible and integrated approach to legal governance. It is crucial to reconsider the function of intellectual property laws in environmental preservation as the world community

[1] Dutfield, G., *Intellectual Property Rights and the Life Science Industries: Past, Present and Future* (World Scientific, 2017).

struggles with ecological degradation and biodiversity loss[2]. In addition to advancing legal study, a critical examination of this problem provides useful insights into how policy and law might be aligned to support sustainable innovation without worsening environmental damage.

2. Intellectual Property Rights and Biodiversity Conservation

IPRs in agriculture and biotechnology. They encourage research, safeguard investments, and influence the creation of new technologies, intellectual property rights, are essential to biotechnology and agriculture[3]. The three main IPRs in this field are patents, plant breeders' rights (PBRs), and trademarks. Each of these has a specific purpose in safeguarding various facets of agricultural and biotechnological innovations.

In agriculture and biotechnology, intellectual property rights (IPRs) serve as both gatekeepers and facilitators of innovation. Plant Breeders' Rights (PBRs) safeguard novel plant types. IPRs, present issues with market control, food security, and seed availability, necessitating a balance between fair access and incentives for innovation. Patenting genetically modified organisms (GMOs) is one of the most contentious uses of intellectual property rights (IPRs) in biodiversity conservation[4]. In order to increase food security and decrease the use of chemicals, biotechnology corporations patent crops that are designed to withstand pests, herbicides, and yield more, by promoting monocultures and causing genetic contamination through cross - pollination, GMOs can lower biodiversity overall and increase an ecosystem's susceptibility to pests and diseases. Another example of how IPRs can inhibit biodiversity is seed monopolies. Large agribusinesses restrict farmers ability to save and replant seeds by controlling seed markets through patents. This strategy causes genetic degradation by increasing farmers reliance on proprietary seeds and displacing conventional crop kinds. On the other hand, by conserving a variety of plant types, farmer managed seed systems and open - source projects support biodiversity conservation. Concerns about ethics and the environment are also raised by bioprospecting. Although it promotes innovation in fields like health, agriculture, and cosmetics, it frequently results in biopiracy, in which businesses patent genetic resources and traditional knowledge without paying indigenous communities. This deters the protection of biodiversity and the exchange of ecological information. Fair benefit sharing is the goal of international agreements such as the Nagoya Protocol[5] and the Convention on Biological Diversity (CBD) [6]. IPRs can aid in the protection of biodiversity notwithstanding certain obstacles. Geographical indicators (GIs) encourage the preservation of rare plant and animal species by protecting goods associated with particular habitats and traditional knowledge, by encouraging collective genetic resource management, open access initiatives like the open - source seed movement oppose restrictive IPRs. Policies that empower local populations, benefit sharing arrangements, and legal reforms can all help to align IPRs with biodiversity conservation. Case studies demonstrate how IPRs affect the introduction and management of species. Both patented genetically modified organisms (GMOs), such as Golden Rice and Bt cotton, have solved nutritional shortages and increased yields, but they have also resulted in market monopolies, farmer reliance on patented seeds, and regulatory delays. Similar ecological issues, such as water depletion and decreased biodiversity, have been brought up by the marketing of non - native species, such as fast - growing eucalyptus hybrids in Brazil and India. Biocontrol initiatives against invading species are also influenced by IPRs. Concerns over patent ownership, accessibility, and ecological hazards are raised by patents on genetically modified mosquitoes, such as Oxitec's gene - drive technique to fight dengue and malaria. Similar to this, small farmers frequently cannot afford patented biopesticides for managing invasive agricultural pests, which restricts their use. IPRs have a big impact on species introduction, control, and biodiversity conservation[7]. They encourage innovation, but they also limit access, produce monopolies, and endanger the environment. To make sure that IPRs support both technological advancement and biodiversity protection, a balanced strategy that incorporates legal reforms and sustainable conservation methods is required.

3. Legal Framework for the Regulation of Invasive Alien Species

Globally, invasive alien species (IAS) are a serious danger to ecosystems, economies, and biodiversity. International treaties, national legislation, and policy initiatives aimed at preventing, controlling, and lessening their effects form the intricate legal framework that regulates them. These legal tools seek to strike a balance between economic and trade factors and environmental protection, which frequently results in difficulties with implementation and enforcement. This examines national legal systems in various jurisdictions, the major international treaties and conventions that deal with IAS, and the function of intellectual property rights in regulating them. International Treaties and Conventions, the legal basis for IAS regulation is provided by a number of international accords, each of which addresses a distinct facet of management, control, and prevention. The World Trade Organization's (WTO) and Agreement on Trade - Related Aspects of Intellectual Property Rights (TRIPS), the Convention on Biological Diversity (CBD) and Nagoya Protocol, and the International Plant Protection Convention

[2] Shiva, V. (2016). *The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics.* University Press of Kentucky.

[3] Brush, S. B. (2007). *Farmers' Rights and Protection of Traditional Agricultural Knowledge.* World Development, 35(9), 1499-1514.

[4] Chiarolla, C. (2011). *Intellectual Property, Agriculture, and Global Food Security: The Privatization of Crop Diversity.* Edward Elgar Publishing.

[5] *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization*, 2010.

[6] The Convention on Biological Diversity (CBD) aims to promote sustainable use of biodiversity while balancing IPRs. See CBD, 1992, Articles 8(j) and 15.

[7] Perrings, C., Dehnen-Schmutz, K., Touza, J., & Williamson, M. (2005). "How to Manage Biological Invasions Under Globalization." *Trends in Ecology & Evolution*, 20(5), 212-215.

(IPPC) [8] are some of the most important legal frameworks. The Nagoya Protocol and the Convention on Biological Diversity (CBD) is One of the most extensive international accords addressing IAS is the 1992 Convention on Biological Diversity (CBD). Parties are expressly required by Article 8 (h) of the CBD to stop the introduction, manage, or eliminate alien species that endanger ecosystems, habitats, or species. In order to effectively control IAS, the CBD highlights the necessity of national policies, risk assessments, and early warning systems. IAS regulation is further affected by the Nagoya Protocol on Access and Benefit - Sharing (ABS), which is a supplement to CBD. By controlling the use of biological materials, including non - native species used for research or commercial purposes, the procedure indirectly influences IAS control, despite its primary focus on just and equitable benefit - sharing from genetic resources. For example, nations with stringent ABS regulations may restrict access to biological control agents that are sourced from other ecosystems, which could impact their use in managing IAS. The CBD[9] relies on voluntary agreements and national implementation, but it lacks legally binding enforcement measures despite its extensive framework. Because of this, there are notable differences in the enforcement capacities and resources of different jurisdictions. The IPPC, or International Plant Protection Conventionis One important agreement addressing plant health and IAS hazards in forestry and agriculture is the 1951 International Plant Protection Convention (IPPC), which is supervised by the Food and Agriculture Organization (FAO). In order to stop the entrance and spread of invasive plant species and pests, the IPPC establishes international phytosanitary standards. It gives nations the legal justification to impose quarantines, carry out risk analyses, and control trade - related routes for the entry of IAS. IPPC standards are used as a benchmark to support trade restrictions based on the risks of pests and diseases under the WTO's Sanitary and Phytosanitary (SPS) Agreement, maintaining compliance is difficult for the IPPC, especially in developing nations with little funding for phytosanitary enforcement and monitoring, phytosanitary regulations and trade liberalization under WTO agreements frequently clash, raising questions about the validity of trade obstacles pertaining to IAS.

Genetically modified organisms (GMOs) and biological control agents used in IAS management are examples of biotechnological advances for which TRIPS compels member nations to offer patent protection. IPRs can encourage innovation, but biocontrol technologies, they might also make it harder to get them, especially for developing nations looking for affordable alternatives.

The implementation of IAS regulations varies across jurisdictions, reflecting differences in legal traditions, enforcement capacities, and policy priorities. A comparison of IAS laws in the United States, the European Union, and developing countries reveals common challenges and diverging approaches to prevention and control.

The United States The legal foundation for IAS regulation in the US is dispersed among several federal and state organizations. Addressing invasive species, with a primary focus on aquatic and terrestrial ecosystems, is made possible by the National Invasive Species Act (NISA) [10] of 1996 and the Lacey Act. The importation, transportation, and management of invasive plants and pests are further governed by the Federal Noxious Weed Act and the Plant Protection Act (PPA). Implementing phytosanitary measures and authorizing biocontrol agents are crucial tasks for the Environmental Protection Agency (EPA) and the U. S. Department of Agriculture (USDA). Regulatory loopholes are created by overlapping authorities and uneven state - level enforcement, which permits the international spread of invasive species. Hence the court cases involving environmental risk assessments and agricultural biotechnology can cause delays, by establishing a list of invasive species of concern, this regulation mandates the member states to take steps to prevent, identify, and eradicate these species. The EU takes a more cautious stance than the US, limiting the import and sale of species that pose a high danger of invasion[11]. Under the Habitat and Birds Directives, the EU also incorporates IAS control into biodiversity protection efforts. Conflicts between conservation objectives and commercial interests, as well as differences in country implementation, make enforcement difficult. For example, sectors like aquaculture and horticulture that depend on exotic species usually oppose trade and investment restrictions.

In developing countries pose restrictions because of their limited financial resources, socioeconomic agendas in regulating IAS. Many depend on donor - funded initiatives and international support to carry out conservation and phytosanitary measures. The National Environmental Management, Biodiversity Act (NEMBA) of South Africa, for instance, offers a legislative foundation for invasive species control; nevertheless, enforcement is hampered by a lack of resources and capacity issues. Similar to this, Southeast Asian nations find it difficult to control IAS brought in by aquaculture and agriculture since economic demands frequently take precedence over environmental concerns. In certain situations, community - based management and traditional knowledge are essential components of IAS control that support official legal systems, the incorporation of indigenous and local knowledge systems into national programs is limited by the absence of explicit legal recognition.

Difficulties with Implementation and Enforcement: Effective IAS regulation is hampered by a number of issues, even in the face of international treaties and domestic legislation:

[8] The International Plant Protection Convention (IPPC) establishes standards for preventing the spread of pests and diseases via plant trade. See FAO, IPPC, 1952 (revised 1997).

[9] Convention on Biological Diversity (CBD), 1992. Article 8(h). Available at: https://www.cbd.int/convention/articles/?a=cbd-08

[10] National Invasive Species Act (NISA), 1996. United States Code. Available at: https://www.congress.gov/bill/104th-congress/senate-bill/1660

[11] WTO Dispute Settlement: European Communities – Measures Affecting the Approval and Marketing of Biotech Products, 2006. Available at: https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds291_e.htm

a) Weak enforcement mechanisms: Many nations lack the resources, manpower, and infrastructure needed to properly monitor and manage IAS.
b) Conflicting policy goals: Trade liberalization, agricultural development, and economic growth frequently clash with conservation interests, creating regulatory gaps.
c) Insufficient coordination: IAS management is dispersed and uneven as a result of environmental, agricultural, and trade authorities overlapping jurisdictions.
d) Concerns about access and intellectual property: The adoption of proprietary solutions for IAS control is limited in regions with limited resources.
e) Legal disputes and public opposition: Legal disputes resulting from disputes over genetically modified biocontrol agents and trade restrictions postpone taking meaningful action.

International accords, national laws, and policy tools make up the intricate and dynamic legal framework for IAS regulation. Although broad principles are provided by treaties like the CBD, IPPC, WTO & TRIPS Agreement, their efficacy is dependent on national implementation and enforcement. The United States, the European Union, and emerging nations all have different strategies, each having advantages and disadvantages. Access to biocontrol technology, policy conflicts, and enforcement gaps are only a few of the major obstacles that still exist. Achieving long - term sustainability in invasive species management requires bolstering institutional and legal capabilities, encouraging global collaboration, and incorporating traditional knowledge into IAS regulations.

4. Conflicts and Challenges at the Intersection of IPRs and IAS Regulation

Issues and Difficulties at the Confluence of IAS Regulation and IPRs, there are many conflicts and difficulties at the nexus of invasive alien species (IAS) management and intellectual property rights (IPRs), especially when it comes to striking a balance between biodiversity conservation and innovation. This has become even more complex because to the growing use of genetic modification and biotechnology in the management of IAS, which raises ethical, financial, and legal issues. The monopolization of genetic resources, instances of biopiracy, legal gaps in the commercialization of invasive species, and discussions on the use of proprietary biotechnologies in IAS control are just a few examples of how these tensions show up.

Conflicts Between Biodiversity Conservation and Patents:
The relationship between biodiversity conservation and patent protection is one of the main areas of contention between IPRs and IAS regulation. Commercial interests are frequently given precedence over ecological sustainability in intellectual property regimes, especially when it comes to patents on genetically modified organisms (GMOs) and biological control agents. Numerous patented biotechnologies, such as modified organisms intended to inhibit invading species or genetically modified crops resistant to invasive pests, are created to solve issues associated to IAS. Nonetheless, companies are granted exclusive rights by these patents, giving them authority over the distribution, pricing, and access of vital technologies

Bt cotton and Bt maize, for instance, are genetically modified crops that have been created to withstand invasion pests. Although these crops lessen the need for chemical pesticides, traditional agricultural methods like sharing and preserving seeds are restricted by their patent restrictions. Concerns are raised over the loss of agrobiodiversity as a result of farmers growing reliance on a few numbers of powerful seed companies, the use of genetically modified crops has occasionally resulted in unforeseen ecological repercussions, such as the rise of secondary pests or resistance in target insect populations, which has made problems associated with IAS worse.

In a similar case, patents on biological control agents, like bacteria or fungus that have been genetically modified to fight invading agricultural pests, may restrict their availability to nations with lower economic standing. Despite being among the most impacted by IAS, many of these nations especially those in the Global South do not have the resources to purchase patented remedies[12]. In biotechnology driven IAS control, the focus on IPRs frequently obscures ecological knowledge and community - based management techniques that have been successful for millennia in some areas.

5. Issues of Bio - Piracy, Monopolization, and Corporate Control Over Genetic Resources

Concerns Regarding Corporate Control Over Genetic Resources, Monopolization, and Bio - Piracy, companies or researchers take advantage of genetic resources and traditional knowledge from biodiversity - rich locations without providing local populations with fair remuneration, is another major issue at the nexus of IPRs and IAS legislation. Biological control agents from foreign environments are frequently used in invasive species management, raising questions concerning the morality and legality of their commercialization.

Large agricultural and biotechnology firms have lobbied for policy frameworks that prioritize proprietary biocontrol solutions, often sidelining non - commercial or community - led strategies. In some cases, invasive species management programs have been structured around the use of patented technologies, even when alternative, more sustainable methods exist. This dominance of corporate interests in IAS regulation undermines the goal of biodiversity conservation, as financial incentives often drive decision - making rather than ecological considerations. Questions about equity and access are brought up by this monopolization of genetic resources, especially for nations that make substantial contributions to biodiversity worldwide yet gain little from its commercialization.

Legal Vulnerabilities still permit the sale of species having the potential to become invasive, despite efforts to limit IAS[13]. The absence of strict risk assessment procedures prior to

[12] Phillips, P. W. B., & Onwuekwe, C. E. (2007). *Accessing and Sharing the Benefits of the Genomics Revolution.* Springer.

[13] Global Invasive Species Database (GISD). Available at: http://www.iucngisd.org/gisd/

introducing non - native species for use in aquaculture, horticulture, or agriculture is one of the main problems. Because patented species or genetically modified organisms frequently receive preferential treatment in regulatory approval processes, intellectual property protection can make this problem even more complicated. For instance, because of their great economic worth, some fast - growing tree species, including acacia and eucalyptus, have been imported for commercial forestry in a number of nations. But in a number of instances, these species have gotten out of control and spread, endangering local biodiversity and changing water cycles. Regulatory systems have had difficulty limiting their commercialization despite knowing concerns since the financial gains from producing biomass or lumber frequently outweigh the disadvantages. Comparably, if genetically engineered fish, like the transgenic Atlantic salmon produced by AquaBounty, escape into the wild and reproduce with native populations, there may be ecological hazards. The long - term environmental effects of these biotechnologies are still unknown, despite supporters claim that they can improve food security and lessen the strain on overfished fisheries. There is lacuna in effective IAS prevention and control because the legislative frameworks governing the commercialization of genetically modified animals frequently prioritize economic viability over environmental stability.

6. The Role of Biotechnology and Genetic Modification in Managing IAS

In the management of IAS, biotechnology and genetic modification have become both a possible remedy and a contentious issue. New options for lowering invasive populations are provided by genetically modified organisms created for biocontrol, such as gene drive technology or genetically modified mosquitoes[14]. Hence here are moral, environmental, and legal issues with their use. As an illustration, consider the creation of genetically modified mosquitoes by businesses such as Oxitec, which are intended to reduce the numbers of invasive mosquito species that spread diseases like dengue and malaria. The long - term ecological implications are yet unknown, despite field trials showing modest efficacy in lowering target populations[15]. Ecosystems may be unexpectedly disrupted by the unintended repercussions of introducing genetically modified organisms into the environment, nations that stand to gain the most from the use of these technologies may find their access restricted by the patents governing them. Another contentious method in the treatment of IAS is gene drive technology, which enables researchers to introduce particular genetic features into invasive populations. Gene drives carry a number of hazards, including the possibility of off - target effects and irreversible genetic alterations that could impact non - target species, even if they have the ability to remove dangerous invading species. There are several difficulties at the nexus between IPRs and IAS regulation, especially when it comes to striking a balance between business interests and biodiversity preservation. The commercialization of potentially invasive species, bio - piracy concerns, and the monopolization of biocontrol technology all serve to illustrate the tensions that develop when environmental concerns and proprietary rights collide. Regulatory measures are made more difficult by legal gaps that allow the introduction of species with the potential to be invasive as well as the expanding role of biotechnology in IAS control. A multifaceted strategy is needed to resolve these issues, including improved risk assessment procedures, fair access to biocontrol technology, and laws that put ecological integrity ahead of profit.

7. Conclusion and Suggestions

There are legal, moral, and financial difficulties in regulating Invasive Alien Species (IAS) at the nexus of environmental law and intellectual property rights (IPRs). Concerns regarding monopolization, biopiracy, and the environmental hazards of proprietary solutions have been brought up by biotechnology and corporate control over genetic resources. The main objectives of legal reforms should be to guarantee fair access to biotechnological solutions, balance IPR protection with biodiversity conservation, and IAS management with sustainable development objectives.

Legal Reforms: Juggling the Preservation of Biodiversity with the Protection of IPRs

Commercial innovation is frequently prioritized over ecological sustainability in current IPR frameworks, especially patent laws. Patents can restrict accessibility, especially for underdeveloped nations, even though they encourage the development of innovative IAS control technology. Principles of biodiversity protection should be included into IPR policies through legal reforms, such as demanding ecological risk assessments prior to patenting genetically modified organisms or biological control agents. Broader access to essential IAS management tools may be ensured by mandatory licensing procedures. To stop bio - piracy and the privatization of genetic resources, patent eligibility requirements must also be improved to differentiate between naturally occurring biological control agents and innovations that have been altered by humans. It is important to establish open - access databases for IAS research to Improved IAS Control Enforcement Mechanisms: International agreements such as the Convention on Biological Diversity (CBD) and the International Plant Protection Convention (IPPC) are in place, but enforcement is still lacking. Unregulated trade makes the issue worse, and many nations lack the resources necessary to control IAS introductions. Campaigns for public awareness can also aid in halting the introduction of IAS through human endeavours such as aquaculture and the pet trade. Many patented options, including tailored biological control agents and genetically modified crops, are still too costly. By making IAS control advances publicly available, promoting open - source biotechnology helps combat monopolization. To create and disseminate non - proprietary IAS management solutions, governments and international organizations ought to fund public research institutes. Introduction of biological control agents and genetically modified organisms should be guided

[14] Oxitec Ltd. (2021). *Innovative Solutions for Controlling Invasive Mosquito Species.* Available at: https://www.oxitec.com

[15] Piaggio, A. J., Segelbacher, G., Seddon, P. J., & Alphey, L. (2017). "Is it time for synthetic biodiversity conservation?" *Trends in Ecology & Evolution*, 32(2), 97-107.

by risk evaluations and environmental impact studies. The precautionary principle should be used by policymakers to reduce unforeseen ecological effects. Important insights can be gained by incorporating traditional ecological knowledge into IAS management. For a more comprehensive approach, technology advancements should be complemented with nature - based solutions like habitat restoration and the introduction of natural predators. There are both advantages and disadvantages to the strong relationship between IPRs and IAS regulation. Patents have stimulated innovation, but they have also resulted in access restrictions, monopolization, and biopiracy. The commercialization of invasive species has been made possible by lax enforcement and legal loopholes, and biotechnology involvement in managing IAS offers both benefits and threats. Through interdisciplinary cooperation between legal professionals, environmentalists, and legislators, a balance between IPR protection and biodiversity conservation must be achieved. Transparency, equity, and sustainability should be the main goals of reforms to make sure that IAS control measures serve the interests of global biodiversity rather than business interests. In order to reduce IAS risks and encourage innovation for the benefit of society, it will be essential to integrate sustainable development concepts, support open - source biotechnology, and strengthen enforcement measures.