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Urgency of sui generis genetic resources law in order to prevent plant biopiracy in Indonesia

Dian Nurfitri *, Simona Bustani and Sri Bakti Yunari

Law Department, Faculty of Law, Trisakti University, West Jakarta City, DKI Jakarta 11440, Indonesia.

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Abstract

Indonesia, as a mega-biodiversity country, holds vast plant genetic resources (PGR) with immense potential for bioprospecting in pharmaceuticals, cosmetics, and food industries. However, the absence of a specific legal framework has left these resources vulnerable to biopiracy unauthorized foreign exploitation without fair benefit sharing for indigenous communities. Existing laws, including the Patent Law, Communal Intellectual Property Regulation, and Conservation Acts, inadequately protect traditional knowledge and collective rights. This legal vacuum has allowed foreign entities to patent innovations derived from Indonesia's biodiversity, marginalizing local communities. Moreover, fragmented institutional oversight, lack of a unified genetic resource database, and limited public awareness further weaken protection efforts. Drawing from international instruments such as the Nagoya Protocol and practices from India and Malaysia, this study advocates for a sui generis legal system tailored to Indonesia's ecological and socio-cultural context. Such a framework must include access and benefit-sharing (ABS) mechanisms, centralized data inventories, digital information systems, and institutional reforms. Proactive legal recognition of indigenous rights and participatory governance are essential for ecological justice and biodiversity preservation. This study concludes that a dedicated Sui Generis Law on Genetic Resources is urgently needed to ensure sovereignty, equity, and sustainable use of Indonesia's biological wealth.

Keywords: Genetic Resources; Biopyracy; Access and benefit sharing; Sui Generis; Traditional Knowledge

1. Introduction

Indonesia, as a mega-biodiversity nation, possesses abundant and diverse plant genetic resources (PGR), including endemic species with medicinal, nutritional, and ecological significance. Based on data from the Indonesian Institute of Sciences (LIPI, 2014), Indonesia holds approximately 15.5% of the world's flora species, ranking second only to Brazil. Genetic resources, as defined under Law No. 5 of 1994, are biological materials containing hereditary functional units with actual or potential value. These resources are essential not only for national development but also attract significant interest from foreign entities, especially in the pharmaceutical, cosmetic, and food industries. The practice of bioprospecting, involving the systematic search for valuable biochemical and genetic resources, has yielded commercially successful compounds—such as anticancer agents from Bajakah (*Spatholobus littoralis*) and cosmetic ingredients from Jernang (Daemonorops draco). Yet, such utilization frequently occurs without appropriate legal frameworks to ensure benefit sharing with indigenous communities, whose traditional knowledge often contributes to such discoveries. Moreover, this exploitation threatens the preservation of genetic diversity due to habitat destruction, lack of regeneration policies, and minimal community-based conservation. Consequently, a comprehensive and ecologically sound legal framework is urgently needed to safeguard these resources while upholding the constitutional recognition of indigenous rights as stipulated in Articles 33(3) and 18B(2) of the 1945 Constitution [1].

* Corresponding author: Dian Nurfitri.

Medicinal plants in Indonesia are one of the genetic resources of plant species that have the potential as raw materials for bioprospecting which are products of high economic value (added value). The potential for utilizing genetic resources of Indonesian plant species, especially those that are forest commodities has been conveyed by the Director General of Natural Resources and Ecosystem Conservation Satyawan Pudyatmoko to dominate the world market, where around 40 - 50% of drugs circulating in the market use natural products and 10 out of 25 pharmaceutical products contain natural ingredients. "Biomimicry" technology that uses an innovative approach to developing new technology by imitating natural technology and the need for the development of drugs and vaccines for new diseases, the need for food security and the need for cosmetics circulating in the world market that contain natural products is also a potential genetic resource of plant species that has very high utility and economic value [2].

Some examples of bioprospecting originating from forest conservation areas include anti-cancer compounds from Bajakah (*Spatholobus littoralis*) in the Central Kalimantan; cosmetic raw materials from Jernang (Daemonorops draco) in Bukit Dua Belas National Park; beauty and cosmetics in the form of Heels Cream from the *Climedia hirta* species in BTN Gunung Merapi; Herbal Medicine Raw Materials, Antibacterial from Kedawung (*Parkia moriana*) in Meru Betiri National Park; Anti-Cancer Compounds from Candidaspongia (*Candaspongia spp*) in East Nusa Tenggara; and Anti Frost from PGMJ bacteria (*Parkia timoriana*) in Mount Ciremai National Park. These bioprospecting products are a great opportunity for Indonesia as a country that holds ownership rights over its biodiversity, to be developed in the pharmaceutical, drug, cosmetic, and other industries to improve the welfare of the Indonesian people, especially indigenous peoples in areas where the plant genetic resources originate.

In addition to medicinal plants, food plants are also one of the genetic resources of plant species that have the potential as raw materials for bioprospecting which is a product of high economic value. Traditionally, bioprospecting has been carried out for a long time from generation to generation by our ancestors, in order to explore the benefits of plants for medicine or food or a source of food. Bioprospecting of food crops is carried out using a metabolomics approach in the form of mapping at the metabolome level, where the metabolome is the end product of gene expression which is usually in the form of sugars, nucleotides, amino acids, and lipids. Examples of bioprospecting products in Indonesian food commodities, for example tropical fruits such as mango, mangosteen, banana, and pineapple; coffee and chocolate plantation products; aquaculture products such as shrimp; and fermented products, for example tempeh and shrimp paste (Terasi) [3].

The great benefits of biodiversity in human life such as for the environment, social, economy can also be interpreted that the loss of biodiversity can be the cause of a global crisis. One of the global crises that can occur is a crisis that threatens the future of the earth and humans caused by three things, namely climate change, pollution and loss of biodiversity (Triple Planetary Crises). In addition to the future of the earth and humans, the loss of biodiversity can also pose a threat of decreasing the area and forest cover in Conservation and Protected Areas against flora and fauna Extinction. Bappenas shows that the decrease in forest cover has an impact on increasing the threat of flora and fauna extinction and the loss of ecosystem services that are essential for humans [4].

Medicinal plants in Indonesia are one of the genetic resources of plant species included in the forest and garden commodity group whose genetic erosion is relatively rapid. This is caused by several factors, namely (1) habitat damage caused by the pressing need for land for production and housing, utilization of forest products for industry and housing so that the habitat of medicinal plants is disturbed, (2) lack of attention to the cultivation of medicinal plants, especially for types used in small quantities, and (3) the slow regeneration ability of medicinal plants, especially annual plant types, as well as the large-scale exploitation of medicinal plants by the foreign pharmaceutical industry [5].

In addition, the wealth of genetic resources of Indonesian agricultural plants also continues to decrease due to minimal genetic conservation efforts. Muhammad Syukur reported that the amount of germplasm in Indonesia reaches 17 percent of the total genetic wealth of plants in the world and as many as 3,256 plant species have not been explored. Excessive utilization of certain types of plant varieties has caused the diversity of other plant genetic resources to be lost and reduced by up to 75 percent. Therefore, efforts are needed to improve plants and save agricultural genetic diversity through genetic banks and encourage planting a variety of local plant varieties among farmers [6].

Given the fact that Indonesia's biodiversity and genetic resources, as well as the socio-cultural diversity of Indonesian society that is rich in culture and traditional knowledge, in addition to being an extraordinary potential for the welfare of Indonesian society, are also attractive to countries that do not have resources but have the technology to be able to utilize them, so that this genetic wealth is now facing a serious threat in the form of biopiracy, namely the practice of taking genetic resources by foreign parties without permission and without fair compensation to the community as the rights holder. This can be seen from the fact that Indonesia's biodiversity and genetic resources, as well as the socio-cultural diversity of Indonesian society that is rich in culture and traditional knowledge, in addition to being an

extraordinary potential for the welfare of Indonesian society, are also attractive to countries that do not have resources but have the technology to be able to utilize them, then biodiversity and genetic resources and the socio-cultural diversity of society that includes traditional knowledge must be managed and maintained to prevent theft or biopiracy of genetic resources in Indonesia [7]. Biopiracy is the practice of taking, utilizing, and commercializing genetic resources by foreign parties without permission and without fair distribution of benefits to local communities or their country of origin. This practice is generally carried out by multinational corporations from developed countries that exploit the weaknesses of the legal systems of developing countries in protecting their biological resources [8]. One of the most famous cases is the patent on the "Tapak Dara" plant by a foreign pharmaceutical company based on Indonesian endemic flora [9]. Ironically, Indonesia as the owner country does not receive economic benefits from this high-value product because there is no institution capable of verifying the origin of the resource, submitting formal objections in international forums, or conducting systemic legal advocacy.

The utilization of genetic resources into a product of economic value (bioprospecting) is usually always accompanied by the use of traditional technology originating from local communities that is passed down from generation to generation. As an agricultural country, Indonesia has various traditional technologies in the agricultural sector that differ in each region. The differences in traditional technology in the agricultural sector are greatly influenced by the geographical and climatic conditions of the area. For example, Indonesia has traditional technology originating from the Bali region known as the "Subak System". The Subak system is a method of managing an agricultural system that has the concept of rice fields that are made in tiers so that they have an irrigation system that is able to meet the irrigation needs of all existing rice fields. This irrigation concept was created because the geographical conditions in the Bali region are hilly [10]. The traditional technology "Subak System" from the Bali region is one part of traditional knowledge that can improve the economy of the Balinese people and can also be an attraction for Balinese tourism. This fact is always utilized by developed countries in developing their technology to meet their needs. Developed countries will always focus on their industrial interests by utilizing genetic resources as well as traditional knowledge owned by developing countries such as Indonesia.

The absence of comprehensive legal protection for SDGs is the root of the main problem. Existing legal instruments such as Law No. 13 of 2016 concerning Patents, Law No. 28 of 2014 concerning Copyright, and Government Regulation No. 56 of 2022 concerning Communal Intellectual Property, have not been able to protect the economic and moral rights of indigenous peoples substantively. In fact, the concept of access and benefit sharing as mandated by the Nagoya Protocol has not been optimally implemented because there are no operational regulations at the national level. This condition creates a legal vacuum that has a direct impact on economic and ecological losses. Unsupervised exploitation of genetic resources has caused genetic erosion, loss of local germplasm, and marginalization of traditional knowledge that has been passed down from generation to generation. In fact, indigenous peoples are the main actors in the preservation and sustainable use of biological resources [11].

The state through Article 33 paragraph (3) of the 1945 Constitution of the Republic of Indonesia is given a mandate to control Indonesia's natural resources and use them as much as possible for the prosperity of the people. On the other hand, Article 18B paragraph (2) mandates the recognition and respect of the rights of indigenous peoples. However, without a sui generis legal instrument, the implementation of this mandate is difficult to realize fairly and effectively. Therefore, the urgency of the formation of a Sui Generis Law on Genetic Resources cannot be postponed any longer. This law is needed to

- Ensure recognition and protection of the collective rights of indigenous peoples to the genetic resources;
- Realizing distributive justice through benefit sharing mechanisms for the use of genetic resources;
- Strengthening Indonesia's position in international forums that regulate biodiversity and intellectual property.

With a specific, comprehensive, and ecological justice-based legal framework, Indonesia can maintain the sovereignty of its biological resources while improving the welfare of local communities in a sustainable manner.

1.1. Formulation of the problem

Given the urgent need for a dedicated legal framework, this study poses the following core legal questions:

- What are the existing legal vacuums and substantive shortcomings within Indonesia's current legislative and regulatory framework concerning the protection of plant genetic resources?
- To what extent can a sui generis legal framework for plant genetic resources realize ecological justice and ensure the constitutional and international protection of collective rights?

2. Research methods

This study employs a normative juridical approach, utilizing doctrinal legal research based on primary and secondary legal sources. It emphasizes the normative analysis of prevailing statutes, legal doctrines, international agreements, and comparative practices from selected jurisdictions relevant to the protection and governance of genetic resources and traditional knowledge.

3. Discussion

3.1. Legal Gaps and Weaknesses in the Protection of Genetic Resources in Indonesia

Until now, Indonesia has not had specific laws and regulations that regulate the protection of genetic resources in a comprehensive manner. The lack of protection of plant genetic resources as raw materials for medicines and food raw materials and related traditional knowledge that cannot protect the rights of indigenous peoples as owners of plant genetic resources and carriers of traditional herbal knowledge can be linked to intellectual property laws and other laws and regulations related to the protection of plant genetic resources. Protection of genetic resources has been regulated in Law Number 13 of 2016 concerning Patents[1], Article 26 paragraph (1), which states that "If an Invention is related to and/or originates from genetic resources and/or traditional knowledge, the origin of the genetic resources and/or traditional knowledge must be clearly and correctly stated in the description". This regulation is based on concerns that domestic and foreign inventors or patent applicants often utilize genetic resources and/or traditional knowledge in Indonesia to produce new inventions without honestly stating the origin of the genetic resources and/or traditional knowledge utilized. If observed together with the provisions in Article 26 paragraph (1) of Law Number 13 of 2016 concerning Patents[1], it only emphasizes the mention of the origin of genetic resources in the description of the Patent application submitted, and does not prevent the granting of patents for the use of plant genetic resources and traditional knowledge. Here it is clear that Law Number 13 of 2016 concerning Patents[1] only regulates genetic resources related to new inventions in the field of technology that contain inventive steps and can be applied in industry that can be protected as patents and their use. Meanwhile, other genetic resources that are not related to new inventions in the field of technology cannot be protected as Patents. Thus, Law Number 13 of 2016 concerning Patents[1] cannot provide protection for all forms of genetic resources and/or traditional knowledge. Protection in Law Number 13 of 2016 concerning Patents[1] is actually given to foreign inventors as owners of modern technology that utilize the genetic resources of the Indonesian people [12].

Furthermore, in Article 26 paragraph (2) of Law Number 13 of 2016 concerning Patents[1] which reads "Information on genetic resources and/or traditional knowledge as referred to in paragraph (1) is determined by an official institution recognized by the government" basically requires patent applicants to report their plant genetic resources used in the development of their inventions to an official state institution. This is intended so that the government obtains information on the use of these plant genetic resources which can then be used for the implementation of profit sharing with the aim of providing the rights of indigenous legal communities. However, until now there has been no determination of an official institution recognized by the government so that the implementation of Article 26 of Law Number 13 of 2016 concerning Patents[1] cannot be implemented.

The intent and purpose of this statement Article 26 paragraphs (1) and (2) are further emphasized in Article 26 paragraph (3) which reads "The distribution of results and/or access to the utilization of genetic resources and/or traditional knowledge as referred to in paragraph (1) is carried out in accordance with laws and regulations and international agreements in the field of genetic resources and traditional knowledge". This statement clearly shows that the reason for mentioning the origin of genetic resources and/or traditional knowledge in the description aims to support Access Benefit Sharing or the sharing of benefits from the utilization of genetic resources and/or traditional knowledge. The Patent Law does not further regulate the implementation of Access and Benefit Sharing or the sharing of benefits from the utilization of genetic resources and/or traditional knowledge. Thus, the protection of economic rights and moral rights in accordance with the intellectual property system for SDG and/or traditional knowledge has not been clearly seen. The patent protection system is an intellectual property regime in the industrial sector that provides personal exclusive rights to a product or process in the field of technology, so that protection of genetic resources provided through this patent system is only given to inventors/applicants who produce an invention in the form of a product or process produced by utilizing genetic resources and/or traditional knowledge, while the owner of the genetic resources used to produce the invention cannot be protected by this patent system [12].

In 2022, the government issued Government Regulation Number 56 of 2022 concerning Communal Intellectual Property. In principle, this government regulation regulates and aims to provide protection, preservation, development,

and utilization of communal intellectual property in accordance with the values contained in Pancasila and the 1945 Constitution of the Republic of Indonesia, as specifically stated in Article 2 of this Government Regulation. As previously discussed in accordance with the ideals of the Indonesian nation and for the welfare and prosperity of the people, the right to communal intellectual property is held by the state and the state has an obligation to inventory, maintain, and preserve communal intellectual property. What is interesting in Government Regulation Number 56 of 2022 is that the right to communal intellectual property is an inclusive moral right. As we know, the concept of moral rights is a right inherent in the creator or perpetrator that cannot be removed or deleted without any reason even though the copyright has been transferred. Moral rights in this case are the rights of the creator to prohibit or grant permission to other parties to add or reduce the contents of the creation, remove the name of the original creator, change the title of the creation, and others [13]. However, in the Government Regulation on Communal Intellectual Property, inclusive moral rights are defined as moral rights that can involve parties who are committed to caring for, maintaining, preserving, developing, and using communal intellectual property, which is very different from the concept of moral rights in general. The application of the concept of inclusive moral rights is something new in the protection of communal intellectual property both in Indonesia and outside Indonesia, this concept is expected to increase the effectiveness of the protection of communal intellectual property in Indonesia, which until now has been underestimated by the Indonesian people.

Protection of communal intellectual property in Indonesia After the issuance of Government Regulation Number 56 of 2022 concerning Communal Intellectual Property, it basically provides great hope for legal protection of communal intellectual property, especially legal protection of genetic resources and traditional knowledge through the concept of communal (group) protection which can increase the protection of communal intellectual property owned by indigenous peoples, in this case the community of origin. However, the concept of inclusive moral rights in Government Regulation Number 56 of 2022 concerning Communal Intellectual Property which involves parties who are committed to caring for, maintaining, preserving, developing, and utilizing communal intellectual property can be a loophole for foreign interests to steal (Biopiracy) of Indonesian genetic resources and traditional knowledge [14]. Instead of wanting to invest and develop Indonesian genetic resources and traditional knowledge, foreign companies, especially pharmaceutical and cosmetic companies, will compete to take advantage of genetic resources and traditional knowledge to be used as products of high economic value without providing benefits to the local communities producing these genetic resources and traditional knowledge.

Legal protection of genetic resources through Government Regulation Number 56 of 2022 concerning Communal Intellectual Property also has a very clear weakness where Government Regulation Number 56 of 2022 concerning Communal Intellectual Property only focuses on the protection, maintenance, maintenance and utilization of communal intellectual property through a communal intellectual property information system built by the government. Meanwhile, the regulation of the utilization of communal intellectual property for commercial purposes and the sharing of benefits from said communal intellectual property including obtaining access permits for genetic resources and traditional knowledge are again regulated by the provisions of each statutory regulation. Government Regulation Number 56 of 2022 concerning Communal Intellectual Property does not provide any sanctions for violations that occur due to the exploitation or unauthorized utilization of genetic resources and traditional knowledge that harms local communities. Thus, Government Regulation Number 56 of 2022 concerning Communal Intellectual Property has not been able to provide justice and legal certainty to local communities regarding the illegal use of genetic resources and traditional knowledge they possess and Government Regulation Number 56 of 2022 concerning Communal Intellectual Property does not provide a meaningful legal solution to the legal protection of genetic resources and traditional knowledge in Indonesia.

Other laws and regulations related to genetic resources also raise legal issues in the implementation of plant genetic resource protection. Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and Their Ecosystems and Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and Their Ecosystems. These regulations regulate traditional knowledge related to genetic resources as part of genetic resources that have real and potential value. By including traditional knowledge as part of the definition of genetic resources, this shows that Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and Their Ecosystems recognizes that traditional knowledge has a very important value in maintaining, preserving and developing genetic resources into products that have real and potential economic value. Furthermore, in the explanation of Article 8 paragraph (4) letter d of the Republic of Indonesia Law Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Natural Resources and Ecosystems, it is also explained that traditional knowledge related to genetic resources is part of the area managed jointly by the local community that is protected. The importance of traditional knowledge in developing genetic resources into products

that have real and potential value requires the government to immediately protect and regulate traditional knowledge as one of the areas managed jointly by the community that must be protected, maintained, maintained and developed.

In principle, Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and their Ecosystems aims to realize the sustainability of biological natural resources and the balance of their ecosystems so that they can better support efforts to improve community welfare and improve human life. Conservation of biological natural resources is carried out by means of conservation through activities to protect life support systems, preserve the diversity of plant and animal species and their ecosystems and sustainable use of biological natural resources and their ecosystems. Specifically, Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and their Ecosystems states that traditional knowledge related to genetic resources is part of genetic resources that have real and/or potential value that must be utilized. Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and their Ecosystems only focuses on protecting traditional knowledge related to genetic resources for the purpose of preserving and conserving biological natural resources to prevent the loss and extinction of biological natural resources, especially genetic resources. Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and their Ecosystems does not regulate and protect genetic resources against the risk of loss of potential economic value from the utilization of the results of genetic resources and/or traditional knowledge related to genetic resources. Both of these Natural Resource and Ecosystem Conservation Laws do not regulate the mechanism for access or permits for sampling of plant genetic resources. Although Law of the Republic of Indonesia Number 32 of 2024 concerning Amendments to Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and their Ecosystems Article 36A paragraph (7) which reads "The government provides equitable distribution of results from the Sustainable Utilization of Biological Natural Resources and their Ecosystems in accordance with the provisions of laws and regulations" has regulated equitable distribution of results from the utilization of plant genetic resources but cannot be implemented. This is of course because there are no laws and regulations that regulate equitable distribution of results from the utilization of plant genetic resources.

Law number 12 of 1992 concerning the plant cultivation system and Law of the Republic of Indonesia Number 22 of 2019 concerning the Sustainable Agricultural Cultivation System. The plant cultivation system is a system of development and utilization of natural plant resources through human efforts that with capital, technology, and other resources produce goods to better meet human needs. The supervision regulated in this Law is supervision of the procurement and distribution of improved seeds by determining the types of plants whose removal from and/or entry into the territory of the Republic of Indonesia through a licensing mechanism. Meanwhile, plant protection is carried out with an integrated pest control system by preventing the entry of plant pests into and spreading from one area to another within the territory of the Republic of Indonesia, controlling plant pests and eradicating plant pests. The mechanism for the distribution of the results of this plant cultivation is not regulated in the provisions of this Law.

To regulate and protect genetic resources originating from plantation crops, the government issued Law of the Republic of Indonesia Number 39 of 2014 concerning Plantations. The Customary Rights of Customary Law Communities are recognized in the provisions of this law. Customary Rights are the authority of customary law communities to jointly regulate the use of land, territory, and natural resources in the territory of the legal community that are the source of their lives and livelihoods. Article 12 explicitly states that Plantation Business Actors must obtain approval from the Customary Law Community that holds Customary Rights for land that will be used for plantation businesses. Similar to the law on plant cultivation systems, in the provisions of this law, regulations are made starting from the regulation of plant seeds, production processes to harvest results. The next policy direction for regulating plantation crops also includes plantation research and development intended to produce the science and technology needed in developing plantation businesses in order to provide added value, high competitiveness and environmental friendliness by respecting local wisdom. Although one of the policy directions of this plantation law is the development of plantation businesses, unfortunately this law does not regulate access and profit sharing from the use of genetic resources from plantation crops.

Law Number 29 of 2000 concerning Protection of Plant Varieties grants special rights to plant breeders to use their own varieties or grant permission to other persons or legal entities to use them for a certain period of time, known as Plant Breeders` Rights. Plant Breeders` Rights are granted for 20 years for annual plants and 25 years for perennial plants. Plant varieties that can be granted plant variety protection include plant varieties from new, unique, uniform, stable, and named plant species. As a manifestation of the sovereignty of the State as stated in Article 33 paragraph (3) of the 1945 Republic of Indonesia Law, Article 7 of Law Number 29 of 2000 concerning Protection of Plant Varieties states that local varieties owned by the community are controlled by the State and planting of local varieties is granted by the

government. The legal problem raised in Law Number 29 of 2000 concerning the Protection of Plant Varieties is that if the plant breeders and plant breeding technology are foreign parties, then the rights of indigenous peoples as owners of wild plant genetic resources cannot be protected and there is no sharing of benefits obtained by indigenous peoples from the commercialization of products that are guilty of developing wild plant genetic resources [15].

In order to implement the mandate of legal protection for traditional knowledge, the Indonesian government issued Law Number 5 of 2017 concerning the Advancement of Culture. This law is the embodiment of Article 32 paragraph (1) of the 1945 Republic of Indonesia Law which mandates the State to advance Indonesian culture during world civilization. Law Number 5 of 2017 concerning the Advancement of Culture is an effort by the Indonesian nation to defend itself from the current of globalization which aims to develop, promote, Indonesian culture. Traditional knowledge and traditional technology are specifically included as part of the objects of cultural advancement as stated in Article 5 of Law Number 5 of 2017 concerning the Advancement of Culture. Culture itself is actually a manifestation of the results of human creativity, feeling, will, and work. Culture can be said to be the result of human work in a certain group, which is influenced or characterized by a certain regional or ethnic unit, which is carried out repeatedly and from generation to generation, which then forms a certain identity [16]. Legal protection of traditional knowledge and traditional technology which are part of the objects of cultural advancement in Law Number 5 of 2017 concerning Cultural Advancement is realized in the form of inventory, security, maintenance, rescue, publication and development of cultural advancement assets. Law Number 5 of 2017 concerning Cultural Advancement in principle only provides protection for traditional knowledge and traditional technology as well as science as objects of cultural advancement which aims to maintain and preserve the nation's cultural heritage, develop the noble values of the nation's culture, enrich cultural diversity and improve people's welfare as stated in Article 4 of Law Number 5 of 2017 concerning Cultural Advancement. Law Number 5 of 2017 concerning Cultural Advancement has not provided clear legal certainty that is able to provide rights to local communities in the form of moral rights and economic rights that are able to provide justice and improve the welfare of the community as owners of traditional knowledge and traditional technology [17] [18].

3.2. Ineffectiveness of Structures and Institutions

The absence of a single institution that is holistically responsible for the supervision and protection of genetic resources results in weak governance. The Ministry of Environment and Forestry, the Ministry of Agriculture, the National Research and Innovation Agency, and the Directorate General of Intellectual Property of the Ministry of Law have partial authorities that often overlap and are not integrated. The absence of a single authority specifically responsible for genetic resource governance has resulted in fragmentation of authority between state institutions. Currently, strategic functions related to the protection of genetic resources are sectorally divided between the Ministry of Environment and Forestry, the Ministry of Agriculture, the National Research and Innovation Agency, and the Directorate General of Intellectual Property of the Ministry of Law. However, there is no hierarchical and binding coordination between these institutions, so that the implementation of the Prior Informed Consent and Access and Benefit Sharing principles as stipulated in the Nagoya Protocol is ineffective.

In addition, Government Regulation Number 56 of 2022 concerning Communal Intellectual Property only provides a normative framework without a concrete implementation mechanism. For example, the role of the Directorate General of Intellectual Property of the Ministry of Law as an intellectual property authority is limited to administrative recording and document verification, without having the substantive authority to reject foreign patent applications involving Indonesian genetic resources without a strong legal basis. Another very striking weakness is the absence of an integrated documentation system that can be a verification tool in genetic resource claims. Unlike India which has the authority of the National Biodiversity Authority, Indonesia does not yet have a national database system capable of recording, classifying, and validating the wealth of genetic resources and traditional knowledge of indigenous legal communities3. As a result, Indonesia often does not have sufficient evidentiary basis to reject patent registration for local knowledge in international forums.

The weakness of institutional capacity is also evident from the absence of a firm and integrated sanction mechanism for violations of access to genetic resources. Currently, violations of biological resources are only regulated through sectoral approaches such as environmental conservation or general criminal law, without a specific compensation or restitution scheme for indigenous communities as the original owners of these resources. In terms of social aspects, intellectual property law literacy among indigenous communities is still very low. The lack of socialization often causes local communities to not understand their rights to the genetic resources they have managed for generations, so that the practice of sampling by outsiders often occurs without reporting or objection. On the other hand, law enforcement officers and judges are also not equipped with adequate capacity and legal instruments to resolve biopiracy disputes or conflicts over access to genetic resources.

Thus, the weaknesses of the layered structure and institutions are one of the main causes of why the genetic resource protection system in Indonesia has not been effective. This emphasizes the urgency of establishing a national authority institution for genetic resources1 that is intersectoral and has substantive authority, as well as the development of a national documentation system that can prevent biopiracy practices and strengthen Indonesia's position in international negotiations related to biodiversity.

3.3. Sui Generis Legal Approach

From the perspective of the Intellectual Property Rights legal system, protection of genetic resources and traditional knowledge in Indonesia is still very limited. The current intellectual property system is individualistic, oriented towards new inventions, and does not recognize the concept of communal ownership as is the case in indigenous communities. This makes traditional knowledge that is passed down from generation-to-generation ineligible for protection under conventional patent, copyright, or plant variety regimes. Therefore, the Indonesian intellectual property legal system has not been able to accommodate the unique characteristics of plant genetic resources and traditional knowledge, which actually require a contextual and unique legal approach. Cases of biopiracy such as the patent on turmeric by the University of Mississippi or the filing of a patent on soapberry plants by foreign companies, show that the national intellectual property system does not yet have a safeguard instrument that can prevent unilateral claims by foreign parties. Indonesia only requires disclosure of the origin of its genetic resources and traditional knowledge in its patent system and has not required evidence of prior informed consent and mutual agreements that support the implementation of Access and Benefit Sharing, which causes an imbalance in control over claims over local SDGs. This inconsistency requires Indonesia to develop an alternative intellectual property legal system, namely communal or sui generis intellectual property protection, which can guarantee the recognition of the collective rights of indigenous peoples and prevent illegal exploitation of national biological wealth. The implementation of international principles such as the Nagoya Protocol and the WIPO-IGC (World Intellectual Property Organization – Intergovernmental Committee) forum needs to be internalized into the national IPR system. This can be done through revision of patent regulations and the establishment of legal instruments that require disclosure of origin, indigenous peoples' consent, and benefit sharing as legitimate conditions for granting exclusive rights or inclusive rights to plant genetic resources or in the form of special Sui Generis laws such as the communal "Genetic Resources Law". Thus, the intellectual property law system can function not only as a protection for technical innovation, but also as a mechanism for ecological justice and recognition of local wisdom that has long been the foundation of the biological knowledge of the Indonesian nation.

The implementation of the legal structure in Indonesia can be seen in government institutions, organizations, and officials who implement and enforce the law. In the context of protecting plant genetic resources, the legal structure includes the relevant ministries, the Directorate General of Intellectual Property of the Ministry of Law, research institutions, courts, and environmental institutions. However, in practice, the legal structure in Indonesia has not been built systematically and responsively to deal with the threat of biopiracy. The absence of a national authoritative institution that specifically handles the protection of plant genetic resources and traditional knowledge is the root of the weak supervision and defense of indigenous peoples' rights. Unlike India which has a National Biodiversity Authority and a Traditional Knowledge Digital Library documentation system, Indonesia still relies on cross-institutional coordination that is sectoral and not integrated. As a result, in cases such as the patenting of the soapberry plant by Avon, or the tapak dara by foreign pharmaceutical companies, Indonesia does not have an institution capable of verifying the origin of these resources, submitting formal objections in international forums, or conducting legal advocacy systematically. In addition, the checkpoint function in the Nagoya Protocol system, which should be carried out by the Directorate General of the Ministry of Law or related ministries to monitor whether a patent originates from Indonesian genetic resources, has also not been running effectively. Indonesia does not yet have a cross-check mechanism between the patent system and the national genetic resource database, so that many foreign claims on Indonesian plants escape supervision, such as in the case of Monsanto's filing of a local corn patent, which allegedly used Indonesian germplasm without approval or benefit sharing.

The legal structure of Indonesia also does not provide advocacy institutions or legal representation for indigenous peoples to defend their rights to traditional knowledge. On the other hand, the courts are not yet equipped with the resources and expertise to resolve biopiracy disputes concerning collective rights and customary law. This leaves indigenous peoples in a very weak position structurally and without adequate legal channels to effectively fight for their rights. Thus, the legal structure protecting genetic resources in Indonesia is still fragmentary, passive, and not adaptive to the complexity of biopiracy issues, especially at the global level. Institutional reconstruction is urgently needed, for example by establishing a National Agency for the Protection of Genetic Resources that is cross-sectoral, equipped with administrative and judicial authority to regulate licensing, supervise patents, and represent the state in resolving international disputes. This step will strengthen Indonesia's legal position as a state of law that not only guarantees legal certainty, but also guarantees ecological justice and protection of the communal rights of indigenous peoples to

their own nation's biological wealth. Meanwhile, in terms of legal culture, Indonesia also faces serious challenges in protecting plant genetic resources and traditional knowledge. Legal culture, as explained by Friedman, reflects the values, attitudes, and legal awareness of society and state administrators towards the law itself. In Indonesia, legal awareness regarding the importance of protecting genetic resources and indigenous knowledge is still relatively low. This is reflected in the minimal documentation of traditional knowledge, the weak initiative of the community to carry out recording or registration, and the lack of government attention in encouraging education and legal participation of indigenous communities.

In many cases of biopiracy, such as patents on local ginger, soapberry, or corn plants, indigenous peoples are unaware that their knowledge can and should be protected by law. Conversely, many bureaucrats and law enforcement officers also do not have cultural sensitivity to the communal and spiritual values inherent in these resources. This has led to a gap between state law and customary law, where formal law does not fully reflect justice from the perspective of local communities. Furthermore, the state legal culture still tends to be elitist and top-down, so that indigenous peoples are often not empowered in the legislative process or decision-making concerning their resources. Their lack of involvement in the Free, Prior and Informed Consent mechanism indicates that a participatory and inclusive legal culture has not yet developed.

Therefore, there needs to be a change in the legal paradigm that is more respectful of the value system of indigenous peoples, as well as strengthening collective awareness that legal protection of genetic resources is not only the duty of the state, but also a shared responsibility between communities, academics, and policy makers. By building a strong and just legal culture, Indonesia can strengthen the position of indigenous peoples as legal subjects who are active in protecting genetic resources. This is in line with the ideals of a state of law as mandated in the 1945 Constitution of the Republic of Indonesia Article 28I and 18B, that the state must recognize and respect the unity of indigenous legal communities along with their traditional rights within a legal framework that lives and develops contextually.

Based on Friedman's Legal System Theory, the weak protection of genetic resources and traditional knowledge in cases of plant biopiracy is caused by an institutional structure that is not yet responsive, legal substances that do not accommodate communal rights, and a legal culture that does not support ecological justice and indigenous communities. Future legal reconstruction must include improvements to these three aspects simultaneously to build a just, effective, and contextual legal system.

sui generis legal system must include access and benefit sharing, institutions, data inventory, and information systems. The concept of access and benefit sharing for the utilization of genetic resources initiated in the Convention on Biological Diversity and the Nagoya Protocol answers the concerns of developing countries including Indonesia as the owner of genetic resources including plants to protect their natural wealth. The term "access" according to the Big Indonesian Dictionary (KBBI) is an entry route. Therefore, access to plant genetic resources can be interpreted as an entry route or a way to obtain or take or utilize plant genetic resources for certain purposes.

Article 15 of the Convention on Biological Diversity specifically regulates the mechanism for genetic resources that are the sovereignty and authority of the country providing genetic resources. The Convention on Biological Diversity gives responsibility to member countries providing genetic resources, including:

- Facilitating access to genetic resources for environmentally friendly uses
- Access granted must be based on mutually agreed terms.
- Access to genetic resources must be subject to the prior informed consent of the provider of those genetic resources.
- The providing country must strive to develop and carry out scientific research based on the genetic resources provided.
- Provider countries shall take legislative, administrative or policy measures, through financial mechanisms, with a view to sharing fairly and equitably the results of research and development and the benefits arising from the commercial and other uses of such genetic resources.
- The distribution must be based on mutually agreed provisions.

Based on the provisions of Article 15, related to the mechanism of access to plant genetic resources, the provider country is required to provide a mechanism for access to plant genetic resources based on mutual agreement and Prior Informed Consent from the provider. Providing a mechanism for access to plant genetic resources must of course be supported by the capacity of infrastructure and institutions that are authorized to manage and protect plant genetic resources.

Plant genetic resource providers are countries that own plant genetic resources that provide plant genetic resources to be accessed by applicants or users. In its implementation, plant genetic resource providers can be local governments, local communities or local communities. Plant genetic resource users are parties who apply for access approval to use plant genetic resources for commercial or non-commercial purposes. Plant genetic resource users can be industries or legal entities, individuals or researchers, academics and others.

The country providing the plant genetic resources is the licensing authority for the plant genetic resources. Adopting the provisions of the Indian Biological Diversity Act (The Biological Diversity Act, 2002) Articles 3 and 18 which state that Indian genetic resources can only be accessed with the approval of the National Biodiversity Authority, the Ministry of Environment and Forests, which has authority over wild species plant genetic resources, can act as the "licensee of wild species plant genetic resources" and the Ministry of Agriculture, which has authority over cultivated plant genetic resources, can act as the "licensee of cultivated plant genetic resources".

The provider of plant genetic resource data information is the country providing the plant genetic resources. Adopting the provisions of the Indian Biological Diversity Act (The Biological Diversity Act, 2002) Article 13 that the National Biodiversity Authority can form several committees to carry out their respective duties, then in this case Indonesia can give authority to the Ministry of Law cq. Directorate General of Intellectual Property to provide and build a digital data information system related to plant genetic resources.

Prior informed consent from the provider is the consent given by the national authority of the provider country to the user before accessing genetic resources. In this case, the national authority providing prior informed consent is the provider of plant genetic resource data information, namely the Directorate General of Intellectual Property.

Mutually agreed terms are mutual agreements reached between providers and users of plant genetic resources. The mechanism for accessing plant genetic resources proposed is as follows: Providers of plant genetic resource data information inventory all data information related to plant genetic resources from providers of plant genetic resources, namely local communities, local communities or local governments. Providers of plant genetic resource data information then build a database or digital data information system for plant genetic resources that is easily accessible to the entire world community. Providers of plant genetic resource data information can provide Prior Informed Consent from providers regarding access to plant genetic resources to prospective users of plant genetic resources. In such cases, Providers of plant genetic resource data information must also provide information to providers regarding the Prior Informed Consent from providers given to prospective users. Providers of plant genetic resource data information can also provide recommendations to national authorities granting permission to access plant genetic resources.

Based on the Prior Informed Consent from the provider (prior informed consent) given, users and providers of plant genetic resources can make a mutual agreement. Based on the mutual agreement and recommendations from providers of plant genetic resource data information, users can apply for access permits to the national authority granting plant genetic resource access permits. Furthermore, the provider of plant genetic resource access permits can grant access permits to plant genetic resources and then access to plant genetic resources can be implemented. In order to support the sharing of benefits, data related to access to plant genetic resources must be reported to providers of plant genetic resource data information to be entered into the database.

In the institution, proactive protection needs to be implemented. Proactive protection is protection that is often carried out specifically aimed at protecting genetic resources and traditional knowledge. This protection implies the important role of government and society in supporting the protection of plant genetic resources and traditional knowledge, both through policies, regulations, and their implementation. As defined in the Regional Government Law, the Central Government is the President of the Republic of Indonesia who holds the power of government of the Republic of Indonesia assisted by the Vice President and ministers as referred to in the 1945 Constitution of the Republic of Indonesia, so the role of the central government is carried out by ministries and government institutions in accordance with their respective functions and authorities.

As a mega biodiversity country, the government and local communities as providers of plant genetic resources must proactively and consistently protect their plant genetic resources by requiring a special contract with potential users of plant genetic resources. This contract is to guarantee or prevent any losses for the provider of plant genetic resources and is useful for obtaining benefits from the use of plant genetic resources. The role of the government in implementing proactive protection of plant genetic resources can be implemented by the central government and local governments in collaboration with local communities. Currently, the role of the government in implementing proactive protection has not been running well, which can be illustrated by the many losses experienced by local communities and the many

Biopiracy against plant genetic resources carried out by multinational companies originating from developed countries. Currently, the role and function of government institutions in the protection and management of genetic resources and traditional knowledge are currently carried out by various ministries and cross-sectoral government institutions. There is no government institution that specifically plays a role in implementing proactive protection by regulating and managing the implementation of access and profit sharing from the use of plant genetic resources including contracts as part of its procedural requirements. Therefore, on this occasion the author tries to provide an idea of reconstruction in the form of reconstruction of the role and function of government institutions or reconstruction of government institutions.

In the inventory of data, Indonesia as a country that has abundant biodiversity, especially plant genetic resources spread throughout its territory, both air, sea and land, of course, experiences many difficulties in conducting an inventory of all types of plant genetic resources. Several factors that make it difficult to conduct an inventory of genetic resource data in Indonesia include:

Lack of trained experts in collecting and managing genetic resource data. Research results from various R&D institutions and universities in Indonesia are the initial steps in obtaining data that can be used in collecting plant genetic resources. Unfortunately, the number of researchers from various R&D institutions and universities in Indonesia is not comparable to the number of plant genetic resources, which number in the millions or billions of plants spread throughout Indonesia.

Limited access to technology is also a limiting factor in the collection of plant genetic resources. Some areas, especially remote ones, do not have adequate access to the technology needed to conduct an inventory. Manual processes and lack of tools can lead to inaccuracies in the data collected, hampering data-driven decision-making. Technologies such as image-based identification software or mobile applications that help identify plant species are inaccessible, making it difficult to determine the type and status of genetic resources. The lack of inventory of existing genetic resources can hamper conservation efforts and environmentally friendly use, leading to the loss of genetic diversity.

The lack of uniform standards for data collection and reporting also makes it difficult to compare and analyze data across regions or sources. Plant genetic resource data information is often scattered across institutions and lacks an integrated system. Fragmented plant genetic resource data makes data collection and access difficult.

Lack of awareness and understanding of the local community about the importance of preserving genetic resources can hamper inventory efforts. To overcome this, of course, community participation in conducting plant genetic resource inventories needs to be maximized. Approaches that can be taken in an effort to support active community participation in plant genetic resource inventories include holding educational programs that provide information about the importance of genetic resources and how to conduct an inventory; providing practical training for the community on inventory techniques, such as data collection, species identification, and the use of technological aids (e.g., mobile applications for plant identification); inviting the community to participate in research projects, either as members of research teams or as volunteers who help with data collection; forming groups or communities that focus on preserving and inventorying plant genetic resources; working with non-governmental organizations or non-governmental organizations that already exist in the area to facilitate community participation in the inventory; exploring traditional community knowledge about local plants and facilitating the recording of this information, which also provides recognition of their role; provide incentives or rewards for communities that are active in the process of inventorying or preserving genetic resources, which can be in the form of recognition, certificates, or financial support for small projects, as well as involving communities in the process of monitoring and evaluating inventory results to give them a sense of ownership and responsibility for the results obtained.

To overcome these difficulties requires cooperation between the government, research institutions, and the community to create a more effective and organized approach. The implementation of information technology and increasing the capacity of experts are very important steps to improve this situation. The genetic resource inventory system has been initiated and stated in the Minister of Law and Human Rights Regulation Number 13 of 2017 concerning the Communal Intellectual Property Data Center and Government Regulation Number 56 of 2022 concerning Communal Intellectual Property. The inventory system initiated and stated in these two regulations is a recording system and data integration system carried out by government institutions and local governments. However, this inventory system has not been running optimally. The factors mentioned above are the main causes of the failure of the plant genetic resource inventory.

To accelerate and maximize the process of inventorying plant genetic resources, it is necessary to implement a firm legal regulation at the statutory level by maximizing the role of the central government, regional governments and local

communities. The idea of recording plant genetic resources and integrating plant genetic resource data from all ministry databases needs to be standardized in a "BIG DATA" in the form of a digital information system.

Currently, almost all ministries of central and regional government institutions have databases containing information on genetic resources and traditional knowledge data. However, the databases in each ministry and institution have different material content and characteristics. This makes it difficult to conduct comprehensive research and implement data-based policies and cannot be used to prevent the granting of intellectual property rights and is unable to prevent Biopiracy or theft of genetic resources and traditional knowledge of Indonesia.

The integration of data from five government institutions has not been able to provide complete data, especially data on genetic resources and traditional knowledge, so that the information presented in the Communal KI data center has not been able to provide legal certainty for the protection of genetic resources and traditional knowledge, both in the form of patents and Communal KI. Thus, the information presented in the Communal KI data center has also not been able to provide justice to local communities in the implementation of access and sharing of results from the use of genetic resources and traditional knowledge.

Neighboring country Malaysia, which has characteristics and culture of society that are almost the same as Indonesian society, also has the same problems and difficulties in building a digital data information system for genetic resources, especially plant genetic resources. As an effort to protect and maintain traditional knowledge owned by indigenous and local communities in Malaysia, the Malaysian government has built a database that aims to create a platform to document and store traditional knowledge regarding the use of medicinal materials, culture, and other local traditions known as the Malaysian Traditional Knowledge Digital Library. The Malaysian Traditional Knowledge Digital Library was built by involving indigenous and local communities in the process of collecting and documenting knowledge, to ensure that they have a voice in managing the knowledge that belongs to them by utilizing information technology to create a database that can be easily accessed by interested parties, both domestically and abroad. The data sources for the Malaysian Traditional Knowledge Digital Library system were obtained from books published by the Forestry Research Institute of Malaysia which were obtained as a result of collaboration in the Project for Comprehensive Documentation of Malay Traditional Knowledge Relating to Ubatan Plants in Peninsular Malaysia, books related to traditional knowledge purchased by Malaysia Intellectual Property Office (the list of relevant books was obtained as a result of visits to libraries and continuous searches on the interne) or journal articles which had been purchased as well as donations from departments, agencies and institutions. government.

The existence of complete and comprehensive data will certainly provide transparent and clear information that can be used as a comparative document to assess patentability (novelty, inventive steps and applicability in industry) when a patent examination is carried out on an invention that uses plant genetic resources and related traditional knowledge. The data information provided by TCM-ID can prevent errors in granting patents which can then prevent misuse and theft of the use of genetic resources and traditional knowledge related to these genetic resources.

Seeing the huge economic benefits for genetic resources and traditional knowledge derived from the exclusivity of intellectual property rights (especially patents), megabiodiversity countries including China have finally proposed disclosure of the origin and/or source of genetic resources in the patent application process as a solution to prevent misappropriation.

As a megabiodiversity country, Indonesia has also built a national data center for communal intellectual property which presents valid data related to communal intellectual property information containing inventory data and documentation of genetic resources and traditional knowledge of Indonesia, including plant genetic resources. However, national data center for communal intellectual property has not been able to provide data that makes it easier for the government to maintain, preserve and preserve genetic resources and traditional knowledge and is able to prevent the granting of Patents to innovations related to genetic resources and traditional knowledge.

4. Conclusion

Indonesia currently lacks a cohesive and comprehensive legal instrument to ensure adequate protection of plant genetic resources. The existing statutory frameworks—comprising patent law, copyright law, and communal intellectual property regulation fail to sufficiently safeguard the communal rights of indigenous peoples and to prevent biopiracy. The absence of a sui generis legal system has led to the continued exploitation of these resources without prior informed consent or equitable access and benefit-sharing mechanisms. Accordingly, there is an urgent constitutional imperative to formulate and enact a dedicated Sui Generis Law on Genetic Resources. Such a legal framework must prioritize ecological justice, sustainable resource management, and the full recognition of collective indigenous rights. Through

this approach, Indonesia will not only fill the existing legal void but also strengthen its sovereignty and international bargaining position in matters pertaining to biodiversity governance.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] The 1945 Constitution of the Republic of Indonesia. Jakarta: State Secretariat of the Republic of Indonesia; 2010.

[2] Pudyatmoko S. Biodiversity and potential for bioprospecting development in Indonesia [press release]. Jakarta: Directorate General of Natural Resources and Ecosystem Conservation; 2023 Dec. Report No.: SP. 442/HUMAS/PPIP/HMS.3/12/2023.

[3] S. D. B. r. h. b. r. o. l. p. [. S. I. University dan 2. J. 2. [. 2. M. 2. A. f. https://www.brin.go.id/news/113670/peneliti-brin-soroti-riset-bioprospeksi-tumbuhan-l.

[4] Ministry of National Development Planning (Bappenas). Indonesia biodiversity strategy and action plan (IBSAP) 2025–2045 [Internet]. Jakarta: Bappenas; 2025 [cited 2025 May 26]. Available from: https://lcdi-indonesia.id/wp-content/uploads/2025/02/IBSAP-202.

[5] Djauhariya E, Sukarman. Utilization of germplasm in the herbal medicine and natural cosmetics industry. Bull Germplasm. 2002;8(2):12–3.

[6] Syukur M. Indonesia loses 75% of diversity of agricultural plant genetic resources. Presented at: Genetic Resource Management Workshop; 2018 Aug 23; Eastparc Hotel Ballroom, Yogyakarta.

[7] Traditional Knowledge Digital Library (TKDL). [Internet]. 2025 May 23 [cited 2025 May 26]. Available from: https://www.tkdl.res.in.

[8] Shiva V. Biopiracy: the plunder of nature and knowledge. Boston: South End Press; 1997.

[9] Sardjono A. Legal protection of traditional knowledge in Indonesia. Jakarta: UI Press; 2010. p. 87.

[10] Bustani S, Rosdiana S, Kansil CS. Dilemma of traditional knowledge protection of Subak agricultural system in the perspective of communal intellectual property. J Crim Law Legal Dev. 2023;5(1).

[11] Indonesia. Government Regulation Number 56 of 2022 concerning Communal Intellectual Property. State Gazette of the Republic of Indonesia. 2022.

[12] I. L. N. 1. o. 2. c. P. S. G. o. t. R. o. I. 2016.

[13] Sutedi A. Intellectual property rights. Jakarta: Sinar Grafika; 2010. p. 115.

[14] Nurfitri D. Protection of communal intellectual property after the issuance of Government Regulation Number 56 of 2022 concerning communal intellectual property. De Lege Ferenda Trisakti Law J. 2023 Sep;1(2):53–61. Available from: https://doi.org/10.25105.

[15] Indonesia. Law Number 29 of 2000 concerning Protection of Plant Varieties. State Gazette of the Republic of Indonesia. 2000.

[16] Sardjono A. IPR and the law on cultural advancement. J Intellect Prop. 2019;2(2).

[17] Indonesia. Law Number 5 of 2017 concerning the Advancement of Culture. State Gazette of the Republic of Indonesia. 2017.

[18] Salsabilla S. Protection of traditional knowledge and cultural expression based on the Law on Advancement of Culture. J Syntax Admiration. 2024 Jun;5(6).