



## Conservation and sustainable exploitation of plant genetic resources: International developments

F. Alizadeh<sup>1</sup>, M.R. Parvin<sup>2\*</sup>, P. Farshchi<sup>3</sup>

<sup>1</sup>PhD candidate, Department of Environment and Energy, Islamic Azad University, Science and Research Branch, Tehran, Iran

<sup>2</sup>Assistant Professor, Department of Microbial Biotechnology, Agricultural Biotechnology Research Institute of Iran (ABRII), Agricultural Research, Education and Extension Organization (AREEO), Karaj, Iran

<sup>3</sup>Assistant Professor, Department of Environment and Energy, Islamic Azad University, Science and Research Branch, Tehran, Iran

*Received: December 2019 ; Accepted: March 2020*

### Abstract

Plant Genetic Resources (PGRs) are one of the most valuable natural resources of any country. Biotechnology through genetic engineering of plants and the creation of new plant varieties can increase the value of these resources. Different technical and legal mechanisms such as ex situ/in situ collection of PGRs, and Intellectual Property Rights (IPRs) indicate also an international institutional effort for sustainable use of biodiversity. Investigating international developments in the fields of exploitation and conservation of PGRs is therefore essential. The main purpose of this manuscript is to explore criteria that international legal instruments use for creating an appropriate interaction between conservation and exploitation of PGRs. These instruments have been especially developed in the two systems of international environmental law and intellectual property rights. Based on a descriptive analysis method, this research attempted to examine the provisions of these two legal instruments. Research findings indicate that intellectual property rights encourages the creation and development of green technologies, especially agrobiotechnology and protects Traditional Knowledge (TK) associated with PGRs as an appropriate tool for the sustainable exploitation of PGRs when implemented in a responsible manner. International environmental law paves also the way for biodiversity conservation through creation of binding and non-binding obligations for preserving genetic diversity on the planet. Sustainable conservation of PGRs requires an appropriate interaction between the two legal systems.

**Keywords:** Precautionary principle, State sovereignty principle, Traditional knowledge, Geographical indications, Breeders' rights.

---

\*Corresponding author; mrparvin@abrii.ac.ir

## Introduction

Since the middle of the 20th century, we have witnessed the rapid development of modern biotechnology (Altieri and Nicholls, 2012). In the 1960s and 1970s, the goal of Plant Genetic Resources (PGRs) conservation was to consider the economic and strategic values of food and agriculture. Growing concerns about loss of biodiversity at the UN Conference on Environment and Development (UNCED) and the Convention on Biological Diversity (CBD) have led to legal obligations for the conservation of PGRs diversity in the framework of international environmental law (Altieri and Toledo, 2011). On the other hand, protection and exploitation of modified plant genetic resources was raised in international intellectual property systems (Ansari and Wartini, 2013). Therefore, identification and examination of key components of the interaction between environmental law and intellectual property law in the field of PGRs constitutes the legal basis of the present study. The goal of biodiversity conservation could be achieved by addressing the required appropriate approaches/principles in the interaction between the two systems of international environmental law and intellectual property rights.

## Materials and Methods

### *International Environmental Approaches to Conservation and Sustainable Use of PGRs*

#### *The Sovereignty of States over Natural Resources: A State-Centric Approach*

Genetic resources as a source of wealth for countries are under the control of States and subject to domestic and international protection (Brahmi and Tyagi, 2017). The main objective of the environmental legal systems is to preserve biodiversity and ensure sustainable use and universally regulated access to these resources (Jaechel et al., 2017; Godfray et al., 2010). The two main treaties of this system - the Convention on Biological Diversity (CBD) and the FAO International Convention on Plant Genetic Resources for Food and Agriculture (ITPGRFA) have recognized the sovereignty of States in determining

how to control and access PGRs. (Khademi and Abbasi, 2010). The protection and sustainable use of biodiversity and the fair and equitable sharing of genetic resources are among the objectives of the Convention on Biological Diversity in its Introduction and Article 3, which was adopted by States during the United Nations Conference on Environment and Development (Kiss et al., 2011). The ITPGRFA treaty also seeks to promote the co-operation and collective action of States in the light of the permanent sovereignty over genetic resources, together with the responsibility for trans-boundary damage caused by the harmful use of genetic resources. The treaty has the closest legal framework to the CBD and aims to access and share benefits in the area of PGRs for food and agriculture. (Ling and Adams, 2016). Article 1.1 of the ITPGRFA treaty deals with the sustainable conservation and management of PGRs as well as the fair and equitable sharing of the benefits arising out of their use emphasizing the sovereignty of States over genetic resources and their rights to determine access to genetic resources within their territories (Maftai, 2015; Milman, 2015).

However, it is worth mentioning that under the principle of permanent sovereignty over genetic resources, the role of the States could be preliminary focused on regulating access to “natural” PGRs on the basis of public interest and moral considerations. This role could be consequently completed by ensuring an appropriate mechanism for fair and equitable distribution of benefits arising from the exploitation of “modified” PGRs.

#### *The Precautionary Principle and the Biosafety Approaches to Conservation of PGRs*

In the recent decades, the increasing appearance and commercialization of products from recombining DNA of plants has raised a flux of biosafety concerns of unintended consequences on human and the environment.

Prevention or minimization of potential environmental harms has arisen because it is often difficult to compensate for serious

environmental damages especially in the agricultural sector that supplies the world's food security. Such damages may cause genetic erosion and even irreversible environmental conditions (Mariana et al., 2016). A part of the introduction of the Convention on Biological Diversity has been also provided in explaining and emphasizing the precautionary principle stipulating that “where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat” (Mashhadi and Mohtashami, 2015). In 2003, the Cartagena Biosafety Protocol also emphasized the precautionary principle. The Protocol has taken an effective step in applying the precautionary principle by requiring exporters to obtain prior informed consent from the importing country to regulate and control the trans-boundary movement of Living Modified Organisms (LMOs), and documentary evidence of risk assessment and risk management (Momenirad et al. 2013). The paragraph 2 of Article 27 of the TRIPS Agreement (Trade Related Aspects of Intellectual Property Rights) refers somehow to the precautionary principle stipulating that “Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect order public or morality, *including to protect human, animal or plant life or health or to avoid serious prejudice to the environment*, provided that such exclusion is not made merely because the exploitation is prohibited by their law”. However, it is important to consider the following points in order to properly apply this principle for environmental protection considerations within the intellectual property rights system. First, the potential risk should be considered as occurring in future. This means that invoking public order and morality within the patent system is possible when preventive measures are based on the damages that may immediately occur after the patent is granted. Second, these potential risks must

be considered as serious and irreversible. Accordingly, the precautionary principle for the inventions cannot be applied when they do not pose any serious environmental harms because they might be remedied naturally within a reasonable time (Moody, 2016; Daniell, 2014). The third point is about the difference between the approaches adopted by international environmental instruments such as the Rio Declaration and the Convention on Biological Diversity and those adopted by WTO agreements such as the SPS Agreement on the Application of Sanitary and Phytosanitary Measures (Hongyan and Yuanyuan, 2013). The SPS Agreement ensures that governments can give health protection priority over trade. It grants governments the explicit right to impose restrictions on international trade when these are necessary to protect human, animal or plant health from certain risks (Article 2.1). Therefore, in line with the differing precautionary approaches adopted by international treaties, member States' obligations may also focus on taking different measures and policies to prevent or reduce the potential risks to the conservation of PGRs (Morgera, 2015).

***International Intellectual Property Approaches to Protection and Sustainable Exploitation of PGRs Protection of Farmers and Breeders Rights***

The FAO, for the first time, introduced the concept of "farmer's right" in discussions on the international exploitation of PGRs in agriculture (Momenirad et al., 2013; Pereira et al., 2010). In these discussions, the rights of farmers and indigenous communities to control the management, development and sustainable exploitation of PGRs were recognized. Indeed, one of the purposes of developing the concept of farmers' rights is to ensure that farmers, farming communities and their countries have a fair share of the benefits arising from the PGRs they have developed, conserved and made available (Morgera and Kulovesi, 2016). Farmers' rights may also pave the way for developing favorable living conditions and global coexistence.

While not paying attention to the importance of PGRs for food and agriculture in which certain rights of farmers are assumed could affect human life and environmental health. Establishing a reliable and effective system for the proper protection and sustainable exploitation of such natural resources will also help ensure the well-being of future generations. Indeed, the survival of current generations and the lives of future generations may be in serious jeopardy due to disregard of farmers' rights in the interaction of developed and developing countries (Morgera, 2014; Servant and Michelangelo, 2010). Apart from that, breeders' rights are also important for providing incentives to plant breeders for developing new varieties. Recognizing the role of breeders' rights for sustainable development and encouraging innovations in agricultural genetic resources are among the goals set forth in some international legal instruments alongside the use of biotechnology to meet food, agriculture and health needs (Nezammaleki, 2015).

According to the definition of the International Union for the Protection of New Varieties of Plants (UPOV), a person who can be identified as a breeder is someone who has bred or discovered and developed a variety (Mariana et al., 2016). In this context, the TRIPs Agreement has also emphasized the protection of plant varieties using patent rights, a sui generis system or some combination thereof (Nicholas and Lai, 2011, Pereira et al., 2010). In general, framers and breeders have already played a profound role in improving agricultural systems productivity worldwide and sustainable development of PGRs. Therefore, the importance of protection of their rights through intellectual property systems cannot be ignored.

### ***Bio patents and Sustainable Development of PGRs***

The relationship between the TRIPs Agreement and the Convention on Biological Diversity is part of a broader relationship, namely between multilateral environmental agreements with the WTO

agreements concerning intellectual property rights (Parks and Morgera, 2015). Despite growing attention to biodiversity and its importance for human life, the TRIPs Agreement seems to be in certain areas in conflict with the Convention on Biological Diversity (Pereira et al., 2010). The TRIPs Agreement permits the grant of a patent for genetic resources without any explicit stipulation in line with the purposes of the Convention on Biological Diversity (Phoebe, 2013; Roa et al., 2008). To this end, Article 27 of the TRIPs Agreement on the patentability of plants and animals is the specific subject of discussion on the relationship between the Convention on Biological Diversity and TRIPs (Rabitz, 2017; Morgera, 2014; Momenirad et al., 2013). In general, Article 27 of the TRIPs enables patentability of all forms of life, but it does allow the member States to exclude plants, animals, and essentially biological processes from patent protection (Phoebe, 2013; Schei and Tvedt, 2010). Whether or not patents on PGRs are appropriate in both moral and development context is beyond the scope of this study. However, given the stark disagreements between members, which are often couched in moralistic language, there seems to be a case for allowing members to decide for themselves as to whether their own patent laws will be used for the patenting of plant genetic material. The Fourth Conference of WTO Ministers in November 2001, instructed also the Council of TRIPs in paragraphs 17 to 19 of the Doha declaration, promotes its action agenda focusing on revision of Article 27, paragraph 3, and examining the relationship between CBD and TRIPs (Qiqi and Logan, 2017). The Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions also recognizes patentability of biotechnological inventions if they meet the relevant legal requirements to be granted a patent. The directive, of course, excludes plant, animals and essentially biological processes from patent protection, but it recognizes the patentability of plant and animal varieties if the technical feasibility of the invention is not confined to a

particular plant or animal variety (Pereira et al., 2010; Vildasen and Havenvid, 2018).

In principle, with the arrival of modern biotechnology in plant and animal sectors, the large amounts of investment needed to develop for example a new crop, requires a legal framework that protects the inventor and the investor. Therefore, if bio patents have the side effect of privatizing a common pool resource, this could be desirable if it helps address a tragedy of the commons type loss of genetic resources. Moreover, bio patents could directly contribute to sustainable development of PGRs and biodiversity conservation through providing an effective legal protection for environmentally sound technologies and R & D process in PGRs. For instance, the biotechnological methods such as plant tissue culture, plant cell culture, embryo culture etc. are quite applicable and useful techniques for ex situ conservation (Pathak and Abide, 2014). The production of superior quality seeds has also been enhanced by the application of plant biotechnology. So, plant biotechnology offers new means of improving biodiversity conservation and needs to be protected by IP systems including bio patents.

### ***Protection of Traditional Knowledge and Benefit Sharing***

Traditional Knowledge (TK) encompasses information about, for example, crop landraces and their agronomic or culinary characteristics or the medicinal qualities of native species. While indigenous people are located primarily, although not exclusively, in biodiversity centers, they have a crucial role in the maintenance of and knowledge about biodiversity (Brookfield et al., 2002). However, there is no mention of Traditional Knowledge in the TRIPS Agreement. The issues of biodiversity and traditional knowledge have been further examined in WIPO in the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC). To this end, there are two approaches. The first is the adoption of an appropriate IP instrument such as Trade Secret, labelling/marketing, and geographical

indications to protect genetic resources, traditional knowledge and folklore. The second is to make it easier to implement the technology stipulations in the Multilateral Environmental Agreements to facilitate access to genetic resources, traditional knowledge which are required to be involved in research and development (Roa Rodriguez et al., 2008; Reynolds, 2013). But, adopting a defensive protection strategy such as setting up of public databases documenting the TK would be also required. In general, the main concern of developing countries is that TRIPS, contrary to the CBD, does not reject the patent application for inventions that use GRs or TKs without considering the rights of countries of origin and indigenous people (Rabitz, 2017; Roa Rodriguez et al., 2008). In order to address these concerns, developing countries have proposed a revision of TRIPS to require that applicants disclose the below information as a requirement of getting a patent for biomaterials or traditional knowledge associated with them: 1. Source and country of origin of genetic resource, 2. Any traditional knowledge used in the invention, 3. The Prior Informed Consent (PIC) must be acquired for using foreign genetic resources, and 4. Proof of fair and equitable benefit sharing between the owner of the GRs/holder of TK and the inventor (Schei and Tvedt, 2010, Schueler, 2008). These requirements have been also stipulated in the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity. Indeed, based on this mechanism, the Protocol creates incentives to conserve and sustainably use genetic resources, and therefore enhances the contribution of biodiversity to development and human well-being.

### ***Protection of Geographical Indications (GIs)***

The term Geographical Indications (GIs) is an initiative of the TRIPS Agreement (Taghizadehansari, 2014; Tsioumani, 2014). The GIs promotes the appropriate use of the name of the geographical origin,

which is the common property of the region. This system requires applicants to describe product specifications with which all producers that want to use the GIs must comply. Indeed, the GI-protected product displays the characteristics and quality it is supposed to have. Today, GIs have raised controversies about agricultural crops. The demand for extending GIs to agricultural products within the framework of multilateral agreements is increasingly on the agenda of most countries as rights holders (Vildasen and Havenvid, 2018; Mashhadi and Mohtashami, 2015). In fact, Geographical Indications have been the focus of countries of origin of genetic resources because of their potential role in protecting traditional knowledge. This has led to conflict between developed and developing countries over the benefits of Geographical Indications (Nezammaleki, 2015; Milman, 2015). On the one hand, the developed countries that are mainly holders of intellectual property rights on biotechnology consider the developing countries as potential infringers of these rights, and on the other hand, developing countries that own rich and abundant genetic resources accuse developed countries of bio piracy (Buyukgungo and Levent, 2009). Inefficiencies in sharing of the benefits arising from the production and sales of GIs products to indigenous communities and holders of these rights have always been a challenge between these countries (Morgera, 2014; Momenirad et al., 2013). In GIs, there is no need to follow the producer of the product, but the place of production is important. As mentioned before, the products with geographical indications have characteristics that originate from a specific region. Geographical indications can give marketing power to genuine products and provide high economic benefits to traditional knowledge owners by creating added value for these products (Rabitz, 2017; Kiss et al., 2011). The GIs can have an impact on the management and in situ conservation of genetic resources and rural development. If the GI promotes the success of an economic activity based on a biological resource, a landscape and a livelihood, then the connection between GIs

and biodiversity conservation becomes more evident (Guerra, 2010).

### Conclusion

One of the objectives of the Convention on Biological Diversity is the conservation of plant biodiversity and the sustainable exploitation of plant genetic resources and the fair and equitable sharing of the benefits resulting from the exploitation of these resources. In this context, Article 19 of the Convention emphasizes the use of biotechnology and the distribution of its benefits. The first paragraph of Article 19 stipulates the necessity of providing favorable conditions for the participation of developing countries in biotechnological research activities by taking appropriate legislative and enforcement measures. Convention on Biological Diversity considers also intellectual property protection as a means of achieving conservation of genetic diversity and equitable sharing of its benefits, and it has set itself the goal of ensuring intellectual property protection. Apart from this interaction between environmental law and intellectual property law, there are some conflicting approaches based on the below-mentioned reasons: 1. Absent harmonization of the provisions of the Convention on Biological Diversity concerning the access to genetic resources (Article 15) with the TRIPS stipulations on patentable subject matters (Article 27), 2. Non-conformity between the Part 3 (b) of Article 27 TRIPS with respect to patents relating to biotechnological inventions and the Parts 3 and 4 of Article 19 of the Convention on Biological Diversity as regards the protection of biodiversity and the required safety regulations to fight against any potential adverse impacts on biodiversity.

The Convention on Biological Diversity primarily protects the State Sovereignty over their natural resources in favor of developing countries. On the other hand, TRIPS Agreement protects the interests of companies and the private sector active in the field of biotechnology inventions. Thus, if there is no sufficient guarantee to disclose and obtain prior consent from the country

of origin of PGRs, the licensee will not be required to observe it. Examination of international legal instruments and evaluation of the provisions and obligations in these two legal systems show that, in order to harmonize the provisions of the Convention on Biological Diversity and TRIPS Agreement regarding the patent protection of inventions in the field of biotechnology, an amendment to Article 27 (b) and Article 29 TRIPS is necessary. It is only in this way that, based on Article 8 of the Convention on Biological Diversity, we can prevent the *unconditional patenting* of PGRs and consequently its' potential adverse effects on genetic diversity. TRIPS can be amended by incorporating international environmental law principles and mechanisms stipulated in the Convention on Biological Diversity, the Biosafety Cartagena Protocol on appropriate and safe use of Genetically Modified Organisms, and the Nagoya

Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefit Arising from their Utilization. However, we should not ignore that intellectual property law protecting the creation and development of green technologies especially biotechnology, and traditional knowledge of indigenous communities plays also an important role in the conservation of plant biodiversity. The role of patent protection in transfer of green technologies is an essential element for the attainment of the objective of global biodiversity conservation. Climate inventions represent about 1% of inventions worldwide. If IP protection for green technology is weakened, innovation capital will be diverted elsewhere. Therefore, patent protection and PGRs access should be carefully and proportionately developed by biodiversity-rich countries to ensure a successful balance between their domestic conservation and socioeconomic goals.

## References

- Altieri, M., and Nicholls, A. 2012. Agroecology Scaling Up for Food Sovereignty and Resiliency. *J. Sustainable Agriculture Reviews*. 11, 1-29.
- Altieri, M.A., and Toledo, V.M. 2011. The agroecological revolution in Latin America. *J. Peasant Stud.* 38, 587-612.
- Ansari, A.H., and Wartini, S. 2013. Precautionary Principle under the SPS Agreement A Critical Exposition. *J. Advances in Environmental Biology*. 7 (4), 653-667.
- Brookfield, H., Padoch, C., Parsons, H., and Stocking, M. 2002. *Cultivating Biodiversity: Understanding, Analyzing and Using Agricultural Diversity*. ITDG, London.
- Brahmi, P., and Tyagi, V. 2017. Access and Benefit Sharing Mechanism under the Multilateral System of the International Treaty on Plant Genetic Resources for Food & Agriculture, in KP Laladhas et al. *Biodiversity for Sustainable development Environmental Challenges and Solutions*. 24, 17-30
- Buyukgungo, H., and Levent, G. 2009. The Role of Biotechnology in the Treatment of Wastewater. *African J. Biotechnology*. 8, 25-29.
- Derclaye, E. 2009. Patent law's role in the protection of the environment reassessing patent law and its justifications in the 21<sup>st</sup> century. *International Review of Intellectual Property and Competition Law*. 40 (3), 249-273.
- Daniell, H. 2014. *Plant Biotechnology*. J. 1, 146-212.
- Dutfield, G. 2011. *The Role of the International Union for the Protection of New Varieties of Plants, UPOV* Quaker United Nation Office. 4, 7.
- Garrity, D. 2010. Evergreen agriculture: a robust approach to sustainable food security in Africa. *Food Secur.* 2, 3-20.
- Godfray, C., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, L., and Toulmin, S.M. 2010. Food security the challenge of feeding 9 billion people *Science*. 327, 812-818.
- Guerra, J.L. 2010. Geographical Indications, in *Situ Conservation and Traditional Knowledge*. ICTSD Project on Genetic resources. 3, 1-15.

- Hongyan, W., and Yuanyuan, S. 2013. Study on the Ownership of Plant Genetic Resources on Farmers Land. *Asian Agricultural Research*. 5 (02), 75-78.
- Jaechel, A., Kristina, M., Gjerde, J., and Ardron, A. 2017. Conserving the Common Heritage of Humankind Options for the Deep Seabed Mining Regime. *J. Marine Policy*. 78, 150-157.
- Khademi, H., and Abbasi, M. 2010. Protecting Genetic Resources in the Light Art. 4(d) of Iran Patent Industrial Designs and Trademarks Act I. *J. Medical Law*. 4 (12), 105-130.
- Kiss, A., Sand, P.H., and Lang, W. 2011. *Environmental law Persian Translation by Habibi Publishing Nashre Mizan*. 1, 275-342.
- Ling, C.Y., and Adams, B. 2016. Farmer Rights to Participate in Decision Making, APBEBES working paper. pp. 1-44.
- Maftai, J. 2015. Sovereignty in International Law. *J Acta Universitatis Danubius Juridica Uni Danubius*. 11 (1), 54-65.
- Mariana, A.M., Nor Anita, A., StiNurani, M.N., and Chan, K.G. 2016. The Principle of Integration in International Sustainable Development Law with Reference to the Biological Weapons Convention Sustainability. 8 (166), 1-16.
- Mashhadi, A., and Mohtashami, M. 2015. Reflection on Relationship between intellectual property law and environmental law. *J. Private Law Studies*. 45 (3), 485-504.
- Momenirad, A., Shahabedin, A., and Azizi, N. 2013. Protection of biodiversity & Traditional Knowledge in World IP System. *J. International Legal*. 1 (49), 233-262.
- Moody, O. 2016. Addressing Biopiracy through an Access and Benefit Sharing Regime Complex In Search of Effective Protection for Traditional Knowledge Associated with Genetic Resources, pp. 231-280.
- Morgera, E., and Kulovesi, K. 2016. *Research Handbook on International Law and Natural Resources Publishing EE (Elgar)*, pp. 3-25.
- Morgera, E. 2014. Conceptualizing BenefitSharing as the Pursuit of Equity in Addressing Global Environmental Challenges. *BENELEX Working Edinburgh School of Law*. pp. 1-41.
- Milman, O. 2015. Earth has lost a third of arable land in past 40 years, scientists say, *The Guardian: Wednesday 2 December*.
- Morgera, E. 2015. Justice, Equity and Benefit Sharing under the Nagoya Protocol to the Convention on Biological Diversity. *BENELEX Working*. pp. 5-7.
- Nezammaleki, J. 2015. How to Support Genetic Engineering Innovations in the System of Property Rights Thoughts and Rights of Iran. *J. Medical Law*. 9 (32), 119.
- Nicholas, R.A., and Lai, L. 2011. *Fundamentals of International Environmental Law Persian Translation by Hossini S.M. Tehran Nashre Mizan*. pp. 493-513.
- Parks, L., and Morgera, E. 2015. AnInterdisciplinary Model for Mapping the Normative Diffusion of Fair and Equitable Benefit Sharing. *BENELEX Working*. 1 (1), 7-9.
- Pathak, M., and Abide, M. 2014. The Role of Biotechnology in Conservation of Biodiversity. *Journal of Experimental Biology and Agricultural Science*. 2, 352-363.
- Pereira Di, Salvo, C.G., and Raymond, R. 2010. Defining the Precautionary Principle an Empirical Analysis of Elite Discourse. *J. Environmental Politics*. 19 (1), 86-106.
- Phoebe, H. 2013. Rights and Responsibilities in Patents A Precautionary Patent Framework in WTO Law. *J. European Intellectual Property Review*. 35 (9), 516-26.
- Poorhashemi, S.A., and Arghand, B. 2013. *International Environmental law. Publishing Nashre Dadgostar*. pp. 254-280.
- Qiqi, K.F., and Logan, K. 2017. Protecting the Public Environmental Right to Know: Development and Challenges in China's Legislative System for EEID. *J. Environmental Law*. 29 (7), 285-315.
- Rabitz, F. 2017. Managing Genetic Resources: International Regimes, Problem Structures National Implementation Earth System Governance Working. 37, 193.
- Reynolds, G.J. 2013. The Precautionary Principle and its Application in the Intellectual Property Context: Towards a Public Domain Impact Assessment in Teresa ScassaMistraleGoudreauCourtneyDoagoo&MadelaineSaginurIntellectualPropertyforthe 21st Century: Interdisciplinary Approaches. *J. Toronto Irwin Law*. pp. 95-113.



- Roa Rodriguez, Van C., and Dooren, T. 2008. Shifting Common Spaces of Plant Genetic Resources An International Regulatory Appraisal. *J. World Intellectual Property*. 11 (3), 176-202.
- Schei, P.J., and Tvedt, W.M. 2010. Genetic Resources' in the CBD the Wording, the Past, the Present and the Future. Project ISSN. pp. 1504-9744.
- Schueler, B. 2008. Methods of Application of Proportionality Principle in Environmental Law. *J. Legal Issues of Economic Integration*. 35 (3), 231-240.
- Servant, H., and Michelangelo, T. 2010. Establishment of the national patent system of biotechnology. *Comparative Law*. 16 (1), 45-49.
- Taghizadeh Ansari, M. 2014. *International Environmental law*. Publishing Khorsandi, pp. 211-221.
- Tsioumani, E. 2014. Exploring Benefit Sharing from the Lab to the Land (Part 1): Agricultural Research and Development in the Context of Conservation and Sustainable. *Edinburgh School of Law*. pp. 40-44.
- Vildasen, S.S., and Havensvid, M.I. 2018. The Role of Interaction for Corporate Sustainability. *J. IMP*. 12 (1), 148-170.

