



RESEARCH ARTICLE

TECHNOLOGY TRANSFER AND BIODIVERSITY: ANALYSIS OF BRAZILIAN LEGISLATION THROUGH THE ACCESS AND BENEFITS SHARING PERSPECTIVE

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ABSTRACT

International agreements recognized the need to limit natural resources exploitation, as well as the fair and equitable access and benefits sharing from the genetic heritage. The purpose of this paper is to analyze the Brazilian legislation, in particular on the new legal landmark for biodiversity. It also aims to analyze the interfaces between benefits sharing and technology transfer. Brazil became one of the first countries to create a special legislation about the use and exploitation of biodiversity that prioritizes the conservation and encourage national scientific and technological development. This new legislation prescribe foreign industries to develop research activities associated with Brazilian universities to access the genetic heritage as well as it imposes the benefits sharing through technology transfer mechanisms even if these benefits come from a finished product or a material derived produced outside the country. The new legal landmark will serve as an important instrument for countries with interest in Brazilian natural resources. However, the success in technology transfer process will depend on the ability to incorporate knowledge and adapt it to new technologies, and also it depends on the level of discipline and the monitoring by research institutions and others organizations involved in this kind of process.

INTRODUCTION

In 2015, Brazilian government approved law n° 13.123, also known as the New Legal Landmark for Biodiversity (NLLB), which regulates the genetic heritage and traditional knowledge associated with fair and equitable Access and Benefits Sharing (ABS). These benefits sharing must happen from economic exploitation of finished products or any material derived from genetic heritage, even if they are produced outside the country, prioritizing the conservation and sustainable use of Brazilian biodiversity and encouraging national scientific and technological development (Brazil, 2015; Menuchi et al., 2015; Saccaro, 2011). The Brazilian NLLB is associated with main international multilateral agreements, such as the Nagoya Protocol in which more than 180 countries were signatories, and the Convention on Biological Diversity (CBD). These agreements prioritize an important subject: Developed countries have the biggest concentration of economic and technological resources, but less natural resources. They should provide mechanisms to promote economic and technological development to the mega-biodiverse countries¹,

allowing them to preserve their ecosystem with a fair exploitation in a more social, economic and environmentally sustainable way (CBD, 1992). These agreements recognized the Technology Transfer (TT) as a relevant mechanism to non-monetary form of ABS in order to promote the qualification of research, technological development and the environment preservation in countries of origin. Ranga and Garzik (2015) point that TT takes an important role in the interface between science and product development, improving the innovation performance and building a competitive advantage for industries as well as universities or any other research organizations. Despite of that, Chapple et al. (2005) and Audretsch et al. (2014) indicate that TT is the process of transferring any type of scientific findings from one organization to another, or from a country to another. These kind of process makes possible to produce innumerable benefits to society through promoting industries competitive advance and, consequently, improving national and regional economic growth (Phan and Siegel, 2006; Perkmann et al., 2015). Even though it is considered as the main forces into the innovation process, the TT is in the early stages in Brazil, especially if it is compared to other countries such as UK and US (GIL, 2015; Mazuccato, 2016). Layargues (1997) believes that innovation and the environment complement each other in terms of the creation of new clean technologies, in which the government becomes responsible for promoting, regulating and supervising this integration. Consequently, the NLLB can be understood as a governmental action aimed at a fairer development, linked to the country's innovation requirements and the preservation of the environment, focused on Brazil's development (Lima et al.,

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¹ Mega-biodiverse countries are considered those who have together approximately 70% of the biology of the planet: South Africa, Australia, Brazil, China, Colombia, Ecuador, United States of America, Philippines, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, Democratic Republic of Congo and Venezuela. Brazil is the world's richest country in terms of biodiversity (Mittermeier and Goettsch, 1997; Valois, 1999).

2015). TT from the developed countries to developing countries has received increased attention as attested by many publications (Madu, 1989). However, the potential benefits, costs and risks of these new technologies must be considered, ensuring that they are economically viable, socially acceptable and respectful of the environment, in light of the national priorities and policies of the technology beneficiary country.

In this context, the purpose of this paper is to analyze the Brazilian legislation, especially in relation to the NLLB and the interfaces between ABS and TT. The main argument is that the NLLB must be understood as a legal norm for the biome's conservation and the technological development for Brazil, as well as to provide a legal framework for managers, policies and researchers to conduct in the correct way their researches and explorations of the Brazilian biodiversity. The methodology of this paper was designed to employ an inductive approach, in which it was made the review and examination of literature with intersections of the main Brazilian legal norms and others related themes. This paper is organized in the following way: a discussion of the literature review about the Biodiversity Protection, CDB and Nagoya Protocol in Section 2. In section 3, the NLLB is exposed and the explanation provides the highlights of the Brazilian Law. The Section 4 is a discussion of the literature review about TT between countries. Section 5 focused on ABS under Brazilian legislation. Section 6 presents the conclusions with limitations of research and directions for further researches.

BIODIVERSITY PROTECTION

Until 80s, the society believed that biodiversity and traditional knowledge were an inexhaustible source of natural and cultural resources, with no limits to access, exploitation and use (Castelli and Wilkinson, 2002). Corrêa (2006) suggests that distorted perception of the environment did not stimulate the policy making for a harmonious and fair development, which is reflected, according to Sanjuan et al. (2011), in the absence of international conventions addressed to the environmental awareness and preservation topic. Since the 90s, the biodiversity has been carried out as an essential matter in several conferences, conventions and agreements of global impact (De Passo and Nogueira, 2009; Jacob, 2005). Among these happenings, Antunes (2010), Saccaro (2011) and Moreira (2016) highlight two of them: The United Nations Conference on Environment and Development (UNCED) took place in Rio de Janeiro, in 1992 - Brazil (RIO-92) and the Conference of the Parties, in the city of Nagoya, in 2010 - Japan (COP-10). Lee and Shon (2016) point that both conferences recognized the countries autonomy on their biota, the need to limit natural resources exploitation, as well as the fair and equitable ABS from the genetic heritage. The Convention on Biological Diversity (CBD, 1992), formulated in RIO-92, is recognized as the main international agreement to establish legal landmarks for the development of economic activities related to the biodiversity (Crespi and Straus, 1996; Antunes, 2010; Chandra and Idrisova, 2011). It is important to clarify that this diversity must be understood as a range of ecosystems, species and genes that needs to be preserved and sustainably used (Laikre et al., 2010). The main issues of the CBD are: The recognition of the country's sovereignty over their natural resources; need for countries to create policies for biodiversity; reduction of deforestation; increase of the number of protected areas;

fighting against biological diversity crimes; investment and promotion of scientific research; and technological development associated with sustainable exploitation of genetic and biological resources (Santilli, 2005; Testilli and Vargas 2007; Laird and Wynberg, 2016). Among the commitments signed by the 180 CBD signatory countries, there is the need to guarantee to the developing countries the right to a fair and equitable benefits sharing of their biological wealth, including through the technology transfer mechanisms in order to achieve the technological development necessary for the economy rise and the strengthening of biodiversity protection in developing countries (Ferreira and Sampaio, 2013; Santilli, 2005).

In this context, COP-10 created the ABS Protocol with the aim of ensuring fair and equitable access and benefits sharing from the genetic heritage (Laird and Wynberg, 2016). In addition, Mittermeier and Goettsch (1997) emphasize that the ABS Protocol is addressed to encourage the technological and scientific progress of the biodiversity exploitation between developed and developing countries, through the agreements between the parties. Buck and Hamilton (2011) argue that the Nagoya Protocol is the end of a long-term legal and political debate over the status of genetic heritage under international law.

Nevertheless, Roa et al. (2016) point the importance of policies that regulate the access and exploitation of genetic heritage, as well as the monitoring of technological evolution, especially in developing countries. In fact, CDB and Nagoya Protocol are not a required mechanism; it is the responsibility of each country to develop and implement their own legislation (Laikre et al., 2010). In this context, the NLLB was created in Brazil associated with CDB and Nagoya Protocol agreement, and aims to protect biodiversity interconnected with technological development.

NEW LEGAL LANDMARK FOR BIODIVERSITY IN BRAZIL

According to Granja et al. (1999), Brazil is one of the most active actors in the international negotiations on recognition of nature resources sovereignty, since it deals with this subject as a key issue for the country's development policy. Brazil also considers the biodiversity as an important tool for the sustainable development of the country. Consequently, in 2000, Brazilian government created Provisional Measure (MP) n° 2.052/2000 (converted into MP n° 2.186/2001) was created to regulate the access and transfer of Brazilian genetic heritage, as well as the ABS resultant from these exploitations (Hathaway, 2004; Menuchi et al., 2015). On the other hand, Azevedo (2005) point that this MP was criticized by research institutions, development organizations, industries and traditional communities because it did not contain significant issues about biodiversity protection. Unfortunately, it was considered an instrument of delay and discouragement for scientific and development research. Years after publication, this measure was canceled mainly because it bureaucratized excessively those who carried out research and allowed biopiracy through legal ambiguities (Brazil 2015; 2016a). Only in 2015, the Law n° 13.123, known as the New Legal Landmark for Biodiversity (NLLB), was approved. However, by this time, the NLLB was

created according to the principles of the CDB and Nagoya Protocol (Brazil, 2016a), in which provides goods, rights and obligations related to the genetic heritage with several issues included, but not limited to: Benefits sharing from access, consignment and deposit of genetic heritage sample, creation of database and a National Benefit Sharing Fund (Lima, 2015).

According to Boff (2015), the new law establish guidelines for access to Brazilian genetic heritage for research and technological development, as well as the benefits sharing from the economic exploitation of the product or reproducible material. In addition, it caused the reduction of bureaucracy and facilitation of procedures for ABS, although the conduct of the whole process remains with the Union. The MP from 2000 covered only the research and development organizations in the biological areas. The creation of the NLLB also covered manufacturers, producers or nurseries, who exploit finished products or reproducible material, developed based on the access to genetic heritage or traditional knowledge associated (Brazil, 2016b). It is important to elucidate that the NLLB considers genetic heritage as any type of genetic source of plant, animal, microbial or other species, including substances from the metabolism of these living creatures (Brazil, 2015).

Although there are several legal gaps that need to be better designed, it is clear that the NLLB plays an important role on the Brazilian biodiversity protection. In addition, Menuchi et al. (2015) believes that the new law has brought many positive legislative changes and if it is implemented, it can improve the relation between protection and exploitation of nature. The NLLB prohibits the access to genetic heritage from a foreign person or industry as well as imposes the ABS even they come from a finished product or a reproducible material produced outside the country. In addition, sustainable development project of the Brazilian biodiversity must be carried out, including one or more of the following items: product availability in the public domain, technology transfer, free product licensing, human resources training in the related areas, free distribution of the products in national social programs (Brazil, 2015; 2016a). The new Brazilian legislation is not focused on creating a market reserve or a protectionism for national companies. In fact, the main goal is to promote international partnerships for access and exploitation of the genetic heritage by a fair and equitable benefits sharing prioritizing the conservation and sustainable use of Brazilian biodiversity and encouraging national scientific and technological development through TT activities.

TECHNOLOGY TRANSFER BETWEEN COUNTRIES

The Technology Transfer (TT) between countries is not something new. It has happened for a long time (Etzkowitz 1998). Holt (1990) and Greene (1994) suggest that the Roman Empire has already carried out the TT between Mediterranean and Middle Eastern countries, not only in matters of military infrastructure, essential for expansion and territorial achievements, but also in fields such as agriculture, arts and philosophy. Therefore, TT can be defined by the movement of technology via some communication channel from one place to another, from a university to an organization or from a country to another (Rogers et al., 2001; Guan et al., 2006; Zhao and Reism, 1992). Gervais et al., (2016) point TT as a blend of activities that require a multidimensional approach with a long-

term process of interaction between organizations and countries. Nevertheless, TT is not just a movement or delivery innovation. It is a dynamic, complicated and a multidisciplinary process whose success due to factors resulted from other sources (Jafari, et al. 2014). In addition, TT involves any kind of activities and processes through incorporated products, processes, or knowledge passed from one user to another (Besant and Rush, 1993). According to Bukalla (2007), TT is an interaction instrument between two or more organizations/countries during a knowledge or technical producing process to create a new product or service.

The dynamic nature of TT has contributed to the appearing of many definitions and conceptions (Anatan, 2015). However, based on the literature studies (Reddy and Zhao, 1990; Etzkowitz and Leydesdorff, 1998; 1999; Chapple et al., 2005; Phan and Siegel, 2006; Audretsch et al., 2014) it is evident that TT has a wide conceptualization, because it refers to: use, mobilization, application, exchange, development and management related to a product, a service, a technology and a knowledge. With the aim of attracting technologies, several developing countries created international policies to stimulate the TT (Hoekman et al., 2005) as a practical alternative to solve their complex social and economic problems (Madu, 1989). As a result of this, TT became an important mechanism for economic development since the acquisition and diffusion of the technology promote the economic growth (Pagani et al., 2016).

However, it is crucial to suit local conditions with effective immersion and diffusion within and between countries, because the key element in TT is not the technology neither the knowledge (Wahab et al., 2012). On the contrary, it is the level of receivers' potential to use it in their own operations (Fazal et al., 2016). As a result, it is necessary to have the ability of maintaining and fully using the appropriate technology to contribute to the economic development (Audretsch and Caiazza, 2015), because TT itself will not lead to economic growth in developing countries. According to Chandra and Idrisova (2011), approximately half of the countries that sanctioned the CBD recognized the nonexistence of TT as one of the main challenges. Since several countries are in the early stages of developing measures of access, use of technology and their economic and social applications, thus damagingly impacting the ability to apply modern technologies for the conservation of biological resources.

In this context, developed and developing countries must find better mechanisms to improve the absorption ability of the technology to guarantee the success of the TT and the social and economic benefits for both suppliers and beneficiary countries (Hoekman et al., 2005; Wahab et al., 2012). Therefore, Madu (1989) emphasizes that all countries should include TT policy in their development plans. Bohm and Collen (2015) argue that the TT between countries has become an important issue of international environmental policy since the CBD recognized the crucial requirement to develop scientific, technical and institutional abilities pointed out to create a better biodiversity protection in the world. Unfortunately, despite of all international agreements, the creation of policies and legislations to encourage the TT from the ABS of genetic heritage remains incipient in most of countries.

BENEFITS SHARING UNDER OF BRAZILIAN LEGISLATION

Before starting the Brazilian legislation framework, it is necessary to understand the ABS concept, in which “access” means to have the route or act of coming or approaching, “benefits” delineates an advantages or a profits grown from something, and “share” means give a portion of something to another. The direct linguistic definition for ABS could cover the action of admission and giving a share of the benefits to others (Schroeder, 2007; Dauda and Dierickx, 2013). In addition, the term ABS refers to the way in which genetic heritage may be accessed, and how the benefits that result from their use, are shared between people or countries using the resources and people or countries providing them (CDB, 1992). Kamau et al. (2010) believe that the ABS concept is strongly linked to the fact that each part is obliged to take legislative, administrative or policy measures to certify that access and benefits ascending from the exploitation of genetic heritage as well as subsequent application and commercialization are shared with the providing party. In fact, the CBD and the Nagoya Protocol recommend that all countries implement specific legislation on this subject to ensure a fair and equitable ABS from the commercialization of the genetic heritage from research results, product developments or new technologies with economic, social and technological value for the country (Buck and Hamilton, 2011). Based on these recommendations and the international agreements, Brazil became one of the first countries to create such legislation, in which the main articles and sections will be discussed below.

Article 1 of the NLLB presents rights and obligations related to the genetic heritage goods, with emphasis on the section V, which highlights the fair and equitable ABS from economic exploitation of finished product or any material derived from genetic heritage focused to the protection and sustainable use of the Brazilian biodiversity. The chapter V of the NLLB and also the Decree nº 8.772 /2016 deals that the ABS will happen when there is economic exploitation of finished product or reproducible material, connected with genetic heritage even though they are produced outside the country (Brazil, 2015; 2016a). Boff (2015), argues that finished products should be understood as any product that has some component of genetic heritage as one of its main elements, carried out on a sample of plant and animal species, including domesticated, found in “*in situ*” conditions, in the national territory, on the continental shelf, in the territorial sea and in the exclusive economic zone. It also includes plant, animal and microbial species maintained in “*ex situ*” conditions, provided that it has been collected under “*in situ*” conditions.

According to Rosenthal (1997), the benefits of ABS agreements may include monetary compensation in the form of royalties and down payments, but also include non-monetary benefits, in which contain but are not limited to: capacity building efforts from source countries such as training, equipment and infrastructure development; development of research in host countries; and building of collaborative relations in scientific research (Kamau et al., 2010). In this context, the Article 16 of NLLB requests the indication of the sharing benefits method, as monetary or non-monetary, at the time of notification.

This notification of finished product or reproducible material and the benefits sharing agreement must be presented to the Brazilian Management Council for Genetic Heritage (Brazil, 2015). Article 19 of NLLB points out that the distribution of benefits may be organized in the following modalities: monetary or non-monetary, including, among others (Brazil, 2015): Projects for the conservation or sustainable use of biodiversity or for the protection and maintenance of knowledge; Innovations or practices of indigenous populations, traditional communities or traditional farmers, preferably at the place of occurrence of the species “*in situ*” condition or obtaining the sample when the original location cannot be specified; Technology Transfer; Provision in the public domain of product, without protection by intellectual property right or technological restriction; Licensing of products free of charge; Training of human resources in matters related to the conservation and sustainable use of genetic heritage or associated traditional knowledge; and free distribution of products in programs of social interest.

Article 19 also indicates that the ABS through the TT may be carried out in the following ways: Participation in research and technological development; Exchange of information; Exchange of human resources, materials or technology between national scientific and technological research institution, public or private, and research institutions based abroad; Consolidation of research and technological development infrastructure; and establishment of a technology-based joint venture (Brazil, 2015). In this context, this legislation points out the TT as a non-monetary mode of the ABS in the hypothesis in which the economic exploitation of finished product or of reproducible materials that contains main elements from access results by Brazilian genetic heritage, even if they are produced outside the country (Brazil, 2015). This protection of national biodiversity promote the use of advanced technologies to allow the sustainable use of biota and the development of new technologies. In addition, Roa et al. (2016) point that non-monetary benefits are capable of bringing huge economic return to developing countries through recent technological advances. Furthermore, Kamau et al. (2010) believe in a new model related to the genetic heritage, in which conservation and exploitation are now explicitly complemented by the obligation of encouraging the flow of benefits for biodiversity sustainability.

The article 52 of NLLB defines that only national public organizations that carry out programs of social interest may be recipients of TT (Brazil, 2016a), within are the universities and research institutions, defined by Law nº 13.243/2016, as an institution of the direct or indirect public administration or a non-governmental organization (NGO), legally constituted under the Brazilian laws, with headquarters and forum in the Country, which also includes in its institutional mission or its social objective or statutory basic or applied scientific or technological research or the development of new products, services or processes (Brazil, 2016b). It is noticed that the TT must happen for the good of the community through the institutions mentioned in the national legislation, and cannot be headed for companies with a unique commercial purpose. The creation of Complementary Law nº 13.120/2015 represents a step forward in legalizing and simplifying the activities of exploitation from Brazilian biodiversity, since it has reduced the limitations of national companies and research institutions,

as well as enforce the foreign companies to develop research activities associated with Brazilian universities (Brazil, 2015). This law aims to stimulate the reception of knowledge and techniques already dominated by other countries, so that the national scientific community will learn the best way to access the genetic heritage and to elaborate innovations from this and also from the traditional knowledge.

Conclusion

We believe the Brazilian legislation represents an improvement in legalizing of the interpretation and application for sustainable use of biodiversity, promoting the technological development of the country through the improvement of research from TT between countries and the debureaucratization of the ABS to genetic heritage. Since it is associated with the CBD and COP-10 principles, these legal norms will certainly become an important conduct instrument for the countries that have an interest in the exploitation of the Brazilian natural resources. Another interesting point is that foreign companies will be able to develop research activities as long as they are associated with Brazilian universities through the TT mechanisms. This fact will enable universities to improve their know-how through the modern technologies and methods controlled by other countries to access genetic heritage and to develop innovations from these resources. In this context, the TT by universities will become one of the main ABS way of non-monetary benefits, in which it will provide economic and environmental advances for Brazil. However, to be successful in the TT process, it is precarious to create the ability to absorb knowledge and adapt new technology, and also depend on the design, the discipline and the monitoring by the research institutions and others national organizations. The future looks very hopeful, but the next steps will certainly impact the Brazilian sustainability.

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