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To Investigate the Role of Biopiracy in Depletion of Traditional Knowledge Of Biological Resources

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Abstract: *The biological resources express rich diversity among organisms surviving in it. The traditional knowledge related to these organisms has been into existence since the interaction of humans with biological resources began. The rapid development due to industrialization in the world has created interest of different researchers, scientists and biotechnological companies to exploit the biological resources of the globe for manufacturing useful bioproducts. In this process of utilization of biological resources by the biotechnological companies, the act of biopiracy is committed. In the search of novel products, the exponential competition has driven excessive exploitation of biological resources. The developed nations have particularly utilized most of the traditional knowledge related to the biological resources of the world. The developing and underdeveloped nations have been excessively exploited for their biological resource reservoirs and the traditional knowledge related to it. The present investigation examines the critical role of biopiracy that has triggered the exhaustion of traditional knowledge of global biological resources. This investigation concludes that though various international treaties, agreements, and conventions have been undertaken at the global level and national level to protect biological resources and its traditional knowledge still they have not been proved to be an asset against biopiracy. Therefore it is suggests in this investigation that a Global Watch Dog Antibiopiracy system should be established.*

Keywords: *Biopiracy, Biological Resources, Traditional Knowledge, Biotechnological Companies.*

1. INTRODUCTION:

The biological resources basically consist of living organisms, their different populations, species and their genetic resources (57). The biological resources are rich in different components that can be utilized for human welfare. The humans have been using the traditional knowledge related to the biological resources for the development of novel varieties of plants and for the purpose of food or agricultural requirements (40). In addition to this traditional knowledge of biological resources has also been used for the treatment of different diseases, by humans. Since ancient times the uses of biological resources have been of great significance (2). The developing and underdeveloped nations have been deprived of their owner's rights on their traditional knowledge (8). The developed nations have been exploring the global biological resources by suggesting the phenomenon denoted as global commons of mankind (46). During the exploration of biological resources, the developed nations have extracted the traditional knowledge of most of the developing and underdeveloped nations through their scientist, research workers, and their biotechnological companies. The biotechnology industry is presently one of the biggest industries with great commercial potential. The bioproducts that have been produced by these companies by utilizing the traditional knowledge of the biological resources are often patented. The patents provide exclusive rights or monopoly to the biotechnological companies for their innovations (41). This restricts others from using the traditional knowledge of different biological resources unless permission has been obtained or royalty has been paid for this purpose. The developed nations with respect to the valuable biological resources have been unfair and have exponentially exploited them for patenting. This is actually the misappropriation of biological resources and its traditional knowledge.

2. DEFINING THE TERM 'BIOPIRACY':

The term biopiracy is defined as the misappropriation of biological resources and its traditional knowledge (42). The misappropriation includes commercial exploitation of exclusively available biological resources like plants, animals, herbs, shrubs, seeds, etc. This misappropriation is truly an imitation of the traditional knowledge of the indigenous people or communities (38). The indigenous people have been improving their traditional knowledge that they have been receiving from their forefathers (23). The biotechnological corporations by using the present patent system have been making billions of dollars just by exploiting the biological resources and its traditional knowledge (4).

3. INTERRELATION OF TRADITIONAL KNOWLEDGE AND BIOLOGICAL RESOURCES:

The biological resources basically comprise of plants, animals and other living organisms. The people living in close vicinity with these biological resources often interact with them. During this interaction for generations, people often acquire knowledge with respect to these biological resources. These people that interact with their biological resources are termed as indigenous people and the knowledge that they acquire is termed as traditional knowledge or indigenous knowledge. In Asia, about 90 % people are associated with rice cultivation (17). Thus the people of this region have better rice varieties that they have generated through their traditional knowledge from their biological resources. Traditional knowledge is also important because it is not only useful naturally but also economically. The farmers who are linked to rice farming provide them financial assistance throughout the year for their livelihood. This traditional knowledge has helped the farmers in breeding hybrid plants, seeds and in other agricultural aspects (48). Likely the traditional knowledge based on herbal medicinal plants is also vital (53). Most of the people of the world often at the local level, particularly in developing and in the underdeveloped nations use traditional herbal medicines for treating different diseases or health problems. The biotechnological companies have been keeping an eye on these traditional medicines for producing new drugs with respect to healthcare, cosmetics, etc (45). The indigenous people are the actual owners of the traditional knowledge of their biological resources. But recently the biotechnological companies, without taking any prior permission or providing any profit share to the indigenous people, have been using their biological resources (1). Overall, the global demand for traditional medicines has triggered competition among the biotechnological companies to exploit the biological resources (44).

4. PATENT LAWS TRIGGERED BIOPIRACY:

The establishment of patent laws has been into books since the 14 century (26). It was in Venice that the novel innovations and knowledge were awarded patents (56). It has been suggested that intellectual property rights were basically related to industrial innovations, literature and artistic works. During the historical period, the innovations in the biotechnological sectors were not considered as inventions and it was considered a casual process. However, it was in recent decades that the development in the field of agriculture has been considered significant. Thus in order to safeguard the rights of those who participate in such developments, it was demanded for the establishment of effective intellectual property rights at the global level. This resulted in the expansion of patent laws.

As the rights on intellectual property were established, the first patent was permitted for living organisms in Finland, 1843 (47). Similarly, a patent was granted for an isolated yeast in America in, 1873 (13). Later on, an act was passed in the U.S. for protecting plant varieties in the year 1930, which dealt with the protection of asexually propagated varieties of plants (37). In the past living organisms were not considered for patenting, as they were considered as natural products of biological resources. Therefore the natural products were restricted from being granted a patent. It was the year 1970 in which several incidents were associated with biological inventions. However, prior to this neither the American patent law nor any other nation of Europe had any provision for patenting living biological organisms. It was the leading case of Diamond V. Chakravarty of 1980 in which a genetically engineered bacterium was patented (10). The bacterium possessed the characteristic of breaking the oil components. Keeping the specific quality of this bacterium the microorganism was patented. It was decided in this case that the bacterium is not a biological product but was genetically engineered, which made it patentable. This patent triggered the patent war around the globe. The biotechnological companies in large numbers applied for different patents for different biological materials. The developed nations with advanced technology were at a peak for patenting the biological material. In the same year 1980, the applications for patenting biological material increased vigorously. In the year 1973, the EPC or European Patent Convention was laid down in which Rule 23c, and Rule27 deals with patentable biotechnological inventions (31). The patent office of Europe with respect to this convention considered various patents relating to molecular biology. In the year 1978 Sweden agreed upon the European Patent Convention (3). Later on Finland in the year 1996 and Portugal and Ireland joined in the year 1992 with EPO (11). The established patent laws were utilized by the biopirates for biopiracy.

5. SIGNIFICANCE OF BIOPIRACY:

The absence of proper legal regulations shields biopiracy from being eradicated. However, the act of biopiracy is spreading rapidly in the global scenario that cannot be overlooked. The biological resources are often denied of patents stating that they are a common heritage of mankind (14). This theory of common heritage of mankind suggests that biological resources are global common resources and thus every person has the right to use such resources without any restrictions. In other words, none can claim any ownership rights over biological resources. This aspect of common heritage has definitely been partial to the indigenous communities and their traditional knowledge. The industrialized nations have exceptionally used this principle and utilized the biological resources and their traditional knowledge throughout the globe even outside their state's territory.

Intellectual property rights have been most useful for the industrialized nations and their societies. They have been exclusively using advanced research and technology for novel innovations. If carefully studied, it can be depicted that all the present intellectual property right laws have been formulated by the developed nations. These patent laws

have been favorable to them. In other words, there is nonequilibrium in the present patent policies at the global level. This has led to rapid commercialization and industrialization of biological resources by the developed nations, which has further promoted biopiracy by the developed nations on a global scale. The developing and underdeveloped nations remained ignorant about their rights on their biological resources and have been exploited by the developed or industrialized nations. The international agreements like the TRIPS agreements mostly have been favorable for the developed nations.

The biopiracy has been hampering the biological resource reservoirs of the developing and underdeveloped nations. These biological resources have been the major sources of employment and economy of the developing and underdeveloped nations. The patents on the biological resources of the developing and underdeveloped nations deprive them of using their own resources by their own people. For using the patented products these nations had to either take permission from the owners of the patents or provide royalty to the patent owners. Biopiracy has thus been a menacing crime against the biological resources of the world.

6. BIOPIRACY IS VANISHING THE TRADITIONAL KNOWLEDGE:

The latest technological advancement in biotechnology has raised a question in relation to the ineffectiveness of the present trends in the patenting system. The excessive biopiracy over biological resources has subjected the traditional knowledge of the biological resources to a stage of vanishment. The present patent laws suggest that a patent on biological material can only be considered if it follows the three basic criteria viz. the innovations should be novel, the innovations should have a specific process or procedure of production, and the innovations should have an industrial application. The biotechnological innovations based on biological resources should follow these criteria for obtaining the patent. Article 52.2 (a) of the European Patent Convention suggests that mere discovery cannot be considered for a patent (12). The patents should be an innovation that follows the innovation criteria.

From the above statements, it can be concluded that the patents based on traditional knowledge are not legal as they are just discoveries rather an innovation. In fact, most of the biotechnological corporations who file patents for biological material often imitate the original products being isolated from the biological resources which have been in use by the indigenous communities for decades. This is a mere theft of nature by giant biotechnological corporations.

7. BIOPIRACY IS LEADING TO SOCIO-ECONOMIC AND ENVIRONMENTAL LOSS:

The commercialization of biological resources has an adverse effect on the environment. The indigenous people have been practicing their age old methods in their daily routine. In addition to this indigenous communities have been using their traditional old medicinal system for treating different diseases. During this long run of advancement, the indigenous people have not changed their methods of living and have effectively used their own knowledge for survival in their native places. Upon providing the knowledge of modern technology to the indigenous communities, it has only perished their indigenous knowledge and their biological resources. For example knowledge of advance agricultural techniques which includes modern tools and chemicals for raised crop production. The maximum utilization of these advanced tools and chemicals has actually depleted soil fertility and the environment. Moreover, the present generations have been made isolated from the traditional knowledge that was available to them from their forefathers. Most of the indigenous people or communities are completely dependent on the biological resources, for their survival like crop rotation practices and the use of different patterns of farming according to the type of land for cultivation. The whole scenario of their lifestyle has been changed due to the excessive exploitation of their biological resources or their traditional knowledge.

The indigenous communities have also been using biological resources and their traditional knowledge for generating income for their livelihood. The unauthorized accessing of their biological resources has not only persuaded the employment issues but also socio-economic loss and loss to the environment.

8. LEADING CASES OF BIOPIRACY:

8.1 The Neem biopiracy case:

The Neem tree possesses many properties that have been an indigenous knowledge of the Indian people for decades. The Neem tree seeds exhibit antifungal properties. The indigenous people of India have been using this for protecting their crops. An American corporation viz. W.R. Grace was granted a patent as EPO patent no. 436257 for producing an antifungal product by using the Neem tree seeds (6). Upon recognizing this patent being granted, some of the European organizations and a famous Indian environmental activist V. Shiva laid an objection against this in the European patent office. They challenged this objection on the basis of lack of nobleness and innovative process. It was also laid down that, the utilization of Neem tree parts in India is evident from centuries for producing medicines for skin infections, insect-killing, manufacturing soaps, and different cosmetic preparations. These pieces of evidence were exclusively studied by the Patent Office of Europe and finally, the patent that was granted on the Neem was revoked.

8.2 The Basmati rice biopiracy case:

The different varieties of rice have been cultivated in India for several decades. Rice has also been produced or cultivated in large regions, throughout the Asian subcontinent. In the year 1994, an American corporation viz. Rice Tec Inc. was granted a patent on basmati rice through a U.S. patent no. 5663484 (43). Around about 20 different patent claims on basmati rice were granted. This resulted in a monopoly on rice cultivation, harvesting, planting and also cooking. It was depicted by Rice Tec. Inc. that it has invented the basmati rice. Moreover, they named it as Texmati rice. The corporation also claimed that it has innovated new varieties of basmati rice. The Indian government protested against this grant of patent and this resulted in the rejection of patent granted to Rice Tech. Inc. This was another great victory of India over biopiracy.

8.3 The Nap Hal biopiracy case:

The wheat crop is a useful crop being cultivated and consumed in India for centuries. A specific variety of Indian Wheat viz. Nap Hal was granted patent as Galatea wheat variety with patent no. EP 0445929 B1 to an American multinational corporation, Monsanto (30). The corporation by just transferring genes from the Indian Nap Hal wheat variety produced Galatea wheat. The patent was objected by three organizations viz. Bharatiya Krishak Samaj, Greenpeace, and Navdanya. However, after these objections in the Patent Office of Europe based in Munich, the patent granted to the wheat variety was revoked. This was a yet another major success for India in protecting its traditional knowledge of its agricultural resources.

8.4 The Atta biopiracy case:

In the year 2000 Conagra, a company based in Nebraska, United States was granted a patent for a process of producing Atta or wheat flour with a U.S. patent no 6,098,905 (25). The process suggested by the company for producing Atta has been a common process of processing Atta or wheat flour throughout various Asian countries, including India. Thus patents could not be granted as it is an indigenous knowledge of indigenous people of Asian countries that they have been implementing for the past several years. The revoking of this patent was also initiated by India but the cost of this procedure is a major hindrance in this fight against this biopiracy.

8.5 The Melon biopiracy case:

In the year 2011, a United States-based company Monsanto obtained a patent on melon with a patent no. EP 1962 578 (19). The Indian melons are naturally resistant against specific viruses like the CYSDV i.e. Cucurbit Yellow Stunting Disorder Virus. This virus has been ruining the melons in different parts of U.S.A. and in Europe. The Monsanto Company by crossing Indian melons varieties with those of the European varieties produced melons that were resistant against the CYSDV and patented them. However, the seeds of Indian melons that are resistant against this virus are registered in the International Bank of Seeds with a registration no. PI 313970. This patent promoted restrictions on the cultivation of melon fruits. However, this patent was also objected and several protests have been made to revoke this patent by different organizations of India.

8.6 The Maca biopiracy case:

A company located in New Jersey viz. Pure World Botanicals was granted a patent with U.S. patent no. 6,267,995 for an extract obtained from Maca that was commercially marketed as MacaPure in the year 2001 (54). The Peruvian people have been growing Maca and using it for various medicinal purposes. The Maca properties are the traditional knowledge of the native people of Peru and they are the original owners of this biological resource and its traditional knowledge. However, even after several initiatives by the indigenous communities of Peru and the Peruvian government, the patent was not revoked. The biopiracy of Maca extract by the Pure World Botanical is a challenge for the native people of Peru.

8.7 The Sacha Inchi biopiracy case:

Almost 60 % of the territory of Peru is surrounded by the Amazon rainforests. Sacha Inchi, is originally cultivated in the Amazon Rainforests by the native people of this region. The indigenous communities of Peru have been cultivating Sacha Inchi and using it for various foods and cosmetic purposes. A French company, Greentech Inc. in the year 2006, obtained a European patent no. 05802707.9 for an extract obtained from Sacha Inchi for producing a cosmetic bioproduct (51). However, after objections laid down by the Peruvian government, the patent was rejected in the year 2009.

8.8 The Turmeric biopiracy case:

In the year 1995, in U.S.A. a patent, U.S. patent no. 5401504 was issued on turmeric to the medical center of Mississippi University by considering its properties of healing of wounds (15**).** Against this patent an Indian

organization, Council of Scientific and Industrial Research, provided documentary evidence that proved that the use of turmeric in India dates back to ancient times in foods, and indifferent local systems of medicine. The evidence was considered by the United States Patent and Trademark Office and the patent on turmeric was rejected.

9. LEGAL TOOLS AGAINST BIOPIRACY:

Biopiracy has been a complex subject that is linked to various fields of law. These laws include laws on environment and intellectual property rights. However, laws have been established both at the global and national levels but they have not been effective in controlling biopiracy thoroughly. Some of the significant laws against biopiracy are described as under

9.1 The International Legislations on Biopiracy:

9.1.1 TRIPS agreement:

It was in the year 1994 in which at the concluding time of the Uruguay session of the World Trade Organization, the trips agreement was the matter of the debate (55). In this debate, it was suggested that the patents are essential for new innovations that have an industrial application. It was also suggested that the biotechnology industry spends huge amounts of money on research; therefore patents in the biotechnology sector must be encouraged. Article 27.3 (b) of TRIPS agreement allow the party nations to eliminate the following materials from patenting (39):

- Living organisms like animals and plants except for microorganisms under certain conditions.
- Significant biological procedures used for producing novel animals or plants other than non-biological and microbiological methods.

It is also mentioned in the agreement that the member nations shall promote the protection of different varieties of plants, by patenting or by establishing a *sui generis* system. The TRIPS agreement had a perspective of the protection of biological resources and its traditional knowledge. But still, the backwardness of the developing and underdeveloped nations had resulted in enormous biopiracy. The main reason is the ignorance of the local governments to protect their biological resources and their traditional knowledge. Another important aspect is the lack of awareness of the indigenous people or communities about their traditional knowledge. It is because of this reason that even after formulating the TRIPS agreement the biopirates are actively performing biopiracy throughout the globe.

9.1.2 Convention on Biological Diversity:

In the year 1992, an important agreement was signed by various global nations in the Earth Summit. This agreement is known as the Convention on Biological Diversity or CBD (28). The CBD has basically three major aspects:

- To protect the biological resources and its diversity.
- The reasonable use of the biological resources and its components
- Upon usage of biological resources, the sharing of its benefits should be equitable and fair with respect to the actual owners of the biological resources.

Though effective and clear indications have been illustrated in the CBD to protect the biological resources, still the global scenario of the utilization of biological resources is alarming.

9.1.3 The Doctrine of Common Heritage of Mankind:

An important global undertaking on the genetic resources of plants and agriculture and food follows the principle of the doctrine of the common global heritage of mankind (7). This undertaking is governed by the FAO of the United Nations. Article 1.1 of this undertaking particularly mentions this that all the biological resource are the common global heritage of mankind and neither can be restricted from using this heritage. Exploiting this principle of common global heritage of mankind various global corporations have been exploring the biological resources throughout the globe. This further led to the biopiracy of biological resources. However, this conception was discarded with the endorsement of CBD.

9.1.4 The Nagoya Protocol:

After the confirmation of the Nagoya protocol in the year 2010, the Access and Benefits Sharing (ABS) protocol in relation to the CBD came into action (34). The protocol suggests to effectively promote fair and equal sharing of benefits for the exploitation of the biological resources and its components. However, the global nations should be active enough to ensure that they obtain their share of benefits that have been generated from the utilization of their biological resources and their important constituents. Lack of activity and ignorance towards their biological resources, the developed and underdeveloped nations are lacking of benefit sharing for the usage of their biological resources.

9.1.5 The Cartagena Protocol:

In the year 2003, on 11 September a significant global agreement dealing with LMOs (Living Modified Organisms) was enforced (24). The basic principle of this agreement was concerned with transportation, careful manipulation, and utilization of LMOs. The protocol of Cartagena is actually concerned with the CBD. Moreover, this protocol contains the reference of the Principle 15 mentioned in the Rio Declaration on Environment and Development dealing with precautions required to be undertaken by the global nations according to the facilities available within its jurisdiction, while exploration of biological resources (36).

The above studies reveal that both the developing and underdeveloped nations have not been quite successful in controlling the exploitation of their biological resources.

9.2 The National Legislations of India on Biopiracy:

9.2.1 The Patent Act of 1970:

Section 3 mentioned in the Patent Act of India 1970 depicts that neither any plant or any animal or any of its parts or its traditional knowledge is patentable (20). It states that these components of the biological resources are not an innovation, therefore any person claiming such a patent shall be prohibited from granting a patent. This shall ensure to protect the biological resources and its traditional knowledge. In the years 2002 and 2005, the act was amended which was added with the requirement of necessary disclosure of reservoir and region of the biological material from which it has been isolated. In case a patent is obtained without any proper disclosure then the patent can be subjected for revocation.

9.2.2 The Protection of Plant Varieties and Farmers Rights Act of 2001:

This act was basically framed for protecting the traditional knowledge of tribal and rural people or communities (16). The act suggests sharing benefit with the farmers if their traditional knowledge is been used or patented. The act established a fund called the National Gene Fund (9). This fund promotes the protection of agricultural biological resources that includes different plant varieties and the privileged rights of farmers.

9.2.3 The Biological Diversity Act of 2002:

This act mainly concerns with the protection of biological reservoirs and its benefit sharing (22). The act also mentions the transfer of the biological materials. This act was enforced keeping into consideration that India has signed the agreement of the Convention on Biological Diversity. After the long passage of time and enforcement of this act, recently PBRs i.e. People's Biodiversity Registers has been prepared to locate the original region of the biological resources that contain different living organisms and its traditional knowledge (5). In 15 states PBRs have been enforced but hardly 3 % of the local authorities of the states have been successful in preparing them, as recorded up to the year 2018. The NBA or National Biodiversity Authority has been formed through this act. The headquarters of this organization is situated in Chennai (18). In response to this State Biodiversity Boards or SBBs have also been established in different states in the country. Further Committees on Biodiversity Management referred to as BMCs are required to be framed at the local level. The awareness towards biological resources by the government has encouraged us to celebrate International Day of Biodiversity on 22 May of every year (29). However, the year 2010, was regarded as the International Year of Biodiversity (33). The biodiversity experts suggest India is losing around about Rs 30000 crores due to improper implementation of the Biodiversity Act of 2002 (35).

9.2.4 The Geographical Indications of Goods (Registration and Protection) Act, 2003:

This legislation commenced in the year 2003 on 15th September (21). In this act, it is stated to protect the different geographical indications of the nation. According to this act, a product is registered by recognizing the geographical region where it is traditionally available. In other words, a product name is tagged with the name of the region of its origin. For e.g. Darjeeling tea that is a GI tag product of India (49). Other GI tagged products include Malabar pepper, Bangalore Blue Grapes etc (32). As of now till August 2018 about 344 products have been tagged as GI products (27). This act has protected the biological resources, its geographical regions and its traditional knowledge.

9.2.5 Traditional knowledge digital library database, 2001:

India is very rich in traditional or indigenous knowledge of herbal medicines. The ancient systems of medicine like Ayurveda, Unani, Siddha play a significant role in the treatment of people of India even in this modern era (50). But due to negligence in past India has not given proper attention to its traditional knowledge of its medicinal systems. But after facing biopiracy in the form of patents being granted to several of its traditional medicines, the Indian Government has realized to protect its traditional knowledge of traditional medicines. Thus for this purpose, a digital library database on traditional knowledge also called as TKDL was established in the year 2001(52). This contained

various medicinal compositions of different herbal medicines being used in India from ancient times. The Government of India has collected a huge account of data from different ancient books of ancient medicinal systems to generate such a vast database. It was on this database the Indian Government was successful in revoking the patents granted for turmeric and Neem.

10. CONCLUSION AND SUGGESTIONS:

From the above evidences and legislations being studied in this investigation it is clear that biopiracy has played a notable role in the depletion of biological resources and its traditional knowledge. In an earlier study carried out by Yousufi with respect to biotechnological inventions and patent laws it was concluded that the developed nations have highly exploited the patent laws according to their requirements for patenting various biotechnology inventions (59). In a study conducted by Yousufi to investigate whether patent laws are acting as a boon or curse against biopiracy (60), it was concluded that patent laws were more favourable to developed nations in comparison to the developing and underdeveloped nations. In another investigation by Yousufi on microorganisms and patent laws, it was depicted that there are no specific laws for patenting of microorganisms due to unclear legislations on patenting of microorganisms (58). Due to the competition for the patenting of biological material in the world, the biological resources are at a greater brink of being exploited. It should be considered that neither the international nor the national legislations have been effective in controlling the biopiracy of biological resources, although various legislations have been established at times both at the international and national levels. The present situation also depicts that an early action with combined efforts of the global nations is mandatory for sheltering the global biological resources. In this investigation, it is also concluded that developed nations have exploited the biological resources not only in their own territory but also in the territory of other global nations. The developing and underdeveloped nations are the most preferred sites for biopiracy by the biopirates. It is suggested through this investigations that the governments of both developing and underdeveloped nations must promote awareness in their own nations, among their indigenous people or communities for their biological resources. Further, it is recommended to control biopiracy of biological resources of developing and underdeveloped nations because once the biopirates patent their biological material it is not only very costly to revoke the patents but also time-consuming for these nations. This study further concludes that the developing nations and underdeveloped nations due to lack of financial assistance and lack of awareness among the indigenous people have been at back foot to protect their own biological resources and their traditional knowledge. It is therefore suggested that a Global Watchdog Antibiopiracy System should be established to control depletion of biological resources and its traditional knowledge.

REFERENCES:

1. Aguilar, G. (2001). Access to genetic resources and protection of traditional knowledge in the territories of indigenous peoples. *Environmental Science & Policy*, 4, 241–256. Retrieved from https://www.cbd.int/doc/articles/2002-/A-00390.pdf
2. Alves, R. R., & Rosa, I. M. (2007). Biodiversity, traditional medicine, and public health: where do they meet? *Journal of Ethnobiology and Ethnomedicine*, *3*, 14. DOI:10.1186/1746-4269-3-14
3. Andersson, F., & Hertzman, P. (1993). Effective patent life of drugs in Sweden-a comparison with international studies. *Managerial and Decision Economics, 14*(1), 53-63. Retrieved from http://www.jstor.org/stable/2487706
4. Andrzejewski, A. (2010). Traditional knowledge and patent protection: conflicting views on international patent standards. *Potchefstroom Electronic Law Journal*. 13. DOI: https://doi.org/10.17159/1727-3781/2010/v13i4a2701
5. Anuradha R.V., Taneja, B. & Kothari, A. (2001). Experiences with biodiversity policy-making and community registers in India. Participation in access and benefit- sharing policy case study no. 3, February 2001. International Institute for Environment and Development (IIED) 3, Endsleigh Street, London, WDC1H 0DD, UK. Retrieved from https://www.cbd.int/doc/case-studies/abs/cs-abs-reg-in-en.pdf
6. Ardhede, H (2006). Traditional knowledge and the patent system – irreconcilable differences or a simple case of mistaken identity? Master thesis, University of Lund, Sweden. Pp.1-62. Retrieved from http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=1555871&fileOId=1563800
7. Baslar, K. (1997). The concept of the common heritage of mankind in international law. Netherlands, Brill & Nijhoff.
8. Britz, J.J., & Lipinski, T.A. (2001). Indigenous knowledge: a moral reflection on current legal concepts of intellectual property. *International Journal of Libraries and Information Studies*, 51(4), 234-246. DOI:10.1515/LIBR.2001.234
9. Chandrashekaran, S. & Vasudev, S. (2002). The Indian plant variety protection act beneficiaries: the Indian farmer or the corporate seed company? *Journal of Intellectual Property Rights*. 7, 506-515. Retrieved from http://nopr.niscair.res.in/bitstream/123456789/4936/1/JIPR%207%286%29%20506-515.pdf

10. Diamond v. Chakrabarty, 447 U.S. 303 (1980).
11. Eaton, J., Kortum, S. & and Lerner, J. (2003). International Patenting and the European Patent Office: A Quantitative Assessment. National bureau of economic research. pp 1-38. Retrieved from http://www.nber.org/CRIW/papers/eaton.pdf
12. Gates, C. (2014). Patenting the life sciences at the European patent office. *Cold Spring Harbor perspectives in medicine, 4*(12), a020792. DOI:10.1101/cshperspect.a020792.
13. Gélinas, P. (2010). Mapping early patents on baker's yeast manufacture. *Comprehensive Reviews in Food Science and Food Safety*, 9, 483-497. DOI:10.1111/j.1541-4337.2010.00122.x
14. Gepts P. (2004). Who owns biodiversity, and how should the owners be compensated? *Plant physiology, 134*(4), 1295–1307. DOI:10.1104/pp.103.038885
15. http://lifeintelect.com**.** Traditional knowledge and Intellectual property: Case of Turmeric**.** Retrieved from http://lifeintelect.com/blog/2013/10/24/traditional-knowledge-and-intellectual-property-case-of-turmeric/
16. http://nbaindia.org. Protection of New Plant Varieties. Retrieved from http://nbaindia.org/uploaded/Biodiversityindia/Legal/30.%20PPVFR%20Act%202001.pdf
17. http://ricepedia.org. Ricepedia. Rice and food security in Asia**.** http://ricepedia.org/rice-around-the-world/asia
18. http://www.bamu.ac.in. The Biological Diversity Act, 2002 No. 18 of 2003. Retrieved from http://www.bamu.ac.in/Portals/0/3_%20The%20biological%20Diversity%20act%2C%202002.pdf
19. http://www.mondaq.com. Beck, B. & Worm, U. (2016). European union: Monsanto patent on virus-resistant melon revoked. Mayer Brown. Retrieved from http://www.mondaq.com/germany/x/463114/Patent/Monsanto+Patent+on+VirusResistant+Melon+Revoked
20. http://www.mondaq.com. Bhatnagar, J. & Vidisha, Garg. (2007). India: patent law in India. Retrieved from http://www.mondaq.com/india/x/54494/Patent/Patent+Law+in+India
21. http://www.mondaq.com. Dalmia, S. (2017). India: geographical indications law in India everything you must know. Retrieved from http://www.mondaq.com/india/x/655394/Trademark/Geographical+Indications+Law+In+India+Everything+You+Must+Know
22. http://www.mondaq.com. Rana, S.S. & Co. (2018).India: access and benefit sharing under CBD and the ayurveda industry. Retrieved from http://www.mondaq.com/india/x/730062/Environmental+Law/Access+And+Benefit+Sharing+Under+CBD+And+The+Ayurveda+Industry
23. http://www.rkdewan.com. Puranik, P. (2007). Traditional knowledge. Retrieved from http://www.rkdewan.com/traditionalknowledge.php
24. https://bch.cbd.int . The Cartagena Protocol on Biosafety. Retrieved from https://bch.cbd.int/protocol/
25. https://ecologicalregeneration.files.wordpress.com. Chapter 4. Problems and issues related to biodiversity protection in India with special reference to patent laws. Pp. 150. (U.S. Patent no. 6098905 issued on August 8, 2000). Retrieved from https://ecologicalregeneration.files.wordpress.com/2018/11/11_chapter-4.pdf
26. https://guides.slv.vic.gov.au. State Victoria Library. Patents: History. Retrieved from https://guides.slv.vic.gov.au/patents/history
27. https://www.business-standard.com. 326 products registered as geographical indication so far. Press Trust of India. New Delhi. April 18, 2019. Retrieved from https://www.business-standard.com/article/pti-stories/14-products-from-different-states-receive-gi-tag-so-far-this-year-119041800503_1.html
28. https://www.cbd.int**.** Chapter 2. The convention on biological diversity**.** Retrieved from https://www.cbd.int/gbo1/chap-02.shtml
29. https://www.cbd.int. International Day on Biological Diversity 22nd May. Retrieved from https://www.cbd.int/idb/
30. https://www.countercurrents.org. Shiva, V. (2007). Wheat biopiracy the real issues the government is avoiding. Countercurrents. org. November 2007. Retrieved from https://www.countercurrents.org/shiva221107.htm
31. https://www.epo.org. The European Patent Convention. Part II – Implementing Regulations to Part II of the Convention. Chapter V – Biotechnological inventions. Retrieved from https://www.epo.org/law-practice/legal-texts/html/epc/2016/e/rcii_v.html
32. https://www.gitagged.com. GI Tagged Products of India. Retrieved from https://www.gitagged.com/gi-tag-products-of-india/
33. https://www.iied.org. International Institute for Environment and Development (2010). International Year of Biodiversity. Article 04 December, 2011. Retrieved from https://www.iied.org/2010-international-year-biodiversity
34. https://www.iucn.org. The Nagoya Protocol. Retrieved from https://www.iucn.org/theme/global-policy/our-work/convention-biological-diversity-cbd/nagoya-protocol

35. https://www.rcdcindia.org. Sutar, P.C. & Swain, N. (2011). Implementation of biological diversity act in India: an overview with case studies. (part-I & part- II). Study commissioned by. Regional Centre for Development Cooperation (RCDC). Bhubaneswar. Retrieved from https://www.rcdcindia.org/PbDocument/81a3eb27083118c-0e2b-4105-948f-344a088c47e3RCDC_Implementation%20of%20Biological%20Diversity%20Act%20in%20India.pdf
36. https://www.un.org. United Nations. E/CN.17/1997/8**.** Economic and social council commission on sustainable development.. Fifth session 7-25 April 1997. Rio Declaration on Environment and Development: application and implementation. Report of the Secretary-General. Principle 15 paragraphs 80-86.page 22. Retrieved from https://www.un.org/esa/documents/ecosoc/cn17/1997/ecn171997-8.htm
37. https://www.uspto.gov. Uspto.gov. Chapter 1600:1601 Introduction: The Act, Scope, Type of Plants Covered [R-11.2013] 35 U.S.C. 161 Patents for plants. Retrieved from https://www.uspto.gov/web/offices/pac/mpep/s1601.html
38. https://www.wipo.int. Intellectual property and genetic resources, traditional knowledge and traditional cultural expression. World Intellectual Property Organisation, 2015. https://www.wipo.int/edocs/pubdocs/en/tk/933/wipo_pub_933.pdf
39. https://www.wto.org. Trips: Review; Article 27.3 (b) and Related Issues: Background and the current situation. Retrieved from https://www.wto.org/english/tratop_e/trips_e/art27_3b_background_e.htm
40. Kannaiyan, S. (2007). Biological diversity and traditional knowledge. Paper circulated for discussion at the national consultation workshop on Agrobiodiversity hotspots and access and benefit-sharing held during July 19–20, 2007 at Annamalai University, Annamalai Nagar. Retrieved from http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
41. Ko, Y. (1992). An economic analysis of biotechnology patent protection. *The Yale Law Journal*, 102(3), 777-804. DOI:10.2307/796918
42. Mathew, B.B. (2013). Traditional knowledge misappropriation and biopiracy in India: a study on the legal measure to protect traditional knowledge. *International Journal of Marketing, Financial Services & Management Research*, 2 (12), 1-9. Retrieved from http://www.macollege.in/app/webroot/uploads/publishers_file/doc_64.pdf
43. Mulik, K. & Crespi, J. M. (2011) Geographical indications and the trade related intellectual property rights agreement (trips): a case study of basmati rice exports. Journal *of Agricultural & Food Industrial Organization*, 9 (1). Retrieved from https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1503&context=econ_las_pubs
44. Pan, S. Y., Litscher, G., Gao, S. H., Zhou, S. F., Yu, Z. L., Chen, H. Q., … Ko, K. M. (2014). Historical perspective of traditional indigenous medical practices: the current renaissance and conservation of herbal resources. *Evidence-based complementary and alternative medicine: eCAM, 2014*, 525340. DOI:10.1155/2014/525340.
45. Pan, S. Y., Zhou, S. F., Gao, S. H., Yu, Z. L., Zhang, S. F., Tang, M. K., … Ko, K. M. (2013). New perspectives on how to discover drugs from herbal medicines: cam's outstanding contribution to modern therapeutics. *Evidence-based complementary and alternative medicine: eCAM, 2013*, 627375. DOI:10.1155/2013/627375.
46. Prathapan, K., & Rajan, P. (2011). Biological diversity: a common heritage. *Economic and Political Weekly.* 46(14), 15-17. Retrieved from http://www.jstor.org/stable/41152045.
47. Raghuvanshi, K.S. (2017). Patent regime of India related to microorganisms: a critical analysis. *The World Journal of Juristic Polity*.1-10. Retrieved from http://jurip.org/wp-content/uploads/2017/01/Kumar-Salva-Raghuwanshi.pdf
48. Ravi, S.B. (2004). Effectiveness of Indian sui generis law on plant variety protection and its potential to attract private investment in crop improvement. *Journal of Intellectual Property Rights*, 9, 533-548. Retrieved from https://www.niscair.res.in/sciencecommunication/ResearchJournals/rejour/jipr/Fulltextsearch/2004/November%202004/JIPR-vol%209-November%202004-pp%20533-548.htm
49. Ravindran, S., & Mathew, A. (2009). The protection of geographical indication in India-case study on Darjeeling tea. International Property Rights Index 2009 Report. Altacit Global. Retrieved from https://www.altacit.com/wp-content/uploads/2015/03/The-Protection-of-Geographical-Indication-in-India-Case-Study-on-Darjeeling-Tea.pdf
50. Ravishankar, B., & Shukla, V. J. (2007). Indian systems of medicine: a brief profile. *African journal of traditional, complementary, and alternative medicines* 4(3), 319–337. DOI:10.4314/ajtcam.v4i3.31226.
51. Ruiz. M. & Vernooy, R. (2012).The Custodians of Biodiversity: sharing Access to and Benefits of Genetic Resources. New York. Earthscan.
52. Sen, S., & Chakraborty, R. (2014). Traditional Knowledge Digital Library: A distinctive approach to protect and promote Indian indigenous medicinal treasure. *Current Science, 106*(10), 1340-1343. Retrieved from http://www.jstor.org/stable/24102476

53. Sen, S., & Chakraborty, R. (2016). Revival, modernization and integration of Indian traditional herbal medicine in clinical practice: Importance, challenges, and future. *Journal of traditional and complementary medicine*, 7(2), 234–244. DOI:10.1016/j.jtcme.2016.05.006.
54. Takushi, S. (2013). Biological prospectors, pirates, pioneers, and punks in the Andes mountains: an examination of scientific practice in the Andean community of nations. Honors Projects. Paper 16. Retrieved from https://core.ac.uk/download/pdf/59227017.pdf
55. Tully, L.D. (2003). Prospects for progress: the trips agreement and developing countries after the Doha conference. *Boston College International & Comparative Law Review*, 26 (1), 129-144. Retrieved from https://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=1144&context=iclr
56. Vaver, D. (2006). *Intellectual Property rights: Critical Concepts in Law Vol.III*. New York. U.S.A. Routledge.
57. Wilson, E.O., & Peter, F.M. (1988). *Biodiversity*. Washington D.C. National Academy Press.
58. Yousufi, Mahmood Khan. (2018a). Analysis of patent laws with reference to microorganisms. *International Journal of Pharmacy and Biological Sciences, 8 (4),* 744-749. Retrieved from https://ijpbs.com/ijpbsadmin/upload/ijpbs_5c0e9775b2552.pdf
59. Yousufi, Mahmood Khan. (2018b). To determine the significance of patent laws against plagiarism of biotechnological inventions. *Global Journal of Bio-Science and Biotechnology. 7 (4),* 659-663. Retrieved from http://scienceandnature.org/GJBB_Vol7(4)2018/GJBB-V7(4)2018-24CS.pdf
60. Yousufi, Mahmood Khan. (2018c).To study patent laws as boon or Curse against biopiracy. *International Journal of Scientific Research and Reviews, 7 (3),* 1419-1437. Retrieved from www.ijsrr.org › down_1331