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Review Article

The Importance of Traditional Knowledge, Intellectual Property Rights in Benefit Sharing

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Abstract

Plants are the basis life on Earth and without their capacity to capture the sun's energy to the process of photosynthesis, there would not have been any life on the planet. The incredible ability of humankind in exploiting the natural resources around him to his advantage has indeed made human species as the most successful/powerful organism on Planet Earth. The history of human culture and civilization is all about the management and utilization of natural resources around him. Living close to nature, the traditional societies in the third world have acquired unique knowledge about the use of wild flora and fauna and most of which are not known to the people who live away from the natural ecosystem (forests). This knowledge is so invaluable for developing new kind of food, cosmetics, drug and pharmaceuticals and other chemicals of industrial importance. The recent advancements in biotechnology and molecular genetics, particularly in the gene transfer technology (transgenic) have opened new vistas and assumed unlimited power to exploit the genetic resources of the biodiversity. As a result, the potential and actual economic values and genetic materials are increasing rapidly and stimulated international trade in genetic resources commonly known as 'biotrade' which soon led to 'bio-piracy' or 'gene piracy'. The Convention of Biological Diversity (CBD) which has entered into force from December 1993 is a unique international legal instrument to protect the sovereign rights of the state and people over its/their biological resources. "Traditional knowledge" is one of several terms used to describe broadly the same subject matter. Other terms in usage include "indigenous cultural and intellectual property", "indigenous heritage" and "customary heritage rights". The Amity Institute for Herbal and Biotech Products Development (AIHBPD) team lead by the PI of this project has played important roles in the National and global debates in promoting Traditional Knowledge, IPR and benefit sharing with back up of technology. Traditional Knowledge and modern technology has to be interlinked optimum returns. However, the legal and operational areas are to be strengthened. With this objective in view a National Conference entitled "Dhishana-2008 Streamlining India's Traditional Knowledge towards formulating a Sui generis Regime" was organized from 23-25th May, 2008 at Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram. The recommendation of the conference in the form of Thiruvananthapuram Declaration was issued by a group of eminent scientists, traditional knowledge stakeholders, academicians and activists which are incorporated many recommendations.

Introduction

Till the beginning of the 21st Century the Biodiversity was treated as a common property and that anybody could access it and make private economic benefits. In the beginning of the 20th Century the industrially developed countries evolved monopolistic rights of the innovations and inventions made by individuals or corporate bodies known as Intellectual Property Rights (IPRs). The innovations, which are essentially the product of human ingenuity sought for protection, which finally led to the evolution of patents for new products and processes and copyrights for writers and trademark and trade secret for other unique products and programmes. The grant of a patents or any other form of IPR like trademark, trade secret, copyright, etc. is the grant of a monopoly. The internationally organized set up for protection of IPR was made at a convention held at Paris in 1883. India became

a member of the Paris Convention and the associated Patent Cooperation Treaty (PCT) w.e.f. December 1998. To comply with the PCT and the later WTO, which administered the Trade Related Intellectual Property Rights (TRIPs), India had to amend its patent law thrice in 1999, 2002 and again in 2005. With the advent of knowledge driven economy in this era of UN-CBD, WTO and TRIPs the focus has shifted from tangible assets to an enterprise to its intangible assets. There also arose contradictions and conflicts between CBD and WTO. The efforts are in progress both by CBD and WTO to iron out and harmonize such contradictions and differences. The growing industrialization in the world IPR protection has become a key element of success and competitive advantage. The internet technology which evolved in the later part of the 20th Century has made the situation very complex in a manner that it made infringement easier for free riders and firms and the third world countries are fighting hard to protect IPR across national boundaries. The Third World Countries are also making a tough battle in the emerging war in the knowledge market [1] since time immemorial the bio-resources have been used as a source of food and medicine. Important ingredients of the plants have been exploited in 19th and 20th centuries for the preparation of curative, protective and preventive medicines. There are a large number of most valuable natural products have been thus developed from the ethno botanical leads to the scientific validation of the secret mysticism of healing arts of many indigenous communities. In other words, folk or traditional medicinal uses represent 'leads' that could shortcut the discovery of modern medicine. The discovery of novel compounds from the plants used by the ethnic communities from tropical rain forests and these are most clinically useful in medicinal science are like 'Resperine' (*Rauwolfia serpentine*-circulatory stimulant, antihypertensive), 'Cocaine'(*Erythroxylum coca*-local anesthetic), 'Emetin' (*Cephaelis ipecacuanha*-amebicide, emetic), 'Quinine' (*Cinchona* spp-antimalarial), 'Neoandrographolide' (*Andrographis paniculata*-dysentery), 'Vasicine' (*Justicia adhatoda*-oxytoxic, expectorant), 'Vinblastin' (*Catharanthus roseus*-antitumor, 'Arecoline' (*Areca catechu*-anti anthelmintic), 'Bromelain' (*Ananus cosmos*-anti-inflammatory) etc. Some wonder compound like 'Taxol' (*Taxus* spp.-anticancer), 'Ephedrine' (*Ephedra* spp-antidiaphoretic), 'Arteether' (Artemisia annua-antimalarial), 'Atropine' (*Atropa belladonna*-bronchodialator) etc. are also the examples of ethnobotanical leads. The compounds derived from herbal resources like "Azadirachtin' (*Azadirachta indica*-pesticides), 'Nicotine' (*Nicotiana tabacum* – insecticides), and 'Steviosides' (*Stevia* spp-sweetner) came to us through indigenous practices. The isolation and characterization of "Picroliv' (*Picrrorhiza kurroa*-hepatoprotective) and 'Guggulpid' (*Commiphora guggul*-hyperlipidaemia, rheumatism) have been traditionally known to Ayurveda for their curative properties [2]. The biological observations based on ethnic knowledge based leads were essential to discover these action oriented natural compounds. The efforts are still continued for the evaluation of promising bio-leads by different organization and laboratories in India like Indian Council of Medical Research (ICMR), Council of Scientific and Industrial Research (CSIR), Central Drug Research Laboratory (CDRL), Department of Ayurveda, Siddha, Unani and Homeopathy (AHYSH), Ministry of Health and Family Welfare, Department of Biotechnology, Department of Science and Technology, Govt. of India, Laboratory of many Universities and R&D of pharmaceutical companies etc.

Traditional Knowledge Digital Library (TKDL)

To prevent bio-piracy of bio-prospection and other scientific evaluation and to protect IPR, CSIR in association with the Ministry of Health and Family Welfare, Govt. of India have launched two important programmes relating to the creation of a Traditional Knowledge Digital Library (TKDL) and designing a Traditional Knowledge Resource Classifications (TKRC). The Department of Indian System of Medicine and Homoeopathy (ISM&H) spearheaded this initiative. The ISM&H set up the TKDL task force, by drawing experts from Central Council of Research of Ayurveda and Siddha, Banaras Hindu University, National Information Centre, CSIR and Controller General of Patents and Trademarks. The Indian TKRC has information on 5000 subgroups and the structure of TKRC is compatible with the International Patent Classification (IPC). TKRC would help enhance the quality of patent examination by facilitating the patent examiners to access pertinent information on traditional knowledge in an appropriately classified forum. This would also check wrong patents made based on traditional knowledge available in India [3].

The Scenario in the Third world

Many third world nations have no capability and legal expertise to develop suitable measures needed to control, protect and maintain their bio-resources and associated cultural expressions, including the traditional wisdom on the use of bio-resources. Many traditional communities in these countries fear that they are losing control on their knowledge systems and those outsiders are appropriating their knowledge and resources without their consent and approval. There are several cases of such illegal plundering of indigenous people's knowledge and resources have been reported from third world nations in Africa, South America and Asia. The recent revocation of the US Patents on turmeric (use of turmeric in wound healing) and on a new variety of *Banisteriopsis caap* by USPTO revealed that the claims made on these two patents were drawn from the traditional knowledge base of the developing countries. These are just two examples of the patent cases that the developing countries have won. Several other ongoing cases of challenging and re-examination of patents filed in developed countries, especially in USA, based on the age-old knowledge system (both undocumented and public domain

knowledge) and resources of local and indigenous communities living in the developing countries. In such a situation the third world nations should strive to develop appropriate policies and procedures to bring out legislations to recognize the values and the rights of indigenous and local communities over their knowledge, innovations and practices, particularly those associated with genetic resources. In order to guarantee the implementation of such policies, the third world nations need to pass legislation to facilitate access to genetic resources and benefit sharing, based on prior informed consent, access agreements (based on mutually agreed terms) and material transfer agreements. In most third world nations, these rights refer to a right to use resources for subsistence purposes, which are considerably different from the interests centered on bio-prospecting activities. Many countries are presently discussing the possibility of developing a national register for documenting the knowledge, innovations and practices of indigenous and local communities. Such community registers could assist the states in ensuring controlled access and use of traditional knowledge systems, and equitable sharing of benefits as well. This register could function as a legal document that certifies the claim of the community about the knowledge and it could also form the basis for evolving a licensing method based on sui generis form of Intellectual Property Rights (IPR). While undertaking such an exercise the countries need to consider the international regimes on IPR, particularly the Trade Related Intellectual Property Rights of the World Trade Organization (WTO-TRIPs) and the World Intellectual Property Organization (WIPO) [4].

India's Measures to Tackle the Issues

Indian Government has passed three revolutionary bills to protect the national Intellectual Property Rights (IPR), viz., Patents (Second) Amendment Bill, Biological Diversity Act of 2002 and Plant Variety Protection and Farmers' Rights (PVPFR) Act of 2001. These Acts are now in position. It contains adequate provisions that would help safeguard the sovereign rights of the country over its biological resources, protect the indigenous knowledge systems associated with biological diversity, and recognize the farmer's rights to save, use, exchange, share or sell the plant varieties which they have developed, improved and maintained over many generations through indigenous practices of selection, domestication and conservation. The specific clauses pertaining to the above provisions include: controlled access and use of biological material and associated knowledge for commercial utilization, bio-survey or bio-utilization with the prior approval of the National Biodiversity Authority; disclosure of source of material and knowledge; and availability of indicative traditional knowledge as ground for opposition or revocation of a patent or a plant variety registered under the PVPFR Act. The national legislation on biological diversity would necessitate registration of local and indigenous knowledge throughout the country, and strict implementation of Prior Informed Consent (PIC) (of the owners of the biological resources and associated knowledge as well as the Government), so that access to and transfer of resources and knowledge and resultant benefit sharing could be regulated and monitored smoothly and efficiently. It also charges Government with monitoring and opposing IPR infringement of Indian resources and knowledge. Efforts of several NGOs (e.g. SRISTI) and the government sponsored National Innovations Foundation (NIF) provide the platform to build the registration and benefit sharing system at the grassroots (Gupta, 2003, Pushpangadan et al. 2012). Encouraging such measures internationally through the World Intellectual Property Organization (WIPO) would be advisable [1,5,6].

An Indian Experiment in Benefit Sharing

India has a glorious tradition of learning, scholarship and material culture dating back 6000 years. The Indians have developed knowledge systems on a variety of subjects. In the present context we are considering just one of such subjects, namely the traditional knowledge on healthcare. The traditional health care system in India is essentially herbal based and it functions mainly through two social streams: viz. (1) The folk stream comprising of oral tradition practiced by village physicians/folk healers and the tribal communities and (2) the classical or scientific (Sasthreeya) systems like Ayurveda, Sidha, Unani and Amchi, comprising of organized, codified and synthesized medical wisdom with strong theoretical and conceptual foundations and philosophical explanations. While the classical systems of medicine utilize about 2000 plant species for medicinal purpose, the tribal communities, who live in and around the forests, utilize over 8000 species of plants, most of which are otherwise not known to the outside world [1,7].

India has the distinction of the first country in the world in experiment a benefit sharing model that implemented the Article 8(j) of CBD, in letter and spirit. It was Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) in Kerala (where the senior author was director) that demonstrated indigenous knowledge system merits support, recognition and fair and adequate compensation. The model, which later on came to be known as "JNTBGRI Model" or "Pushpangadan Model", relates to the sharing of benefits with a tribal community in Kerala, the Kanis, from whom a vital lead for developing a scientifically validated herbal drug (Jeevani) was obtained by scientists of JNTBGRI. The JNTBGRI Model has got wider acclaims, acceptance and popularity the world over, because it was the first of its kind that recognized the resource rights and IPR of a traditional community by way of sharing equitably the benefits derived out of the use of a knowledge that has been developed, preserved and maintained by that community for many generations. Further, it demonstrates the vast and as yet under - explored or untapped potentials of the Indian traditional knowledge systems, particularly the traditional health care practices of the local and indigenous people in India.

It would, therefore, be interesting to give brief background information regarding the traditional medicine system of India and the genesis and operation of an ambitious programme- "All India Coordinated Research Project on Ethno biology (AICRPE), which led to the JNTBGRI Benefit sharing Model [8].

TKS and Healthcare Traditions in India

There are about 70 million tribal's belonging to over 550 communities. They are in possession of a treasure of rich traditional knowledge system associated with the conservation and use of wild flora, fauna and other natural resources. The inroads of modernization are presently posing imminent danger to this rich and varied knowledge system of these communities, and it is likely that it may be completely lost to the humanity for all time to come. Recognizing this danger, Prof. M.S. Swaminathan and then the Director General of Indian Council of Agricultural Research (ICAR) mooted the idea of starting a research programme to document the knowledge system of the tribal communities of India in 1976. Government of India finally launched an 'All India Coordinated Research Project on Ethno biology' (AICRPE) under the Man and the Biosphere (MAB) Programme in 1982. The overall objective of AICRPE was to make an in-depth study and analysis of the multidimensional perspectives of the life, culture, and tradition and knowledge system of the tribal communities of India. Initially the project was under the Department of Science and Technology, but later transferred to the Ministry of Environment and Forests, Govt. of India. The author, then a senior scientist at Regional Research Laboratory (RRL), Jammu, now known as the Indian Institute of Integrative Medicine (IIM-a constituent laboratory of Council of Scientific and Industrial Research-CSIR), was appointed as the chief coordinator of this massive programme. It was operated at 27 centers in the country and about 600 scientists drawn from botany, zoology, sociology, anthropology, ayurveda, chemistry and pharmacology worked in this project that lasted for 16 years (1982-1998). AICRPE project documented the use of over 10,000 wild plants used by tribal's for meeting a variety of their requirements [6].

Traditional Diets and Nutraceuticals

The key to the development of health foods/pharma foods or nutraceuticals lies in the value addition in the traditional natural diets. India has over 5000 years of heritage of health science where in food has been given an important role in maintaining healthy life. People living in different agro climatic regions of the country had experimented and made a variety of food and diet and health care practices, which is now termed as ethnic foods. The Ayurvedic medicine deals with a unique system of management called 'Rasayana which is essentially a combination of food and medicinal herb recipes intended to rejuvenate the whole body system and make it fully healthy and functional. These will have tremendous impact on health securities of the nation. Phytonutrients/phytochemicals of 'Rasayana' drugs have tremendous impact on the health care system and may provide health benefits including prevention and treatment of diseases and physiological disorders. Polyphenols are one of the most widely distributed groups of phytochemicals and range from simple phenols to highly polymerised tannins. They protect plants from oxidation damage and the same in human protecting the tissue from oxidative days there by acting as antioxidants. The outstanding feature of these phytonutrients is their ability to block specific enzymes that cause inflammation. They also modify prostaglandin pathways and there by protect platelets from clumping. There is also tremendous amount of research going on in the field of nutraceuticals with around 900 publications with nutraceucticals as the key word. An actual class of nutraceuticals is represented by the polyunsaturated fatty acids (PUFAs) especially of those n-3 and n-6 fatty acid (FA) families. Current interest is devoted to the so-called fish oils containing a high share of n-3 FA (eicosapentanoic acid [EPA] and decosahexaenoic acid (DHA). It is claimed that these particular FA exert a positive effect on the development of cardiovascular and inflammatory diseases and the beneficial effects of fish oil supplementation in many other chronic diseases have been advocated. Many recent observations suggest a potential role of fish oils in the treatment of atopic dermatitis and psoriasis. There are also indications that premature infants have limited dietary support of the n-3 FA required for normal composition of brain and retinal lipids [1].

Strategies for Development of Nutraceuticals in India

There are only limited opportunities for small and medium sized companies in the functional food market due to the specific challenges, which have to be overcome in this segment. The future strategies for this group of companies must include:

- Production and marketing of functional "me too" products in case the original product or functional ingredient is not protected by patents.
- Exploitation and further R&D for development of functional ingredients discovered by researchers of scientific institutes.
- Development and marketing of specific functional niche products with the help of innovative suppliers
- Development of functional ingredients in specialized biotech companies
- Production of functional private label brands
- Collaboration with scientific institutes in the area of fortification of the normal food to make it a functional food, thereby providing a value-added product

WTO-TRIPs versus CBD

Immediately after the CBD came into being, another international body called the World Trade Organization (WTO) was established in June 1994 for streamlining and regulating the trade relations of the world. Most of the countries have signed both CBD and WTO. But there arose certain contradictions in the Trade Related Intellectual Property Rights (TRIPs) under the WTO with those of CBD. The ministerial conference of the member countries of WTO was constituted to iron out the contradiction and to harmonize TRIPs and CBD, and thereby to create a fair and enabling situation for all countries of the world. Similarly, CBD has also constituted Conference of Parties (COP) to streamline and implement the CBD directives. Access and benefit-sharing issues have become the central themes for subsequent detailed discussions and decisions- making under CBD, TRIPs, and the World Intellectual Property Organization (WIPO). CBD began to address the ABS issues and their implementation since Fourth Meeting of the Conference of Parties (COP-IV) held in Bratislava (Slovakia) in May 1998.

In its efforts to evolve an international regime for access and benefit sharing based on genetic resources and traditional knowledge, CBD has constituted two separate working groups and one Expert Panel viz. (i) Ad-hoc Open-ended Working Group on Traditional Knowledge [CBD/COP IV/9/1998] (ii) Ad-hoc Open-ended Working Group on Access and Benefit Sharing [CBD/COP V/6/2000] and (iii) Panel of Experts on Access and Benefit Sharing (CBD/COP IV/8, 1998). The terms of references of these Working Groups and Expert Panel included mainly the development of a framework that would help assist Parties to develop national and regional regulations or guidelines on ABS, with special focus on evolving standards and principal elements of "Prior Informed Consent (PIC)", "Mutually Agreed Terms (MAT)", "Material Transfer Agreements (MTA)" and Monetary and Non-Monetary Benefit Sharing Agreements [9], [10].

One of the significant outcomes of CBD's work on ABS is the development of the "Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization" at the October 2001 meeting of the Ad-hoc Open-ended Working Group on Access and Benefit Sharing held in Bonn, which were adopted at the Sixth Meeting of the Conference of Parties held in April 2002 in The Hague (COP Decision VI/24). The Bonn Guidelines provide the Parties and Stakeholders with a transparent framework to facilitate access to genetic resources and ensure fair and equitable sharing of benefits through standard practices and procedures of PIC, MAT, MTA, and other relevant agreements. The Guidelines provide details of an overall strategy and the essential steps, elements and principles to be adopted in developing access and benefit sharing regimes by the Parties and Stakeholders [11].

World Intellectual Property Organization (WIPO) and ABS & Article 8 (j)

The CBD Secretariat and ABS Work Group have been studying the possible mechanisms to address the ABS issues regarding prior informed consent, benefit-sharing agreements, technology transfers on the basis of mutually agreed terms and other relevant provisions with reference to WIPO, UNCTAD, and other organizations. The Group of Like-Minded mega diverse Countries (LMMC), who was the first to raise these issues for discussion in the context of CBD, however, objects any idea of a strong collaboration with WIPO due to the apprehension that the interests of these countries would not be addressed appropriately at WIPO, whose prime concern is to negotiate and implement the IPR policies concerning the monopolistic rights of individual or corporate innovators. The WIPO's Intergovernmental Committee (IGC) on Intellectual Property, Genetic Resources, Traditional Knowledge and Folklore is now examining the issues of ABS and traditional knowledge (WIPO, 2001). However, the latest (seventh) meeting of the WIPO-IGC convened in Geneva during 1-5, November 2004 remained inclusive as no consensus was reached on the future work of the IGC on genetic resources. IGC have considered the Agenda at its 8th session to hold on 6-10, June 2005 in Geneva (WIPO/GRTKF/IC/7 [12].

Cancun Declaration of Like-minded Mega Diverse Countries, February 2002

The Cancun Declaration made at the meeting of the Like Minded Mega Diversity Countries (LMMC) held on February 16-18, 2002 in Cancun, Mexico and the decision thereof to create a strong committed Group of Like- Minded Mega Diverse Countries was a landmark event which could help achieve more tangible outcomes on conservation and sustainable use of over 70% of the world's biodiversity which the mega diversity countries hold together. One of the key objectives of LMMC as outlined in the Cancun Declaration is to seek the creation of an international regime to effectively promote and safeguard the fair and equitable sharing of benefits arising from the use of biodiversity and its components. This regime should contemplate, inter alia, the following elements: certification of the legal provenance of biological materials, prior informed consent and mutually agreed terms for the transfer of genetic material, as requirements for the application and granting of patents, strictly in accordance with the conditions of access agreed by the countries of origin.

Cusco Declaration on Access to Genetic Resources, TK and IPR of Like-minded Mega Diverse Countries, November 2002

The Cusco Declaration on Access to Genetic Resources, Traditional

Knowledge and Intellectual Property Rights of Like-minded Mega diverse Countries issued at the meeting of the state ministers and high-ranking representatives of LMMC held at Peru's Urubamba valley, Cusco on November 29, 2002, reaffirmed the objectives of Cancun declaration, 2002 and considered the Bonn guidelines on "Access to Genetic Resources and Fair and Equitable sharing of Benefits arising from their Utilization" as a useful framework for developing international ABS regimes. The Cusco declaration also agreed upon to adopt a number of important actions, including among others, developing and formulating a strategy and action plan, which may contain targets, objectives, activities and means including financial resources to develop joint coordination towards the consolidation to reach LMMC objectives. The criteria of equity and ethics need to be strictly adhered to in dealing with any access laws, policies and regulatory mechanisms. The LMMC's focus should be to develop an access mechanism that would be fair, transparent, effective and implementable. Given the international guidelines such as the Bonn Guidelines and other model frameworks, one of the serious concerns for implementing uniform standards and elements for ABS mechanism is the absence of appropriate definitions of various terms related to genetic resources and traditional knowledge and other components of biodiversity in the national legislations and other documents on biodiversity. Through a decision taken at its Seventh Meeting of the COP in Kuala Lumpur in 2004, the CBD secretariat has initiated a process to compile the national definitions that each Party has accorded to the following terms: access to genetic resources, benefit sharing, commercialization, derivatives, provider, user, stakeholder, ex situ collection, voluntary nature, and other relevant terms (CBD/COP 7/19/2004). Another concern in relation to developing ABS procedures at national or institutional level is the lack of adequate capacity and experience in evolving equitable bio-prospecting partnerships that would cover all essential steps of PIC, MTA, MAT, and agreements for sharing the benefits arising from the production and commercialization of any product or technologies derived from the genetic resources, its components and/or derivatives and the associated knowledge. The disproportionate distribution of biodiversity and biotechnology across the world, and the North-South divide in policy and legal issues related to biodiversity, biotechnology, traditional knowledge, global trade and intellectual property protection are other reasons that cause delay in implementing a transparent and comprehensive international regime on access and benefit sharing [13] India has about 126,756 species of plants, animals, fungi and microorganisms already identified and classified. The flora of India is both rich and diverse due to wide range of variations in climate, altitude and ecological habitats. It is estimated that the floristic spectrum of India comprises of over 30000 species (excluding fungi, which are now being treated as a separated kingdom), of which the flowering plants with about 17,500 species constitute the dominant group-representing about 7% of the flowering plant species of the world. Endemism in Indian flora is now almost well documented. It is estimated that out of 17,500 species of flowering plants, 140 genera and 5285 species are endemic to the country (Figure 1) [14].

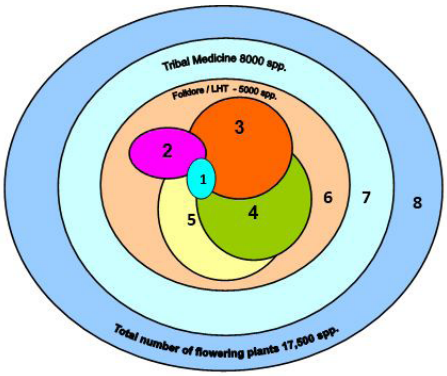

Figure 1: Flowering plants used in Traditional Systems of Medicine in India.

1. Modern Medicine 30 spp.
2. Amchi 300 spp.
3. Unani 700 spp.
4. Siddha 800 spp.
5. Ayurveda 900 spp.
6. Local Health Traditions (LHT) 5,000 spp.
7. Tribal Medicine-8,000 spp.
8. Total Flowering Plants-17,500 spp.
9. After Pushpangadan (2002)

In India species richness is complemented by enormous genetic diversity found within individual species. This makes India one among the 12 mega gene centers of the world. The Indian Gene Centre (Vavilovian 'Hindustani' Centre) is considered the centre of origin and domestication of as many as 356 major and minor crop plant species and as many 326 wild relatives of crop plants. The occurrence of several ecotypes, chemo types and cyto types ever within a single plant species offer ample opportunities to systematically survey, study, characterize and evaluate the economic uses and potentials of the plant resources of India. But unfortunately, due to various reasons much of our precious biodiversity is eroding fast. We have to make concerted efforts to stop this erosion as well as sustainably utilize them. By the application of S&T it is possible to convert our rich biodiversity into economic wealth which can generate mass rural employment and thereby prosperity to our country. Our army can play a very key role in this programme particularly in reforestation/forestation of the vast deforested areas and wastelands of our country [15].

India can offer a leadership for developing appropriate

strategies to facilitate easy and regulated access to and transfer of relevant technologies as well as exchange of information pertaining to conservation and sustainable use of biogenetic resources and associated knowledge through Material Transfer Agreements (MTA), Prior Informed Consent (PIC) of the resource holder or resource providing country and other suitable procedures and mechanisms of equitable benefit sharing in accordance with CBD, WTO-TRIPs and the national legislations of respective countries. A South-South cooperation among the Third World Countries, particularly of the Asiatic region is inevitable to build up their S & T capabilities in protecting their sovereign rights over biodiversity and associated traditional knowledge, and in capitalizing these invaluable resources to generate Intellectual Property Rights in all domains of biodiversity-based R&D, commercial and industrial ventures. Such a partnership will help the Third World developing countries to insulate themselves from bio-piracy and bio-imperialistic attitude of the biotechnologically-rich countries of the North and thereby to achieve self-reliance and economic prosperity. Empowering the rural communities, particularly women, and ensuring their traditional resource rights as well as intellectual property rights are important prerequisites to conservation of biodiversity and sustainable development in the Asiatic region. The technologically poor countries of Asia can capitalize their traditional knowledge and bio-resources through S&T -based location specific value addition of the bio-resources for developing small or medium scale bio-prospecting industries, and thereby scaling up intellectual property on grass-root level innovations. However, many of the Third World countries in Asia lack the much-needed expertise and infrastructure to undertake R & D on biodiversity-based bio-prospecting programmes. Third World countries like India, China and Australia, which are endowed with rich bio-resources and R& D capabilities, can offer leadership in training and capacity building programmers in Asiatic region in both basic and the applied areas of biodiversity and biotechnology research and development. Such leadership initiatives should focus on

- Developing transparent policies and mechanisms to ensure access to and transfer of genetic resources and technologies among the participating countries and to evolve equitable benefit sharing models based on sustainable use and S&T-based value addition to bio-resources and associated traditional knowledge systems.
- Promoting multi-country collaborative R&D projects on various facets of bio-prospecting, particularly herbal drug and pharmaceutical prospecting and other natural product development sectors.
- generating IPR covered products, technologies and services and thereby converting the bio-resources and associated traditional knowledge into economic wealth of a nation and its people

India's Strengths in Providing Leadership in Bio-Prospecting and Value Addition

India is strategically well positioned to provide leadership to the rest of the Third World countries in several key areas of biodiversity, biotechnology and bio-prospecting. India is rich both in biodiversity and associated traditional knowledge systems. India's biodiversity is marked by occurrence of diverse types of ecosystems, high species diversity with high incidence of endemism, and enormous genetic diversity in crop plants, domesticated animals and their wild relatives. The traditional knowledge systems embody a plethora of unique time-tested knowledge, wisdom, beliefs, traditions and practices associated with conservation and sustainable use of biogenetic resources. The traditional knowledge base of Indian ethnic and local communities is the richest in the Third World. India's tribal and folklore traditions, particularly the traditional medicine systems are rich and unique.

India has an excellent network of R&D in biodiversity, biotechnology and bioinformatics managed by various government departments and agencies (Department of Science & Technology, Department of Biotechnology, Council of Scientific & Industrial Research, Department of Agriculture, Department of Indian System of Medicine & Homeopathy, and Department of Forests & Environment) and Universities. Indian plant biology research is spread across 200 universities, including 3 full-fledged agricultural universities, more than 90 R&D institutes and centers, and a few private foundations and companies.

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