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Biodiversity Management Open Avenues for Bioprospecting

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Abstract

Biodiversity management plays important role in progress for bioprospecting in the field of agriculture. Genetic enhancement based on discovery and use of novel genes has been the key in meeting the demands of food for feeding the ever-increasing population. With the advent of new biotechnological tools and techniques, it has been possible to access genes from diverse biological systems and deploy them in target species and this has made the whole living world a single gene pool.

Keywords: Biodiversity; bioprospecting; agriculture; benefits; policy.

1. Introduction

Bioprospecting has been conducted by local people, such as traditional healers, since a long time. This has not created major tensions or problems, since they conducted their bioprospecting activities in their own region and on a relatively small scale. Problems occurred once private organizations or individual prospectors started exploiting bioresources in areas to which they were foreign, without equitable benefit sharing and while neglecting the interests and wishes of local people; a phenomenon that is sometimes referred to as 'biopiracy'. Bioprospecting is systematic search for and development of new sources of chemical compounds, genes, micro-organisms, macro-organisms, and other valuable products from nature. It entails the search for economically valuable genetic and biochemical resources from nature. So, in brief, bioprospecting means looking for ways to commercialize biodiversity. Lately, exploration and research on indigenous knowledge related to the utilization and management of biological resources has also been included into the concept of

bioprospecting. Thus, bioprospecting touches upon the conservation and sustainable use of biological resources and the rights of local and indigenous communities.

Bioprospecting, if well managed, can be advantageous, since it can generate income for developing countries, and at the same time it can provide incentives for the conservation of biological resources and biodiversity. In addition, it can lead to the development of new products, including for example new medicines. On the other hand, if not well managed, bioprospecting may create a number of problems, including environmental problems related to unauthorized (over-) exploitation, and social and economic problems related to unfair sharing of benefits -or the total absence of benefit sharing- and to disrespect for the rights, knowledge and dignity of local communities. Bioprospecting is the process of discovery and commercialization of new products based on biological resources and it often draws on indigenous knowledge about uses and characteristics of plants and animals [1]. Bioprospecting includes biopiracy, the exploitative appropriation of indigenous forms of knowledge by commercial actors, as well as the search for previously unknown compounds in organisms that have never been used in traditional medicine [2]. Biopiracy is a situation where indigenous knowledge of nature, originating with indigenous peoples, is used by others for profit, without permission from and with little or no compensation or recognition to the indigenous people themselves [3]. Greenpeace [4], claim these practices contribute to inequality between developing countries rich in biodiversity, and developed countries hosting companies that engage in 'biopiracy'.

International Cooperative Biodiversity Group (ICBG) aimed to document the biodiversity of Chiapas, Mexico and the ethnobotanical knowledge of the indigenous Maya people - in order to ascertain whether there were possibilities of developing medical products based on any of the plants used by the indigenous groups [5-7]. Different countries are reported as having acquired different beliefs about the medical properties of the plant [8]. The Hodgkin's lymphoma chemotherapeutic drug vinblastine is also derivable from the rosy periwinkle [9]. Legal action by the Indian government followed, with the patent on *neem* eventually being overturned in 2005 [10-11]. The Enola bean is a variety of Mexican yellow bean, so called after the wife of the man who patented it in 1999 [12]. The dwarfing genes in wheat and rice, and rust resistance genes in wheat are some of the most prominent examples, which stand testimony to the power of genetic technology that ushered in green revolution and subsequently helped sustaining the productivity gains. The conventional methods of genetic enhancement however have certain limitations including incompatibility barriers among different species. Use of crystal protein genes from the soil bacterium Bacillus thuringiensis in genetic engineering of crops like cotton clearly depicts how genes from evolutionarily distant organisms can bring new revolution in agricultural production. Several other genes have also been prospected, validated and are being deployed to gain commercial advantage. This sub-project aims to prospect for novel genes and mine new alleles of known genes for abiotic stress tolerance from the unified gene pool cutting across taxa and phyla and functionally validate them for future deployment to enhance and sustain agricultural productivity.

2. Convention on Biological Diversity (CBD)

The CBD came into force in 1993 and it secured rights to control access to genetic resources for the countries in which those resources are located. One objective of the CBD is to enable lesser-developed countries to better benefit from their resources and traditional knowledge. Under the rules of the CBD, bioprospectors are required to obtain informed consent to access such resources, and must share any benefits with the biodiversity-rich country. However, some critics believe that the CBD has failed to establish appropriate regulations to prevent biopiracy. Main problem is the failure of national governments to pass appropriate laws implementing the provisions of the CBD. The Nagoya Protocol to the CBD (negotiated in 2010, expected to come into force in 2014) will provide further regulations. The CBD has been ratified by all countries in the world except for Andorra, Holy See and United States. The 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) and the 2001 International Treaty on Plant Genetic Resources for Food and Agriculture are further relevant international agreements.

3. Bioprospecting Contracts

Bioprospecting contracts lay down the rules, between researchers and countries, of benefit sharing and can bring royalties to lesser-developed countries. The ethical debate has sparked a new branch of international patent and trade law. However, the fairness of these contracts has been a subject of debate. Unethical bioprospecting contracts (as distinct from ethical ones) can be viewed as a new form of biopiracy. An extensively discussed example of a bioprospecting contract is the agreement between Merck and INBio of Costa Rica [13]. On June 14, 2011, Colombia approved a policy for the sustainable commercial use of its biodiversity resources, primarily through the development of biotechnology research. It includes plans to set up a national company for bioprospecting to link up with the commercial sector and will be backed with US$14 million in government funds over the next four years [14-15]. In response to concerns of biopiracy raised by research into turmeric, neem and basmati rice, the Government of India has been translating and publishing ancient manuscripts containing old remedies in electronic form, and in 2001 the Traditional Knowledge Digital Library was set up as a repository of 1200 formulations of various systems of Indian medicine, such as Ayurveda, Unani and Siddha [16].

4. Bioethics and Principles

The scope of bioethics can expand with biotechnology, including cloning, gene therapy, life extension, human genetic engineering, astroethics and life in space, and manipulation of basic biology through altered DNA, XNA and proteins. These developments will affect future evolution, and may require new principles that address life at its core, such as biotic ethics that values life itself at its basic biological processes and structures, and seeks their propagation. The field of bioethics has

addressed a broad swath of human inquiry, ranging from debates over the boundaries of life (e.g. abortion, euthanasia), surrogacy, the allocation of scarce health care resources (e.g. organ donation, health care rationing) to the right to refuse medical care for religious or cultural reasons. Bioethicists often disagree among themselves over the precise limits of their discipline, debating whether the field should concern itself with the ethical evaluation of all questions involving biology and medicine, or only a subset of these questions. Some bioethicists would narrow ethical evaluation only to the morality of medical treatments or technological innovations, and the timing of medical treatment of humans. Others would broaden the scope of ethical evaluation to include the morality of all actions that might help or harm organisms capable of feeling fear. One of the first areas addressed by modern bioethicists was that of human experimentation.

The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research was initially established in 1974 to identify the basic ethical principles that should underlie the conduct of biomedical and behavioral research involving human subjects. However, the fundamental principles announced in the Belmont Report (1979)--namely, autonomy, beneficence and justice--have influenced the thinking of bioethicists across a wide range of issues. Others have added non-maleficence, human dignity and the sanctity of life to this list of cardinal values. Another important principle of bioethics is its placement of value on discussion and presentation. Numerous discussion based bioethics groups exist in universities across the United States to champion exactly such goals. Examples include the Ohio State Bioethics Society and the Bioethics Society of Cornell. Professional level versions of these organizations also exist. Medical ethics is the study of moral values and judgments as they apply to medicine. As a scholarly discipline, medical ethics encompasses its practical application in clinical settings as well as work on its history, philosophy, theology, and sociology. Medical ethics tends to be understood narrowly as an applied professional ethics, whereas bioethics appears to have worked more expansive concerns, touching upon the philosophy of science and issues of biotechnology. Still, the two fields often overlap and the distinction is more a matter of style than professional consensus. Medical ethics shares many principles with other branches of healthcare ethics, such as nursing ethics. A bioethicist assists the health care and research community in examining moral issues involved in our understanding of life and death, and resolving ethical dilemmas in medicine and science.

5. Biodiversity Resources

Biodiversity-rich countries often face serious problems with regard to the prevention of unauthorized bioprospecting, due to weak law enforcement, which is further worsened by the fact that the practice usually takes place in remote locations. A first step in order to avoid biopiracy would be to develop an integrated and comprehensive national policy on access or -rather- on access and benefit sharing. Ideally, access is granted after mutual agreement and has a legal basis. Access can be divided into authorized

and unauthorized access. Authorized access may be conducted through formal (institutionalized) collaboration on research and utilization or through purchasing from recognized institutions etc. Unauthorized access can be practiced through individual contacts, through unauthorized exploration, via abuse of concession permits for the utilization of certain resources etc. Biodiversity has been defined under Section 2(b) of the Act as "the variability among living organisms from all sources and the ecological complexes of which they are part, and includes diversity within species or between species and of eco-systems". The Act also defines, Biological resources as "plants, animals and micro-organisms or parts thereof, their genetic material and by-products (excluding value added products) with actual or potential use or value, but does not include human genetic material."

The National Biodiversity Authority (NBA) is a statutory autonomous body, headquartered in Chennai, under the Ministry of Environment and Forests, Government of India established in 2003 to implement the provisions under the Act. State Biodiversity Boards (SBB) has been created in 28 States along with 31,574 Biological management committees (for each local body) across India. Functions of NBA includes regulation of acts prohibited under the Act; advise the Government on conservation of biodiversity; advise the Government on selection of biological heritage sites; and to take appropriate steps to oppose grant of intellectual property rights in foreign countries, arising from the use of biological resources or associated traditional knowledge. A foreigner, non-resident Indian as defined in clause (30) of section 2 of The Income-tax Act, 1961 or a foreign company or body corporate need to take permission from the NBA before obtaining any biological resources or associated knowledge from India for research, survey, commercial utilization. Indian citizens or body corporate need to take permission from the concerned State Biodiversity Board. Result of research using biological resources from India cannot be transferred to a non-citizen or a foreign company without the permission of NBA. However, no such permission is needed for publication of the research in a journal or seminar, or in case of a collaborative research made by institutions approved by Central Government. No person should apply for patent or other form of intellectual property protection based on the research arising out of biological resources without the permission of the NBA. The NBA while granting such permission may make an order for benefit sharing or royalty based on utilization of such protection.

6. Bioprospecting Policy

Benefits can be tangible as well as intangible, and should be fairly shared among the parties involved. Tangible benefits may include fees, royalties, profit sharing arrangements etc. Intangible benefits could for instance be the strengthening of institutional capacity and joint publications. In order to deal in a comprehensive way with the opportunities and the potential drawbacks which bioprospecting encompasses, several countries have developed a national bioprospecting policy. To develop a comprehensive bioprospecting policy, it is necessary to coordinate, align and integrate

policies and strategies across sectors; in the case of bioprospecting, this would comprise issues related to intellectual property rights, tenure of land and natural resources, R&D, conservation and protection of biodiversity etc. The policy should provide for mechanisms whereby its objectives can be translated into appropriate action and which can influence decision making on relevant issues.

A comprehensive bioprospecting policy should contain at least the following, complementary elements: (a) l*egislation and regulation:* appropriate legislation and regulations are the basis for implementation of the policy, and are needed in order to make it enforceable. Probably the most crucial issue to be addressed is regulation of access to biological resources, and to the associated knowledge. Legislation and regulations should (i) ensure that clear conditions and procedures govern access to genetic resources, (ii) make access subject to written agreement based on prior informed consent and (iii) require fair and equitable sharing of the benefits. Enforcement is needed to ensure that the handling of genetic resources, both by nationals and foreigners, is consistent with the national policies and laws; (b) b*enefit sharing mechanisms:* a mechanism for benefit sharing should be developed. Benefits should be distributed fairly and equitably among all parties concerned, including local communities, indigenous groups, universities, etc; (c) c*apacity building:* building technological capacity, including the capacity to innovate, is important in order to increase the possibilities to add value to genetic resources, thus generating greater social and economic benefits. Similarly, education and training are needed to encourage the protection of biodiversity. Institutional development should also be included in capacity building efforts; (d) f*inancing:* obviously, sources of funding will have to be identified for the development and implementation of the policy.

Often, the *process* of formulating a policy is as important as its contents, since it can generate commitment and thereby facilitate implementation, and key points are: (i) a*ssessment or situation analysis:* a sound assessment of relevant aspects, notably the opportunities, needs, resources and capacities of a country to make sustainable use of its biological and genetic resources should be the basis for developing an appropriate policy and for devising sound strategies on bioprospecting and access. National capacity should also be assessed in order to make optimal use of existing opportunities; (ii) p*articipation in policy making:* participation of all national stakeholders in the policy making process is crucial in order to devise policies and strategies which are feasible and take into account stakeholders' interests, as well as to motivate them and to obtain their cooperation. At the same time, safeguards should be put in place to ensure that the interests of weaker parties are duly taken into consideration; (iii) m*onitoring and evaluation:* procedures for monitoring and evaluation should be put in place, so that progress -or the lack thereof- can be assessed. Moreover, this will allow for adjustment of policy goals and strategies as and when needed. Bioprospecting should be regulated, both at national and international level, based on the principles of the Convention on Biological Diversity[3]: conservation of biodiversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

7. Conclusion

Access to biological and genetic resources may be sought in order to acquire and use these resources for purposes of research, bioprospecting, conservation, industrial application or commercial use, etc. Bioprospecting involves searching for, collecting, and deriving genetic material from samples of biodiversity that can be used in commercialized pharmaceutical, agricultural, industrial, or chemical processing end products. The Convention on Biological Diversity (CBD) has embodied the principles of compensated bioprospecting globally. Compensated bioprospecting involves obtaining prior informed consent from the source country, sharing benefits, and promoting sustainable use of biodiversity. Where indigenous knowledge holders are involved, efforts are made to recognize and protect their rights. Benefits can take various forms, from royalties to negotiated advance and milestone payments, capacity building, facilities and equipment transfer, personnel training, sharing of research, and other forms. There is need for further research to understand various components and issues for bioprospecting in relation with biodiversity management.

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