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Defining an Intellectual Property Right on Traditional Medicinal Knowledge: A Process-Oriented Perspective

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**DEFINING AN INTELLECTUAL PROPERTY RIGHT ON
TRADITIONAL MEDICINAL KNOWLEDGE: A PROCESS-
ORIENTED PERSPECTIVE***

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* This paper is based entirely on a chapter from my doctoral thesis, titled *Biodiversity Prospecting Contracts for Pharmaceutical Research*.

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1. INTRODUCTION

The recognition of the rights of local and indigenous communities over their knowledge, innovations and practices related to biological resources under Article 8(j) of the Convention on Biological Diversity, 1993, has been considered a watershed in international law.¹ The ongoing legal debate over what form this mandate ought to assume at the national levels, and how it ought to be reconciled with the provisions of the Agreement on Trade Related Aspects of Intellectual Property Rights, 1995 (hereafter the TRIPs Agreement), reveals different levels of interests involved in traditional knowledge.² At the supra-national level, there is the overall global long-term interest in conserving genetic resources and related knowledge - with respect to both use and conservation techniques - as laid out by Article 8(j) of the Convention on Biological Diversity (hereafter, the CBD).³ At the national level, there is the interest of the source nations (nations who host such genetic resources or the local and indigenous communities) who have the authority as per Article 8(j), to enact laws governing the use of traditional knowledge and the sharing of benefits that accrue from such use. Source nations' interests are split between conservation of biological diversity and ensuring that benefits for the use of genetic resources and traditional knowledge are, in fact, shared with the holders of these resources. At the local level are the interests of the local and indigenous communities to be part of such rule-making for access and benefit-sharing within national legal frameworks and to ensure that the use, exchange and benefit-sharing aspects respect their customary laws and institutions. But an interest permeating through all these levels that cannot be neglected at all is that of scientific research and international trade that depends on proper and reliable access to traditional knowledge-based information and genetic resources situate within territories ancestrally owned by local and indigenous communities.⁴ The design of successful legal instruments for the protection of traditional knowledge depends on the way the three levels of interests above-mentioned are balanced with needs of research.

¹ Article 8(j) of the Convention on *In-situ* Conservation reads as follows: "Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of benefits arising from the utilization of such knowledge, innovations and practices."

² These categories are based on those identified by Biber-Klemm, "The Protection of Traditional Knowledge on the International Level - Reflections in Connection with World Trade", UNCTAD Expert Meeting, Geneva, p. 7.

³ Ibid.

⁴ Ibid.

The promise of intellectual property rights on traditional medicinal knowledge is recognition and benefit sharing for communities in drug discovery and research, apart from incentive generation for biodiversity conservation. But control over resources is theoretical and incomplete if exchange of the resources is not possible or somehow hindered. A central aspect of valuing any tradable resource is the rights of action available on this resource and how these rights of action are to be enforced⁵ - this is what links intellectual property rights and contracts inextricably in practice.⁶

From an economic perspective, ideally, contracts have a two-fold effect: firstly, they should maximize the aggregate surplus that can be bargained upon, and secondly, they should allow for the distribution of this surplus in a fair and equitable way. But such welfare-maximizing contracts result only when specific conditions are satisfied. One pre-condition is the presence of well-defined, enforceable property rights that can be exchanged only by mutual consent of the holders of the property rights. Mutual consent would ensure that the estimated value of the resource incorporates all the conditions of its usage (the opportunity cost of using the resource) apart from the subjective benefits that the user associates with the resource (this includes social, cultural and spiritual values). This condition for contract formation means that if communities associate high values to their resources, they will not have to contract away such resources, tangible or intangible. The second condition for welfare maximizing contracts is the presence of equal bargaining power amongst the parties in the sense that there should be no inefficiencies resulting from imperfect competition (monopolistic or oligopolistic in nature) in the bargaining process. The third and final condition for the efficiency of private contracts is that of absence of externality effects, such as biodiversity depletion.

In the absence of these conditions being met, the right to traditional knowledge will suffer from problems of precise definition and demarcation of sets of beneficiaries, mechanisms that facilitate and mandate their free consent in the contractual process, which would in turn result in the value of the right (any values associated by the communities) not being fully incorporated into the economic price agreed as part of benefit-sharing.

The focus of this paper is to find an operative definition of traditional knowledge for purposes of drug research and development. The paper seeks to do so by limiting the scope of traditional knowledge to traditional medicinal knowledge and assumes that the right ought to be an intellectual property right. If this taken as given, as the analysis shows, the predominant task then to define such a right is to be able to demarcate the nature and content of the information

⁵ See Demsetz, Towards a Theory of Property Rights, Journal of Law and Economics, Vol. 7, 1964, p. 11-26.

that we seek to protect. Once this criterion is clear and the nature of the information can be clarified, countries have a wide range of intellectual property options to choose from to make the right operative.

The paper is structured as follows. Section 1 enumerates the different issues that confront international and national decision-makers alike in the realm of traditional knowledge. Arguing for a sector-wise treatment for traditional knowledge, the section narrows down the focus to traditional medicinal knowledge only and seeks to list the predominant issues that confront legislative efforts to protect traditional medicinal knowledge. It puts forth the point that the most critical elements on the basis of which the right ought to be devised are the factual differences between the different kinds of information that could be called “traditional knowledge” as well as the practical nuances in implementation – aspects that have not received that much attention until now. Section 2 explores the contribution of traditional medicinal knowledge (defined in the sense of ethnobotanical knowledge) to the drug research and development process by highlighting the importance of tacit information within the process of cumulative innovation in biotechnology-based pharmaceutical research. The exercise here is to embed the contribution of ethnobotanical information within the theory of cumulative innovation thereby making the case for allocative efficiency, as against broader definitions that neglect such a perspective. By addressing the specific attributes of ethnobotanical knowledge and its role in drug research, Section 3 stresses upon the need for a narrower, pinpointed definition of traditional medicinal knowledge components, based on the sector in which it is to be applied. The thrust is on being able to provide rights that are representative of the usefulness of traditional knowledge and that are capable of being traded. A part of this section shows that if the communities are defined according to their knowledge holdings of ethnobotanical knowledge and then granted the power to exclude outsiders from the use of the tangible resources within their territories (restriction of access), this right will also serve best the interests of biodiversity conservation. Section 4 offers a summary of findings and elaborates upon the institutional issues required for its enforcement that still remain at large.

1.1. A Property Rights Allocation over Traditional Knowledge: The Trade-off Faced by Source Nations

In the post-CBD phase, the protection of traditional knowledge of indigenous and local communities has been a heavily debated issue in international and national contexts. But despite almost ten years of international negotiations and scores of legal justifications, there has not

⁶ See Nimmer, *Breaking Barriers: The Relationship Between Intellectual Property and Contract Law*, *Berkeley Journal of Technology Law*, 1998, p. 245-279 for an extensive assessment of the relationship between intellectual property rights and contracts in the case of software.

been much headway made towards reaching any form of consensus amongst nations on the nature and extent of the knowledge in question. Scientific literature, negotiations as well as empirical surveys reveal that there is not only traditional knowledge of importance to drug research, but knowledge that is of importance to agricultural research (traditional knowledge of farming communities), biodiversity conservation (traditional ecological knowledge) and also to other cultural areas such as music and arts (such as folklore). The vastness of the concept coupled with the different levels of stakeholder interests that play a role has made it a tough task to steer the discourse towards a productive definition.

The main issues that have hindered consensus on definitional aspects of traditional knowledge are:

Subject Matter: Assuming that the right should be an intellectual property right, there is no international consensus on what should be the subject matter of the right - in other words, there needs to be a systematic attempt to clarify the information categories that could be called “traditional knowledge” that lists precisely its plausible contribution to collaborative research and to decide upon rights structures based on these categories.

Identification of Beneficiaries: Associated with the above-mentioned issue is the issue of identification of beneficiaries. Whether to define the right defined as broadly as possible and thereby include most communities concerned or to define the right as part of the process it should form part of - the lack of consensus on this issue relates to differences in expectations.

The Issue of Biodiversity Conservation: The nature of contribution that the grant of such a right could have to encourage attempts for biodiversity conservation and the institutional mechanisms required to achieve it is also not clear.

Specific Attributes: Even apart from the subject matter of intellectual property protection, the kind of intellectual property right and its characteristics is another matter of disagreement. The issues here relate to the particular characteristics of the intellectual property right that will be chosen to be *sui generis*, such as the duration of the right and other details of enforcement. Concerns have also been voiced regarding the nature of overlap that the *sui generis* right could have on other rights within the drug research process.

Implementation: The implementation mechanisms that can help enforce such *sui generis* rights are also a matter of disagreement. Should there be a system of certification to ensure prior informed consent, if so, should this be an international system of certification or a national one and what expeditious procedures can be put in place for this - are still largely in the open.

1.2. What are we Trying to Protect: Towards Clarity on the Subject Matter

The terms “traditional knowledge” or “indigenous knowledge” are used interchangeably by scholars in the literature and often in different senses (see Table 1), based mainly on the academic disciplines and the different expectations placed on the right.

Table 1: Definitions of Traditional Knowledge⁷

The CBD, in Art. 8(j) defines traditional knowledge as the knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity.
Traditional knowledge can refer to, as the World Intellectual Property Organisation (WIPO) uses it, “...the tradition-based literary, artistic or scientific works; performances; inventions; scientific discoveries; designs; marks; names and symbols; undisclosed information; and all other tradition-based innovations and creations resulting from intellectual activity in the industrial, scientific or artistic fields.” ⁸ Indigenous knowledge, on the other hand, is understood by the WIPO to be the traditional knowledge of indigenous peoples. Taken this way, “Indigenous knowledge is therefore part of the traditional knowledge category, but traditional knowledge is not necessarily indigenous.” ⁹
The word “indigenous knowledge” and “traditional knowledge” are used synonymously to “...differentiate knowledge developed by a given community from the international knowledge system as generated through universities, government research centres and industry sectors.” ¹⁰
Traditional knowledge or indigenous knowledge is also defined as the “...unique traditional, local knowledge existing within and developed around the specific conditions of women and men to a particular geographic area”. ¹¹
Traditional knowledge is also often used to denote indigenous medicinal knowledge which is defined as “...a coherent system linking social behavior, supernatural beings, human physiology, and botanical observations.” ¹²

All these definitions represent different facets of the universe of traditional knowledge, which are related yet distinct in nature, and are in keeping with the spirit of Article 8(j). But it is gen-

⁷ Partially sourced from the Indigenous Knowledge and Development Monitor, Vol.6, Issue 3, Dec. 1998, p. 13.

⁸ WIPO, Intellectual Property Needs and Expectations of Traditional Knowledge Holders, WIPO Report on Fact-Finding Missions on Intellectual Property and Traditional Knowledge (1998-1999), p. 25.

⁹ *Ibid.*, p. 23.

¹⁰ Warren, Indigenous Knowledge and Development Monitor, , Vol.6, Issue 3, Dec. 1998, p. 13.

¹¹ Grenier, Working with Indigenous Knowledge: A Guide for Researchers, Ottawa: IDRC 1998, p. 1.

¹² Reid, Sorcerers and Healing Spirits, 1983 cited in Huft, Indigenous Peoples And Drug Discovery Research: A Question Of Intellectual Property Rights, Northwestern University Law Review, 1995, 89:1652-1694, p. 1695.

erally overlooked that Article 8(j) is a concept only and not an exercisable right in itself.¹³ Therefore, defining traditional knowledge within national contexts exactly or in a way similar to Article 8(j) does not help us derive a functional regime for traditional knowledge, due to its broad mandate. Such traditional knowledge could either be innovations or practices that are relevant from a commercial perspective, but even amongst this category, different forms of intellectual property-like protection may be necessary depending on whether it is medicinal knowledge or knowledge such as folklore and other forms of cultural expressions. Traditional knowledge and practices that relate to biodiversity conservation and management systems may demand a different mode of protection. In a similar way, the specific issues that confront the policy makers in relation to knowledge of farming communities are also different, and need to be dealt with separately, if a tailor-made regime is desired.

The *sine qua non* of successful legislative enforcement is to break up the mandate of Article 8(j) into successful compartments, and legislate vis-a-vis each one of them, according to the kind of knowledge in question. This is important for various reasons. To begin with, such a clear conceptualization is also the first step in resolving the inter-linkages between the right to traditional knowledge and the rights over access regulation (Article 15 of the CBD) and patent rights of firms over biotechnological products and drugs as part of Article 27(3)(b) of the Trade Related Aspects of Intellectual Property Rights, 1995.¹⁴ Another reason why such a utility-based compartmentalization is extremely important is because the beneficiary categories also decidedly change from area to area, even apart from the property right that can be used to protect the said knowledge input. For example, the farming communities in the case of something like the case on *Basmati*¹⁵ are decidedly different from indigenous communities whose medicinal knowledge needs to be protected through intellectual property rights. Moreover, the appropriate mechanism to protect something like Basmati might more likely be “geographical indication” whereas for the latter, patent-like *sui generis* rights may be more suitable. Therefore, identifying the subject matter of the right will automatically pave the way for decisions on identification of beneficiaries who will exercise the right, the link between the

¹³ See Burhenne-Guilmin and Glowka (1994) in this regard who note that the framework of the Convention, is result-oriented, leaving a lot flexibility for Parties to decide how to put its mandate into action within their respective national situations. In Burhenne-Guilmin and Glowka, “An Introduction to the Convention on Biological Diversity”, in Krattiger *et al*, Widening Perspectives on Biodiversity, IUCN, 1994, p. 15-18, at p. 16.

¹⁴ Straus, Biodiversity and Intellectual Property, 35th Congress of the Workshop of the International Association for the Protection of Intellectual Property, 1998, p. 119.

¹⁵ Basmati”, a long-grained aromatic variety of rice traditionally grown in the India and Pakistan in the regions along the foothills of the Himalayas, was the subject of a US patent (See Dutfield, Intellectual Property Rights, Trade and Biodiversity, Earthscan, 2000, p. 88). The issue of the patent to the firm Ricetec has now been revoked.

right and biodiversity conservation, the kind of right that will suit the demands of the knowledge category and the beneficiaries best and so on.

It is not the intent here to curb the scope of the rights of local and indigenous communities as recognized under various international instruments, such as the ILO Convention 169 to the CBD itself. It is a suggestion as to the means, which should be used to achieve the various forms of recognition. For the larger goals of empowering indigenous and local communities, broader rights structures are required. But for the purpose of making good their specific knowledge pools, whether relevant of drug research or some other field like music, more pointed rights and implementation structures need to be designed, failing which broad and over-lapping property rights structures could hinder meaningful contractual exchange.

2. JUSTIFYING AN INTELLECTUAL PROPERTY RIGHT OVER TRADITIONAL MEDICINAL KNOWLEDGE

According to utilitarianism, the prevailing school of thought in intellectual property jurisprudence, the nature of information and its usefulness (actual or potential) is the key criterion to decide who ought to hold/exercise the right. The role of the right is then to grant appropriate incentives for the production and/ or dissemination of the kind of information desired. Both these aspects translate into interesting propositions when applied to traditional knowledge. Firstly, it implies that if we agree that there ought to be an intellectual property right on traditional knowledge, then this right has to be based on the potential contribution that it could have to the process of innovation in biotechnological drug research and development. This is the best clue to the question: which kind of information are we are trying to protect? The answer to this question will amount to a limitation on the right as well as the set of beneficiaries who should exercise the right. Secondly, the ‘incentive’ criteria of conventional intellectual property jurisprudence can give us a basis on which to differentiate between the different forms of information that constitutes traditional knowledge, and which out of these ought to be protected and what forms of institutional mechanisms are best suited for its production and dissemination.

2.1. The Predominance of the Utilitarian Paradigm in Intellectual Property Jurisprudence

Intellectual property is a tough notion to justify, even under normal instances, due to the elusive nature of information as a resource - when the use of information by one person does not affect or even reduce its availability to others, why should it be protected? If it is indeed protected, how and on what basis should a person be awarded for the creation of information? To answer these questions, society has to sort out issues such as: does creation bestow ownership and if so, is the creator the total owner of the information thus generated?¹⁶ If this is true and intellectual property rights are to confer absolute ownership rights over information, how and on what terms can such a right be overridden? It is here that the form of justification advanced for the intellectual property right assumes importance. Although almost all justifications of intellectual

¹⁶ May, A Global Political Economy of Intellectual Property Rights: The New Enclosures?, Routledge, 2000, p. 51.

property rights are incomplete to defend such a right in its entirety,¹⁷ the kind of justification that is advanced is critical to determine whether such a right may be over-ridden or not.¹⁸

Contemporary explanations for the grant of rights in general, and intellectual property rights in particular, can be broadly defined into two main schools of thought - right-based theories and goal-based theories.¹⁹ The right-based theories are also known as natural rights theories, and the goal-based arguments go commonly under the name of consequentialist arguments. Of the two, the goal-based theory/consequentialist argumentation is the more widely accepted basis for the grant of intellectual property rights. The juxtaposition of individual's needs as against the society's and making it as the basis of granting rights forms the core of goal-based theories for the grant of rights.²⁰ "Goal-based" meaning that whether rights for something ought to be granted or not, and to whom they are to be granted are decided on the basis of what needs to be furthered in the interest of the society and what not.²¹ Utilitarianism is the main paradigm on the basis of which such a goal-based/consequentialist argumentation is based.

Within intellectual property, the predominant view dominating patent law is that since information is a public good, intellectual property rules and institutions are to be constructed to facilitate the production of specific kinds of knowledge within society.²² Since production of information that can lead to societal progress and technological development has been the look out of almost all societies, intellectual property is justified on the tradeoff between the static and dynamic gains of such information. As long as the gains to the society by encouraging the dynamic production of many types of information exceeds the static costs of creation and distribution, it is desirable to design appropriate incentives for its production.²³

¹⁷ See, for example, the discussion on justifications for intellectual property rights and their insufficiencies in May, op. cit. footnote 16 p 16-66.

¹⁸ See Freedman (1994) who notes, "We cannot determine whether a right may be overridden until we see the how it is justified. We should look not to its formulation, but to the values which underlie it", in Freedman, Lloyd's Introduction to Jurisprudence, Sweet and Maxwell, 1994, p. 383.

¹⁹ For a detailed discussion of rights' jurisprudence, see Freedman, op. cit. footnote 18 p 379-392.

²⁰ Freedman, op. cit. footnote 18 p 380.

²¹ *Ibid.*

²² May, op. cit. footnote 16 p. 27.

²³ See also Calandrillo (1998), "An Economic Analysis of Property Rights in Information: Justifications and Problems of Exclusive Rights, Incentives to Generate Information, and the Alternative of a Government-Run Reward System", Fordham Intellectual Property, Media and Entertainment Law Journal, Vol. 1X, Autumn 1998. for an analysis of various justifications of intellectual property rights in the US context.

As Rai (2002) notes, that the law of intellectual property, for its most part, focuses on creating the right conditions for the production of information within the society to further its progress,²⁴ and that the economics of information analyses the conditions and costs under which information is produced and disseminated explains much of the common ground between the legal theory of intellectual property rights and the economics of information. A second look at information economics helps clarify the unifying points.

According to Arrow (1962), innovation is all about the production of information.²⁵ Information economics posits that information as a good is characterized by non-rivalry and non-excludability. It is non-rival because one more person using the good would not affect the availability of the good to others, and it is non-excludable because the use of the information would result automatically in its divulgence (atleast partially) to others. Knowledge, hence being a pure public good would be under-provided for within the society, since the social returns to research investment exceeds the private returns faced by an individual. To rectify this under-investment in research and development (from the viewpoint of societal welfare) and to ensure optimal production of information, there is a need to internalize atleast some of the social benefits. The grant of patent protection is meant to achieve this by creating a mechanism of exclusion, though imperfect, by giving incentives for individuals to invest in the production of knowledge.²⁶ This monopoly protection granted by patents creates a deliberate trade-off between the monopoly rents of the producers of the knowledge and the consumer welfare of the society at large.²⁷

Arrow's contribution was seminal to the theoretical economic framework on information and prompted a wave of economics literature arguing for the strengthening of intellectual property rights in order to promote the production of information in society.²⁸ Arrow's analysis focused on the elusiveness of information due to its non-rivalrous and non-excludable nature and

²⁴ Rai, "The Intersection of Intellectual Property and Antitrust in Cumulative Biopharmaceutical Innovation", Paper presented at the Conference on Antitrust, Technology and Intellectual Property, Berkeley Centre for Law and Technology, 2-3 March 2001, p 5.

²⁵ Arrow (1962), "Economic Welfare and the Allocation of Resources for Invention", in National Bureau of Economic Research Volume, *The Rate and Direction of Inventive Activity*, Princeton: Princeton University Press, p. 609-625.

²⁶ Scherer and Ross, *Industrial Market Structure and Economic Performance*, Houghton Mifflin Company, 1990, p. 613-660.

²⁷ In other words, the monopoly protection for a limited time would imply that the producer would be in an advantageous position with respect to his product and there would be a considerable loss to the consumer group by way of a monopoly price, but the system intends that within the period of a monopoly, the inventor's sunk costs of investment need to be recuperated, and the consumers can derive complete benefit of the product upon the expiry of the monopoly.

²⁸ Winter, "Patents in Complex Contents: Incentives and Effectiveness", in Weil and Snapper (eds.) *Owning Scientific and Technical Information: Values and Ethical Information*, Rutgers, 1989, p. 41-60, at p. 41.

stressed for the need for an incentive scheme to ensure its optimal production in society.²⁹ According to Arrow, the continuous paradox for the society remains one of creating institutions that rectify the disproportionate division of private versus social gains, so that production of information is encouraged.³⁰ Looking at institutions of intellectual property, patents in particular walk this thin line of balancing private rewards with social benefits. Hence they have been the subject of much tension and debate, academic, policy-related and otherwise, even within the neoclassical perspective.³¹

2.2. The Right-Based Theories Versus the Utilitarian Paradigm

In contrast to the utilitarian justification, right-based claims for intellectual property in general are based upon arguments of labour or the instrumentalist justification,³² individual self-assertion,³³ self development,³⁴ the idea of sovereignty,³⁵ or even moral individualism.³⁶ Of these, the strongest are discussed here.

The Instrumentalist Justification is based on John Locke's labour theory that people are entitled to the fruits of their own labour.³⁷ Because it assumes that individuals create 99% of the value of the resource, it is believed that Locke's justification for property rights is probably more

²⁹ According to Arrow (1962): "...no amount of legal protection can make a thoroughly appropriable commodity of something so tangible as information. The very use of the information in any way is bound to reveal it, atleast in part. The demand for information also has uncomfortable properties. In the first place, the use of information is certainly subject to indivisibilities...In the second place, there is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has, in effect acquired it without cost." See Arrow, op. cit. footnote 25 p 615.

³⁰ See Winter (1989) for a critical appraisal of Arrow's model in Winter, op. cit. footnote 28 p 41-60.

³¹ There is much evidence that patent protection can lead to severe inefficiencies. On the issue of the inability of the patent system to cope with modern innovative activity, see again, Winter, op. cit. footnote 28 p 41-60.

³² Based on John Locke's Treatises.

³³ See Hart "Are there any Natural Rights?" (1955) 64 Philosophical Review 175, discussed extensively in Freedman, op. cit. footnote 18 p 388.

³⁴ The self-development justification draws on the work of Hegel, as spelt out in the Philosophy of Rights (1967: 1821) and elsewhere, discussed extensively in May, op. cit. footnote 16 p 26-28.

³⁵ See the discussion on Austin's notion of sovereignty, in Freedman, op. cit. footnote 18 p 216-221.

³⁶ This is one of the intellectual underpinnings of the law of contract, more popularly known as the will theory. In Freedman, op. cit. footnote 18 p 388.

³⁷ Hettinger, "Justifying Intellectual Property", in Drahos, Intellectual Property, Ashgate, 1999, p. 117- 139 at p 122.

applicable to intellectual property than any kind of physical property.³⁸ This remains one of the most popular right-based justifications for intellectual property.³⁹

Another popular natural rights based argument is the self-developmental justification. The *Self-developmental Justification* is based on Hegel's idea that the legitimacy of property is inextricably linked to the existence of the free individual and the recognition of the free individual by the rest of society.⁴⁰ Property, according to this school of thought, rested on the identity of the free individual in society, 'since the respect others show of his property by not trespassing on it reflects their acceptance of him as a person'.⁴¹

2.2.1. *The Inadequacy of Rights-Based Justifications*

Despite the fact that natural rights-based justifications are based on a variety of primal concepts, they are limited in explaining the nature, scope and extent of intellectual property institutions in today's society. Even the Lockean approach that stresses upon the needs to reward creators for their creations through ownership proceeds when intellectual goods are exchanged has its own limitations in arguing for intellectual property.⁴² To begin with, as Hettinger (1999) notes, "Even if one could separate out the labourer's own contribution and determine its market value, it is still not clear that the laborer's right to the fruits of her labor naturally entitles her to receive this."⁴³ Locke's justification is also considered problematic due to the absolute sanctity it vests upon property rights and its institutions.⁴⁴ And finally, such a justification is more applicable to certain forms of intellectual property like copyrights, than other forms such as patent rights.⁴⁵ This inadequacy is evident by the amount of confusion there was within patent law right from the start, about what exactly is the act for which inventors should be granted protection. Drahos (1996) notes the confusion in English law about the nature of the act for which a 'patent' should be granted – authors create something as a result of which they are to have a right to property on their creation, inventors get a 'patent' because they merely uncover what is already there.⁴⁶

A second but equally grave issue in granting rights completely based upon moral justifications is the question of conflict of rights. Since the possibility of over-riding rights depends on the

³⁸ Taken from the criticism on Nozick, in Hettinger, op. cit. footnote 37 p 123.

³⁹ May, op. cit. footnote 16 p 49.

⁴⁰ May, op. cit. footnote 16 p 26.

⁴¹ Avineri, 1972, cited in May, op. cit footnote 16 p 26.

⁴² May, op. cit. footnote 16 p. 47.

⁴³ Hettinger, op. cit. footnote 37 p 38.

⁴⁴ May, op. cit. footnote 16 p 49.

⁴⁵ Drahos, *A Philosophy of Intellectual Property*, Dartmouth, Aldershot and Brookefield, 1996, p. 29.

⁴⁶ Drahos, op. cit. footnote 45 p. 29. The reasoning of the English courts was hence thus: 'If Milton had not written *Paradise Lost* it would never have been written: if Watt had not

basis on which they have been defended, if rights are stated as moral claims and presented as pre-eminent, it is difficult to determine whether a right can be over-ridden at all, and if so under what situations.⁴⁷ As Freedman (1994) notes, “What happens when rights conflict? Are there any situations and if so, which, in which such rights may be ‘trumped’?” - these issues may tend to frustrate the rights-giving exercise when rights are justified on the basis of pre-eminence.⁴⁸

2.2.2. *Intellectual Property Rights Over Traditional Knowledge: The Justifications*

Until now, the major defense for intellectual property protection for traditional knowledge has come from a natural rights-based perspective.⁴⁹ Intellectual property rights for indigenous peoples have been justified on the basis of a system of entitlement theory,⁵⁰ theories of self-development, as value of individual autonomy.⁵¹

2.2.3. *The Lack of an Information Economics Perspective and its Repercussions on Traditional Knowledge*

The two general drawbacks of moral justifications already mentioned are all the more aggravating in the case of traditional knowledge. Moral justifications do not provide us with any guiding parameters for either demarcating the resource that we would like to protect and make transaction-worthy or the set of beneficiaries who would be entitled to share benefits by way of the right. This drawback hinders meaningful exchange of the intellectual property right – a pre-

discovered the use of high-pressure steam, someone else would have done so.’ See Halsbury, *The Laws of England* (London, 1912), vol. 22, p. 127; c.f. Drahos, *op. cit.* footnote 45 p 39.

⁴⁷ Freeman *op. cit.* footnote 18 p 381.

⁴⁸ Freeman *op. cit.* footnote 18 p 381.

⁴⁹ Note the distinction between systems of protection proposed and the nature of justification advanced for the protection of traditional knowledge. The various systems of protection proposed for traditional knowledge include a system of traditional resource rights (See Posey, *Traditional Resource Rights: International Instruments for Protection and Compensation for Indigenous Peoples and Local Communities*, IUCN, 1996), a system of discoverer’s rights (Gollin, “The Convention on Biological Diversity and Intellectual Property Rights” in Reid *et al* (eds.), *Biodiversity Prospecting: Using Genetic Resources for Sustainable Development*, World Resources Institute, 1993, p. 289-302.), a system of identification of source materials (Gadgil and Devasia, “Intellectual Property Rights and Biological Resources: Specifying Geographical Origins and Prior Knowledge of Uses”, *Current science*, 69(8), 1995, p. 637-639) and a system that advocated separation of ownership of genetic resources from the ownership of the knowledge itself (See Lesser, 1996, Draft 4/30, *Using Access Legislation to Provide Intellectual Property Rights Protection for Indigenous Knowledge*, on file with author).

⁵⁰ As Stenson and Gray (1999) note, this view holds that communities are “...(m)orally entitled to intellectual property rights in plant genetic resources and associated knowledge.” For a detailed discussion, see Stenson and Grey (1999), *The Politics of Genetic Resource Control*, London, England: Macmillan Press Ltd, Chapter 4.

⁵¹ See Stenson and Gray, *op. cit.* footnote 50 p 93-114, where they develop the argument for a community intellectual property right as value for individual autonomy.

condition for benefit sharing to occur.⁵² The issue of not being able to reconcile the right with other rights in times of conflict of rights is also grave, especially because, when viewed within the process of biotechnological research and development, the right to traditional knowledge has to be functional and flexible vis-a-vis its interactions with the other rights in question. Failing this, issues of over-lap between the right to traditional knowledge and other rights in the process can hamper efficient contract formation.

This does not mean that moral justifications cannot be a basis for the grant of an intellectual property right over traditional knowledge,⁵³ but that it cannot be the sole basis on which the right is to be defended.

Even apart from this, the second major drawback when we try to derive a right based on moral considerations is that it fails the set criteria of information economics. Since traditional knowledge is knowledge that has already been produced, one could argue that there is no need to protect this right through intellectual property protection. This is because knowledge or information once produced is a public good. The diffusion of the information among the members of the society can be achieved at negligible marginal cost and thus the optimal equilibrium price for such information should be close to zero. A simplistic economic analysis could argue, that already produced traditional knowledge is such an information pool, which could and should be made available freely to potential users like researchers or firms. This economic analysis would prevail if the knowledge could be provided at negligible costs.⁵⁴ Needless to say that traditional knowledge would pass the test of efficiency only when the answer to this question is in the negative.

The ineffectiveness of the justifications for traditional knowledge makes the best argument to re-assess the status of traditional knowledge as an intellectual property right. It would not be wrong to argue that in order that traditional knowledge is granted intellectual property right, two

⁵² It is widely recognised that the most complex issue in this area is the identification of beneficiaries. Benefit-sharing rests upon the pre-condition that we are able to demarcate the community that will be the beneficiary of such a bargain. See, for example, Rosenthal, "Equitable Sharing of Biodiversity Benefits: Agreements on Genetic Resources", in Krattiger *et al* (eds), *Investing in Biological Diversity*, The Cairns Conference, OECD, Paris, 1997, p. 252-274, at p. 260.

⁵³ Look for example, the case of copyrights where moral justifications, especially those based on the Lockean theory of creating value dominates the grant of the right.

⁵⁴ See Hirschleifer and Riley, *The Economics of Uncertainty and Information*, Cambridge University Press, 1995; also see May who notes that "If the provision of the building blocks of knowledge involves no necessary diminution of utility to the previous users/owners when re-used to create or invent, then the rationale for charging for inputs is not particularly robust. The marginal cost is close to nil - once an idea has been had there are no extra costs in others re-thinking it. Neither is it clear why protecting a particular creator (the idea's current possessor), over and above the creators who contributed earlier through their ideas is legitimate." In May, *op. cit.* footnote 16 p 51.

important criteria have to be satisfied. Firstly, the right has to pass the test of incentives - what are the incentive effects of granting the right to traditional knowledge? And more importantly, it has to be that the dissemination of this already existing knowledge should not occur at negligible costs.

It is not so much the argument here that there has to be the conventional incentive to “produce information” when an intellectual property right is sought, but that there has to be some alternate incentive effect that such a right ought to achieve - otherwise the argument for the grant of an intellectual property right for information would be vitiated.⁵⁵ Such a definition would make it easier for us to determine the scope and nature of protection, thereby paving the way for the design of appropriate institutional mechanisms for its exercise.⁵⁶ The property right itself has to be one of the key criteria in the identification of the beneficiaries as is the case amongst other forms of conventional intellectual property categories. For this, it is critically important to determine the contribution that an intellectual property right to traditional knowledge can have towards (a) drug research and development; and, (b) biodiversity conservation, and base the right upon it.⁵⁷

⁵⁵ Law and Economics literature explores, in many cases, alternate incentive effects that could lead to a grant of intellectual property right for the production of information, for example, see Landes and Posner, *An Economic Analysis of Copyright Law*, 1989, 18 *Journal of Legal Studies*, 325, also see Calandrillo, *op. cit.* footnote 19, for a detailed analysis of alternate incentive effects for the production of information.

⁵⁶ Equity should no doubt be a strong basis for such a right, but trying to derive a right mainly based on fairness and equity considerations, wherein the maximum good for maximum people is the aim, would theoretically work but practically yield little due to difficulties in implementation.

⁵⁷ Marguiles (1993) has argued for the grant of a right to traditional knowledge in conjunction with the incentive to preserve biodiversity. See Marguiles.,”*Protecting Biodiversity: Recognising Intellectual Property Rights in Plant Genetic Resources*, *Michigan Journal of International Law*, 1993, p. 322-356.

3. THE PROCESS OF INNOVATION IN DRUG RESEARCH AND PLAUSIBLE INCENTIVE EFFECTS FOR TRADITIONAL KNOWLEDGE

The application of biotechnology as a research tool across various industrial sectors has had far-reaching implications for the value of technological information within the research and development process.⁵⁸ The changed nature of innovative activity induced thereby has major implications towards finding a more convincing argument for traditional medicinal knowledge. The industrial structures in these fields of technology are characterized by the important role that availability of knowledge inputs and their transfer, in either tacit or codified forms, play in further production of knowledge. Therefore, if we can assert that traditional medicinal knowledge qualifies to be what can be called “tacit” inputs to this sequential innovation process, it will provide us with a very convincing basis on which to argue for an intellectual property right on such knowledge. To find out whether this is the case, we begin with assessing the changed nature of innovative activity and the importance of tacit information in the process of cumulative innovation for drug research. A part of this inquiry is directed towards economic theory of innovation and the critiques on the inadequacy of the neoclassical theory to cope with the functional attributes of information in the newer forms of industrial organization. We shall then focus on parts of traditional knowledge, those parts that are specifically called ethnobotanical knowledge, which can be called “tacit” inputs in this process.

3.1. The Process of Cumulative Innovation in Pharmaceutical R and D

Innovative cumulateness, according to Scotchmer, means that “...innovators build on each other’s discoveries.”⁵⁹ Cumulative innovation therefore refers to a pattern of innovation, wherein the innovation at the end of each stage is an important input for reaching the next stage.

Of the many recent technologies that demonstrate this sort of innovative cumulateness, biotechnological research is a prominent one.⁶⁰ Biotechnological innovations are cumulative in

⁵⁸ Note that “technological information” simply denotes the category of information that is mainly produced through research and development activities, in Zeckhauser, “The Challenge of Contracting for Technological Information” Proceedings of the National Academy of Sciences of the United States of America, p, 12743-12748, at p. 12743. Also see Mandeville, “An Information Economics Perspective on Information”, International Journal of Social Economics, 25, p. 357-364 in Drahos, Intellectual Property, Ashgate, 1999, p. 46-47.

⁵⁹ Scotchmer, “Cumulative Innovation in Theory and Practice”, University of Berkeley Working Paper Series, February 1999, p. 1.

nature, characterized by the incremental value that the product gains as it moves up the R and D chain, ‘...(m)ost of the sequential innovation occurring in the pre- commercial stage, before the initial marketable product, most often a drug, is produced’.⁶¹ This nature of biotechnological research has changed the focus of knowledge enterprise - from sheer knowledge creation to knowledge access and transfer as well.

3.1.1. The Changing Emphasis of Patent Policy

There are two critical features of cumulative innovation that do not figure in a dominant way in the traditional literature in economics of information are:

- (a) The relevance of already produced knowledge, largely tacit knowledge, for the production of codified knowledge (here, codified knowledge refers to knowledge of the kind that can be protected through modern intellectual property instruments as we know them);⁶²
- (b) The cumulative nature of knowledge, i.e., every advance being strongly dependent on the accumulated stock of knowledge and the evolution of “knowledge streams.”⁶³

This emphasizes the large importance within biotechnology-based sectors not only for incremental knowledge creation, but also for the transfer of these complimentary assets through what are called “knowledge-intermediaries”.⁶⁴

This changing reality of innovative activity has set into motion a criticism of the conventional approach to information. Starting with Arrow (1962) and Nelson (1959), other neoclassical scholars who espoused the theory of innovation tended to look at research as an investment decision of the profit-maximizing firm and the impetus for this investment decision lay in expected returns. This inadvertently led to the assumption in patent literature that innovation

⁶⁰ Another very interesting example of changed industrial organization due to cumulative innovation is the field of computer technology. For a detailed analysis of cumulative innovation and its repercussions in this field, see Scotchmer, op. cit. footnote 59.

⁶¹ Rai, op. cit. footnote 24 p. 1.

⁶² Mandeville, op. cit. footnote 58 p 46.

⁶³ Foray, “Knowledge Distribution and the Institutional Infrastructure: The Role of Intellectual Property Rights”, in Albach and Rosenkranz (eds.), *Intellectual Property Rights and Global Competition: Towards a New Synthesis*, WZB: Berlin, 1995, p. 77-118 at p. 84. In the same context, Scotchmer notes that the “...cumulativeness of innovation brings to the forefront four kinds of characteristics which were hitherto not taken into account by economics of information, namely, (a) later products can be improvements of earlier products; (b) later products can bring in cost reductions for the production of earlier products; (c) later products can be applications of earlier basic technologies; and lastly, (d) later products can be enabling technologies such as research tools”. See Scotchmer, op. cit. footnote 59 p 1.

⁶⁴ See Saviotti, “Industrial Structure and the Dynamics of Knowledge Generation in Biotechnology” in Senker and van Vliet (eds.), *Biotechnology and Competitive Advantage: Europe’s Firms and the US Challenge*, Edward Elgar, 1998, p. 19-44 at 33, where he explains the knowledge intermediation role played by dedicated biotechnological firms and public research centres for large diversified firms.

denotes seemingly isolated events, even within the same field of technology and that the disclosure requirement in patent law was sufficient to tap the indirect impact that any given invention could have on future innovations. Mainly due to this, economic theory of intellectual property rights has been criticized to “limit its applicability to modern controversies in the field of biotechnology, computer software and computer hardware”.⁶⁵

Not only does the description of information as a “public good” not take into account the knowledge intensive nature of exploiting already produced information, neoclassical treatment of information also undermined the critical role that the utilization of the results of some other R & D activity and associated information, whether in tacit or highly codified forms, played for commercially successful innovations.⁶⁶ Zeckhauser (1995) observes that the public goods description (of non-rivalry and non-exclusiveness) might be an adequate description for some types of information, particularly comparative in nature - such as the scores of sportive events. But he claims that this is certainly not true if we are dealing with technological information. He notes that “...(t)he focusing on the public goods aspect of information has deterred economists and policy analysts from delving more deeper into the distinctive properties of information, including most particularly, the challenge of contracting for technological information.”⁶⁷

In the context of cumulative innovation, the neoclassical construct that technological information as something that is created mainly within the isolated firm is not only considered to be unrealistic,⁶⁸ it is also considered to run contrary to the reality in modern technological processes wherein transferring and exploiting information required for innovative activity is by itself a costly and intensive process.⁶⁹ Based on this, authors have argued that the costs of

⁶⁵ Scotchmer, op. cit. footnote 59 p 1.

⁶⁶ Rosenberg, *Inside the Black Box: Technology and Economics*, Cambridge, Cambridge University Press, 1982, p. 6. At p. 5, he notes: Where Arrow and Nelson’s neoclassical theory of R and D has been criticized in the modern context as having portrayed research only as an activity resulting from an investment decision made by the profit-maximising firm, the critical element for the investment decision being the returns on the investment. Nelson and Arrow argue that since social returns to research investment exceed the private returns faced by the individual firm, this would lead to under-investment by the firm (from a societal point of view) in R and D, is seen as having resulted from the micro-economic bias of treating the firm as ‘black-box’ as such. See also Foray who notes vehemently that, “...knowledge possesses particular properties (non-rivalness, cumulativity) which leads us to observe that the value of a given item of knowledge is basically determined by the extent of its use and distribution within the system...This effect is not confined merely to the application of existing knowledge in the production of conventional commodities; it extends also to the use of information to produce more information.” in Foray, op. cit. footnote 63 p 84-85.

⁶⁷ Zeckhauser, op. cit. footnote 58 p 12743.

⁶⁸ Mandeville, op. cit. footnote 58 p 360.

⁶⁹ See again Rosenberg, *Inside the Black Box: Technology and Economics*, Cambridge, Cambridge University Press, 1982; Mowery, “Economic Theory and Government Technology Policy”, *Policy Sciences* (Winter 1983b): 27-43.

acquiring information and the information properties of markets and organizational structures are central issues to resolve.⁷⁰

3.1.2. *The Underpinnings of Modern Innovative Activities*

As Gallini and Scotchmer (2002) note, “Arrow explained *why* some incentive scheme is needed, but not *which* scheme.”⁷¹ This gives us enough room to identify the changing nature of innovative activity and to devise tailor-made incentive schemes that capture its needs to the fullest. There are newer demands on policy-making due to the cumulateness of innovation; demands that stem from the extensive reliance on building up on already existing knowledge inputs.⁷² The dilemma in intellectual property policy making in the traditional model was to find ways to reconcile the two private contradictory demands of protecting the inventor’s needs and the society’s need of knowledge dissemination. In contrast, modern innovative activity lends strength to the proposition that generation of new knowledge and distribution of such knowledge are not contrasting policy aims; the performance of the system would only improve if access to existing knowledge stocks would function in a more efficient way.⁷³

Such efficient access to and dissemination of already created knowledge stocks consists of two parts - first to give incentives to reveal to agents who hold useful information, and second with providing the right mechanisms for its trade. The repercussions of a lack of legal and contractual mechanisms for easy and cost-effective access to such knowledge and its trade are not to be under-estimated. In the absence of adequate policy initiatives that allow the former, even when there is no direct restriction on access to information, it may be extremely costly to acquire.⁷⁴ Disputes relating to innovation may become commonplace when there are non-existent or ill-functioning mechanisms for trading information.

All this is more than clear when one takes a closer look at biotechnology-based research and development. Biotechnology-based sectors are characteristic of a “...new form of industrial organization mainly based on high-knowledge/science intensive small and medium-sized enterprises and a sharply increasing frequency of inter-institutional collaborative agreements.”⁷⁵ Agreements and ventures that are popular in this field of technology show clearly that first, these new technology paradigms are more knowledge intensive than before, and second,

⁷⁰ Ibid.

⁷¹ Gallini and Scotchmer, “Intellectual Property: When is it the Best Incentive System?” in Jaffe, Lerner and Stern, *Innovation Policy and the Economy*, Vol. 2, MIT Press, 2002 (forthcoming).

⁷² Foray proposes three models of innovative activity in order to enable us to distinguish the changing nature of innovation and its specific policy demands; see Foray, *op. cit.* footnote 63 p 89.

⁷³ Ibid.

⁷⁴ Zeckhauser, *op. cit.* footnote 58 p 12475-12476.

successful innovation relies on the capability to acquire more information on what is going on in the field.⁷⁶ This acquisition of information on what is relevant for the field largely entails identifying and contracting for both tacit and codified information inputs that can contribute to the R & D process.

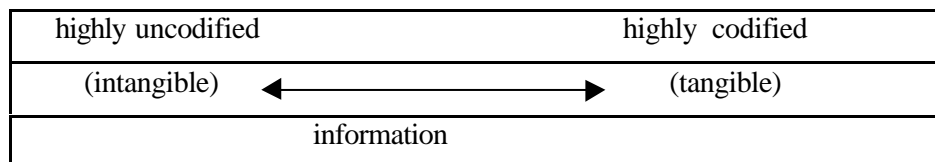
3.2. Quantifying the Importance of Tacit Information in General and Traditional Knowledge in Particular

Given that acquiring and building upon knowledge incrementally in cumulative innovation is a process wherein bits and pieces of information are gathered from a variety of external sources,⁷⁷ one is tempted to inquire into the nature of such information. What sort of information are these bits and pieces that have an incremental effect to the building of such “knowledge streams”?

3.2.1. Innovations as Improvements of Earlier Products: The Relevance of Uncodified Information

It has been proposed that in the context of cumulative innovation, technological information be viewed along a continuum wherein the nature of information ranges from highly uncodified to highly codified (see Table 3). According to Mandeville (1999), codified information on this continuum refers to information that has been recorded and realized - for instance, highly uncodified information becomes codified when products out of it have been derived, such as machines and the relevant information has then been formalized through blueprints or patents, etc. This is why he refers to such information as “tangible” although it still refers to intellectual property.⁷⁸

Table 3: A Continuum of Technological Information⁷⁹



⁷⁵ Saviotti, op. cit. footnote 64 p 19.

⁷⁶ Archibugi and Michie, “The Globalisation of Technology: A New Taxonomy”, Cambridge Journal of Economics, 1995, 19, 121-140 at p. 128 and 129.

⁷⁷ Mandeville, op. cit. footnote 58 p 360.

⁷⁸ Mandeville, op. cit. footnote 58 p 362.

⁷⁹ Reproduced from Mandeville, op. cit. footnote 58 p 362.

On the contrary, highly uncodified information refers to intangible information that may include either undeveloped ideas or particular know-how of any sort, which is best communicated through personal communication between people.⁸⁰ Making the distinction between the two forms of information would necessitate the realization that the public good nature of information, as made out by neoclassical theory, would rather hold good for information at the far right of the continuum (which consists of the highly codified category), wherein the information has been accumulated, produced and recorded and therefore can be replicated at negligible costs.⁸¹ In contrast to this, tacit information entails high costs of acquiring information and exploiting it for the newer technologies that may be profited by it. (see Table 4).⁸²

Table 4: Appropriability of Knowledge: Regimes of Consequence (Modified)⁸³

Legal Instruments	Nature of Technology
- patents	- product
- copyrights	- process
- patents, industrial design	- codified
-trade secrets or no protection; increasing costs of trading with such information.	- tacit

This role of tacit information within biotechnology-based drug research is best ratified by the behavior of industry actors themselves.

The industry, which was earlier characterized by high barriers to entry and in-house research-oriented research is now divided between large diversified firms (LDFs), small and medium sized firms (SMFs) and dedicated biotechnology firms (DBFs) depending on their functional roles in the R&D process. Although the LDFs are usually the most capable of owning all the complimentary assets that are essential for full-fledged biotechnological research (such as an older technological knowledge base, marketing, legal infrastructure, etc), the newer form of research has paved the way for newer roles for the SMEs and the DBFs in this industry, which can be anything out of the three following possibilities: an independent innovator, a niche operator or a supplier of knowledge services.⁸⁴

⁸⁰ Mandeville, op. cit. footnote 58 p 362.

⁸¹ Mandeville, op. cit. footnote 58 p 363.

⁸² Ibid.

⁸³ Source: Teece, "Profiting From Technological Innovation", in Teece (ed.) *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, Cambridge, 1987, p. 189.

⁸⁴ Saviotti, op. cit. footnote 64 p 30-33.

The most interesting and one of the most common roles that such SMEs and DBFs play is the supply of knowledge services. As such suppliers, they engage in acquisition and integration of technological knowledge relevant for biotechnology - which is still a highly profitable activity. These SMEs and DBFs undertake research through repeated interactions and technological collaborations with the LDFs who have the competence and the resources to acquire and integrate different types of knowledge and assets.⁸⁵

In this endeavor to be competitive suppliers of knowledge services, these knowledge intermediaries rely on acquiring and processing large amounts of tacit information – this can be tacit information in the form of technological skills or also tacit information about the usage of plants/ animals/ microorganisms among other genetic substances. As Saviotti (1998) notes on the process of cumulative innovation in biotechnology and the role of such SMEs and DBFs, “...In spite of the very important role played by the SMEs/ DBFs they are not replacing the LDFs as suppliers of biotechnology-based products. What seems to have emerged, both in the US and in Europe, is an industrial structure characterized by a high degree of complementarity between SMEs/ DBFs and LDFs (based on their respective roles in the R and D process).”⁸⁶

3.2.2. *Traditional Knowledge as a “complimentary asset” in Cumulative Drug R and D*

The most important aspect of capturing the value of ethnobotanical knowledge to modern drug research lies in firstly, being able to harness the complementarity between traditional and modern knowledge for drug research and development, and more importantly, defining property rights so as to best address these complementarity.⁸⁷ Therefore, the interesting question is: does traditional knowledge qualify to be called “tacit information” in the context of cumulative innovation for biotechnological drug research?

There are mainly three different types of targeted search methods when pharmaceutical firms would like to conduct research based on genetic resources. Apart from taxonomic search and ecological search, ethnobotanical search method is the third option that firms and researchers could opt for.⁸⁸ Within these, ethnobotanical searches rely on short-listing plants that already have a history of medicinal usage amongst local populations.⁸⁹

⁸⁵ Saviotti, op. cit. footnote 64 p 31. See also Powell, W. W., “Inter-Organizational Collaboration in the Biotechnology Industry”, *Journal of Institutional and Theoretical Economics*, Vol. 152, no. 1, 1996, p. 197-215 who examines the key factors that promote inter-organizational collaborations in the biotechnology industry.

⁸⁶ Saviotti, op. cit. footnote 64 p 33.

⁸⁷ Personal Communication, Prof. Gordon Rausser, University of California at Berkeley, 08 March 2001.

⁸⁸ Cox notes that plants are selected for further research and development through selection techniques that search for plants based on some kind of bioactivity detection methods. There are two types of plant selection programmes that are traditionally attempted –random and targeted.

Viewed within the process of cumulative innovation, ethnobotanical knowledge fits into what we have call tacit, uncodified information that has a specific contribution to make to the R & D process. In order to transform a plant into a medicine, informational details such as the correct species, its location, the proper time of collection (some plants are poisonous in certain seasons), the solvent to use (cold, warm, or boiling water, alcohol, etc.), the way to prepare it (time and conditions to be left) and finally, the posology (route of administration, the dosage) are extremely important.⁹⁰ In this way, the systems of traditional knowledge are more relevant as tacit knowledge because it is knowledge that is “acquired experimentally and transferred by demonstration, rather than being reduced immediately or even eventually to conscious and codified methods and procedures”.⁹¹ Furthermore, its transfer requires more than just transfer of just an element; it is the transfer of many elements of the system.⁹² Cox (1995) lists this pattern of events as follows:⁹³

1. Specialist indigenous healing knowledge is recorded by interviewing indigenous healers;
2. The plant materials used by indigenous healers are collected and identified;
3. These plant materials are screened for pharmacological activity;
4. The molecular entities responsible for the observed pharmacological activity are isolated using bioassay-guided fractionation;
5. The purified materials are structurally determined using extant technology.

When this role is assessed within the process of cumulative innovation, ethnobotanical knowledge seems to amount to information that can provide a means of 'prescreening'

Random programmes are usually difficult and expensive because here plants are collected and screened without regard to their taxonomic affinities, ethnobotanical context or other intrinsic qualities. In targeted surveys plants are collected and analyzed for their chemical compounds based on some or the other taxonomic or chemical information. See Cox, "Ethnopharmacology and the Search For New Drugs", In: Chadwick and Arsch (eds.), *Bioactive Compounds From Plants*, Cambridge University Press, 1990, at p. 42; Also see Cox, "Shaman as a Scientist", in, Hostettmann et al, *Phytochemistry of Plants Used in Traditional Medicine*, Clarendon, 1995, p. 1-16.

⁸⁹ Ibid.

⁹⁰ Elisabethsky, "Folklore, Tradition or Know-How?", *Cultural Survival Quarterly*, Summer 1991, 9-13 cited in Cox, "Shaman as a Scientist", in, Hostettmann et al, *Phytochemistry of Plants Used in Traditional Medicine*, Clarendon, 1995, p. 1-16.

⁹¹ David, 1993, p. 27, cited in Foray, op. cit. footnote 63 p 80.

⁹² See Winter, "Knowledge and Competence as Strategic Assets", in Teece (ed.), *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, Ballinger Pub. Co., Cambridge MA, 1987, p. 359-183, at 173.

⁹³ See Cox, op. cit. footnote 90 p 10.

incoming material.⁹⁴ This knowledge comes into question before the screening of compounds starts within drug research and can have two distinct contributions to drug research. First and foremost, it can make the research process cost-effective by providing easy and efficacious means of short-listing plants that should be tested for higher pharmacological activity. Secondly, traditional knowledge itself could be the end use over which the product is based - this is a possibility when one talks of medicines for common ailments, such as common cold, fatigue, etc.

3.2.3. *Estimates of Ethnobotanical Contribution to Modern Drug Research*

Although the proof that ethnobotanical knowledge has much to contribute to modern drug research and development has been advanced by many a writings in law, anthropology and ethnobotany, the evidence gathered is unsystematic and many a times, based on historical anecdotes, rather than any futuristic predictions. One of the more specific estimates of the contribution of ethnobotanical knowledge to drug research, is that by Ried *et al* (1993), who note that using ethnobotanical knowledge actually increases the probability of drug discovery by 4 times.⁹⁵

What makes this estimate more appealing is that the same probability estimate has been proposed by many other studies using economic and statistic tools, albeit representative of a very small proportion of all the research in this field.⁹⁶ One interesting study that arrives upon a similar conclusion is Balick's study of the work of the Institute of Economic Botany of the New York Botanical Gardens for the National Cancer Institute, United States of America, to collect 1500 plant samples for its anti-cancer and anti-AIDS screening programmes. Most of his work for the National Cancer Institute consisted of collecting ethnobotanical samples in Belize. Based on his experience on random versus ethnobotanical collections of samples in this project, Balick

⁹⁴ Aylward, "The Role of Plant Screening and Plant Supply in Biodiversity Conservation, Drug Development and Health Care, in Swanson (ed.), *Intellectual Property Rights and Biodiversity Conservation: An Interdisciplinary Analysis of the Values of Medicinal Plants*, Cambridge University Press, 1995, p. 93-127, at p. 115.

⁹⁵ Reid et al, "A New Lease on Life", In: Ried et al (eds.), *Biodiversity Prospecting: Using Genetic Resources for Sustainable Development*, WRI, 1993, p. 1-52 at p. 17.

⁹⁶ Cox (1986) notes that a survey of Samoan ethnopharmacopoeia revealed that 86% of the plant species used in Samoan traditional herbal medicine shows pharmacological activity in broad in vitro and in vivo screens; See Cox, Sperry, Tuominen and Bohlin, *Pharmacological Activity Of The Samoan Ethnopharmacopoeia*, *Econ. Botany* 1983,43: 487-497; Also see, Anderson, "Ethnobotany of Hill Tribes of Northern Thailand. I. Medicinal Plants of Akha", *Economic Botany*, 40(1), 1986, p. 38-53, wherein he lists the 121 different species of plants used by the indigenous tribe of Akha; Anderson, "Ethnobotany of Hill Tribes in Northern Thailand. II. Lahu Medicinal Plants" *Economic Botany*, 40(4), 1986, p. 442-450, where again 68 species of plants in use by the Lahu people are listed; Preance, "Ethnobotanical Notes from Amazonian Brazil", *Economic Botany*, 1972; Riswan and Sangat-Roemantyo, "Javanese Traditional Cosmetics from

conducts an Ethno-Directed Sampling Hypothesis by comparing two groups of plants that were collected and sent to the National Cancer Institute for screening against HIV-AIDS. The random collection included plants from Honduras and Belize, although Balick admits that the results are preliminary and that data from only a small number of samples are available for analysis, the data which has been analyzed using the Fisher Exact Probability Test (a methodology useful for handling data from small size samples) shows a 4 time increase in probability when ethnobotanical information is used in such research instead of random searches.⁹⁷ The results of this test show that $P=0.101$. Although this is not conclusive evidence, it is a strong indication that the null hypothesis (that there is no relation between ethnobotanical collections and active compounds) should be neglected.⁹⁸

Apart from this, there are other studies that report the use of such knowledge in discovering novel compounds and can confirm it until the stages of clinical trails (for products pending these trails).⁹⁹ But estimates are rather the exceptions in ethnobotanical studies. Ethnobotany, which could perform the task of quantifying the contributory capabilities of such knowledge falls short of doing so, because of its methodological constraints. Most of the ethnobotanical studies do study in detail the plants used by indigenous groups and list their uses, but do not validate them through lab testing, or any other sort of modern medical methods.¹⁰⁰

3.2.4. *Traditional Knowledge as “Tacit Information” in the Cumulative Process*

Apart from the limited evidence presented above, the temptation to simplify traditional knowledge as an issue for distribution is also negated by the behavior of the industry once again, which itself seeks out sources of such information from journals or other such sources.¹⁰¹

Plants”, in Shaare, Kadir, Mohdi (eds.), *Medicinal Products from Tropical Rain Forests: Proceedings of the Conference*, Forest Research Institute, Malaysia, May 13-15, 1991.

⁹⁷ Balick notes that when compared to a 6% activity level found in plants collected randomly, the activity level in plants collected through ethnobotanical surveys rose to 25%. See Balick, “Ethnobotany and the Identification of Therapeutic Agents from the Rainforest” in *Bioactive Compounds from Plants*, p. 26- 28, at p. 28.

⁹⁸ Ibid.

⁹⁹ For example, Vlietinck and van den Berghe, (1998) point out potent anti-viral activity being confirmed in R & D centres from traditional medicines, research based on which is right now at the stage of clinical trails. See Vlietinck, and van den Berghe, “Leads for Antivirals from Traditional Medicines” in Prendergast, Etkin, Harris and Houghton (eds), *Plants for Food and Medicine*, The Royal Botanical Gardens, Kew, 1998, p. 333-344. Also see, Raman, and Skett (1998) who talk of validity of scientific studies which have shown that activities of plants to be anti-diabetic when their traditional usage was also anti-diabetic, in Raman and Skett, “Traditional Remedines and Diabetes Treatment” in Prendergast, Etkin, Harris and Houghton (eds), *Plants for Food and Medicine*, The Royal Botanical Gardens, Kew, 1998, p. 361-372.

¹⁰⁰ Ibid.

¹⁰¹ See Rausser and Small, “Valuing Research Leads: Bioprospecting and the Conservation of Genetic Resources”, *Journal of Political Economy*, 2000, Vo. 108, no. 1, p. 173-206 at p. 177-

Within the three niche operations that the SMEs and DBFs choose to supply within the industry, there are also SMEs and DBFs who no doubt supply knowledge services to LDFs, but restrict themselves to a particular niche, that of ethnobotanical knowledge.

Ethnobotanical knowledge is not readily available for dispersal at marginal costs - it requires collaborative activity, either by scientists, ethnobotanists or even national agencies, to be able to clearly document such knowledge and map it on a one-to-one basis to modern medicinal theories. This being the case, within the scheme of complimentary assets in cumulative innovative activity,¹⁰² ethnobotanical knowledge qualifies to be called a “complimentary asset” for the innovation process in biotechnology.

This role of ethnobotanical knowledge within the knowledge chain of biotechnological research and development, as tacit, uncodified information within this process gives us one of the most powerful arguments to defend such an intellectual property right.

3.3. An Intellectual Property Right Over Ethnobotanical Knowledge: The Incentive Effects

Such an intellectual property right can be defended on the basis of two incentive effects - the incentive effect to reveal the knowledge, thereby reducing the costs of acquiring it and the incentive effect to keep the knowledge pool in its entirety. Another purpose that such a definition could serve, when coupled with recognition of autonomy on the tangible properties of the communities is that of creating an incentive for biodiversity conservation.

3.3.1. Granting a Right over Ethnobotanical Knowledge: Incentive Effect I

One incentive that such a right could achieve first and foremost is the incentive to reveal. It has been noted that as a result of researchers and private individuals appropriating the knowledge for purposes that are not agreeable to the communities, or in many cases, not even made knowledgeable to them, many of the communities fear the misappropriation of their information against their economic, social and cultural values.¹⁰³ Grant of such a right (when supported by

179 who discusses industry behaviour that seeks out biodiversity “hotspots” and ethnobotanical information.

¹⁰² Winter, “Knowledge and Competence as Strategic Assets”, in Teece (ed), *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, Cambridge, 1987, p. 359-383.

¹⁰³ A patent by an US Based firm on the use of Ayahuasca as a hallucinogenic agent was revoked by the USPTO after objections to the same by the indigenous groups of the Amazonian basin where the plant had a spiritual significance. The patent was granted by the USPTO although the application mentioned the source of the plant, as well as the information related to it. See CIEL Newsletter, *The Ayahuasca Dispute*, Feb. 1999.

appropriate institutional mechanisms) ensures that they are, in fact, in a position to control the usage of the knowledge thereby giving them an incentive to reveal useful knowledge.

3.3.2. *Granting a Right Over Ethnobotanical Knowledge: Incentive Effect II*

It has been noted that the communities often maintain their own indigenous forms of intellectual property rights structures, wherein common remedies and usage of plants are known to all members but the more complex systemic parts are held in secret amongst a select few.¹⁰⁴ In the absence of a community right over such knowledge there may be incentives for individual parties to divulge parts of the knowledge known to them, thereby endangering on the one hand the holistic nature of these knowledge pools passed on from one generation to another and on the other hand, the structures of the communities itself.¹⁰⁵ Therefore, a second and equally important incentive of such a right would be that when a community intellectual property right is granted, it mandates that the communities and its constituent members devise mechanisms to enforce it as a whole, thereby ensuring that the knowledge pools are kept intact.

3.3.3. *The Right vis-a-vis Biodiversity Conservation*

The main stimulus for the recognition of rights of local and indigenous communities in Article 8(j) is based on biological conservation. Art. 8(j) is titled *in-situ* conservation and the CBD envisages that the grant of such a right acts as an incentive for conservation purposes. There is ample evidence that such communities serve as guardians of their immediate environment most times, and that they also have possess specific knowledge of conservation and sustainable use mechanisms that can be of much use to us. Proof of contributions of traditional knowledge to sustainable use and conservation is abundant - ranging from systems of indigenous

¹⁰⁴ Huft, *Indigenous Peoples And Drug Discovery Research: A Question Of Intellectual Property Rights*, *Northwestern University Law Review*, 1995, 89:1678, at p. 1697. Daly and Limbach (1996) note that there are different levels of healers within each community referring to the Kayapo communities in Brazil, in Daly and Limbach, "The Contribution Of The Physician To Medicinal Plant Research", in Balick et al (eds), *Medicinal Resources Of The Tropical Forests*, Columbia University Press 1996.

¹⁰⁵ Kanbur notes that in the case of common property resources, heterogeneity issues arise within otherwise homogenous groups as a result of external exchanges in the economic environment, see, Kanbur, *Heterogeneity, Distribution and Cooperation in Common Property Resource Management*, Working Paper Series of the World Bank, 1992, WPS 844.

management,¹⁰⁶ environmental impact assessments,¹⁰⁷ seed selection and preservation,¹⁰⁸ breeding of animals¹⁰⁹ to other methods of hunting, fishing or agriculture.¹¹⁰

But at the same time, as Kothari and Das (1999) note, communities have tendencies to over-use,¹¹¹ or also that given the tough situations these local and indigenous communities live in today, the realization that their knowledge about such resources is profitable may actually lead them to be *fait accompli* in exploitation of the resources itself.

Despite this, local and indigenous communities demonstrate common property resource management in territories that they occupy, wherein membership in the group of co-owners is determined by membership in some other group, e.g., village, tribe, etc.¹¹² Common property resources have sustained such local and indigenous communities by either directly providing resources that can be exchanged through market mechanisms, or by just enabling them to sustain themselves on the basis of such resources. The dependence of the communities on the resources leads to internalization of social sanctions, thereby creating conditions for its regeneration.

The hypothesis of welfare maximizing norms suggests that common property management is based on the ability of private agents to co-operate in order to invest together in sustainable and prolonged use of the resource such that each of them could benefit better for a longer time from resource use.¹¹³ In common property management usually community mechanisms exist that clearly control the extent to which the resources are used and sanction deviance. One precondition for these mechanisms to work is the ability of members of a given community to exclude outsiders, such that internal rules and control mechanisms can be created and maintained in a strict way. Therefore, the main characteristic which is decisive in terming a

¹⁰⁶ See Mundy, (1993), "Indigenous Communication Systems: An Overview", Journal of SID, Development 3, p. 41-44.

¹⁰⁷ Sallenave, Giving Traditional Ecological Knowledge its Rightful Place in Environmental Assessment", CARC-Northern Perspectives, 22: 1, 1994.

¹⁰⁸ Bandhopadhyay and Saha, "Indigenous Methods of Seed Selection and Preservation on the Andaman Islands in India", IKDM, Vol. 6, Issue 1, March 1998, p. 3-6.

¹⁰⁹ Ning Wu, "Indigenous Knowledge of Yak Breeding and Cross Breeding Among Nomads in Western China", IKDM, Vol. 6, Issue 1, March 1998, p. 7-9.

¹¹⁰ See Warren, "Using Indigenous Knowledge in Agricultural Development", World Bank Discussion Paper no. 127, 1992.

¹¹¹ Kothari and Das, "Local Community Knowledge and Practices in India" in Posey *et al* (eds), Spiritual and Cultural Values of Biodiversity, UNEP, 2000.

¹¹² *Ibid.*

¹¹³ According to Ellickson (1994), "...members of a close knit group develop and maintain norms whose content serves to maximize the aggregate welfare that members obtain in their workaday affairs with one another." Ellickson, also cites other authors who have advanced similar propositions that are of interest for us, see, for example, Edwin, The Biological Origin of Human Values, 362 (1977), who analyses how norms of co-operative behaviour evolve in small tribes. In Ellickson, Order Without Law, Harvard University Press, 1994, p. 167.

resource a “common property resource” is in the ability of the members of the community to exclude the persons (mainly outsiders but in situations of misconduct, even the members of the group) from the use of the resource.¹¹⁴

This leads us to another interesting result. If we vest the communities who possess the categories of traditional knowledge in the sense of ethnobotanical knowledge as argued for in the previous sections with the right to control physically their territories, then it would help them impose limitations on users for the usage of biological resources within their territories, which is the crux of achieving such community-based conservation. Empirical studies also widely recognise and accept that access restrictions have been the key instrument in older times that have helped such communities manage their resources.¹¹⁵ To this extent, the proposal that traditional knowledge should be defined much more narrowly and in keeping with the aspect of autonomy that such communities require to exclude outsiders from the use of their resources also would serve best the goal of biodiversity conservation.¹¹⁶

¹¹⁴ For e.g., in Indian villages where a lot of property was managed in common, expulsion was a technique used to punish persons of the village community for disobedience of rules of use. For more, see Bromley and Cyrene, *The Management of Common Property Natural Resources: Some Common Conceptual and Operational Fallacies*, World Bank Discussion Papers No 57, 1989; Jodha, *Common property Resources*, World Bank Discussion Papers, World Bank, Washington, 1992.

¹¹⁵ See for instance, Schaaf, “Environmental Conservation Based on Sacred Sites”, in Posey *et al*, op. cit. footnote 123 p 325-344, where he explains how the system of preserving areas with special ecosystems by denoting them as ‘sacred sites’ only worked through access restrictions.

¹¹⁶ For an account of how management techniques that allow communities to exclude outsiders could lead to sustainable biodiversity prospecting partnerships that respect the goal of conservation and sustainable use of biodiversity, see Chapela, “Using Fungi from a Node of Biodiversity: Conservation and Property Rights in Oaxacan Forests”, in Hoagland and Rossman, *Global Genetic Resources: Access, Ownership and Intellectual Property Rights*, 1997, p. 165-180.

4. A SUMMARY OF FINDINGS

The major contribution of this paper has been to show that successful attempts to define traditional knowledge ought to focus on demarcating the nature of contribution that such knowledge could have rather than on the physical attributes of the right itself. The emphasis on the nature of the information itself serves as the best parameter of what the limits of “community/communities” are and what sort of knowledge ought to be protected and made contractible through an intellectual property right. This paper has undertaken this exercise for traditional medicinal knowledge and shown that allocative efficiency issues for grant of such a right do, in fact, exist.

After thus asserting the nature of the contribution, countries can choose amongst a wide range of intellectual property instruments. The most effective options to protect traditional medicinal knowledge/ ethnobotanical knowledge seems to be the options of trade secret protection or a system of sui generis community intellectual property rights.¹¹⁷ Categories of traditional knowledge that do not fall within the above-mentioned criteria could be documented into traditional knowledge databases to prevent third parties from claiming patents on already existing knowledge. Making such public domain available as “prior art” will ensure that third parties do not unduly benefit by claiming patents on such information.

Trade secrets seem to be especially suitable for the protection of ethnobotanical knowledge because of two reasons. Firstly, it affords protection for informational goods that do not fit into the strict standards set out by patent law. Secondly, Article 39 of the TRIPs Agreement has made trade secrets an internationally acceptable intellectual property option.

Before the TRIPs Agreement, countries had their own ways of dealing with trade secrets, a majority of them treating infringement of a trade secret only as a harm to the holder of the secret, thereby prescribing damages or injunctions as legal remedies.¹¹⁸ Now, as per Article 39(2), exploitation of a secret without the consent of the owner is improper (contrary to honest

¹¹⁷ An experimental project based in Ecuador and being supported by the Interamerican Development Bank seeks to transform indigenous knowledge into trade secrets. These are to be contracted away by way of material transfer agreements. For details, see Dutfield, *op. cit.* footnote 15 p 89; Vogel, “Bioprospecting and the Justification for a Cartel, *Bulletin of the Working on Traditional Resource Rights*, 1996, No. 4, p 16-17.

¹¹⁸ See Wise, *Trade Secrets and Know-How Throughout the World*, 1981, cited in Verma, “Protection of Trade Secrets Under the TRIPs Agreement, and Developing Countries”, *The Journal of World Intellectual Property*, 1998, Vol. 1, No. 5, p. 723-742 *op. cit.* footnote 126 p 729, for a review of trade secret protection in different national jurisdictions.

practices). But since “improper” in this context depends on breach of contractual restrictions, a large onus in making the protection work rests on effective contractual restrictions.¹¹⁹

Another advantage of Article 39 is that the Member States are free to adopt effective measures of protection under national laws. Thus, if groups of persons who shared ethnobotanical knowledge could be organized as legal persons and if “...[r]easonable steps...by the person in control of the information, to keep it a secret”¹²⁰ can be proved, ethnobotanical knowledge can be protected through trade secrets. It would also make much sense for contractible ease, since much information in the biotechnological industry is kept as trade secrets.

Article 39’s weaknesses lie in its lack of protection against third parties and accidentally disclosed secrets. Article 39 does not afford any protection to holders of trade secrets when persons who are not in contractual relations with the lawful holder/ user of the information, acquire information through lawful means. But in case third parties knew about the confidential nature of the information or were grossly negligent in failing to know that dishonest commercial practices were used to acquire the information, they may be held liable.¹²¹ Since the definition of the terms ‘gross negligence’ or ‘knowledge’ is left to national jurisdictions, this discretion could be used to protect communities against dishonest practices by government or private agencies who document and their knowledge as trade secrets (or even their own compatriots who break off and attempt to sell their knowledge as trade secrets). The lack of protection against accidentally disclosed secret could be a considerable issue when applied to traditional medicinal knowledge given that such accidents may be hard to prevent within members of communities.

But a well-defined right with an easily segregable set of beneficiaries is only the first step in empowering local and indigenous communities in this regard. A large onus rests on the design of institutions that will put this right into an enforceable framework. Whatever be the mode of intellectual property option chosen for the right (like a trade secret or a know-how license), the institutions have two major tasks: that of representing the communities effectively, and of providing for rules of contract formation that take into account the difficulties of dealing with information as a resource.

The task of representing the communities effectively, in turn, has two main components to it. Firstly, the institutional framework has to provide mechanisms to minimize principal-agent problems that can arise between the communities, and their agent, the State. The second and

¹¹⁹ See Krasser, “The Protection of Trade Secrets in the TRIPs Agreement”, in Brier and Shricke, *From GATT to TRIPs - The Agreement on Trade Related Aspects of Intellectual Property Rights*, IIC Studies, Vol. 18, 1996, p. 216-225 at p. 223.

¹²⁰ Article 39(2) of the TRIPs Agreement.

¹²¹ Verma, *op. cit.* footnote 118 p 730.

equally important aspect is that of ensuring the unified participation of the communities and their members in decision-making processes. There are many shortcomings of a community right, which the institutions have to take into account in order to facilitate this. One shortcoming relates to the gradual breakdown of control mechanisms within community structures in transitory phases due to modern inroads¹²² or heterogeneous elements,¹²³ making resources more prone to unsustainable exploitation. Another potential shortcoming that could hamper unified decision-making is caste-creed conflicts within communities, like for example, is the case amongst communities in India. It could also be that knowledge holdings are segregated within communities, making the people who possess the relevant knowledge more important than the rest. As a result, the successful implementation of the right for the welfare of the communities and societal welfare rests on the capability of the institutional mechanisms to anticipate and prevent such issues of enforcement.

The second task of the institutional mechanism is to provide contractual rules that can take into account problems caused by information asymmetries, uncertainty and other transaction costs issues that parties face in evaluating and trading with traditional knowledge. Due to paucity of time, these issues that confront national policy makers in making the right enforceable could not be dealt with.

¹²² Cox, op. cit. footnote 90.

¹²³ Kanbur, Heterogeneity, Distribution and Cooperation in Common Property Resource Management, Working Paper Series of the World Bank, 1992, WPS 844.

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