Traditional Knowledge Database: IPR and Opportunities for R&D

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Intellectual property rights issues have assumed significance in the context of the protection of traditional knowledge. The paper examines the current initiatives in the documentation and setting up of digital databases of traditional knowledge, the issue of conceptual classification of such databases, and suggests integration of the biologists' classification, applications of plant-based inventions, and the classification system practised by the patent offices. Such a classification is expected to serve the requirements of both the R&D scientists and the patent offices. The patenting activity of 46 plants pertaining to the medicinal plants, spices, fruits, vegetables, woods, dyes and fibres have been analysed. R&D directions emerging from the analysis of the patenting activities are indicated.

Traditional knowledge is the product of the continuity of creative skills and craftsmanship in a variety of cultures, traditions, and beliefs since ancient period. The knowledge and ideas have flown freely across cultures and gained strength from the interactions amongst civilizations. Apart from the rich biodiversity resources, the traditional societies have generated a vast reservoir of information and experiences that have helped in sustaining their social and economic life. India possesses a great wealth of biological

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diversity in its forests, its wetlands and in its marine areas. Its species of flowering plants range up to 15,000 as compared to 250,000 species in the world. In addition, there are more than four thousand different species of animal kingdom against about 45,000 species at the world level. According to Pushpangadan and Nair, the systematists have identified, catalogued and classified about 1,26,565 species of plants, animals, fungi and microorganisms from different biogeographic zones of India. There is still a lot more to be explored and documented.

During past few decades, the bioresources and traditional knowledge of most developing societies have been extensively discussed in various international fora. With regard to traditional knowledge as well, a number of initiatives have been underway to bring about common positions of the stakeholders. The interest of the developing countries is to ensure protection of the interests of its inhabitants. Developed countries have varied perspectives ranging from conservation to economic exploitation of the traditional knowledge base. The technological developments primarily in the field of biotechnology enabled the most developed countries to exploit the leads from the traditional knowledge base in obtaining new products and processes in a large number of applications of commercial importance. Since the bioresource rich developing countries lacked the necessary technological expertise, new regimes of co-operation were sought to be established through international negotiations and agreements. The Convention on Biological Diversity in 1992 gave the sovereign rights to nation states over the bioresources within their territories, and enunciated the key principle of linking the access to and benefit sharing in genetic and biological resources. There is an increased activity to evolve systems of protection of traditional knowledge and take initiatives so that the benefits accrue to the local indigenous people.

Multilateral institutions, like United Nations Environment Programme, Commission on Genetic Resources for Food and Agriculture of the Food and Agriculture Organization, International Labour Organization, UNESCO, World Health Organization, World Bank, United Nations Conference on Trade and Development, World Trade Organization, World Intellectual Property Organization have addressed these issues from different perspectives and in different contexts. The approach adopted by these organizations is a reflection of each organization's particular mandate and objectives.

The main concern is to find operative ways of protecting traditional knowledge by using existing intellectual property mechanisms, or by developing new sui generis system of protection or by adopting a combination of both.

Role of IPR

The World Intellectual Property Organization has been exploring the role of intellectual property protection in the context of traditional knowledge. The issues are far from being clear and require greater technical understanding of the basic concepts and principles of intellectual property and their application in the specifics of concrete uses of traditional knowledge. There are many inherent problems in applying these concepts to real life situations. For example, for patenting, it is essential that the inventions reflect an element of novelty, non-obviousness and industrial usefulness, which may not hold true in case of most of the traditional
knowledge per se. In a recent study of patenting in clove, it was found that inventions otherwise well known to the indigenous communities were patented by diluting many of these concepts. In some cases, known applications of clove as aromatic and flavouring agent, insecticidal and antimicrobial, in dentrifices, or medicinal applications were patented in countries, like USA, UK and Japan with minor human interventions. In case of China, even the criteria of human intervention were not explicit and it appeared as if the whole of traditional knowledge as such was protected by patenting.

In spite of such difficulties there is a school of thought, which considers that, in future, the intellectual property system might be adapted to provide effective protection for traditional knowledge.

The potential role of IPR in the protection of traditional knowledge is an emerging field. Although there are no clear standards for intellectual property protection of such knowledge, there are instances wherein attempts have been made to resort to existing IPR mechanisms, like patents, trademarks or copyrights. The role of IPR in traditional knowledge protection should be based on an understanding of the context in which traditional knowledge is generated, preserved and used including the rights of the knowledge holders. This will require an explicit description of the subject matter that is to be protected, documenting of the knowledge as searchable prior art, and how such prior art is to be established for patent examination purposes.

**Documentation of Traditional Knowledge**

Many initiatives have been taken to consider the protection of traditional knowledge base from the legal angle. The real purpose of such protection is the inherent economic potential of traditional knowledge. The thrust of most of the national and international initiatives on traditional knowledge is to develop a system that documents and preserves traditional knowledge created in the past, and contributes to the promotion and dissemination of innovations. Such a system might provide appropriate information for continuing creativity and innovation in most fields of technology including traditional, medicinal, and agricultural practices.

An important step is to establish digital databases to enable quick retrieval of information of traditional knowledge for a variety of uses. In the first instance, such databases may enable the patent offices to have quick access to the prior art. The Patent Offices need information about the existing traditional knowledge to enable them to examine the novelty of the proposed inventions before granting patents. Information on traditional knowledge is also significant for researchers and scientists. The database may also meet the requirements of R&D scientists. How can such a database be developed? Identification of a conceptual classification for storing data and information is of prime importance in developing the database on traditional knowledge.

Classification, in a broad sense, is a mechanism for both organizing and utilizing information and knowledge. At a fundamental level, we make sense of the word by organizing information that is essential to learning. The core traditional knowledge may include agricultural, medicinal, ecological, and biodiversity related knowledge - most of which is flora and fauna based. In order to gain insights into the conceptual basis of the classification for building the database, it may be worthwhile to explore the classification system of the biological knowledge,
how this basic classification is transformed into plant-based technological inventions or traditional knowledge and evolve concepts to integrate this understanding into the classification system followed by the patenting systems.

**Plant-based Inventions: Classification**

The characteristic of plants and animals is that they exist as individuals, propagating their like from generation to generation in a series. Of such series of individuals, there are very many kinds, and these have extremely varied and unequal degrees of resemblances. For the sake of convenience, and avoiding confusion, there has to be a means of distinguishing individuals. The biologists have classified organisms in taxonomic groups taking help from morphological characters, genetics, physiology, molecular biology, embryology, etc. Based on this, the living things are divided into two kingdoms: Plant kingdom and Animal kingdom. Bacteria and certain other microorganisms are sometimes classified as a distinct kingdom called Protista.

Plant kingdom is divided into divisions, classes, orders, families, genera, and species. Some groups may be further subdivided such as sub-divisions, sub-classes, sub-orders, sub-families, and species into races or varieties. This classification has maintained the rhythm of scientific research in biological sciences. The application of this knowledge has led to a number of patentable inventions wherein these are governed by a different set of classification system. For example, the technical content of the patent documents is classified according to the International Patent Classification (IPC). The classification is made up by a letter, denoting the IPC section, followed by a number (2 digits), denoting the IPC class. Optionally, the classification can be followed by a sequence of a letter, denoting the IPC subclass, a number (variable, 1-3 digits), denoting the IPC main group, a forward slash "/", a number (variable, 1-3 digits), denoting the IPC subgroup, *viz.* B60N2/28. Both these systems should work in tandem to meet the requirements of scientists as well as Patent Offices.

It is observed that most of the patentable inventions are based on the use of traditional knowledge into novel applications. This brings in the third element that needs to be taken care of while developing the conceptual classification for traditional knowledge databases. The most important plants and their products have been grouped into four primary categories, *viz.* food plants, plants and plant products of industrial value, medicinal plants and drugs, and food adjuncts. Food plants include cereals and millets, legumes and nuts, vegetables, sugars and starches, and fruits. Plants and plant products of industrial value include fibres and fibre-yielding plants, wood and cork, tannins and dyes, rubber and its products, fatty oils and vegetables fats, essential oils, gums and resins, and mucilages. Medicinal plants, fumitories, and masticatories form the category of medicinal plants and drugs whereas food adjuncts have two subsidiaries, namely, spices and condiments, and beverages. Plant-based traditional knowledge can be examined in terms of an application-based classification and integrated into the conceptual scheme of the databases thereby facilitating quick analysis of the relevant patenting activity.

**Traditional Knowledge Digital Library (TKDL): Classification**

The Government of India has taken an important initiative to establish National Tradi-
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tional Knowledge Digital Library (TKDL) so that, in the current phase, all the documented information about medicinal plants in Indian traditional system become accessible to the patent examiners globally with the objective to prevent the grant of patents for non-original inventions. The Project sets out to start with documenting selected plants, which have direct or indirect relationship with life expectancy. The starting point is to match the traditional knowledge with the International Patent Classification (IPC) System. This will aim at identifying various classes, sub-classes, groups and sub-groups that are, for example, applicable to medicinal plants. The TKDL will enable identification of information on patents in the category of traditional plants indicating the prior art. The traditional knowledge is to be placed in the structured form that can be quickly retrieved on processes for the preparation of drugs and its uses, details of plants used, therapeutical compound formulations, compositions, doses and diseases.

The TKDL aims to develop its own internal classification system that is transparent to patent examiners, permitting total functionality and search facility based on IPC and key words. IPC does not target traditional knowledge, which is unclassified and is in unstructured form. However, the Project finds IPC in its present form adequate to retrieve information pertaining to the traditional knowledge, once IPC codes are integrated to the available traditional knowledge. The system could also be beneficial to the R&D scientists, the dimension that has not been explicitly considered in the current phase of the Project.

The IPC has developed its classification system to account for the novelty of an invention. Accordingly, the same invention may find place in a different classes or sub-classes or groups or sub-groups. In turn, the IPC helps the inventors as well as patent examiners to ascertain prior art and established knowledge. The classification system renders support to R&D scientists in identifying latest inventions and technological advances. The proposed classification system of the TKDL, supplementing the IPC, can thus be useful to R&D scientists in obtaining leads based on the prior art in Indian traditional knowledge system. This dimension of the utilization of TKDL and above-mentioned guiding principle of classification of traditional knowledge databases should be kept in view while developing TKDL’s internal classification system.

Classification system of digital traditional knowledge databases, like TKDL should facilitate access of information for use by R&D scientists that integrate all the three classification systems, namely, the biologists classification of plant-based knowledge, applications of plant-based inventions, and the classification system practised by the Patent Offices for quick retrieval of information. This should establish the guiding principles for classification of digital traditional knowledge databases.

Patenting and Opportunities for R&D

The inputs from science and technology are of crucial importance in undertaking research and development and innovations based on traditional knowledge. It is therefore essential that R&D scientists from the developing countries make efforts to develop innovative and novel products and processes for exploitation of the traditional knowledge base. The documentation of traditional knowledge will help scientists in identifying their topics of research and commercialization of inventions thereupon. R&D scientists will be required to look into
the patent literature in addition to the published research work to identify opportunities for R&D.

Table 1 gives the number of patents taken in some economically important plants. These are some of the priority plants that were identified as of inventive importance in the report of the task force on traditional knowledge digital library. The data on patenting of these plants was obtained from the US patent database. For each plant, the search was made in title, abstract and claim of the patents using the botanical name, English name and the common Indian name. The data were searched up to 29 May 2001. The patenting activity has been analysed and R&D directions are reviewed in the following sections.

Analysis of Patenting

Most patenting activity was observed in the inventions pertaining to the medicinal plants, spices, fruits, vegetables, wood, dyes, and fibre. In medicinal plants, the most inventions were relating to Nicotiana tabacum, Azadirachta indica, Aloe vera, Croton tiglium and Cannabis sativa. In other important plants like Withania somnifera, Picrorhiza kurroa, Achyranthes aspera, and Commiphora mukul, the patenting is limited indicating scope for R&D efforts for commercial innovations. The high number of patents in Nicotiana tabacum are due to the inventive activity relating to plant-based research as well as patents on tobacco-based articles, which is due to the use of English name tobacco in the search strategy. In spices, maximum patents were obtained for inventions relating to Cinnamomum camphora, Cinnamomum zeylanicum, Mentha spicata, and Zingiber officinale. In fruits, major activity was observed in case of Musa paradisiaca, Tamarindus indica, and Mangifera indica. In vegetables, Citrus limon, Allium sativum, Daucus carota, and Cucumis melo received attention. Boswellia serrata was one of the active plants in the category of wood. Indigofera tinctoria and Lawsonia inermis were found to be given attention by the inventors in patenting. High level of patenting activity was related to the plants, namely, Cocos nucifera and Linum usitatissimum in the fibre category.

R&D Directions

The main focus of R&D in the area of medicinal plants is on the usages of plant materials as repellents, insecticides, healing and protecting skin, in chewing gum, dentifrices, cosmetics, therapeutics, pharmaceuticals, and ophthalmic. R&D has also been undertaken at the levels of preparation of plant extracts, products like edible neem oils, stable azadirachtin and a variety of plant-based molecular research. In spices, main thrust of patenting activity is development of inventions for medicinal applications. These applications cover inventions relating to treatment of asthma, enhancement of immune functions, use in dentifrices, body coolant, in antiplaque and antacid chewing gums, peptic ulcers, hair tonic, analgesic, antivenom compositions, treatment of viral infections including HIV, as laxative, in skin treatment, in compositions for intestinal health, for Parkinson's disease, as antitoxicant, anti-inflammatory, in recurrent mouth ulcer, as antimicrobial, for joint pains, in hyper-tension, in wound healing, and in herbal compositions for diabetes, nasal congestion, adenovirus vector for gene therapy, protection of microorganisms against bacteriophage virus attack, and for stimulating blood circulation. Apart from these, inventions in spices have led to patents for their applications as animal repellant, pest repellant, in-
Table 1—Patenting activity in selected plants of importance to traditional knowledge

<table>
<thead>
<tr>
<th>Economically important plants</th>
<th>No of patents</th>
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</thead>
<tbody>
<tr>
<td>(Botanical name, English name, Common Indian name)</td>
<td></td>
</tr>
</tbody>
</table>

**Medicinal Plants**

- Aloe vera; Indian aloe; Kumari
- Nicotiana tabacum; Tobacco; Tamraparna
- Commiphora mukul; Indian badellium tree; Guggulu
- Cannabis sativa; Cannabis; Bhanga
- Azadirachta indica; Neem tree; Nimba
- Croton tiglium; Croton; Jayapala
- Picrorhiza kurroa; Kuru; Katuka
- Withania somnifera; Ashwagandha; Ashwagandha
- Achyranthes aspera; Achyranthes; Apamarga

**Spices**

- Capsicum annum; Sweet pepper; Lanka
- Piper nigrum; Black pepper; Maricha
- Curcuma longa; Turmeric; Haridra
- Zingiber officinale; Ginger; Ardraka
- Cinnamomum camphora; Camphor; Karpoora
- Foeniculum vulgare; Fennel; Madhurika
- Carum carvi; Caraway; Jiraka-Krishna
- Ocimum basilicum; Common basil; Barbari
- Coriandrum sativum; Coriander; Dhanyakya
- Myristica fragrans; Nutmeg; Jatiphala
- Crocus sativus; Saffron; Keshra
- Cinnamomum zeylanicum; Cinnamon; Twak
- Cuminum cyminum; Cumin; Jiraka-Shweta
- Mentha spicata; Spearmint; Udinaka
- Elettaria cardamomum; Lesser cardamom, Ela
- Nigella sativa; Black cumin; Epakunchika

**Fruits**

- Mangifera indica; Mango; Amra
- Phoenix dactylifera; Date palm; Kharjura

Contd
Table 1—Patenting activity in selected plants of importance to traditional knowledge— Contd

<table>
<thead>
<tr>
<th>Economically important plants (Botanical name, English name, Common Indian name)</th>
<th>No of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Punica granatum</em>; Pomegranate; Dadima</td>
<td>16</td>
</tr>
<tr>
<td><em>Tamarindus indica</em>; Tamarind; Amlika</td>
<td>121</td>
</tr>
<tr>
<td><em>Musa paradisiaca</em>; Banana; Kadali</td>
<td>367</td>
</tr>
<tr>
<td><em>Zizyphus jujuba</em>; Jujube; Badara</td>
<td>2</td>
</tr>
<tr>
<td><em>Aegle marmelos</em>; Bael; Bilwa</td>
<td>3</td>
</tr>
<tr>
<td><strong>Vegetables</strong></td>
<td></td>
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<tr>
<td><em>Daucus carota</em>; Carrot; Garjara</td>
<td>210</td>
</tr>
<tr>
<td><em>Citrus limon</em>; Lemon; Jambira</td>
<td>599</td>
</tr>
<tr>
<td><em>Cucumis melo</em>; Musk; Kharbuja</td>
<td>116</td>
</tr>
<tr>
<td><em>Allium sativum</em>; Garlic; Lashuna</td>
<td>304</td>
</tr>
<tr>
<td><em>Trigonella foenum-graecum</em>; Fenugreek; Methi</td>
<td>47</td>
</tr>
<tr>
<td><strong>Woods</strong></td>
<td></td>
</tr>
<tr>
<td><em>Boswella serrata</em>; Indian olibanum tree; Shallaki</td>
<td>17</td>
</tr>
<tr>
<td><em>Cedrus deodara</em>; Deodar; Devadaru</td>
<td>5</td>
</tr>
<tr>
<td><em>Terminalia arjuna</em>; Arjun tree; Arjuna</td>
<td>3</td>
</tr>
<tr>
<td><em>Terminalia chebula</em>; Chebulic; Haritaki</td>
<td>3</td>
</tr>
<tr>
<td><em>DyesLawsonia inermis</em>; Henna; Madyantika</td>
<td>17</td>
</tr>
<tr>
<td><em>Impatiens balsamina</em>; Garden balsam; Dushpatrisati</td>
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</tr>
<tr>
<td><em>Indigofera tinctoria</em>; Indigo; Nili</td>
<td>358</td>
</tr>
<tr>
<td><strong>Fibres</strong></td>
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<tr>
<td><em>Linum usitatissimum</em>; Flax; Atasi</td>
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</tr>
<tr>
<td><em>Cocos nucifera</em>; Coconut; Narikela</td>
<td>2049</td>
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</table>

sect repellant, as fungicide, soil treatment for termites, as spice, in food supplements, in freeze dried ginseng berry tea, liquid seasoning, as coffee substitute, as coagulant for soybean milk and soybean food, in coating dry roasted nuts, as salad dressings, flavourant, colourant, surfactant, cosmetics, perfumery, foot powder, anti-oxidant, non-combustible artificial cigarettes, and extraction of spices.

In the domain of fruits, R&D has largely involved applications in medicines and as food. The medicinal applications cover antiviral and fungal compositions, herbal extracts compositions and method for immune-boosting capability, treating allergic dermatitis, a wound covering material, for treating cancer, for relieving arthritic pain, and in analgesic formulations. Applications in food include R&D for inventions like...
banana desert, chocolate beverage, as condiment, preparation of low calorie food, confectionery, fruit candy, fast cooking rice, in baby food, and milk based drinks. The other R&D focus is diversified into applications, like preparation of nematicidal proteins, as cosmetics, in banana starch production, as herbicide, in molecular biology, surface sizing efficiency in paper making, in mosquito control, as thickening agent, for making coloured plant culture media, in production of alcohol, and method of cutting frond stubs from a date palm.

In vegetables, R&D is mainly in medicinal compositions, for acne, diabetes, and oral compositions, food and feed substances, as food ingredient, flavourant (deodorant, perfumery), isolation and formulation of nutrient rich carotenoids, method of preparation of juice, in cosmetics, as insect attractant and repellant, bird repellant, antimicrobial, germicidal, for nematode control, in preparation of artificial seeds and transgenic fungal resistant plants.

In wood, R&D activity is limited to medicinal use in herbal formulations, for example, *Terminalia arjuna* finding application as a component in anti-viral drug, and use of *Boswella serrata* in the treatment of hepatitis B and E, and viral infections, like HIV, and flu. The woods also find use in dentrifices, cosmetics, aromatic compositions and applications in molecular biology inventions, for example, in method to identify tumour suppressor genes, cloning and sequencing vector, control of plant gene expression, and biotin binding containment systems.

In dyes, R&D and inventive activities mainly relate to the usages as herbal colouring materials. The patents have also covered aspects, such as use in herbal composition for treatment of diabetes, or in anti-pollution cosmetic composition. *Cocos nucifera* is an important fibre plant. Patents in this taxa are the result of R&D in applications as fat and oil, cosmetics, food and feed, surfactants, medicine, fibre boards, insulating board, marine cables, non-inflammable fibre products, and composites.

The above review of the patenting and R&D activity indicates that there is ample scope for R&D scientists to benefit from the traditional knowledge digital database in addition to the Patent Offices. The patent offices will find out the existing knowledge for grant of novelty while the R&D scientists will obtain the leads for further research.

**Summary and Conclusions**

Traditional knowledge has become economically important. Many initiatives have been made to conserve the biodiversity and the traditional knowledge. Intellectual property rights issues have assumed significance in the context of these developments. There is no clear established mechanism of IPR to provide protection and check unfair exploitation by the unscrupulous agencies. This may also facilitate the deserving to reap the benefits of the traditional knowledge for commercial gains. The documentation and setting up of digital databases of traditional knowledge are of prime importance for this purpose. The paper examines the crucial issue of conceptual classification of such databases and suggests a guiding principle that integrates the biologists’ classification, applications of plant-based inventions, and the classification system practised by the Patent Offices. It examines the patenting activity and opportunities for R&D based on the traditional knowledge about plants. Most patenting activity was observed in the inventions pertaining to the medicinal plants, spices, fruits, vegetables, woods, dyes and fibres. R&D directions emerging from the analysis of the patenting activities
have been indicated. The main focus of R&D is in the area of medicine, cosmetics, molecular and genetic inventions, food and feed, composite fibres and herbal colouring materials. R&D scientists could benefit from such information and databases.

Acknowledgement

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