Patenting scenario in agriculture: Indian perspective

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An attempt has been made to analyse the trends of patenting and patented technologies in India in different areas of agriculture using data from Gazette of India Part III Section 2. The study covers data from the period 1 January 1995 to 31 December 2004 (WTO era), wherein 449 patents exclusively related to agriculture have been taken up for analysis. The analysis has been used for examining present technological status.

Keywords: Agriculture, India, patent activity, patent analysis.

IN India, most of the population relies on agriculture for its livelihood. India is self-sufficient in wheat and paddy, but deficient in other agricultural produce. The Union Government, through its annual budget for 2005/06, has emphasized that the main thrust on agriculture sector would be to achieve further diversification in farm activities[1]. Boosting agricultural growth through agricultural diversification such as horticulture, floriculture, pulses and oilseeds and development of agro-processing such as dairy, poultry and fisheries are being focused in the agriculture roadmap.

Patents are good indicators of research and development output. However, not all patents are equally valuable. Patent analysis makes it possible to map out the trend of technological change and life cycle of a technology – growth, development, maturity and decline. Patent information and patent statistical analysis have been used for examining present technological status and to forecast future trends. One can determine the directions of corporate R&D and market interests by analysing patent data.

The present study is an attempt to analyse patents granted in India in the field of agriculture. Earlier, an attempt was made to analyse patenting activities from India in the field of agriculture, where all patenting activities emanating from India were analysed[2].

Objectives

The objectives of the study are to:

- examine the growth of patenting activity in agriculture compared to total patents granted in India,
- examine the growth of Indian patenting activity compared to patenting activity by foreign countries in India,
- document and analyse the patented technologies in different areas of agriculture,
- identify sub-areas of agricultural research like agricultural machines or implements, forestry, planting, sowing, harvesting, cultivation, biocides, etc. where patenting activity has taken place.

The study also interprets innovative activities in the agricultural sector with regard to patent statistics. The result of the study will provide a global scenario of applicants who have obtained patents in India.

Genesis of Indian legislation

According to the Indian Patent Act 1970 and subsequent Patent (Amendment) Act, 1999 and 2002, patents could be applied mainly for agricultural tools and machinery or the processes for the development of agricultural chemicals[3]. However, methods in agriculture or horticulture, life forms of other micro-organisms like plant varieties, strain/breeds of animals, fish or birds as well as products derived from chemical/biochemical processes, and any processes for medicinal, surgical, curative, prophylactic or other treatments of animals or plants to render them free of diseases or to increase their economic value or that of their products as such, did not constitute the patentable subject matter under the previous patent regime.

Till 2004, for inventions relating to substances prepared or produced by 'chemical processes' (including alloys, optical glass, semiconductors and inter-metallic compounds) and substances intended for use or capable of being used as drug and food, no patent was granted in respect of claims for the substances themselves, but claims for the method or processes of manufacture were patented. 'Chemical process' includes biochemical, biotechnological and microbiological process. Now the inventions related with agrochemicals as products can be patented according to the Patent (Amendments) Act, 2005. Earlier, India did not have any legislation to protect plant varieties and no immediate need was felt. However, after becoming a signatory to Trade

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Related aspects of Intellectual Property Rights (TRIPS) agreement, such legislation was necessitated. TRIPS provides protection for plant varieties by mandating their protection by patents or by an effective *sui generis* system or by any combination thereof[4]. The *sui generis* system for protection of plant varieties was developed integrating the rights of breeders, farmers and village communities. *Sui generis* enables the design of one's own system of protection for plant varieties as an alternative or addition to a patent system for protecting plants.

Data and methodology

International Patent Classification as a tool has been used to obtain a specific level of precision in relation to activities related to agriculture. Based on International Patent Classification (IPC), a manual search by IPC code 'A01…' was made in all the weekly issues[5] of *Gazette of India Part III, Section 2* for all the patents issued since 1 January 1995. Bibliographic references of all the patents from 1 January 1995 to 31 December 2004 were collected. Most up-to-date data would of course be desirable, but the most recent data available at the time of study was only up to 31 December 2004. The bibliographic references contain information on patent number, publication date, IPC number, inventor's name, applicant's name, inventor's country, title, etc. A database of 449 patents was developed for data analysis. The patents were grouped into different subclasses to analyse patenting activities in India, including patents granted to Indian or foreign individuals/organizations/industries. The study conducted a technology assessment to observe the distribution of patents in various sub-fields. The data were analysed to examine the trend in the growth of patenting activities year-wise. The research results are summarized in Tables 1–3, reflecting the patenting activities and scope of the field of research. The study also includes names of countries that have been granted patents in India. The total number of patents and year-wise distribution of patents is also given in Tables 1–3.

Findings

Growth of patenting activity in agriculture

Analysis of the data indicates that agriculture patents constitute ~ 2% of the total Indian patents (Table 1).

The growth of patenting activity during 1995–2004 is shown in Figure 1. It can be concluded that there is a gradual increase in the number of patents. The number of patents reached a maximum during 2001–2002, while it declined during 2003–04.

Indian versus foreign patenting activity

Patents granted to India as well as foreign countries during the period 1995–2004 have been normalized using Activity Index (AI). AI has been suggested by Frame[6] and elaborated by Schubert and Braun[7]. Karki and Garg[8] have used it to compare India's performance with the world performance in the field of alkaloids for different years. AI characterizes the relative research effort of a country in a given subject. If AI = 100, it indicates that the country's research efforts correspond precisely to the world average. If AI > 100, it reflects that the country's research efforts are higher than the world average and if AI < 100, it indicates that efforts are lower than the world average efforts[9]. However, AI has been calculated in blocks of two years. The formulae used are:

$$\text{AI (India)} = \frac{\text{Indian patents in a particular block/ total patents in that block}}{\text{Total Indian patents/total patents}} \times 100,$$

$$\text{AI (Foreign)} = \frac{\text{Foreign patents in a particular block/ total patents in that block}}{\text{Total foreign patents/total patents}} \times 100.$$

Table 2 indicates that AI for Indian as well as for foreign patents does not follow any systematic pattern during these years.

Country-wise distribution of patents

Data from the country of the applicants were analysed in order to ascertain the countries of the research group active in R&D in agriculture. Data on the number of patents granted to different countries indicate that 113 Indian applicants obtained 288 (64%) patents and the rest 161 (36%) patents were granted to 98 foreign applicants. Applicants

Table 1. Total output of Indian patents in agriculture

Block year	Total no. of granted patents	Total no. of patents in agriculture	Percentage
1995–96	2780	47	1.69
1997–98	4780	100	2.09
1999–2000	3250	91	2.8
2001–02	3820	109	2.85
2003–04	5930	102	1.78
10 yrs	20,560	449	2.18

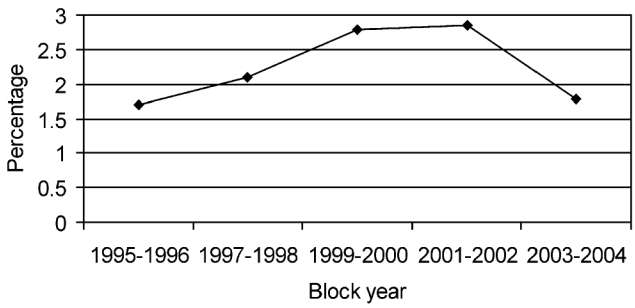

Figure 1. Growth of patenting activity during 1995–2004.

Table 2. Activity index

Block year	Total no. of patents granted to India	Total no. of patents granted to foreign countries	Total no. of patents	Activity index (India)	Activity index (foreign countries)
1995–96	29	18	47	96.20	106.80
1997–98	62	38	100	96.66	105.98
1999–2000	49	42	91	83.95	128.71
2001–02	72	37	109	102.98	94.67
2003–04	76	26	102	116.16	71.09
Total	288	161	449		

Table 3. Distribution based on IPC

IPC class	Class title	Total no. of patents	Total no. of Indian patents
A01B	Soil working in agriculture or forestry agriculture machines or implements	11	11 (3.82%)
A01C	Planting, sowing, fertilizing	15	10 (3.48%)
A01D	Harvesting, mowing	22	14 (4.87%)
A01F	Processing of harvested produce, devices for storing	8	4 (1.39%)
A01G	Horticulture, cultivation, forestry	33	22 (7.63%)
A01H	New plants or processes for obtaining them, plant reproduction	11	8 (2.78%)
A01J	Manufacture of dairy products	9	4 (1.39%)
A01K	Animal husbandry, rearing or breeding animals, new breeds	30	16 (5.55%)
A01M	Catching, trapping apparatus for destruction of noxious animals	12	7 (2.43%)
A01N	Biocides, pest-repellants or attractants, plant growth regulators	298	192 (66.66%)
Total		449	288

from the United States, United Kingdom and Japan are on the top three foreign countries in terms of the number of patents granted in India. Majority of applicants that accounted for total patents granted in India are American Cyanamid Co, USA (17), Zeneca Ltd, UK (11) Sumitomo Chemical Co, Ltd, Japan (6), CSIR (58), United Phosphorous Ltd, (12), Sulphur Ltd, (11), Montari Industries Ltd (7), Rallis India Ltd (7) are the major players. Among foreign countries, USA topped the list with 66 patents followed by UK 23, Japan 21, Australia 9, Germany and Israel, 7 each. The remaining 28 patents were granted to countries such as Brazil, Canada, Denmark, France, Italy, Korea, Luxembourg, Malaysia, Mauritius, Norway, South Africa, Spain, Sweden, Switzerland and USSR. It may be concluded that maximum number of patents was granted to the home country.

USA received patents for cotton harvester; cultivation of fungi; watering arrangements for growing plants; cheese-making apparatus; fast-cooling container for milk; milk protease production; feeder apparatus for birds; device for egg-collection; insect-killing device; preservative composition for animals; pesticidal; herbicidal and fungicidal composition and biocides containing halogenated hydrocarbon, acyclic compounds, organic nitrogen compound or hetrocyclic compounds. Patenting activities in UK were focused on preservative composition for plant; antimicrobial material containing micro-organisms; biocides containing inorganic compounds, organic nitrogen compounds or nitrogen carbon, and devices for storing farm produce. In Japan, the main focus of patenting activity was on preparing bactericide containing inorganic compounds; herbicides; vapour or smoke-emitting composition; biocides containing acyclic compounds or organic nitrogen compounds; mushroom cultivation; container for marine animals; beehive device and device for catching insects.

Further analysis of data indicates that majority of the Indian applicants were individuals (47%), while 41% was industries and the rest R&D institutions. Patenting activity in the ICAR (six patents) was low, while CSIR (58 patents) played a significant role. However, in case of foreign applicants, 82% belonged to industry, 13% individuals and the rest 5% R&D institutions. Like the number of patents, the number of applicants also was highest for USA (33) followed by Japan (13), UK (12), and Australia (8).

Discipline-wise classification of patents in agriculture

Discipline-wise analysis and classification of patents in agriculture according to the total number of patents granted, has been categorized into ten classes of IPC. The subclass number covering medicinal preparation containing materials from plants has been clubbed with subclass biocides and plant growth regulators.

Analysis of data presented in Table 3 indicates that maximum patents have been granted in the field of biocides, plant growth regulators, pest repellants or attractants, while processing of harvested produce and devices for storing

accounted for the minimum. Patenting activities in these IPC classes have been discussed in detail.

In the IPC class A01B (soil working in agriculture or forestry agricultural machines or implements), all the patents (11) were granted to Indian applicants for developing agricultural and gardening tools set, seed-cum-fertilizer drill, human-propelled tiller, ploughing-cum-sowing implement, mattock cultivator, rotary tilling device, shaft-driven timing system for internal combustion engines, improved plough with a mounted adaptor, adaptor for plough and improved process for manufacturing tractor discs.

In the IPC class A01C (planting, sowing and fertilizing), out of 15 patents Indian applicants received 10 for developing portal digital soil salinity tester, air screen cleaner machine, preparing *in situ* compost, machine for cleaning and grading of seeds, preparation of synergistic fertilizer composition from agricultural compost and agricultural waste, groundnut planter, animal-driven agricultural apparatus, manufacturing a slow-release urea fertilizer by nitrification inhibition, sowing device and composition for increasing herbage and essential oil yield in Palmarosa. Switzerland was granted a patent for the process for preparing seeds having prolonged shelf-life, Sweden for surge arrester, Australia for harvesting apparatus, and Norway for improved agricultural composition.

In the IPC class A01D (harvesting and mowing), out of 22 patents 14 were granted to India, while 5 to Australia, one to Germany, Israel and USA respectively, for harvester, harvesting apparatus and harvesting machine. Indian applicants received patents for self-driven crop-orienting two-wheeler and three-wheeler harvester; machine for harvesting sugarcane; trimmer; sugarcane-harvesting knife, harvester for harvesting crops; lawnmower and machine for separating out cotton from cotton pods.

In the IPC class A01F (processing of harvested produce, devices for storing agricultural or horticultural produce), four patents were granted to India for multi-crop thresher, novel container for storing plant products, storage pot and improved process for the preparation of a pseudobactin useful for storing agricultural/horticultural produce; while one patent to Australia for method of making rice straw silage, Brazil for silo for vegetable grains, Germany for cleaning method and UK for liquid composition for preserving farm produce.

In the IPC class A01G (horticulture, cultivation and forestry), out 33 patents 22 were granted to India, 4 to USA, 2 to the Netherlands, and 1 to France, Israel, Italy, Japan and Mauritius respectively. Indian applicants received patents for khurpa for gardening and sowing, automatic device for soil irrigation for shallow rooted agricultural farms/gardens, underground subsoil irrigation, automatic drip irrigation system, improved dripper, tractor for use in horticulture operations, rainguard for a latex yielding tree, implements for gardening and sowing, device for supporting latex collection receptacle, cutting and gripping device, secateur, water candle for automatic watering of plant and apparatus for irrigating plants. Foreign applicants received patents for preparing a substrate for culture of fungi, composition for promoting mycelial growth, medium for mushroom bed cultivation, reservoir container assembly, drip irrigation tape and emitter, irrigator, fluid distributing system and plant protection device.

In the IPC class A01H (new plants or processes for obtaining them, plant reproduction by tissue culture techniques), 8 patents were granted to India, 2 to UK and 1 to Germany. Patents were granted for nutrient medium composition for enhancing shoot sprouting from bamboo species and excised embryo-axis of cotton, transformation of plant/tissue, rhizobial preparation for enhancing nodulation activity and grain yield in legumes, cold extruded composition, and synergistic composition as growth medium for fungi and bacteria.

In the IPC class A01J (manufacture of dairy products), 4 patents were granted to India, 3 to USA and 1 to Italy and USSR respectively. Indian applicants received patents for continuous production of cheese free from aspartic protease, manufacturing paneer; while foreign applicants for the production of immobilized milk-clotting protease, method of preparing milk, producing shredded cheese, no-fat cheese analogue and container for fast cooling used for preservation of milk.

In the IPC class A01K (animal husbandry, silk rearing or breeding animals, new breeds), 30 patents were granted, 16 to India, 5 to USA, 3 patents to Canada, 2 each to Israel and Japan, 1 to South Africa and Spain respectively. Indian applicants received patents for composition to attract *Apis flora*, chick drinker set, device for storing and feeding poultry feeds, dispensing liquid in poultry farming, weighing and testing fat contents of milk, developing fishes in flowing water, killing mosquitoes, a sensor for intrusion detection, plastic beehive box to breed honeybees, degumming of silk with a fungal protease, process for extraction of silk enhancing fraction from aerial parts of the plant *Cassia tora*, preparing extract of *Silene vulgaris* used for enhancing silk yield, feed supplement for silkworm to enhance silk production and improved honey-processing device. Foreign applicants received patents for drinking-water dispenser; water-delivery assembly; feeder apparatus; feeder assembly; poultry feeder; apparatus for incubating eggs and holding eggs and collection of eggs, production of honeycombs for beekeeping; fish hook; container for storing/transporting marine animals and constant temperature box for pollinating insects.

In the IPC class A01M (catching, trapping apparatus for destruction of noxious animals), 12 patents were granted, 7 to India and 3 to USA and 2 to Japan. Indian applicants received patents for bird deterrent device, catching narcotizing or killing insects by electric means using illumination for attracting trapping and killing flying mosquitoes and mosquito/insect-repellent device. Foreign applicants received patent for dispensing device, insect bait station, electronic device and apparatus for controlling pests.

In the IPC class A01N (biocides, pest-repellants or attractants, plant growth regulators), 298 patents were granted,

192 to India, 50 to USA, 21 to UK, 14 to Japan, 4 to Germany, 3 to Israel and Korea, 2 to Australia and France, 1 to Denmark, Luxemburg, Malaysia, South Africa, Spain, Switzerland and USSR respectively. Indian applicants received patents for process and methods of preparing biocide from the roots of *Decalpis hamiltoni*; synergistic insecticide, weedicide, herbicide, bactericide, fungicide, disinfectant, rodent-repellant, pest-repellant, cockroach-repellant composition; water-based stable micro-emulsion formulation of neem oil; herbal insect repellant; formulation useful for insect-free storage of cereals, modulating plant growth and sensescence, composition for preventing post-harvest deterioration of sugarcane and biocide for rapid action in sugarcane juice. USA received patents for preparing pesticidal, herbicidal, fungicidal, weedicidal, anthropodicidal, germicidal, wood preservative composition. UK received patents for preparing disinfectant composition, antimicrobial material, pesticidal compound, composition for enhancing shelf-life, preserving aquatic and farm produce. Japan received patent for preparing insecticidal mat, bactericide, insect-repellant composition and water soluble anti-microbial composition. Rest of the countries received patents for insect-repellant composition, insect-repellant device, synergistic fungicidal mixture, herbicidal, germicidal, disinfecting composition.

Conclusion

The study indicates that average annual output of patents in agriculture is low compared to total annual output of process patents. The analysis revealed that patenting activity does not follow any pattern. Foreign applicants were more active during 2000–01, while Indian applicants during 2002–03. The Patent Act, 1970 does not provide any product protection to agricultural chemicals. However, the Patents (Amendment) Act, 1999 provided Exclusive Marketing Rights (EMR) in agricultural chemicals, which helped foreign multinationals to exclusively market their agricultural chemicals in India for a period of 5 years, subject to the right granted in a convention country and marketing approval in that country on/after 1 January 1995. Major patenting activity was in the field of biocides, pest-repellants or attractants. Foreign countries did not receive any patent in the field of soil working in agriculture, or forestry, agricultural machines or implements, where all the patents were from the home country. Collaborative R&D effort is insignificant (only 4–5 cases). Industries are more active in comparison to the R&D sector. Of the total patents granted to foreign countries, USA holds the first position. In our country, patenting activity at the ICAR is low, while CSIR is the major contributor to Indian patents.

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