# IP Rights in China: Spurring Invention and Driving Innovation in Health and Agriculture

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## ABSTRACT

During its relatively brief history of IP (intellectual property) rights protection, China has achieved early success, thanks to the strengthening of governmental IP rights legislation, the establishment of an IP rights management system, the promotion of public knowledge about IP rights, and increasing opportunities for international exchange and cooperation. IP rights protection in the fields of health and agriculture has increased investment in these sectors, encouraged innovation in health and agricultural science, increased farmers' incomes, and improved the quality of life for Chinese citizens. Dramatic increases in patent applications in China suggest that widespread implementation and greater enforcement of IP rights are stimulating inventive activity, encouraging technology transfer, and driving greater and greater innovation.

## 1. A BRIEF HISTORY OF IP RIGHTS PROTECTION IN CHINA

The China Patent Administration (CPA) was founded in 1980. China joined the World Intellectual Property Organization (WIPO) in March 1980. The first Chinese patent law was passed in March 1984 and became effective on 1 April 1985. China joined the Patent Cooperation Treaty (PCT) in 1994, indicating that China's IP rights legislation was consistent with international standards. China became a member of the World Trade Organization (WTO) in 2002 and pledged to follow the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) while promoting the development of its own IP rights protection system. The CPA was renamed the State Intellectual Property Office (SIPO)[1] in 1998.

China's patent system has developed quickly in the past 20 years. IP rights regulations, management systems, and publicly available information have gradually improved. In 2006, China ranked fifth in the world for the number of patent applications filed.

Chinese IP rights protection covers the following five categories of intellectual property: (1) patents and technological secrets; (2) trademarks and business secrets; (3) software; (4) copyrights; and (5) know-how about technologies, information, instructions, and so on involved in cooperation activities that need to be kept confidential.

## 2. AN OVERVIEW OF PATENT DEVELOPMENT IN CHINA

In 2006, 573,178 patent applications were filed for three kinds of patents (invention, utility-model, and design). This figure was 4.6 times the number of patent applications filed in 1998. Numbers of patent applications increased by an average of 19.4% each year from 1998 to 2006. There was an average annual increase of 23.9%

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for inventions, 14.0% for utility models, and 21.4% for designs.

Between 1985 and 2006, the total number of patent applications was 3,334,374, including 1,089,521 inventions (32.6%), 289,868 utility models (38.7%), and 954,985 designs (28.7%).

The total number of patents granted by the SIPO from 1998 to 2005 was 1,469,502, including 238,717 inventions (16.2%), 730,573 utility models (49.7%), and 500,212 designs (34.1%).

In 2006, 82% of patent applications came from domestic applicants; 18% came from foreign applicants. The number of foreign applications (all of them for inventions) was four times higher in 2006 than it was in 1985. (Table 1)

In the period between 1985 and 2006, 296,507 Chinese patents were awarded. Of these, 37.9% represented domestic applicants and 62.1% represented foreign applicants.

The ten regions with the greatest number of patent applicants are all located in eastern China (Table 2), in areas with strong science and technology bases and stronger economies than average.

## 3. IP RIGHTS IN THE HEALTH SECTOR

There are four ways to protect intellectual property in the Chinese health industry: (1) through "administrative" protection, which is used to protect new and traditional medicine; (2) with patents; (3) as trade secrets; and (4) through laws and regulations, such as trademark protection.

Patents for medicine, veterinary science, and health are represented by the code "A61," according to the international patent classification. Table 3 below shows that the total number of A61 patent applications was 24,875 in 2005, four times the number of patent applications for 1994 (6,227). There is a strong annual growth trend. The total number of patents granted in 2005 was 10,179, or 3.5 times the number granted in 1994.

Ninety-seven percent of domestic applications for A61 patents in the "medical" subsector were for traditional Chinese medicines. Foreign applicants filed 92% of the applications for nontraditional pharmaceuticals; there were few domestic applications for nontraditional pharmaceuticals. Chinese applicants filed nearly half

**Table 1: The Top-Ten Countries in which Foreign Applicants for Chinese Patents Were Based (2006)**

| Country | Number of patent applications filed |
|---|---|
| Japan | 36,221 |
| U.S. | 20,395 |
| Republic of Korea | 9,300 |
| Germany | 7,502 |
| Netherlands | 3,988 |
| France | 3,190 |
| Switzerland | 2,106 |
| Italy | 1,632 |
| U.K. | 1,613 |
| Sweden | 1,101 |

Source: *SIPO Annual Report 2006.*[2]

### Table 2: The Top Ten Chinese Regions in which Patent Applicants Were Based (2006)

| Province/Municipality | Number of patent applications |
|---|---|
| Guangdong | 72,220 |
| Zhejiang | 43,221 |
| Jiangsu | 34,811 |
| Shanghai | 32,741 |
| Shandong | 28,835 |
| Beijing | 22,572 |
| Taiwan | 20,599 |
| Liaoning | 15,672 |
| Tianjin | 11,657 |
| Hubei | 11,534 |

Source: *SIPO Annual Report 2006*.[2]

### Table 3: Patents Granted in Medicine, Veterinary Science, and Health (1994–2005)

| Year | Number of patent applications | Number of patents granted |
|---|---|---|
| 1994 | 6,227 | 2,891 |
| 1995 | 6,177 | 2,517 |
| 1996 | 6,203 | 2,084 |
| 1997 | 7,589 | 2,250 |
| 1998 | 5,720 | 2,554 |
| 1999 | 8,757 | 4,865 |
| 2000 | 9,296 | 5,285 |
| 2001 | 12,509 | 4,781 |
| 2002 | 13,196 | 5,418 |
| 2003 | 16,583 | 6,838 |
| 2004 | 17,448 | 9,094 |
| 2005 | 24,875 | 10,179 |
| Total | 134,580 | 58,756 |

Source: *China Statistics Yearbook 2005*.[4]

(48%) of the patent applications for modern medicines. However, the number of domestic applications for *creative* patents fell well short of the number of foreign applications; this is an area for future improvement.

Overall, the Chinese medical and health sector seems to lack qualified personnel and an IP rights concept. The government needs to promote research and development, capacity building, technical innovation, and the promotion and modernization of industry, in order to increase China's competitiveness in the medical and health sector.

## 4. THE CURRENT STATE OF AGRICULTURAL IP PROTECTION

The Patent Law of the People's Republic of China, passed in 1984, stipulated regulations for IP protection of plant varieties. China entered the International Union for the Protection of New Varieties of Plants (UPOV) in April 1999 as its 39th member. The State Regulation for Protection of Place of Origin and Products was issued in 1995 and the Seed Law was passed in 2000.

To date, China has granted protection for a total of 62 categories and species of crops and 78 species of trees. In the agricultural sector, there are more than 150 kinds of products protected by trademarks, and more than 600 varieties have plant variety protection certificates.

New regulations that protect plant varieties have encouraged investment in agricultural research and development. A survey conducted by the Ministry of Agriculture (MOA) of more than 500 patent applications and patent grants revealed that companies contributed 83% of the money invested in the research and development of new plant varieties; the government contributed only 17%.

These new regulations have promoted agricultural innovation. In the last 40 years, China has successfully cultivated more than 40 new varieties of different crops and more than 6,000 new varieties. One outcome of this innovation is a 30-40% of increase in grain production in recent years.

The regulations mean that plant breeders have begun to receive economic benefits for their work, which in turn has encouraged them to put still more effort into research and innovation, thus benefiting farmers. As a result, farmers' incomes have increased. In addition, the MOA survey mentioned earlier found that nearly 43 million hectares (ha) had been planted with new plant varieties, increasing yields by 56.3 million tons and increasing farmers' profits by US$2,886 million. Another investigation found that the new, protected varieties of paddy rice protected by IP rights could produce an average profit of US$562 per ha in east China's Jiangsu Province; while ordinary varieties of rice produce an average profit of only US$420 per ha, which is US$142, or 13%, less. The investigation also indicated that the new varieties of paddy rice in southwest China's Sichuan Province produced a 37% higher yield than ordinary varieties.

As Table 4 illustrates, the number of agricultural patent applications has steadily increased. There were 6,802 applications filed in 2005, 4.4 times the number of applications filed in 1994. In 2005, the total number of patents granted was 3,157, which was 4.5 times the number granted in 1984.

China is one of the most prolific filers of applications for IP protection of new plant varieties. According to statistics provided by MOA, the number of applications for variety rights protection increased from 115 applications in 1999 to nearly 1,000 in 2006. There were 3,879 variety rights applications filed in the period from 1999 to the end of 2006, and 899 patents were eventually granted. During the same period, foreign applicants filed 144 patents and five patents were granted (see Table 5). Most applications for variety rights are filed for field crops (90.5%); paddy rice accounts for 31.5% and corn accounts for 39.5% (Table 6).

## 5. CASE STUDIES

### 5.1 *Genetically modified cotton*

China has a long history of producing cotton and has been a major cotton-producing country for some time. After China joined the WTO, Monsanto quickly established two subcom-

### Table 4: Chinese Patents in the Agriculture, Forestry, Livestock, and Fisheries Industries (1994–2005)

| Year | Number of applications | Number of patents granted |
|---|---|---|
| 1994 | 1,538 | 693 |
| 1995 | 1,845 | 1,045 |
| 1996 | 2,107 | 904 |
| 1997 | 2,685 | 942 |
| 1998 | 2,581 | 1,266 |
| 1999 | 3,534 | 2,163 |
| 2000 | 3,420 | 2,235 |
| 2001 | 4,027 | 2,068 |
| 2002 | 4,782 | 1,989 |
| 2003 | 4,835 | 2,530 |
| 2004 | 5,856 | 2,758 |
| 2005 | 6,802 | 3,157 |
| **Total** | **44,012** | **21,750** |

Source: *China Statistics Yearbook* 2005.[5]

### Table 5: Number of Total Plant Variety Protection Applications Filed for New Plant Varieties (1999–2006)

| Year | Patent applications |
|---|---|
| 1999 | 115 |
| 2000 | 112 |
| 2001 | 227 |
| 2002 | 290 |
| 2003 | 567 |
| 2004 | 735 |
| 2005 | 950 |
| 2006 | 883 |
| Total | 3,879 |

Source: Ministry of Agriculture.[6]

panies in China and introduced its transgenic pest-resistant (GMPR) cotton. Ninety-six percent of the cotton planted in Hebei Province from 1999 to 2001 was American GMPR cotton. In 1999, 400,000 ha of Chinese soil was planted with American GMPR cotton. In 1999, 65% of the pest-resistant cotton planted was American GMPR cotton; 80% was American GMPR cotton in 2000. Monsanto has since obtained a total of nine biosafety certificates from the MOA: four for corn, one for soybeans, one for oilseeds, and three for cotton.

The Chinese government realized that it was important to protect the pest-resistant cotton varieties developed by Chinese scientists. Less American GMPR cotton is now planted, and there is healthy competition between Chinese and American scientists for the GMPR cotton business. To date, China has protected 55 new varieties of GMPR cotton, which makes up 10% of the total amount of all cultivated cotton. More than 6.7 million ha of Chinese GMPR have been planted, yielding profits of close to US$2 billion.

### 5.2 *Hybrid rice*

Hybrid rice has contributed remarkably to Chinese food security. To date, hybrid rice has been planted on more than 300 million ha of Chinese soil. The current annual yield has been increasing since 1976, and it now feeds 60 million people per year.

**Table 6: Patent Applications and Granted Patents for Plant Varieties (1999–2006)**

| Crops | Number of patent applications | Percentage of total patent applications (%) | Number of patents granted | Percentage of total patents granted (%) |
|---|---|---|---|---|
| Field crops[a] | 3,510 | 90.0 | 831 | 92.5 |
| -Paddy rice | 1,222 | 31.5 | 261 | 29.0 |
| -Corn | 1,531 | 39.5 | 344 | 38.3 |
| -Soybeans | 126 | 3.2 | 34 | 3.8 |
| -Wheat | 357 | 9.2 | 89 | 9.9 |
| | | | | |
| Vegetables | 164 | 4.2 | 34 | 3.8 |
| Flowers | 101 | 2.6 | 13 | 1.4 |
| Fruit | 101 | 2.5 | 21 | 2.3 |
| Grasses | 3 | 0.8 | 0 | 0.0 |
| Total | 3,879 | 100.0 | 899 | 100.0 |

a This list of individual crops is not complete but represents the major crops. Hence, the totals of field crops is higher than the combined total of paddy rice, corn, soybeans, and wheat.

Source: Ministry of Agriculture.[7]

After approval by the Ministry of Agriculture and the State Import & Export Commission, U.S. Western Petroleum's Ring Round Co. paid for the rights of transferring the Hybrid-Rice Technology via the China Seed Corporation in March 1980. It was the first time in China's history that it made such a paid-technology transfer to the outside.

Since the passage of the Regulation for the Protection of New Variety of Plants of the People's Republic of China, a total of 3,879 patent applications have been received for plant varieties; 899 patents have been granted, 280 of them for paddy rice.

The Food and Agriculture Organization of the United Nations has listed Chinese hybrid rice as the most important technology for combating food insecurity in developing countries, especially low-income and food-deficit countries. Vietnam sowed 600,000 ha of hybrid rice in 2003 and achieved a high average yield of 6.3 tons per ha. The country plans to increase the area planted with hybrid rice to one million ha in 2010. India sowed 280,000 ha of hybrid rice in 2003 and 700,000 ha in 2005; the hybrid rice produced a 15–20% higher yield than ordinary rice would have produced. With China's assistance, the Philippines has greatly expanded its hybrid-rice production areas. In the Philippines, 200,000 ha of hybrid rice were planted in 2004 and one million ha will be planted in 2007. In the United States, 20,000 ha of hybrid rice were planted in 2001 and 87,000 ha in 2006. An estimated 30% of all paddy rice planted in the United States in 2007 will be hybrid rice.

The protection of variety rights has encouraged research institutions and private companies to make continuous innovations with regard to hybrid rice. The Hunan Hybrid Rice Research Center developed 36 varieties of hybrid rice in five years (2001–2005), which was 1.5 times the amount developed in the previous ten years (1990–2000).

The protection of new varieties of plants, not only creates direct economic benefits for China, but also helps coordinate the efforts of those working in different areas of the hybrid-rice sector: seed breeding, research, and extension. Sixty-seven million ha of the Pei'ai 64S, the most popular photoperiod- and temperature-sensitive strain, have been planted in China, producing US$10.3 billion, up to year 2004.

### 5.3 *Pharmaceuticals*

According to the Derwent Innovation Index, the United States is ranked first in the world for the production of new pharmaceuticals, with 1,676 patent applications. China is ranked second, with 1,083 patent applications. China is followed by Japan, with 88 applications. Of the ten companies in the world with the greatest number of patent applications, eight of them are American and two of them are Chinese.

The Shanghai Shengyuan Gene Development Co. Ltd. in China is mainly involved in the research and development of human cDNA. It has a strong technical team and is well equipped. It has identified more than 500 gene elements and has submitted 851 patent applications for genes, more than any other company in the world.

### 5.4 *The case of Jiangsu Provincial Academy of Agricultural Sciences*

The Jiangsu Provincial Academy of Agricultural Sciences applied for its first patent in 2000 in order to protect a new variety of double-line hybrid paddy rice named Liangyou-Beijiu. By the end of 2004, the Academy had applied for 32 patents and received 23 grants.

The academy could get a benefit of more than US$2.5 million by transferring a series of new variety rights of new wheat seeds cultivated by the academy to a total area of 4.5 million ha. This would provide great social benefits represented by more than US$1.2 billion in value.

## 6. CONCLUSIONS

Developing countries must protect their IP rights in order to promote domestic innovation, increase resource utilization, improve farmers' income, and promote international cooperation and competition. The following four steps are essential for protecting IP rights: (1) the passing of government legislation; (2) the establishment of a national IP rights-management system; (3)

publicity and promotion of the IP rights concept; and (4) international cooperation.

In general, IP rights protection in developing countries is inferior to that in developed countries. This is because the international IP system may not be fully understood, the legal system may be incomplete, and the human capacity for IP work may be weak. To overcome these obstacles, it is important for developing countries to draw on the experiences of developed countries.

China still lags behind many other countries in IP matters. According to the *WIPO IPRS Report* of 2006, an average of 148 patents were filed for each million people in 2004. Japan filed 2,884 patents per million people; Korea filed 2,189; the United States filed 645; and China filed only 51, putting it in 27th. The global average for patent applications per US$1 billion GDP was 19 applications in 2004. For the Republic of Korea, the number was 116.2 applications; for Japan, 107.3 applications; and for China, only 9.4 applications, putting it in 17th place.

Over the last decade, led by a cadre of world-class scientists and researchers, China's investment in biotechnological R&D has dramatically increased. This has generated remarkable developments and successes, benefiting the people of China in many ways. However, in order to sustain and continue to drive this enormous leap in progress, greater human and institutional capacity in IP law and management will be necessary. Such capacity will serve to further foster and encourage even more inventive activities, innovative initiatives, and the development of the next generation of advances in health and agriculture, for the benefit of all in China. ■

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1 See www.sipo.gov.cn.

2 China Statistics Yearbook. 2006. SIPO Statistics: Beijing.

3 Ibid.

4 China Statistics Yearbook. 2005. SIPO Statistics: Beijing.

5 Ibid.

6 Ministry of Agriculture. Office for the Protection of New Varieties of Plants.

7 Ibid.