



IPDEV Work Package 6:

ASSESSING THE ECONOMIC IMPLICATIONS OF DIFFERENT MODELS FOR IMPLEMENTING THE REQUIREMENT TO PROTECT PLANT VARIETIES

CASE STUDY ON CHINA

Produced with support of the European Commission's
6th Framework Programme for Research as part of the project
“Impacts of the IPR Rules on Sustainable Development”
(IPDEV)

Authors: Muriel Lightbourne
Lois Muraguri

Date: November 2006

Disclaimer: This report does not represent the views of the European Commission, the European Union or of its member states.

CONTENTS

- I. THE STATUS OF AGRICULTURAL RESEARCH
- II. NATIONAL FRAMEWORK FOR RESEARCH
- III. BROAD MODELS FOR IMPLEMENTING ART 27(3)(b)
- IV. ECONOMIC IMPACT OF THE IMPLEMENTATION MODELS
- V. CONCLUSION

I. THE STATUS OF AGRICULTURAL RESEARCH

China has experienced one of the fastest rates of agricultural and overall economic growth. Current estimates show that the economy grew by 10.3 per cent in the January to March 2006 period with agriculture expanding faster than was earlier envisaged.¹

With only about 9 percent of the total global arable area under cultivation² it is commendable that China is not only able to feed its own population estimated at 1.3 billion³ or 21 percent of the earth's total population, but also in total supports close to a quarter of the world's population.⁴ This demonstrates that the agricultural output per unit is high although it is reported that output per worker is low.⁵

China's agriculture is characterised by a varied topography, climatic conditions and ecological zones with distribution of crops being region specific.⁶ The abundant labour in agriculture uses little mechanisation and is mainly on small scale. It is reported that in 2004, the total sown area of grain was 101.61 million hectares with an output of 469.47 million tons; cotton 5.69 million hectares with an output of 6.32 million tons; oil bearing crops 14.52 million hectares with an output of 30.57 million tons; sugar crops 1.57 million hectares and an output of 95.28 million tons while vegetables were grown over 17.67 million hectares.⁷

The agricultural scene in China is dominated by the public sector. The main actors in the public sector are institutes under the national agricultural research system and universities. Agriculture research is also conducted under non-agricultural ministries. In 1999, institutes under the national agriculture research system accounted for 83 percent of all research staff in agriculture. The rest was distributed equally between universities and non-agriculture research institutes.⁸ The estimated number of public sector researchers in agriculture was only 500 in 1998 with the research expenditure of only about 1.7 percent of China's total agricultural research budget.⁹ According to

¹ 'China upgrades growth rate in first quarter' The globe and mail, 24 May 2006, available at <http://www.theglobeandmail.com/servlet/story/LAC.20060524.RTICKERB24-1/TPStory/TPBusiness/Asia/> last accessed 24 May 2006.

² According to the National Bureau of Statistics, the national total land area is approximately 1,300 million hectares. Of this, only approximately 127 million were under cultivation in 2001. see more details at www.allcountries.org/China-statistics last accessed 24 May 2006.

³ 2004 estimate according to the National Bureau of Statistics of China, 'Statistical Communiqué of The People's Republic of China on the 2004 National Economic and Social Development' February 2005 available at http://www.stats.gov.cn/english/newrelease/statisticalreports/t20050228_402231957.htm last accessed 24 May 2006

⁴ Chinese Ministry of Agriculture, 'China: Country Report to the FAO International Technical Conference on Plant Genetic Resources' Beijing, May 1995 available at <http://www.fao.org/ag/aGp/agps/pgrfa/pdf/china.pdf> last accessed 24 May 2006

⁵ OECD, Agricultural Policy Reform in China, *Policy Brief*, October 2005

⁶ China Country Report *supra* note 4

⁷ National Bureau of Statistics (2004) *supra* note 3

⁸ Huang, J., Hu, R. & Rozelle, C. 2004. China's Agricultural Research System and Reforms: Challenges and Implications to the Developing Countries. Centre for Chinese Agricultural Policy Working Paper 04-E5.

⁹ Pray, C. 1998. Private Investment in China. Working Paper, Rutgers University

Pray, the limited private research is attributed to government near monopolies on production and distribution of agricultural inputs, the weakness of intellectual property rights and the restriction on imports of agricultural inputs.¹⁰

Table 1: Output of Major Farm Products, 2004

Item	Output (10,000 tons)	Increase over 2003(%)
Grain	46947	9.0
Summer crops	10104	4.8
Early rice	3208	8.8
Autumn crops	33635	10.3
Oil-bearing crops	3057	8.8
Peanuts	1431	6.6
Rapeseed	1304	14.2
Cotton	632	30.1
Sugar crops	9528	-1.2
Sugarcane	8948	-0.8
Beetroot	580	-6.1
Cured tobacco	214	6.2
Tea	84	8.7
Fruits	15243	5.0
Vegetables	54927	1.7

Source: National Bureau of Statistics of China, 2005

Agriculture research in China is highly decentralised with over 90 percent of research centres and more than 85 percent of research staff found at provincial and prefectural levels. Each province has its own research academy whose budget is drawn from the local authority. There are five main academies at national level with the Chinese Academy of Agriculture Science (CAAS) being the largest in terms of both budget and staff. Agriculture R&D is institute oriented being built around research institutes.¹¹

Table 2: Number of institutes and staff in public agricultural research in China in 1999

	university ^a	others ^b	MARS ^c				Total
			National	Provincial	Prefecture	Subtotal	
Number of institutes	312	104	56	451	712	1,219	1,635
Number of total staff	10,200	12,457	10,706	51,609	46,467	108,782	131,439

¹⁰ Pray, C. 2001. Private Investment in Agricultural Research and International Technology Transfer in Asia. USDA Agricultural Economic Report No. 805, November 2001

¹¹ Paragraph is drawn from Huang, J., Hu, R. & Rozelle, C. *supra* note 8 where more details can be found.

Staff per institute	33	120	191	114	65	89	80
Staff shares(%)	8	9	8	39	35	83	100
			(10) ^d	(47)	(43)	(100)	

^a Under universities, agricultural research staff are those professors or lecturers who have research projects in agriculture related fields; staff members in other columns are the total staff including all professional, support and other staff working in and supported by the institutes

^b Others include those under other institutions other than MARS and universities

^c MARS is the mainstream agricultural research system

^d the numbers in parentheses are the staff shares (%) within MARS

Source: Huang, Hu & Rozelle, 2004

Table 3: Total revenue in public agricultural research in China in 1999

	university	Others ^a	MARS				Total
			National	Provincial	Prefecture	Subtotal	
Revenue per institute (000 yuan)	1532	8548	14768	6146	2640	4495	4187
Revenue per staff (000 yuan)	47	71	77	54	40	50	52
Total revenue (million yuan)	478	889	827	2772	1880	5479	6846
revenue shares(%)	7	13	12	40	27	80	100
			(15)	(51)	(34)	(100) ^b	

^a Others include those under other institutions other than MARS and universities

^b Numbers in parentheses are the staff shares (%) within MARS

Source: Huang, Hu & Rozelle, 2004

Financing in agriculture R&D

As mentioned earlier, agricultural R&D in China is mainly within the public sector. Food security and self sufficiency are paramount in China's national policy. Agricultural financing has undergone fundamental changes in the last two decades. In the 1980s, the government provided all the funding for agricultural research largely on the basis of number of research staff; funding was not linked to the performance of the institute. Research reforms initiated in the mid 1980s saw the funding system gradually change to competitive grants where research institutes were encouraged to pitch for funds from the government and to generate income from the commercial activities. Funding sources from international organisations and foreign agencies through collaborative research was also encouraged. The result is that by the late

1990s, the government's share of funding was down to about 50 percent with about 41 percent of research institutes' budgets being made up from commercial activities.¹² Agricultural research expenditure and intensity.

Table 4: China's agricultural research investment in public research system in 1985 – 1999

Year	At 2004 price (million yuan)		
	Fiscal	Commercial	Total
1985	1015	203	1355
1986	958	200	1346
1987	948	269	1403
1988	1189	366	1782
1989	1400	402	2095
1990	1243	499	2050
1991	1283	655	2381
1992	1442	840	2761
1993	1558	1077	3273
1994	2072	1322	4409
1995	2441	1541	4856
1996	2754	1580	5238
1997	2789	1588	5377
1998	3060	1687	5847
1999	3358	1810	6368
Annual growth rate			
1985-95	8.4	21.8	13.3
1996-99	7.4	3.9	6.5
1985-99	9.6	17.6	12.5

Source: Huang, Hu & Rozelle, 2004

Agriculture research investment intensity i.e. agriculture research as a percentage of GDP, declined between 1985 and 1997 but has been rising since. Investment in agriculture is made up of total government and non-government investment in agriculture; government investment is made by various agencies who allocate funds to national, provincial and prefectural institutes mainly as core funding.

Table 5: Intensity of investment in agricultural research in China, 1985 - 99

Year	Agricultural research

¹² Huang, J., Hu, R. & Rozelle, C. *supra* note 8. See also Fan, S. 'Research Investment and the Economic Returns to Chinese Agricultural Research' *Journal of Productivity Analysis* 14, 163-182 (2000)

	Government fiscal expenditure	Commercial income & others	Total
1985	0.40	0.13	0.53
1986	0.35	0.14	0.49
1987	0.30	0.14	0.44
1988	0.31	0.15	0.47
1989	0.33	0.16	0.50
1990	0.25	0.16	0.41
1991	0.24	0.21	0.45
1992	0.25	0.23	0.48
1993	0.23	0.25	0.48
1994	0.22	0.25	0.47
1995	0.20	0.20	0.40
1996	0.20	0.18	0.38
1997	0.20	0.18	0.38
1998	0.21	0.19	0.40
1999	0.23	0.21	0.44

Source: Huang, Hu & Rozelle, 2004

Between 1985 and 1999, intensity from government investment was highest in 1985 and lowest between 1995 and 1997. In 1999, the total research intensity was 0.44 one of the lowest in the world.¹³ Agriculture research expenditure as a share of the total public R&D expenditure has been stable at about 12% throughout the past four decades. There has however been a steady increase in agriculture research expenditure as a percentage of government spending in agriculture from about 1.5% in the first five year plan (1953 to 1957) to about 8% in the period between 1995 to 1997 while agriculture research expenditure as a percentage of total agriculture GDP increased from 0.12 to 0.32 in the respective periods.¹⁴

Private spending in agriculture R&D has grown rapidly since 1985. However, at US\$16 million in 1995, private investment represented only 3% of the total agriculture research expenditure with an intensity of 0.008 of total agriculture GDP compared to the government's 0.32.¹⁵

From the 1950s and early 1970s, the number of agricultural scientists increased steadily resulting in about 10,000 in 1973. This figure rose to about 60,000 in the period up to 1990 and has more or less stabilised since. This makes the Chinese public

¹³ See Huang, J., Hu, R. & Rozelle, C. *supra* note 8 who compare agriculture research investment in the middle 90s in various countries and ranks China 17 out of the selected 19. The first is the UK with a total investment intensity of 6.09 although this accounted for only 37.8% of the government share in the total. China's research intensity of 0.45 on the other hand, has a government share of 51.1%

¹⁴ Fan, S. (2000) *supra* note 12

¹⁵ Pray, C. and Fuglie, K. Private Investment in Agricultural Research and International Technology Transfer in Asia. USDA Agricultural Economic Report no. 805. November 2001.

sector the biggest in terms of staff than any other agriculture public system worldwide.¹⁶

Plant biotechnology

Research in modern plant biotechnology in China commenced in the mid 1980s.¹⁷ Investment in agriculture biotech has seen a rapid increase both in terms of staff and expenditure; the number of staff working full time on plant biotechnology has tripled in the last two decades from approximately 740 in 1986 to about 2690 in 2003. Expenditure in plant biotech increased from US\$4.2 million in 1986 to US\$56 million in 2003. Public investment accounted for 94 percent of the total plant biotech budget in 1999 with the ratio rising to 98 percent in 2003.¹⁸

Plant biotechnology research in China includes food crops including some that have received little attention elsewhere demonstrating China's concern in attaining food security.¹⁹ Furthermore, the emphasis in plant biotech in China has been on increasing crop yield and preventing pest outbreaks.²⁰

Unlike most of the world where plant biotechnology is largely funded by the private sector, virtually all investment in biotech in China is from the public sector. Government spending in 2003 accounted for 98 percent of the total plant biotech budget.

Huang²¹ compares China's public investment in plant biotech with other major developing countries such as Brazil and India and concludes that China accounts for over half of the developing world's expenditure on plant biotechnology. Most developing countries are estimated to spend only 2 to 5 percent of their public research on biotechnology.²² With China spending 9.2% of the national crop research budget on plant biotechnology in 1999,²³ it effortlessly exceeds the level of spending in other developing countries. In comparison to developed countries however, China's expenditure in biotechnology is relatively small; China nonetheless accounts for 10 percent of global public expenditure in biotechnology.²⁴ This is likely to increase following a government initiative announced in 2001 where the government

¹⁶ This part draws from Fan, S. (2000) *supra* note 12

¹⁷ Huang, J., Rozelle, S., Pray, C. & Wang, Q. Plant Biotechnology in China. *Science*. Vol 295. 25 January 2002.

¹⁸ Huang, J., Hu, R., Pray, C & Rozelle, S. Public Biotechnology in China: Public Investments and Impacts on Farmers. New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep – 1 Oct 2004, Brisbane, Australia.

¹⁹ GM crops in China include potato, rape seed, peanut, tobacco, cabbage, tomato, melon, sweet pepper, chilli, petunia and papaya in addition to cash crops such as cotton, rice, wheat and maize which are the main subjects of biotech research in most of the other parts of the world that conduct plant biotechnology.

²⁰ Huang, J., Rozelle, S., Pray, C. & Wang, Q (2002) *supra* note 17

²¹ Ibid.

²² Byerlee, D. & Fischer, K. Accessing Modern Science: Policy and Institutional Options for Agricultural Biotechnology in Developing Countries. *World Development* Vol. 30. No. 6 pp 931-948. 2002.

²³ Huang, J., Rozelle, S., Pray, C. & Wang, Q (2002) *supra* note 17

²⁴ China's expenditure in biotech is less than 5 percent of the total annual expenditure in developed countries. Ibid.

renewed its commitment to plant biotechnology by raising its plant biotech budget by 400 percent over the following 5 years. Current figures on spending are unavailable to ascertain the success and impact of this initiative. If realised, China's public spending in plant biotechnology would account for almost a third of the total global public spending on biotechnology.²⁵

Private sector companies in China's agriculture research system are almost all foreign with Monsanto and Delta and Pine Land being the major players.²⁶

Table 6: Estimated research staff and annual expenditure on plant biotechnology research in China, 1986-2003

Year	Staff	Research expenditure			US\$ based on 2004 price
		Million yuan at 2004 price	Million yuan at 2000 price	Million US\$ based on 2004 price	
1986	740	14	38	4.2	
1990	1067	40	68	8.3	
1995	1447	88	87	10.5	
2000	2128	322	322	38.9	
2003	2690	462	463	55.9	

²⁵ This part draws from Huang, J., Rozelle, S., Pray, C. & Wang, Q. 2001 Plant Biotechnology in the Developing World: The Case of China. Centre for Chinese Agricultural Policy Working Paper 01-E1.

²⁶ Based on a study conducted in 1998; see Pray, C. Public and Private Collaboration on Plant Biotechnology in China. *AgBioForum* Vol. 2. No. 1 1999

II. NATIONAL FRAMEWORK FOR RESEARCH

Policy reforms affecting agriculture in China

Reforms in Chinese agriculture can be traced back to the 1950s when the government allocated land to peasants who had little or no land of their own. During the first Five-Year Plan (1953 to 1957), the yearly gross output of agriculture saw an increase of 4.5 percent. Between 1958 and 1978, agriculture developed at a much slower pace with the agricultural output value dropping to 2.3 percent annually on average. This might have been due to the commune systems adopted in the rural areas where emphasis was on centralised and unified management. In 1978, the household contract responsibility system (also called the household production responsibility system) was introduced. This linked remuneration to output. This system ensured that virtually all rural households had access to land the result of which was a rise in agricultural production and a drop in rural poverty.²⁷ Further, in 1985, state monopoly in the purchase and marketing of agricultural products was eliminated thereby allowing the market to adjust the supply and demand for agricultural products.²⁸

The current land tenure system is a variation of the household contract responsibility system where village collective *de facto* own the land and lease it to individuals or households for up to 30 years. The latter can use, sub lease, transfer the land but cannot sell it. It has been reported that although this system has benefited rural China in the past, it has shortcomings such as limiting market transactions where land leasing is informal, short term and arbitrary being mostly among relatives and friends.²⁹

Alongside the land tenure reforms, public funding in agriculture also underwent substantial reform from the mid 1980s. The *raison d'être* was to make agricultural research more efficient and responsive to the agricultural needs of the Chinese society. The main reforms resulted in a change of the funding system from one based on number of staff in research institutes to one of competitive grants linked to institutes' performance. The reforms encouraged institutes to commercialise the products of their research and put in place a reward system where compensation of researchers is linked to performance.³⁰

In resonance with the *raison d'être* in the agriculture financing reforms, China has recently reiterated its commitment to increasing efficient agricultural production and eradicating poverty. A recent strategy issued by the State Council identifies agriculture and biotechnology among its top priorities. The strategy will increase annual investment in research and development to 900 billion Yuan by 2020.³¹ Policy reform in tax law to encourage private investment in agriculture R&D and to encourage small and medium companies to invest overseas is to follow in order to

²⁷ OECD(2005) *supra* note 5

²⁸ Most of this part draws from *Agricultural Introduction to China* available at http://www.china-window.com/china_briefing/China-Agriculture/agricultural-introduction.shtml last accessed 05 June 2006

²⁹ OECD(2005) *supra* note 5

³⁰ For further details, see Fan, *supra* note 12

³¹ 'China unveils plans for science-based development' 10 February 2006 available at www.scidev.net last accessed 01 May 2006.

implement the strategy.³² China's commitment to improving private investment is already evinced in the abolishment of the tax on agricultural products that has been in place for about 2000 years. [FIND REF, FAILING – MURPHY & WU]

Legal framework for the protection of Intellectual Property – international and domestic

China is a member of most international treaties relating to intellectual property and agriculture. China has one of the richest bio systems in the world with plant species representing 11 percent of the world's total. Recognising this, and concerned that this rich biodiversity is under continued threat from the high speed of economic development, overpopulation and the attendant problems such as overexploitation of living resources,³³ China signed the Convention on Biological Diversity (CBD) on 11 June 1992 and ratified the same on 5 January 1993 becoming one of the CBD's earliest member states.³⁴

The Food and Agriculture Organisation (FAO), an intergovernmental organisation was established in 1945. Its paramount objective is to achieve food security for all. The International Treaty on Plant Genetic Resources for Food and Agriculture (International Treaty)³⁵ is one of the most important treaties administered by the FAO. Unlike its predecessor the International Undertaking, the International Treaty is a legally binding treaty and covers all plant genetic resources relevant to food and agriculture. It is based on the same principles as the CBD. The International Treaty was adopted by the FAO through Resolution 3 of 2001 in November 2001 and entered into force on 29 June 2004. In spite of China being an active member of FAO,³⁶ China has neither signed nor ratified the FAO International Treaty.³⁷

The International Union for the Protection of New Varieties of Plants (UPOV) was concluded in 1961 and has since been amended three times: 10 November 1972, 23 October 1978 and 19 March 1991 with each version displaying significant changes from the preceding version. UPOV acknowledges plant breeders' achievements by granting them exclusive property rights on the basis of a set of predetermined clearly defined principles. By depositing its instrument of accession to UPOV on 23 March 1999, China adopted UPOV 1978 which entered into force on 23 April 1999.³⁸

China joined the World Intellectual Property Organisation (WIPO) on 3 June 1980. Of the 21 treaties administered by WIPO, China is a party to 11 including UPOV while two other treaties have been signed and are yet to enter into force.³⁹

³² Id

³³ See 'China: Biodiversity Conservation Action Plan' available at www.bpsp-neca.brim.ac.cn/books/acpln_cn/index.html last accessed 18 June 2006

³⁴ See the CBD website www.biodiv.org last accessed 18 June 2006

³⁵ available at www.fao.org last accessed 18 June 2006

³⁶ China is on various committees and is a member of the FAO Council, the executive organ of the FAO Conference.

³⁷ See www.fao.org/Legal/TREATIES/033se.htm for a list of parties to the FAO International Treaty

³⁸ 'China accedes to UPOV' UPOV Press Release No. 36, Geneva 23 March 1999 available at www.upov.int/en/news/pressroom/36.htm last accessed 18 June 2006

³⁹ Eleven of WIPO administered treaties are in force in China: the Berne Convention, Budapest Treaty, Locarno Agreement, Madrid Agreement (Marks), Madrid Protocol, Nice Agreement, Paris Convention,

The road to the World Trade Organisation (WTO) was long and arduous for China taking more than 15 years of protracted negotiations beginning as early as 1982 when the then GATT contracting parties granted China's request to participate as a non-voting observer. Motivated mainly by rational self interest,⁴⁰ China requested for status as a contracting party in 1986. China was obliged to make specific commitments to join GATT/WTO. After more than a decade of negotiations, the US-China bilateral agreement of November 1999 was reached; this was a major breakthrough in China's lengthy effort to join the WTO. The agreement laid out the obligations that China was to assume on accession. China joined the WTO on 11 December 2001.⁴¹

Intellectual property protection was one of the issues in the negotiations building up to China's accession. All WTO members are required to comply with the Agreement on Trade-Related Aspects of Intellectual Property Rights (hereinafter TRIPs) part of their WTO obligations. According to China's Protocol of Accession, China was required to enact legislation to provide adequate IP protection. Numerous revisions were made to IP legislation already enacted while new laws were enacted to cater for IP areas hitherto unaddressed by the legal system.

A synopsis of the national legislation on IP

The ensuing amendments, revisions and enactment of various IP related legislation means that China now has over ten parent statutes regulating all the main categories of intellectual property. Industrial designs and patents are governed by the Patent Law of March 1984 as amended in September 1992 and August 2000. Trademarks are protected under the Trademark Law of August 1982 as amended in February 1993 and October 2001 while copyright and related rights are addressed by the Copyright Law of September 1990 as amended in October 2001. The Implementing Regulations of the Copyright Law were enacted in May 1991 and amended in September 2002. The Regulations on Collective Management were enacted in March 2005. Enforcement of copyright is addressed by the Copyright Administrative Penalty of September 2003.

The 1993 Law Against Unfair Competition governs unfair competition, computer programs are protected under the 1991 Regulations on Computer Software, while integrated circuits are protected under the 2001 Regulations on Protection of Layout Designs of Integrated Circuits. Most importantly to this paper, plant varieties are

PCT, Phonograms Convention, Strasbourg Agreement and the UPOV Convention (1978). Treaties signed but not yet in force are TLT (Trademark Law Treaty) and the Washington Treaty. The complete list with dates of entering into force is available at

http://www.wipo.int/treaties/en>ShowResults.jsp?search_what=C&country_id=38C last accessed 19 June 2006

⁴⁰ See Terrie, W. & Thomas, H. China's Accession to the WTO: Timing is Everything. *The World Economy*, Vol. 24. No. 8, September 2001 pp1019-1049 who recount the changes the Chinese economy has encountered since the 1970s, detailing past negotiations for accession and the effects of the same.

⁴¹ For a detailed chronological account on China's accession, see Bhala, R. Enter the Dragon: An essay on China's WTO Accession Saga. *American University International Law Review*, Vol. 15. No. 16, October 2000.

protected under the Regulation on the Protection of New Plant Varieties enacted in March 1997 which is discussed in greater detail below. Other legislation not specifically on IP but with some provisions indirectly relating to IP includes the 1985 Drug Administration Law which has some provisions on protection of undisclosed information in the marketing of pharmaceutical products.⁴²

⁴² These two paragraphs draw from Moga, T. The TRIPS Agreement and China. *The China Business Review*, November- December 2002; Hailin, Z. & Una, X. The Development of China's IP Laws *Managing Intellectual Property*, February 2004 p19-21; and the China Legislative Profile available at www.wipo.int last accessed 19 June 2006

III. BROAD MODELS FOR IMPLEMENTING ART 27(3)(b)

Implementation options

The TRIPs Agreement in its Article 27 on patentable subject matter requires member states to offer protection vide patents for all inventions in all fields of technology if they meet the criteria; they must be new, must involve an inventive step and must be capable of industrial application.

The same Article however allows members to exclude from patentability plants and animals other than micro-organisms but requires that members provide for the protection of plant varieties in one of three ways: either by patents, by an ‘effective’ *sui generis* system, or by a combination of the two. There has been considerable debate over what constitutes a *sui generis* system and not least what an *effective* one is. *Sui generis* system has not been defined and unlike other subjects under TRIPs, there is no mention of adherence to the pre-existing international convention, UPOV.⁴³ This notwithstanding, a *sui generis* system has generally been understood to mean the UPOV Convention not in the least because UPOV represents the only internationally recognised system of plant variety protection.⁴⁴ Even when *sui generis* system is not read as UPOV, there are arguments that an *effective sui generis* system means that the system would have been in place and likely to be determined and approved of by developed countries.⁴⁵

The 1978 UPOV Convention became effective in China from 23 April 1999. Before then, China already had Regulations on the Protection of New Varieties of Plants⁴⁶ which were promulgated on 20 May 1997, came into effect on 1 October 1997 but were only implemented after UPOV became effective.

Pursuant to Article 3 of the PVP Regulations, the administrative departments of agriculture and forestry are jointly responsible for the receipt, examination and grant of plant variety rights. Implementing Rules for the Regulations on the Protection of New Variety of Plants were promulgated in two parts: Forestry Rules which generally cover forest trees, fruit trees, beverage and condiment plants and woody medicinal materials; and Agriculture Rules under which generally other agricultural plants fall.⁴⁷

⁴³ Watal, *Intellectual Property Rights in the WTO and Developing Countries*, (Kluwer Law International: London, 2001) explaining that the possible reason for this was because at the time of the negotiations, the UPOV 1991 Act was not yet in force, and therefore reference to it would be premature while the UPOV 1978 Act was considered inadequate. Another reason could have been the disparity in opinion among industrialised countries as to the meaning of an ‘effective’ system.

⁴⁴ Mugabe, J., Barber, C., Henne, G., Glowka, L. & La Vina, A., ‘Managing access to genetic resources: National Policy and Legislative Framework’, in Mugabe, J., Barber, C., Henne, G., Glowka, L. & La Vina, A., eds, *Access to Genetic Resources: Strategies for Sharing Benefits*, (ACTS Press: Nairobi, 1997)

⁴⁵ Matthews, D., *Globalising Intellectual Property Rights: the TRIPs Agreement*, (Routledge: New York, 2002)

⁴⁶ hereinafter PVP Regulations, available at

<http://www.upov.int/en/publications/npylaws/china/china.pdf> last accessed 29 June 2006

⁴⁷ See Article 2 and Rule 2 respectively. See for http://www.grain.org/brl_files/china-pvpdecree3-1997-en.pdf Forestry Rules and http://www.grain.org/brl_files/china-pvpdecree13-1999-en.pdf for Agriculture Rules. Both last accessed 29 June 2006

In any case, plant varieties can only be protected if they are in the published list of protected varieties.⁴⁸ This list is determined and published by the approving authorities. The Agriculture Rules are administered by the Office for the Protection of New Varieties of Agricultural Plants under the Ministry of Agriculture while the Forestry Rules are administered by the Office for the Protection of New Varieties of Plants under the State Forestry Administration.⁴⁹

Beside PVP Regulations, plants may also be subject to Patent Law, Law of Seeds and the Implementing Measures for administration of safety in Bio-engineering. Article 25 of the Patent Law states that ‘no patent right shall be granted for animal and plant varieties’ however, processes used in producing animal and plant varieties may be protected under patent law. Regarding PVP, the Patent law may be applied only to the process of producing new plant varieties rather than in the protection of the plant varieties themselves. It would appear that of the three options prescribed under Article 23b of TRIPs, China elected to adopt the *sui generis* option.

Principles of PVP under the PVP Regulations

Article 2 of the PVP Rules defines a new plant variety as one that is cultivated or developed based on a discovered wild plant. Further, this should be new, distinct, uniform and stable with a designated denomination. The PVP Rules define what constitutes the four tier criteria.⁵⁰ Although UPOV 1978 does not define PVP, there is an implicit requirement that discovered varieties should be protected. The PVP Rules conform to this tacit UPOV 1978 requirement.⁵¹

In addition to the novelty, distinctness, uniformity, stability and adequate denomination test, the plant variety to be protected must be in the list of protected varieties.⁵² It is not clear what criteria are used to include plants in the list. The UPOV Convention 1978 requires members to protect a minimum number of plant varieties; it would appear that the use of the lists might be justified under UPOV 1978. In any case, China has published five batches of the lists since 1999⁵³ so that there are now about 120 protectable genera and species.⁵⁴ There are intentions of publishing additional lists in the future.⁵⁵

As mentioned above, the examining and approving authorities are set out in Article 3 as the respective administrative departments in the ministries of Agriculture and Forestry. These are charged with the receipt, examination of applications and the

⁴⁸ Art 13 of the PVP Rules

⁴⁹ Rule 3 and Art 3 of the Agriculture Rules and Forestry Rules respectively

⁵⁰ Articles 14 to 18 under the conditions for the grant of variety rights

⁵¹ Mo, J. Protection of Plant Varieties in China, *Journal of World Intellectual Property* Vol. 4, Issue 6, November 2001

⁵² Art 13

⁵³ ‘Protection of Plants bears Fruits’ *China Daily* 24 January 2005 available at

http://www.chinadaily.com.cn/english/doc/2005-01/24/content_411537.htm last accessed 26 June 2006

⁵⁴ 41 genera and species under the Ministry of Agriculture and 78 under the State Forestry Administration. See ‘The Executive Summary of the UPOV Report on the impact of Plant Variety Protection’ UPOV Publication No. 353(E). December 2005. Available at

http://www.upov.int/en/about/pdf/353_Executive_Summary.pdf last accessed 29 June 2006

⁵⁵ Murphy, M & Wu, K. China’s Plant Variety Protection Explained. *Managing Intellectual Property*. June 2004 Issue 140 pp43-45

grant of PVRs. There are now about 14 DUS testing centres under the Ministry of Agriculture.⁵⁶

The breeder enjoys an exclusive right over the protected variety. No one can, without the consent of the right holder, produce or sell the propagating material of the protected variety or use it repeatedly for commercial purposes, to produce propagating material of another variety.⁵⁷ This right is subject to two exemptions: where the protected variety is exploited for breeding and other scientific research activities or where farmers use the protected variety for propagating on their own holdings, there is no requirement to seek authorisation from or payment of royalties to the right holder.⁵⁸ UPOV 1978 prescribes similar ‘scientific research’ and ‘farmers’ rights’ exceptions.

The transfer or assignment of plant variety rights from a Chinese right holder to a foreigner requires approval by the examining and approving authorities whereas an assignment within China need be approved only when the relevant national regulations so require.⁵⁹ In all assignment cases, a written contract between the parties shall be included in the application for assignment which is in turn published by the examining and approving authorities.

A compulsory license may be granted to exploit new plant varieties in the national or public interest. The right holder and the person granted the compulsory licence agree to a reasonable exploitation fee and where this agreement between the two parties fails, the examining and approving authorities adjudicate. The right holder has recourse to the court system to challenge the outcome of the adjudication.⁶⁰ The term of protection for trees, vines, fruit trees and ornamentals is 20 years while that for all other protectable plants is 15 years.⁶¹

⁵⁶ ‘Plant Variety Rights in China’ available from www.hczl.com/eng/pvr.htm last accessed 29 June 2006

⁵⁷ Article 6 PVP Rules

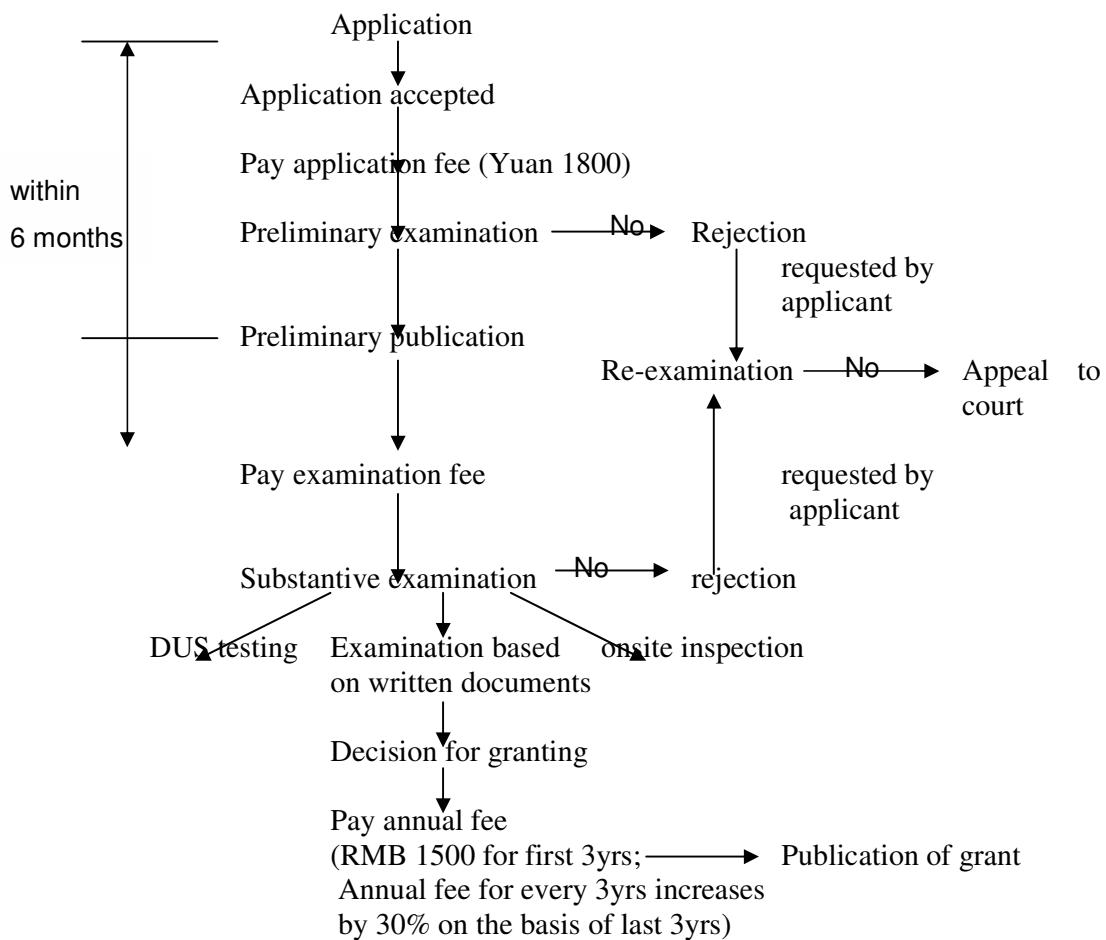
⁵⁸ Article 10 PVP Rules

⁵⁹ Article 9 PVP Rules

⁶⁰ Article 11 PVP Rules

⁶¹ Article 34 PVP Rules

Figure 1: The PVP application and approval process in China



Articles 19 to 26 address the procedure for application of PVRs while articles 27 to 33 account for the examination and approval of PVRs.

The rest of the PVP Rules address the term, termination, invalidity and penalty provisions. The PVP Rules appear to contain combined features of the UPOV 1978 and UPOV 1991 Conventions although China has only ratified the former. The Rules and the Detailed Measures under the two departments are largely consistent with the principles enshrined in the TRIPs agreement.

Quarantine

Quarantine regulations are an important aspect in the process of attaining PVRs particularly for foreign breeders wishing to export a plant variety to China for protection. China has about 15 different laws and regulations on quarantine although only about six are specific to plants.⁶² The 1991 Law on the Entry and Exit Animal

⁶² See <http://www.chinabiodiversity.com/etf/appendix2-en.htm> last accessed 30 June 2006 for a list of all the laws and regulations on quarantine.

and Plant Quarantine⁶³ which entered into force on 1 April 1992 provides the legal basis for the inspection of plants and animals at Chinese exit and entry points. The law establishes the Animal and Plant Quarantine Administration under the State Council who are mandated to carry out quarantine inspections at exit and entry points.

Once allowed in, plant varieties introduced into China for the first time are subject to further strict requirements. Under rules promulgated by the State Forestry Administration, a complete growth cycle of a plant must be seen by the quarantine officers before it is allowed to pass the quarantine process. Therefore, depending on the plant's growth cycle, it could take three years to pass the quarantine process. The safety of plant materials during quarantine is a common concern among foreign breeders.⁶⁴ The foreign breeder therefore has two options in this regard: to first seek PVRs over the imported variety before beginning the quarantine process or to have the two processes run concurrently. Whilst the first option provides comfort of mind to the breeder that whatever happens to his variety during quarantine, he holds the variety rights and no person can seek PVRs over the variety if say, it is smuggled out of quarantine. However, this does not serve as a guarantee that the plant material would be treated any differently during quarantine if PVRs are first sought. Further, the first option would take more time than the latter option. It would seem that for foreign breeders, commencing the PVR registration process and the quarantine process concurrently would be more time efficient.

Enforcement

Generally, IP enforcement in China presents an insuperable challenge evinced by the high level of activity in producing counterfeit goods. China is the world's largest source of counterfeit goods which account for 8 percent of the GDP.⁶⁵ The TRIPs Agreement in article 41.1 requires that member states put in place enforcement measures that "permit effective action against any act of infringement of [IPRs] ... including expeditious remedies to prevent infringements and remedies which constitute deterrent to further infringements..." Article 63.1 further requires member states to be transparent in the protection of IP by publishing laws, regulations and rules as well as judicial decisions.

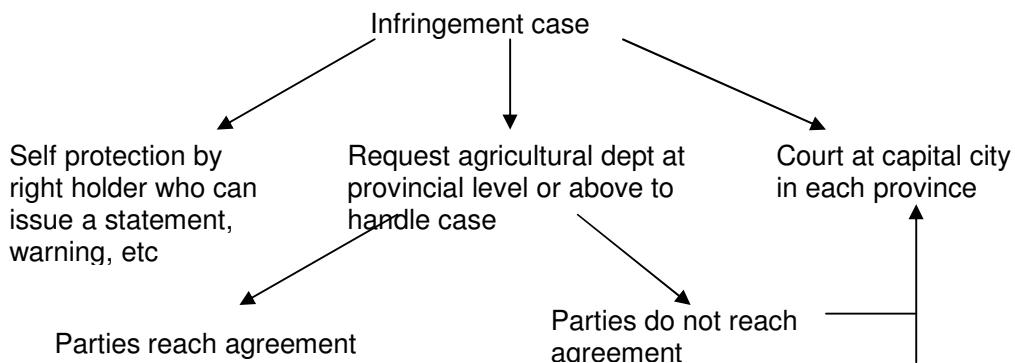
With regard to PVRs, the Regulations on the Protection of New Varieties of Plants (PVP Regulations) lay out the enforcement options and procedures in articles 39 to 44. In case of infringement of PVRs, a right holder has two options: going through the examining and approving authorities i.e. the Ministry of Agriculture and State Forestry Administration or filing a suit in court.

⁶³ Available at <http://chinagate.com.cn/english/2164.htm> last accessed 30 June 2006

⁶⁴ Murphy, M & Wu, K (2004) *supra* note 55

⁶⁵ Moga, T. (2004) *supra* note 42

Figure 2: Options to deal with infringement of PVRs



Counterfeiting cases are handled by administrative departments in agriculture and forestry at county level or above which shall order the counterfeiting to stop, confiscate the earnings and propagating material and issue a fine between one and five times the unlawful earnings. If the case is so serious as to constitute a crime, the counterfeiter may be subjected to criminal liability investigation.⁶⁶ There is no guide as to how to determine the unlawful earnings neither is there a definition as to what constitutes a crime.

China is straddled with enforcement problems. Moga⁶⁷ reports that there is rampant corruption, lack of training for judges and law enforcement officers, local protectionism and inadequate punishment for infringement. Judges also seem unwilling to impose severe penalties.

There have however been recent IP reforms demonstrating China's effort to meet its enforcement requirements. Some of these reforms include the establishment of a chamber of specialised IP courts distributed nationwide.⁶⁸ The ministry of Agriculture has also set up law enforcement pilot regions in 10 agricultural production areas.⁶⁹ In addition, the courts' jurisdiction over IP infringement suits is now well defined and the judicial remedy for losses as a result of infringement is legalised with the relevant laws and regulations prescribing respective penalties including fines.

As a result of the reforms, it is reported that more than 800 PVR violation cases have been investigated with 460 cases ending up in Court.⁷⁰ Local courts are reported to have addressed over 100 cases by April 2006.⁷¹ Some of these include the Sichuan Agricultural University case where in June 2005, the Sichuan court ruled in favour of the university where the latter claimed its rights over a new rice strain which had been violated.⁷² In 2001, the Chinese press reported that Jilin Academy of Agricultural Science successfully sued a group of defendants for unauthorised use of its PVRs.

⁶⁶ Article 40 of the Regulations

⁶⁷ Moga, T. (2004) *supra* note 42

⁶⁸ Ibid.

⁶⁹ 'Protection of Plants Bears Fruit' *supra* note 53

⁷⁰ 'China Steps up Efforts to Protect New Plant Varieties' *People's Daily Online* April 24, 2006 available at http://english.peopledaily.com.cn/200604/24/eng20060424_260677.html last accessed 27 June 2006

⁷¹ 'Protection of Plants Bears Fruit' *supra* note 53

⁷² Ibid.

Similarly, the plaintiff in Denghai Seeds Co Ltd v Agricultural Science Research Institution Co Ltd of Shandong Province was awarded compensation for PVR infringement by the defendant.⁷³

With regard to transparency, the Chinese Intellectual Property Office launched a new website in English⁷⁴. The website has links to various laws on IP in China. There have also been judicial decisions that have sought to clarify rules and terminology with a direct impact on IP. Judgments are still however hard to find and although the IP website has made research on IP somewhat easier, there is still room for improvement.

⁷³ Murphy, M & Wu, K (2004) *supra* note 55

⁷⁴ http://www.sipo.gov.cn/sipo_English/default.htm last accessed 03 July 2006

IV. ECONOMIC IMPACT OF THE IMPLEMENTATION MODELS

The Chinese seed market

In 2000, the land area dedicated to agricultural plantations amounted to 156 million hectares, of which 108 million ha were sown to food crops, 15 million ha to vegetables and fruits, and the rest to rapeseed and other oil crops, cotton, tea, etc.⁷⁵

China is a major producer of seeds; however, it still occupies an intermediate position in the international seed trade. This can be explained by the size of domestic demand (table 8) These figures reveal that China has been gradually focusing on horticultural crops (which sell at much higher prices than food crops, and are widely exported, especially to Japan⁷⁶), in particular vegetables. They also show that China has become a net importer of seeds.

Table 7: Estimated size of the domestic market for seed (US\$ million):

Ranking	Country	Size
1	USA	5,700
2	China	3,000
3	Japan	2,500
4	France	1,930
8	Argentina	930
18	United Kingdom	257
45	Kenya ⁷⁷	50

Source: ISF 2004

⁷⁵ Koo, B., Parday, P., Qian, K. and Zhang, Y. *The Economics of Generating and Maintaining Plant Variety Rights in China*, International Food Policy Research Institute, University of Minnesota and Chinese Academy of Agricultural Science (CAAS), February 2003

⁷⁶ China surpassed the United States as the leading fresh vegetable exporter to China in 1996, according to Huang, S. and Gale, F. *China's Rising Profile in the Global Market for Fruits and Vegetables*, in *Amber Waves* April 2006, available at <http://www.ers.usda.gov/AmberWaves/April06/DataFeature/> last accessed 20 April 2006

⁷⁷ Kenya appears in this table as horticulture has been developing very fast in this country in the past few years.

Table 8: seed exports and imports, 2004

Country	Seed Exports (US\$ million)				Seed Imports (US\$ million)			
	Agri.	Hort.	Total	Rank	Agri.	Hort.	Total	Rank
USA	598	298	896	1	335	105	440	1
Netherlands	165	672	837	2	157	192	349	4
France	521	186	707	3	318	120	438	2
Japan	25	71	96	10	64	49	113	10
China	22	28	50	16	52	37	89	12
UK	38	6	44	17	85	14	99	11
Argentina	39	3	42	18	34	10	44	25
Kenya	5		5	41	7	4	11	59

Source: ISF 2004

The shift from food crops to vegetables makes sense when one considers the relative average seed prices.

Table 9: average seed price per crop

Crop	Average seed price (yuan/kg)
Non-hybrid maize	2
Hybrid maize	6
Non-hybrid rice	2.5
Hybrid rice	8
Wheat	2
Soybean	3
Chinese cabbage	120
Tomato	800
Watermelon	1000

Source: IFPRI (2003)

The Chinese authorities have recently adopted a series of measures aimed at supporting the grain sector, totalling US\$ 41 billion per year over the period 2000-2003, and amounting to 3.3% of China's GDP in this period⁷⁸. The government eliminated taxes on growers, valued at US\$ 5 billion to US\$ 7 billion. It also granted farmers US\$ 18 billion in projects to improve irrigation, US\$ 5 million subsidies in farm machinery, US\$ 1.4 billion in direct subsidies to rice, wheat, maize and other grain farmers, and introduced a minimum purchase price for early crop rice in 2004, at the level of RMB 1,400 per metric ton. Thus, the early crop rice output rose by nearly 9% in 2004 compared to 2003⁷⁹ to 32 million tons, with a total rice output of 470 millions for that year. However, the demand, estimated at more than 490 million

⁷⁸ OECD (2005) *supra* note 5

⁷⁹ The rice year in China runs from June to May.

tons, outstripped domestic supply. Prior to 2004, China had been a net exporter of grains for seven years⁸⁰

Market organisation

Fertilisers

As a result of decades of voluntary policy, the Chinese production of fertilisers jumped from 12 million tons (nutrient weight) in 1980 to 36 million tons in 2002. In 1996, China overtook the United States as the world's largest producer of chemical fertilisers. However, increases in consumption were higher than increases in production. Since 2002, China has been consuming 25% of the annual global supply of chemical fertilisers.⁸¹ China's use of fertilisers is one of the highest in the world (after that of Japan), at 280 kg per hectare, and compares with the levels of the most highly intensive industrial farming in Western Europe.⁸² Overuse of chemical fertilisers - with the share of organic ones falling from 60% of total fertilisers used in 1980 to 46% in 1995 - combined with large-scale mono-cropping have resulted in soil erosion, water pollution and higher vulnerability of crops to pest damages. The proportion of soils with good inherent fertility has decreased from 33% in 1980 to 20% in 1995.⁸³

Pesticides

Pesticides are rather cheap in China, and hence applied in high doses. The average spraying rates of pesticides are two to three times higher than the recommended dosages although commonly used pesticides are highly toxic organophosphate ones.⁸⁴ The inappropriate use of pesticides can create pest resistance in the target pest populations, such as cotton bollworm ones. It also constitutes a serious human health hazard for farmers.

Seed distribution

According to IFPRI, the common practice in China is for research institutes or seed development firms to outsource the multiplication of seeds to state-owned seed companies, which in turn contract with individual growers to produce commercial quantities of seeds. Thus, owing to the risks of production of higher quantities by farmers, research institutes and seed development firms are keen on resorting to plant variety protection certificates.⁸⁵ After being multiplied, seeds are distributed to farmers mainly by research institutes, state-owned seed companies, extension agents

⁸⁰ See *Oryza Market Report – China*, February-April 2005 available at <http://www.oryza.com/asia/china/index.shtml> last accessed 23 June 2006

⁸¹ Williams, J. 'Understanding the Overuse of Chemical Fertilizer in China: A synthesis of historic trends, recent studies, and field experiences.' P.R.E.M.I.U.M. Research, National Science Foundation and Michigan State University. July 2005

⁸² See OECD (2005) at 5, and FAO. 'Sustainable Agriculture and Rural Development in China, Part 1: The Agro-Ecosystem and China's Rural Economy', July 1997. Available at <http://www.fao.org/sd/EPdirect/EPan0009.htm> last accessed 29 June 2006

⁸³ Williams, J. (2005) *supra* note 81

⁸⁴ Ibid.

⁸⁵ Koo, B., Parday, P., Qian, K. and Zhang, Y. (2003) *supra* note 75.

and small traders.⁸⁶ The average farm size is only of 0.65 hectare in average, planted to several crops.⁸⁷ Pursuant to the rural reforms launched in the beginning of the 1980s, “the clientele of the extension service shifted from a relatively small number of communes, brigades, and production teams, to millions of individual rural households.”⁸⁸ Extension services are being criticised for not encouraging farmers to adopt resource-friendly practices, and for potential conflicts of interest in their sales of agrochemicals. Generally, farmers make contractual arrangements with extension services by which they borrow inputs against their harvest. Farmers can also enter into one-year contracts with companies responsible for the procurement and distribution of farm products that “have no inherent incentive to invest in long-term sustainability.”⁸⁹

The Seed Law

According to the World Bank⁹⁰, agriculture plays a major role in the Chinese economy, by employing an estimated 200 million families. Less than 15% of the total land area is arable, leading to very intensive farming practices in terms of labour and inputs (in particular fertilisers).

The World Bank had launched in 1990 a programme aimed at introducing modern methods and equipment for producing and handling seeds. Another project run between 1996 and 2003 was concerned with the restructuring of state enterprises, the availability of credit and the use of inputs such as improved varieties.

This later project also involved the drafting of a draft seed sector policy, which was not approved as such by the Chinese government. Thus, the adoption of the Seed Law and of the Regulations on the protection of new varieties of plants was delayed compared to the initial schedule set forth by the World Bank⁹¹.

In one of the first articles of the Seed Law consists in a declaration that the “State supports the protection of seed resources, and the breeding, production, and dissemination of quality seeds.”⁹² This law asserts the State sovereignty over seed resources, whether improved or found in the wild; thus, collection or falling (of trees) are prohibited, unless such activities are carried out for scientific research and provided the approval of the State Council or of local authorities has been obtained.⁹³

⁸⁶ OECD (2005) *supra* note 5

⁸⁷ Ibid

⁸⁸ Williams, J. (2003) *supra* note 81

⁸⁹ Ibid.

⁹⁰ See World Bank *China: Seed Sector Commercialization Project*, available at <http://lnweb18.worldbank.org/EAP/eaprural.nsf/40ByDocName/ChinaSeedSectorCommercializationProject>, last accessed 14 March 2006.

⁹¹ The Internet page mentioned in the previous footnote states that “[t]his action delayed *our* enacting the seed law and the legal framework for plant variety protection” (emphasis added), which is a surprising language.

⁹² Art. 4.

⁹³ Articles 8 and 10. Two articles of the Chinese Constitution, promulgated on 4 December 1982, are worth mentioning here (see <http://english.peopledaily.com.cn/constitution/constitution.html>, last accessed 22 March 2006):

Art 9:Mineral resources, waters, forests, mountains, grasslands, un-reclaimed land, beaches and other natural resources are owned by the State, that is, by the whole people, with the exception of the forests, mountains, grasslands, un-reclaimed land, and beaches that are owned by collectives in accordance

However, the “National People’s Congress encourages and supports entities and individuals to breed and develop quality seeds.”⁹⁴ The Seed Law contemplates the establishment of a reserve seed system to meet demand in the event of calamity.

Seed quality control

The State is deemed to regularly release the catalogue of available varieties. Varieties are defined as “a plant grouping that has been identified, selected, cultivated, and improved by human intervention, whose shape and biological characteristics are uniform, and whose genetic characteristics are relatively stable.” The terms of “main crops refer to rice, wheat, maize, cotton and soybean.”⁹⁵ The approval of seed release after safety examination may be obtained from the national or provincial governments. Article 14 provides for special rules for the safety assessment of genetically-modified seeds. Where the applicant is not satisfied with the decision regarding the approval of a particular crop variety, he or she may ask for a second examination by the Examination and Approval Committee of the national or provincial departments of agriculture and forestry.

Licenses

The government grants two types of licenses: seed production licenses and seed processing licenses. Applicants must show that they fulfil the following requirements:

- cultivation conditions required for seed propagation,
- possession of a site for seed production free of diseases or pests,
- possession of enough capital and facilities to produce and test the seed,
- employment of professional technicians to produce and test the seed.

Additionally, where an applicant seeks a seed production license for seeds that are protected by plant breeders’ rights, consent in writing must be obtained from the right holder.⁹⁶ Seed production licenses are not transferable.⁹⁷

Seed processing licenses are granted by the same authorities as those granting seed production licenses, upon showing that the applicant has:

- the capital necessary to trade in the seed quantities specified for the species considered,

with the law. The State ensures the rational use of natural resources and protects rare animals and plants (...) The Constitutional amendment adopted on 14 March 2004 and introduced under Art. 13(1) reads as follows: “Legally obtained private property of citizens shall not be violated.” Additionally, a Draft Property Rights Law was issued for public consultation in July 2005, and expected to be enacted in March 2006. This Bill does not modify the land use right, i.e. the right to use, sub-lease and transfer (but not sell) an immovable property owned by village collectives, and receive the income arising therefrom, through a 30-year lease contract. After reaffirming that public ownership is the main form of ownership in China, this draft law devolves some ownership rights to private persons, which include citizens, foreigners, persons without nationality, enterprises owned by a single person, and foreign companies – see *China: The proposed PRC Property Rights Law*, posted on 12 September 2005 on www.hg.org, last accessed 20 April 2006.

⁹⁴ Art. 11 para. 2.

⁹⁵ Art. 74 (2) and (3).

⁹⁶ Art. 21.

⁹⁷ Art. 22 para. 2.

- the personnel qualified to identify the seed, check the seed quality, and store and maintain the seed,
- a site that is consistent with the variety and quantity of seed to be processed, the facilities to process, pack and store the seed, and the equipment to carry out seed quality controls.⁹⁸

Labels must be affixed on seed bags that indicate the seed variety, name, place of production, quality index, quarantine certificate number, licenses numbers or reference of import approval. Imported seed bags must be labelled in Chinese and show the applying quarantine certificate.⁹⁹ In case of repackaging, the entity that undertakes this activity should be clearly identified on the seed bags and held responsible for the seed quality¹⁰⁰

Where a seed user incurs loss due to poor seed quality, he/she is entitled to compensation by the seed supplier amounting to the seed price and the loss of profit. The seed processor can in turn ask for compensation from the seed producer or other seed processors where applicable.¹⁰¹ The parties to a dispute regarding seed use may seek intermediation, resort to arbitration or directly go to the People's Court.¹⁰²

In situations of emergency, where the crop seeds to be used are of lower quality than the standards set out by the national or local government, their use must be approved by the people's government above county level.¹⁰³

Importation and exportation of seeds

Any entity engaging in seed import or export operations used to have to obtain a seed import-export permit in pursuance of the law on foreign trade until the latter was modified with effect as of 1 July 2004, in addition to the seed processing license. An entity importing seed in order to produce seed to be re-exported to foreign countries was not bound by the latter obligation, provided such seed was not sold in China.¹⁰⁴ The 2004 revision of the Foreign Trade Law authorised for the first time individuals to conduct foreign trade, and lifted the requirement for administrative approval of operators engaging in foreign trade. Foreign Trade dealers shall simply have fulfilled the industrial and commercial registration required from any operator.¹⁰⁵

⁹⁸ Art. 29.

⁹⁹ Articles 35 and 38.

¹⁰⁰ Art. 34.

¹⁰¹ Art. 41.

¹⁰² Art. 42.

¹⁰³ Art. 47. There are three administrative levels according to the Chinese Constitution: the province level (which comprises 22 provinces, 5 regions, 4 municipalities and 2 special administrative regions), the county level (which includes districts, cities...) and township level. In practice, there is an intermediary level between the province and the county ones, i.e. the prefecture level, mainly for the two autonomous regions of Xinjiang and Tibet.

¹⁰⁴ Articles 50 and 52.

¹⁰⁵ Interestingly, the new Foreign Trade Law includes provisions dealing with intellectual property and competition (under chapters 5 and 6). This law in particular prohibits coercive package licensing and exclusive grant-back provisions in licensing contracts. It maintains the provision, under Art. 16, regarding restrictions and prohibitions of import or export of goods and technologies "in order to protect human health or security, animal and plant life or health, or the environment" that was already to be found in the previous version of the law of 1994.

Liabilities

The Seed Law provides that where an entity or individual produces or processes low quality seeds, the administrative departments in agriculture and forestry or other administrative management organisations of industry and commerce shall order them to stop their activities, revoke the seed production license, seed processing license or business license, and confiscate the seeds and profits derived thereof. Where a profit is effectively derived from such activities, a fine of 5 to 10 times this amount shall be imposed. Where no profit is generated, a fine of 2,000 to 50,000 yuan shall be imposed.¹⁰⁶ These figures, expressed in terms of purchasing power parity, are equivalent to US\$ 1,111 and US\$ 27,778.¹⁰⁷

Where an entity or individual counterfeits, buys or leases a seed production or seed processing license, or cannot produce according to the stipulations of the seed production or seed processing license, the seeds and profits derived thereof shall be confiscated, a fine of up to 3 times the amount of these profits, or comprised between 1,000 and 30,000 yuan, shall be imposed, and the license revoked.

Where seeds to be produced for export to foreign countries are sold in China, a fine of up to 3 times the amount of the profits derived from the seed sale, or comprised between 1,000 and 20,000 yuan, shall be imposed and the seed production or seed processing license, revoked. All the above-mentioned acts may incur criminal liability¹⁰⁸

Where the processed seeds are not packed, or there is no label affixed to the seed bags, or the content of the label is not consistent with the requirement of the Seed Law, or the test data shown on the label are counterfeited, the amount of the fine shall be comprised between 1,000 and 10,000 yuan.¹⁰⁹

Some indicators of innovation – statistics on new varieties released

The total number of plant variety rights in force at the end of 2004 amounted to 584, just five years after the entry into force of the law¹¹⁰. As of 10 August 2005, 2,518 applications had been received by the Ministry of Agriculture.¹¹¹ Table 10 shows the progression.

¹⁰⁶ Art. 59.

¹⁰⁷ In 2002, the official exchange rate between Renminbi yuan and US\$ was of 8.28 RNB for US\$ 1, and the ppp rate was of 1.8. See http://siteresources.worldbank.org/ICPINT/Resources/Table5_7.pdf, last accessed 13 March 2006. In pieces of legislation, only the word “yuan” is used in general.

¹⁰⁸ especially severe and already old instance, in *Re Pan Xingwu*, decided by the Supreme Court of Guangxi Province in 1993, see Mo, J. (2001) *supra* note 51. The defendant bought 200 kg of stale seeds and resold them to more than 4,500 customers, who all suffered losses after sowing these sterile seeds. Given a life sentence by the Appeal Court of Liuzhou Region, Pan Xingwu appealed to the Provincial Supreme Court of Guangxi to see his sentence commuted to a ten-year imprisonment.

¹⁰⁹ Articles 60 to 62.

¹¹⁰ To be compared with 5,526 titles in force in Japan in 2004. See UPOV Statistics dated 25 October 2005 available at http://www.upov.int/en/documents/c/39/c_39_07.pdf, last accessed 30 March 2006.

¹¹¹ See WTO Doc. WT/TPR/S/161, January 2006 available at www.wto.org last accessed 5 April 2006

Whereas in 1999, one-fifth only of the domestic applicants were individuals or companies, their share has risen to 40% in 2004.¹¹²

Table 10: PVP applications and grants 2000-2004

Years	Applications		Granted titles	
	Residents	Non-Residents	Residents	Non-Residents
2000	118	5	57	5
2001	229	8	56	0
2002	299	8	128	0
2003	579	37	241	0
2004	733	37	87	4

Source: UPOV Plant Variety Statistics (2005)

Table 11: Share of PVP applications by plant (%) 2002

Plant	Applications (in %)
Maize	61
Rice	21
Wheat	4
Soybean	3
Others	11

Source: IFPRI 2003

The IFPRI study outlines the fact that most of the applications are concerned with hybrids, rather than open-pollinated maize and rice varieties, whereas “[a]mong the more than 190 crops for which PVP protection was sought during the past 30 years in the United States, open pollinated crops accounted for the lion’s share of applications.”¹¹³ The same study estimates that 82% of the PVP applications in China are filed by public agencies. Among the 10 main applicants that account altogether for more than 40% of total applications, the Jilin Academy of Agricultural Science ranks first (with 13% of total applications, 16% of those directed to maize, and 65% of those for soybean). The Sichuan AAS ranks fourth in terms of number of applications, but first for those on rice (13% of applications for rice). The first two private operators, namely Chengde Greatwall Seed Ltd. And Shandong Denghai Seed Ltd., respectively 5th and 8th in terms of number of applications, specialise in maize production.¹¹⁴

¹¹² ‘Protection of Plants Bears Fruit’ *supra* note 53

¹¹³ Koo, B., Pardey, P., Qian, K. and Zhang, Y. (2003) *supra* note 75

¹¹⁴ This whole paragraph draws from IFPRI (2003)

V. CONCLUSION

China presents an interesting and ambivalent profile, having both a traditional agricultural sector, made up of numerous tiny land plots, and a particularly advanced biotechnology sector. Agricultural research is still largely run by the public sector. In the past decade, China has adopted and enacted legislation and regulations some of which were in order to conform to the WTO requirements and the Convention on Biological Diversity and its Cartagena Protocol on Biosafety. However, land reform remains incomplete, and China still is still straddled by important concerns such as water management, soil erosion and desertification. Accordingly, the size of the arid and semi-arid area has more than doubled since the 1950s.¹¹⁵ Although there has been a significant improvement in agricultural production, the overall sustainability of Chinese agriculture is at stake.

¹¹⁵ FAO (1997) *supra* note 82

REFERENCES

ARTICLES AND BOOKS

- Bhala, R. Enter the Dragon: An essay on China's WTO Accession Saga. *American University International Law Review*, Vol. 15. No. 16, October 2000.
- Byerlee, D. & Fischer, K. Accessing Modern Science: Policy and Institutional Options for Agricultural Biotechnology in Developing Countries. *World Development* Vol. 30. No. 6 pp 931-948. 2002
- Fan, S. 'Research Investment and the Economic Returns to Chinese Agricultural Research' *Journal of Productivity Analysis* 14, 163-182 (2000)
- Hailin, Z. & Una, X. The Development of China's IP Laws *Managing Intellectual Property*, February 2004 p19-21
- Huang, J., Hu, R. & Rozelle, C. 2004. China's Agricultural Research System and Reforms: Challenges and Implications to the Developing Countries. Centre for Chinese Agricultural Policy Working Paper 04-E5.
- Huang, J., Hu, R., Pray, C & Rozelle, S. Public Biotechnology in China: Public Investments and Impacts on Farmers. New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep – 1 Oct 2004, Brisbane, Australia.
- Huang, J., Rozelle, S., Pray, C. & Wang, Q. 2001 Plant Biotechnology in the Developing World: The Case of China. Centre for Chinese Agricultural Policy Working Paper 01-E1.
- Huang, J., Rozelle, S., Pray, C. & Wang, Q. Plant Biotechnology in China. *Science*. Vol 295. 25 January 2002.
- Koo, B., Pardey, P., Qian, K. and Zhang, Y. *The Economics of Generating and Maintaining Plant Variety Rights in China*, International Food Policy Research Institute, University of Minnesota and Chinese Academy of Agricultural Science (CAAS), February 2003
- Matthews, D., *Globalising Intellectual Property Rights: the TRIPs Agreement*, (Routledge: New York, 2002)
- Mo, J. Protection of Plant Varieties in China, *Journal of World Intellectual Property* Vol. 4, Issue 6, November 2001
- Moga, T. The TRIPS Agreement and China. *The China Business Review*, November-December 2002
- Murphy, M & Wu, K. China's Plant Variety Protection Explained. *Managing Intellectual Property*. June 2004 Issue 140
- OECD, Agricultural Policy Reform in China, *Policy Brief*, October 2005
- Pray, C. 1998. Private Investment in China. Working Paper, Rutgers University
- Pray, C. 2001. Private Investment in Agricultural Research and International Technology Transfer in Asia. USDA Agricultural Economic Report No. 805, November 2001

Pray, C. and Fuglie, K. Private Investment in Agricultural Research and International Technology Transfer in Asia. USDA Agricultural Economic Report no. 805. November 2001.

Pray, C. Public and Private Collaboration on Plant Biotechnology in China.
AgBioForum Vol. 2. No. 1 1999

S Terrie, W. & Thomas, H. China's Accession to the WTO: Timing is Everything.
The World Economy, Vol. 24. No. 8, September 2001

Watal, *Intellectual Property Rights in the WTO and Developing Countries*, (Kluwer Law International: London, 2001) Mugabe, J., Barber, C., Henne, G., Glowka, L. & La Vina, A., 'Managing access to genetic resources: National Policy and Legislative Framework', in Mugabe, J., Barber, C., Henne, G., Glowka, L. & La Vina, A., eds, *Access to Genetic Resources: Strategies for Sharing Benefits*, (ACTS Press: Nairobi, 1997)

Williams, J. 'Understanding the Overuse of Chemical Fertilizer in China: A synthesis of historic trends, recent studies, and field experiences.' P.R.E.M.I.U.M. Research, National Science Foundation and Michigan State University. July 2005

WEB SOURCES

'China accedes to UPOV' UPOV Press Release No. 36, Geneva 23 March 1999
available at www.upov.int/en/news/pressroom/36.htm last accessed 18 June 2006

'China Steps up Efforts to Protect New Plant Varieties' *People's Daily Online* April 24, 2006 available at
http://english.peopledaily.com.cn/200604/24/eng20060424_260677.html last accessed 27 June 2006

'China unveils plans for science-based development' 10 February 2006 available at
www.scidev.net last accessed 01 May 2006.

'China upgrades growth rate in first quarter' The globe and mail, 24 May 2006,
available at
<http://www.theglobeandmail.com/servlet/story/LAC.20060524.RTICKERB24-1/TPStory/TPBusiness/Asia/> last accessed 24 May 2006.

'China: Biodiversity Conservation Action Plan' available at www.bpsp-neca.brim.ac.cn/books/acpln_cn/index.html last accessed 18 June 2006

'China: The proposed PRC Property Rights Law' 12 September 2005 available at
www.hg.org, last accessed 20 April 2006.

'Plant Variety Rights in China' available from www.hczl.com/eng/pvr.htm last accessed 29 June 2006

'Protection of Plants bears Fruits' *China Daily* 24 January 2005 available at
http://www.chinadaily.com.cn/english/doc/2005-01/24/content_411537.htm last accessed 26 June 2006

Agricultural Introduction to China available at http://www.china-window.com/china_briefing/China-Agriculture/agricultural-introduction.shtml
last accessed 05 June 2006

- CBD website www.biodiv.org last accessed 18 June 2006
- China Agriculture Rules available at http://www.grain.org/brl_files/china-pvpdecree13-1999-en.pdf last accessed 29 June 2006
- China Forestry Rules available at http://www.grain.org/brl_files/china-pvpdecree3-1997-en.pdf last accessed 29 June 2006
- China, Regulations on the Protection of New Varieties of Plants available at <http://www.upov.int/en/publications/npylaws/china/china.pdf> last accessed 29 June 2006
- Chinese Intellectual Property Website
http://www.sipo.gov.cn/sipo_English/default.htm last accessed 03 July 2006
- Chinese Ministry of Agriculture, ‘China: Country Report to the FAO International Technical Conference on Plant Genetic Resources’ Beijing, May 1995 available at <http://www.fao.org/ag/agps/pgrfa/pdf/china.pdf> last accessed 24 May 2006
- FAO website www.fao.org last accessed 18 June 2006
- FAO. ‘Sustainable Agriculture and Rural Development in China, Part 1: The Agro-Ecosystem and China’s Rural Economy’, July 1997. Available at <http://www.fao.org/sd/EPdirect/EPan0009.htm> last accessed 29 June 2006
- Huang, S. and Gale, F. *China’s Rising Profile in the Global Market for Fruits and Vegetables*, in *Amber Waves* April 2006, available at <http://www.ers.usda.gov/AmberWaves/April06/DataFeature/> last accessed 20 April 2006
- National Bureau of Statistics of China, ‘Statistical Communiqué of The People’s Republic of China on the 2004 National Economic and Social Development’ February 2005 available at http://www.stats.gov.cn/english/newrelease/statisticalreports/t20050228_402231957.htm last accessed 24 May 2006
- See *Oryza Market Report – China*, February-April 2005 available at <http://www.oryza.com/asia/china/index.shtml> last accessed 23 June 2006
- See World Bank *China: Seed Sector Commercialization Project*, available at <http://lnweb18.worldbank.org/EAP/eaprural.nsf/40ByDocName/ChinaSeedSectorCommercializationProject>, last accessed 14 March 2006.
- UPOV, ‘The Executive Summary of the UPOV Report on the impact of Plant Variety Protection’ UPOV Publication No. 353(E). December 2005. Available at http://www.upov.int/en/about/pdf/353_Executive_Summary.pdf last accessed 29 June 2006
- UPOV. Plant Variety Statistics 2000–2004 available at http://www.upov.int/en/documents/c/39/c_39_07.pdf, last accessed 30 March 2006.