Policy Brief

NO.7, YEAR 2004

Seed Industry Concentration
Implications for the HKH Farmers

INTRODUCTION

The strengthening of intellectual property right (IPR) in the biotechnology sector has had much to do with the increased concentration of the global seed industry. The wave of vertical integration of giant pharmaceutical firms with small seed companies in the 1990s was driven by several motives. Among them the high complementarities of key intellectual assets like transformation and gene technologies with germplasms as well as the high costs of licensing were the key ones.

In theory, the impact of IPRs on market structure would have consequences in the competitive behaviour of firms competing in the industry, both in the product and innovation market. By innovation market, this policy brief refers to the production of further research based on existing knowledge. For instance, further increase in market power could be brought about by a firm's control of crucial technological input that bars other potential entrants. It can also influence behaviour of its competitors through contractual licensing arrangements and commercial agreements.

In particular, the consolidation of the seed industry would have potential impact on farmers, both as consumers and producers of seed. This impact need not always be adverse, in the same way that industry consolidation *per se* need not always be a problem. Arguably, however, the greater the market power, the greater is the potential for abuse of such dominant positions.

IPRs AND CONCENTRATION IN THE SEED SECTOR

Discussion of developments in the seed sector is hard to divorce from technological advance in the biotechnology industry. Indeed, in the foregoing discussion, when we talk of how innovation influenced market structure, the innovations referred to are the technical changes and research and development (R&D) process that grew out of biotechnology research.

Biotechnology Innovations and IPRs

Biotechnology research was given a significant push by the discoveries of recombinant DNA and genetic engineering in the early 1970s. Its agricultural applications sparked a lively research among scores of start up R&D firms in the USA.

The biotechnology research process requires a number of inputs and key intellectual assets which scientists work on. These include basic biological knowledge, genes, commercial promoters varieties, transformation technologies, and plant germplasm. Many of these research inputs are protected by IPRs, particularly by patents.

However, one of the fundamental problems in these agricultural biotechnology patents, which affected strategic acquisition directions in the late 1990s, is disagreements over the limit of the patent breadth. For example, Mycogen's patent for its insertion of a particular Bt gene sequence in a specific plant is claimed (by them) to have been infringed by Novartis, which inserted a Bt gene on corn, albeit through a different method. Many similar cases involving disputes about breadth and scope of patents, as discussed by Barton (1998), are not yet fully resolved in court, illustrating the complexity of the litigation problem arising from patent infringement and labyrinthine pedigree of patented

genes, genetic traits, and enabling technologies. This legal restriction on access to new biotechnology is one of the important reasons why firms decided to acquire other firms, or else implicitly participate in cross-licensing (Barton, 1998). So far, nowhere is this best illustrated than in the seed industry.

The Seed Industry Market Structure

Seed is the basic input to agriculture. Its role as a catalyst in ensuring optimum utilisation of other agro-production and protection inputs and cost effectiveness is well recognised. It is the single most important technology capsule that makes the major difference on the productivity belt (Chopra, 1999). Farmers could acquire seed from three major sources: a) own saving or informal exchange; b) public sector supply; and c) private sector supply.

Private seed supply accounts for about a third of the total value of the seed industry. The other two-thirds are equally shared between farm-saved seed and seed from public institutions. There are about 60,000 seed varieties sold all over the world. There are varying estimates of the commercial seed market, ranging from US$ 24 to US$ 30 billion (RAFI, 2000 and Rabobank, 2001). More than a third of the value of world seed market is earned from OECD sales, but African and Asian demands for seed have also been growing.

There are about 1,500 seed companies (Rabobank, 2001) but power is concentrated in a few: the top 10 seed firms account for 30 percent of the commercial seed market *(See Table: 1)*. These seed companies specialise in the breeding and production of hybrid and improved crop seeds. They have mostly been 'stand-alone' or independent firms, but with the advent of biotechnology, seed sales became a crucial direct link for biotech firms as they embody the input of genetic material into the agricultural production process. This is a fundamental reason for biotech firms' vertical integration with the seed industry, as discussed below.

Table: 1

TOP 10 GLOBAL SEED COMPANIES, 2002

Company	Country	Seed Sales (million US$)
Du Pont (Pioneer)	US	2,000
Pharmacia (Monsanto)	US	1,600
Syngenta (Novartis/AstraZeneca)	Switzerland	937
Seminis	US	453
Advanta (AstraZeneca and Cosun)	Netherlands	435
Groupe Limagrain	France	433
KWS AG	Germany	391
Sakata	Japan	376
Delta and Pine Land	US	258
Bayer Crop Science	Germany	250

Source: ETC (2003)

Prior to the merger frenzy in the mid-1990s, there was a wave of acquisitions about a decade earlier. The 1978-80 period of the mergers coincided with the strengthening amendments to the US Plant Variety Protection Act. At that time, a number of observers identified a direct causal relationship between the strengthening of IPRs and merger activity as the IPRs created expectations of increased earnings in the seed sector. But, whereas many of the acquiring firms in the 1980s merger round were new entrants to the sector, the 1990s round involves existing participants and high-profile multinational firms (Lesser, 1998).

This wave of consolidation has been thoroughly discussed elsewhere,[1] but what we provide here is a summary of the result of those series of acquisitions to paint the market structure that emerged. It should be noted, however, that some of those acquisitions have been spun off a few years afterwards for several reasons: a) anticipated synergies might have failed to materialise; b) concern over consumer acceptance of GMOs and thus the underperformance of the agro-biotech firms relative to pharmaceuticals leading to increased shareholders pressure; and c) anti-trust scrutiny of mergers.

However, some of the basic features of the 1990s merger round are worth highlighting. First, several large chemical and pharmaceutical firms moved into plant biotechnology, making huge investments in the life sciences, and acquired all of large national seed firms (e.g. Pioneer, DeKalb, Agracetus, Mycogen, etc). Some chemical and pharmaceutical firms merged horizontally (e.g. Rhou-Poulenc and Hoechst to form Aventis, and Sandoz and Ciba Giegy to form Novartis), then integrated vertically all the way to seed breeding and marketing. The result on the seed industry is that a large set of small-start up firms, which appeared in the 1980s, had, by the end of 1990s, either folded up or been acquired by the new agronomic systems giants (Graff, *et al.*, 2001).

Thus, in contrast to the diffuse structure in the 1980s, the emergent industry structure is now a relatively small number of tightly woven alliances among pharmaceutical firms, biotech research firms, and seed industry. The life science industry has solidified to 5-7 major firms that are highly vertically integrated and organised around a major life science firm. These five major gene giants that dominate the life science industry are: Du Pont, Pharmacia (Monsanto), Syngenta, Aventis, and Dow. Together, they account for 60 percent of global pesticide market, 23 percent of commercial seed market,

Table: 2

KEY GLOBAL PLAYERS AND THEIR POSITIONING IN THE SEED MARKET

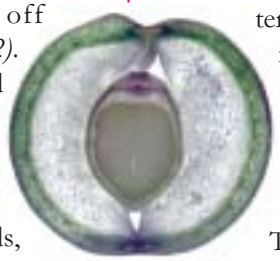
BIG LEAGUE	MINOR LEAGUE	NICHE PLAYERS
DuPont (Pioneer), Pharmacia (Monsanto), Novartis (Syngenta)	Limagrain, Grupo Pulsar, Sakata, Advanta (AstraZeneca), KWS, Delta & Pine Land, Dow Agro, Aventis	Cebeco, Pau Euralis, Ball, Pennington DLF, Svalof Weibul, Saaten Union, Sigma, Ragt, DSV, Maisadour, Barenbrug

Source: Rabobank (2001)

and virtually 100 percent of the transgenic seed market (ETC Group).

The Product Market

With regard to the seed industry itself, three companies dominate, namely Du Pont, which bought Pioneer, a major seed company; Pharmacia, which bought Monsanto and which, in turn, acquired many dominant seed companies prior to its acquisition by Pharmacia Upjohn; and Novartis, which spunned off Syngenta, its agro-business arm *(See Table: 2)*. Together, the three dominant firms accounted for 19 percent of total seed sales in 2000.



In terms of market share of the major seed traded in the commercial market, these three likewise dominate the corn and soybeans seeds, with a combined share of 63 percent and 46 percent in the respective seed market. Delta and Pine Land, whose acquisition by Monsanto for US$ 1.9 billion was disapproved, dominate the cotton seed market with 71 percent, and is one of the minor league players and niche players in the seed market.

The Innovation Market

As a result of the wave of buyouts, the purchased firms' IPRs came to be held by its 'mother firm'. Graff, *et al.* (2001) find that the top seven seed firms own more than 80 percent of total patents in agricultural biotechnology *(See Table: 3)*, while the three major ones have 55 percent of total patents. Du Pont and Pharmacia own a majority of all major types of patents: 38 percent of transformation technology patents; 31 percent of gene patents; and 81 percent of germplasms, the latter merely reflecting the aggressive buyout strategies of these two firms in the seed industry. This pattern raises concern regarding potential entry difficulties for new firms in the agricultural biotechnology industry, as anyone trying to get in runs the risk of being blocked or infringing any of the biotech patents held by the major firms.

The same concern over concentration may be gleaned from the increasing concentration of innovations after the mergers. Brennan, *et al.* (2000) computed the concentration index in the innovation market for agricultural biotech using data on applications for field trials. These field trials are research outputs of firms, but since agricultural biotech outputs use a vast array of specialised assets, field trials can also be used as proxies for these specialised assets. The result shown in Table 4 points towards a highly concentrated structure in the innovation market. For instance, using standard analysis of the Herfindahl-Hirschman Index (HHI), the post merger HHI went beyond the threshold level of 1,800 in 1997 and 1998, suggesting high concentration. All the mergers since 1995 collectively raised the HHI by more than 100 points, which from standard merger analysis, normally raises alarm, and has the presumption of an anti-competitive effect.[2]

Table: 3

SHARE OF AGRICULTURAL BIOTECHNOLOGY PATENTS
(as of January 1999)

Firms	Transformation Technology Patents	Gene Patents	Germ-plasm	Total	Firm share (%)
Pharmacia (Monsanto)	64	100	130	294	25
Du Pont	22	80	177	279	23
AstraZeneca	10	49	22	81	7
Novartis	18	47	21	86	7
Dow	26	88	3	117	10
Grupo Pulsar (Savia/ELM)	20	14	4	38	3
Aventis	11	67	1	79	7
Total (Top 7)	171	445	358	974	
Total Industry Patents	229	582	377	1188	
Top 7 share of total industry patents (%)	74.7	76.5	95	82	

Source: Graff, et.al (2001)

Thus, in both the product and innovation market, the major firms have cornered majority share, raising concerns on possible anti-competitive behaviour in the seed market and potential slowdown in the rate of agricultural biotechnology innovations.

IMPACT ON HKH FARMERS

Before trying to ascertain the impact of seed concentration on farmers' livelihood, it is necessary to set the whole issue in context. In the Hindu-Kush

Himalaya (HKH) region, like in other developing countries, traditionally farmers' and state institutions have been in the forefront of seed R&D. With the withdrawal of the state, often forced under the different hues of structural adjustment programmes (SAPs), the farmers are already loosing a good support mechanism. In most Asian countries, seed systems' transformation, that is taking place now, is characterised by the increasing role of commercial enterprises in developing varieties and providing seed, and by the concomitant decline in public sector seed activity (APSA, 1999). Therefore, the dependence of HKH farmers on purchased seed is likely to accentuate in days to come.

Market concentration and monopoly power of seed industry can potentially hurt farmers' interests. There is enough theoretical justification for this to be the case, but it needs to be substantiated by empirical evidence, which is unfortunately lacking at the moment. Therefore, this paper would try to look at some of the potential impacts of the concentration in seed industry on the poor, marginalised and vulnerable farmers of the HKH region.

The first major potential impact results from the outright increase in the price of seeds developed by the highly oligopolistic seed corporations. Simple economic theory suggests that when the number of firms decreases in an industry and competition reduced, resulting in oligopolistic or monopolistic market structure, prices tend to rise. Seed industry can be no exception. The price rise could take various forms. When the seed companies themselves are involved in direct selling of seeds, they charge the increased cost directly to their consumers (farmers).

Persuasive evidence has been presented on the relationship between the rising prices of seeds and intellectual property (IP) protection in agriculture. Price movement data from 1967-79 for seed prices of crops dominated by non-hybrid varieties enable a comparison to be made of prices before and after the enactment of Plant Variety Protection Act (PVPA) in the USA. Between 1970 and 1979 prices of seeds of major crops increased nearly threefold. The price of corn seeds increased between 1967 and 1970 but this increase was modest compared to the next three years. The increase in seed prices stands out even more when compared to price trends in other inputs. For these, the increase between 1970 and 1979 was less than 130 percent, while seed prices increased by over 150 percent (Dhar, 2002: 25).

Similarly, a US General Accounting Office report in 2000 showed US soya bean farmers paid more than twice as much for Roundup Ready seeds compared to Argentinean farmers. Pre-1998, a bag of this seed cost nearly the same in the two countries but subsequently, seed prices fell to about US$ 9 a bag in Argentina, compared to US$ 21.50 in the USA. This was primarily because 80 percent of the soya bean seed market in Argentina was either farmer-saved or brown-bagged. On the contrary, market for Roundup Ready soya seed was highly concentrated in the USA with only two companies involved in producing the same.

When these seed companies license their seed producing technology to local breeders/suppliers, they charge increased royalties to the latter, which would then have to jack up the seed prices in order to cover their increased cost of acquiring technology. This has already happened in Canada, where farmers have "brown-bagged" various commodities as the royalties charged by seed companies on protected varieties (owned by these very concentrated firms) raised seed prices.

In Argentina, farmers used more farm-saved seeds as seed prices rose – even when the benefits from seed saving was eroded by the deterioration of saved seed, causing yield losses. This was particularly high for hybrids, but even then, farmers used farm-saved seeds instead of buying new seeds. The major reason for this was the exorbitant prices charged by the seed companies.

Another impact comes from the fact that farmers are not organised at all, which is mainly due to their heterogeneity. Moreover, high costs of organising and classic free rider problem create disincentive for those who would otherwise have taken initiative to organise them. Their vulnerability is further accentuated by the fact that due to concentration in the seed industry, number of

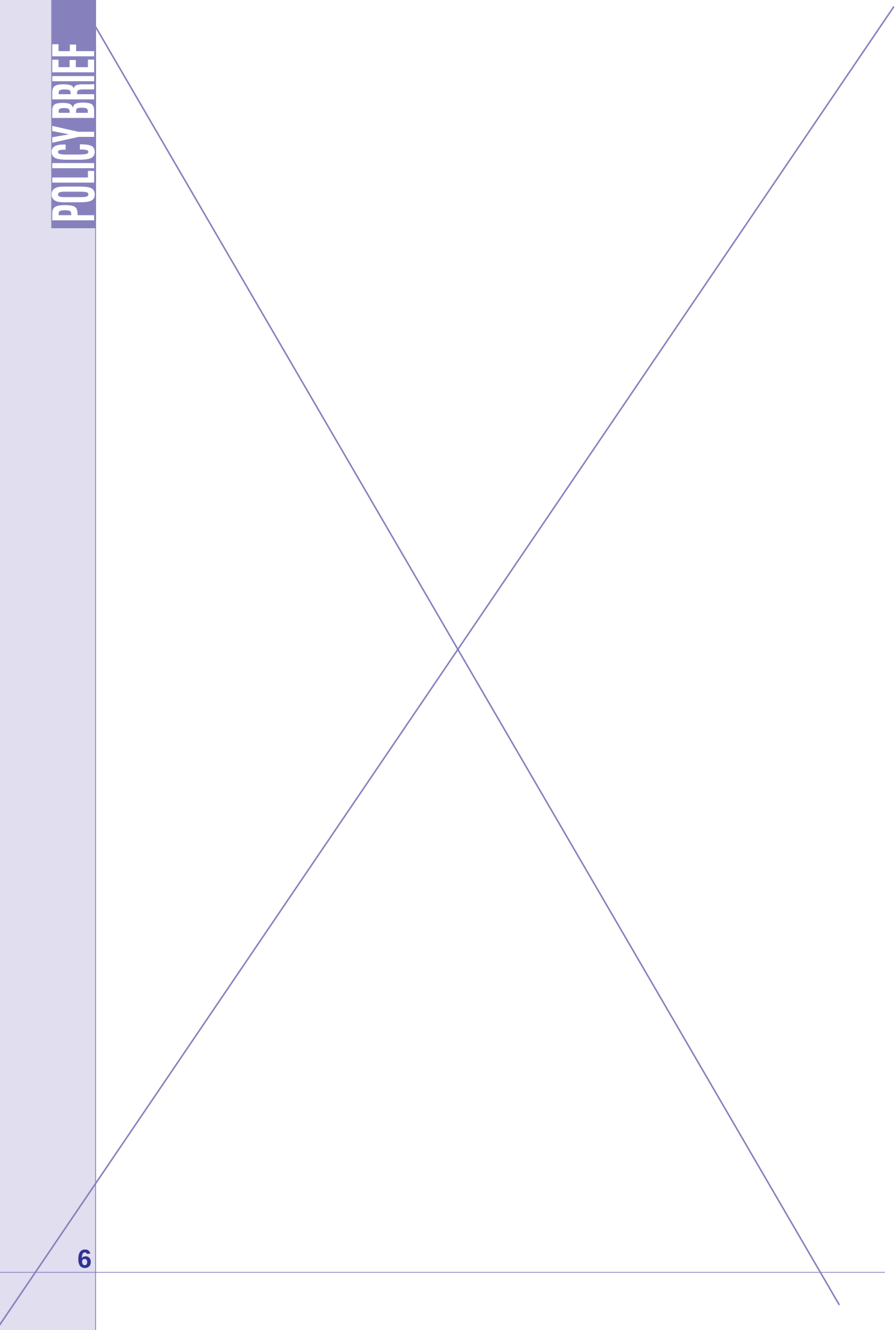
Table: 4

ANALYSIS OF INNOVATION CONCENTRATION*

Year	4-Firm Concentration Ratio (C4) (%) Post Merger	Hirschman Index Pre Merger	Herfindahl-Hirchman Index Post Merger	Number of Mergers
1994	67	1517	1521	2
1995	63	1143	1310	3
1996	69	894	1290	7
1997	71	1327	1862	5
1998	79	1608	2182	4

Source: Brennan, et.al (2000), quoted source: APHIS

* *Computation is based on field trial data*



players in this industry are becoming smaller and relatively homogeneous, making it possible for them to easily organise themselves. Such a possibility could have two impacts *(See Box: 1)*.

A third potential impact could emanate from the possibility of exclusion of farmers as well as public sector research institutions in developing countries from conducting adaptive research and experimenting seeds through natural processes. When the IP of the new and useful seed varieties is concentrated in the hands of a limited number of private sector companies, they can restrict their use for the purpose of further research by the farmers and public sector agricultural research stations. It is precisely with this objective in mind that the MNCs engaged in plant breeding have managed to broaden the definition of the term "essentially derived varieties" within the UPOV system. By restricting the ability of the farmers and public sector research institutions; MNCs are further tightening their control over the global seed market. For example, as per a study conducted in the USA, of 187 plant breeders surveyed, 48 percent testified to experiencing difficulties with obtaining genetic stocks from private companies while 45 percent indicated the obstacles interfered with research (Price, 2000). Such a problem is likely to be more pronounced in the HKH countries because of the weak bargaining powers of the farmers and publicly funded research agencies to assert their rights.

A fourth possible impact is the entry barrier for the small seed manufacturers. This is particularly so in the case of developing countries where even the largest players are dwarfed by the size of the seed companies of the developed countries. Barton (1998) notes the unusually large number of patent suites in the area of agricultural biotechnology (a total of 48 as of May 1997). While some such disputes are common to all industries and are needed to clarify the scope of related patent grants, other disputes involve very broad grants, such as the right to the use of Bt. Such broad patents tend to drive all competitors out of the market. Further, it is noteworthy in the case of agricultural biotechnology that there is a greater "incentive to sue outsiders seeking to enter the industry than to sue other major participants..." (Barton, 1998). Infringement litigation is very costly, easily in the multi-million dollar range, because of the complex issues raised by agricultural biotechnology; and even the threat of litigation can deter smaller entrant firms (AgBioForum).

Box: 1

ORGANISED INDUSTRY THREATENS UNORGANISED FARMERS

The first impact is the distortion in market structure and rent extraction. As the theory of Industrial Organisation suggests the smaller the number of players in an oligopolitic market and the more homogeneous they are, the greater there is a likelihood of creation and survival of cartel. As a cartel, they would be in a position to better exploit the consumers (farmers) than if they had to compete with each other. All the rents accruing to the seed companies due to market imperfection are likely to be gainfully shared by them.

A second impact is the creation of stronger lobby group. As the group becomes more organised due to smaller number of players and greater homogeneity among them, they tend to become more cohesive and are in a position to exert pressure to the politicians to ensure favourable policy environment for them to operate and maximise their profits. Stronger IP protection for agricultural innovation (through WTO/TRIPS), exclusion of farmers from their traditional rights to save, reuse, exchange and sell seeds (through the 1991 amendment of the International Union for the Protection of New Varieties of Plants, UPOV) are all manifestations of the growing political clout of the highly concentrated seed industry *(See Adhikari and Adhikari, 2003)*.

POLICY RECOMMENDATIONS

- Seed sector, like any other sectors of the economy, should be brought under the strict competition discipline relating to merger, amalgamation, takeover, cartel (including price fixation and territorial allocation), and abuse of IPR. For example, Section 42 of the draft Fair Competition Bill of Nepal and Article 10.4 (c) Plant Variety Protection Bill of Bangladesh have already made a provision to remedy the problem relating to abuse of IPR.
- While designing PVPA, developing countries should tactfully include remedies against potential anti-competitive practices resulting from the high level of concentration of seed industry. Two such remedies include provision on compulsory licensing and parallel imports, which are even allowed under TRIPS. For example, Section 47 and 48 of the Indian Plant Variety Protection and Farmers' Rights Act, 2001 have made explicit provisions for compulsory licensing.
- A mechanism should be devised to discourage broadening the scope of IPR and using it as a potent tool for anti-competitive business conduct, by granting such patents as "all the genetically modified variety of soybean".
- Since farmers are relatively voiceless communities, they should be involved in the decision making process (including drafting of legislation and policy formulation) which could have possible impact on their ability to access seeds.
- Considering equity issue in the farming sector, public sector research on agriculture, and its international

component, should be strengthened and better funded. The objective should be to ensure that research is oriented to the needs of poor farmers, that public sector varieties are available to provide competition for private sector varieties, and that the world's plant genetic resource heritage is maintained.

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ENDNOTES

[1] See for instance, Fullton and Giannakas. 2001, Hayenga and Kalaitzandonakes. 1999, Barton .1998

[2] See FTC US Horizontal Merger Guidelines. 1992

Launched in December 1994 at Nepal by a consortium of South Asian non-governmental organisations, SAWTEE is a recognised, registered, non-profit and non-governmental organisation. Its goal is to enable South Asian communities to benefit from and minimise the harms of changing regional and global economic paradigms. It operates as a regional network through its secretariat in Kathmandu and 11 member institutions from five South Asian countries, namely Bangladesh, India, Nepal, Pakistan and Sri Lanka.

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Published with the support from Ford Foundation and ActionAid, this Policy Brief is a part of the three-year Regional Programme on *Securing Farmers' Rights to Livelihood in the Hindu-Kush Himalaya Region* implemented by SAWTEE and ICIMOD. We are indebted to Prof Carlos M. Correa, University of Buenos Aires; Prof J. George, Senior Research Fellow, RIS, New Delhi; and Ms Helen Wedgwood, Rural Livelihood Adviser, DFID Nepal, Kathmandu for their invaluable comments and suggestions.