13-098-2004-1

A NOTE ON THE SEED BUSINESS IN PAKISTAN

Introduction

The need for food security and the economic value of agricultural products highlights their significance for all countries of the world, no matter at what stage of development they may be. In Pakistan, agriculture has contributed about 24 per cent of the gross domestic product (GDP) and employed 47 per cent of the national employed labour force. The agricultural sector earnings are estimated to comprise about 60 per cent of the country's total export earnings, and agriculture provides employment to 47 per cent of the total work force. The contribution of the agricultural sector to the GDP declined gradually from over 50 per cent in 1950 to about 25 per cent by 2000. The actual size of the agribusiness sector was much greater, given major industries and services involved with inputs into agricultural production, and then downstream with the trade, processing and distribution of agricultural products. Agriculture has thereby remained the major GDP contributor; and a significant portion of the Pakistani economy has remained dependent on farming and processing of major agricultural commodities.

Almost 70 per cent of the Pakistani population still lives in rural areas. The post-2000 population was estimated to be approximately 150 million, up from 35 million at the time of independence in 1947. The total cultivated area was approximately 22 million hectares (ha). Approximately 4.1 million farmers owned small farms (under five ha), 620,000 farmers owned medium farms (5-10ha), and 350,000 farmers owned large farms (above 10 ha). The farm sector virtually supported the entire economy. At the beginning of the twenty-first century, the share of agricultural commodities, and agro-based products, as a percentage of total exports was: cotton (61), leather (6.3), rice (6.3), synthetic textile/mixed (5.3), sports goods (3.3), and others (13.1). This came to over 95 per cent of total exports. However, Pakistan's agriculture remained vulnerable, with low productivity levels, a large proportion of land tied up in smallholdings, and with much of the area under the larger farms actually rented out to subtenants by absentee landlords. About 27 per cent of the country's total land area was arable. Over 60 per cent of this arable land (32 out of 47 million acres) remained in holdings of above 5 ha (see Exhibit 1).

As the world agricultural production system moved towards globalization, important developments reshaped the competitive field for all players involved in it. Achieving greater efficiency in this changing environment required a multifaceted approach for ensuring availability of key inputs. Seeds have been the most basic of agricultural inputs; and the seed industry played a pivotal role in boosting agricultural production. The seed business in Pakistan consisted of the formal and informal sectors, the former in turn comprising the public and private sectors. Though earlier the public sector had been more prominent, by the mid-2000s the formal seed sector in Pakistan saw the growing influence

of private and multinational companies. Nevertheless, the informal sector continued to dominate the market, as it had done traditionally.

The formal seed system comprised national, regional and international public and private sector companies and business associations involved in the processing, marketing and distribution of seeds. It was supported by research and development institutes working on plant breeding and related aspects of seed physiology and plant diseases. It was involved in variety release, seed multiplication on 'seed farms', and seed storage and distribution. The formal seed system largely followed the rules and regulations in place to manage variety release, quarantine, intellectual property rights on plant varieties and genes, seed certification, product labelling, marketing and pricing. This segment generally tended to be influenced, if not driven, by government policies.

This note focuses on salient aspects of the seed industry in Pakistan, and on the role of the major players involved in the seed business. It will consider the role of the public sector in the regulation, production, processing and distribution of seeds. It will also discuss the growing role of the formal private sector, as well as the continuing entrenchment of the informal sector. The broader perspective of international experiences and reforms will also be discussed, as well as the emerging debate on genetically modified organisms (GMOs).

The Public Sector[1]

In Pakistan, seed production was carried out by both public and private sector organizations (see Exhibit 2). The public sector was involved not only in producing, processing and distributing seeds, it also provided the regulatory framework and policy base on which the industry operated.

Seed Production and Processing

The formal sector aimed to supply 100 per cent, 33 per cent and 20 per cent, respectively, of the seed requirement for cotton, maize and cereals. In practice, more than 90 per cent of the cereal seed needs, and almost the entire requirements of legumes, oilseeds and fodder crops, continued to be met from other sources, mainly from the informal sector. Thus only in cotton was the formal sector able to adequately supply the seed requirements of the farming community in Pakistan. Public sector agencies had pioneered the production of quality seeds for the major crops, and fostered farmer awareness for the use of certified seed. However, the public sector could not meet even the replacement rate of seed for the major crops: indeed its availability remained under 10 per cent of demand. After 1990 the government was induced to open the market to private seed companies.

The seed processing capacity of both the public and private sectors was concentrated in the Punjab and Sindh. The public sector had five seed processing plants and three mobile seed-cleaning units. The four seed plants installed in the Punjab and Sindh had a combined capacity of 103,000 metric tonnes (mt) per year for crops such as wheat, rice, maize and cotton. The proportion of seed processing and storage capacity of the formal sector was not impressive, in comparison to the capacity of the informal sector; and even

[1] This section is primarily based on information collated by the Federal Seed Certification and Registration Department and printed in their reports, *Focus on Seed Programs 2002; Seed Industry of Pakistan 2002,* and on the Agricultural Development Research Council report, *Seed Industry in Pakistan*

cumulatively it remained inadequate against the estimated national seed requirements (see Exhibit 3).

The legislation governing the seed system in Pakistan was the Seed Act of 1976. Amendments to the Act were later adopted to grant permission to the private sector to produce basic seed, if authorized by the provincial governments. The public sector mainly concentrated on production of high-volume, low-cost seed of major crops like wheat, rice and cotton varieties, many coming from public sector research institutions. In view of the requirements, there was still tremendous potential for growth in the seed market. Even by the early 2000s, the public sector was able to supply seeds for less than 15 per cent of wheat, 35 per cent of cotton, 3 per cent of rice and 5 per cent of maize. Despite the availability of several varieties, the public sector clearly failed to produce enough quantity of seed to meet the demand from the farming community, except perhaps for cotton.

The actual operations of seed production and dissemination were managed at the provincial level. The Punjab Seed Corporation (PSC), and its equivalent in Sindh, were set up with the help of international donors, particularly the World Bank. They were intended to become efficient public sector companies. In 2000-01, the Sindh Seed Corporation ceased to function, and the seed program was assigned to a Foundation Seed Cell, within the Department of Agriculture. The North-West Frontier Province (NWFP) and Balochistan did not have seed corporations. In NWFP the Agricultural Development Authority was delegated this task; but it too ceased to function in 2000-01. Its work was taken over by various components of the Department of Agriculture, as was the case in Balochistan.

The PSC was for a time a chronic loss maker, but later benefited from more stable management. It began operating much as large farmer-owned cooperatives did in the United States, whilst managing to break even. It did not operate to obtain profits, but rather to maximize benefits to farmers. It did retain a bureaucratic rather than entrepreneurial approach to its work, operating, like many other parastatal bodies in Pakistan, virtually like a government department. Its personnel were drawn almost entirely from a background in government service. In the early 2000s its Managing Director was a retired brigadier of the Pakistan Army.

Two factors helped to transform the PSC from a loss maker into a modestly profitable public entity. The first was quality control: the company recognized that farmers rightly believed that the corporation's seed was little better than the best of their own retained seed. At first only half the seed that the corporation submitted to the Federal Seed Certification and Registration Department (FSCRD) could be certified. Much tighter attention to all aspects of quality control raised this proportion to over 95 per cent. In the process, the corporation almost halved the unit cost of the seed produced. Stock control was also tightened, reducing unaccounted for losses, and raising profitability. The second factor was a demonstration programme. The PSC started to provide farmers with free seed for an acre of crop, provided that these farmers followed recommended husbandry procedures, and displayed information on husbandry and cost structure. About 1,000 such plots were created, distributed widely over the Punjab. With increased acceptance of its seeds, PSC enjoyed over 20 per cent growth in seed sales in the late 1990s. Lottery prizes for seed purchasers also helped with sales.

Yet the market penetration of the seed corporations remained constrained. Pakistan had a flourishing informal trade in seed. About 90 per cent of the rice and wheat seed, and about 60 per cent of the cotton seed sown, came from farmers' own previous harvests, or was bought from other farmers or small traders. It was estimated that, with an 8 per cent replacement rate for rice, if no seed were traded among farmers, the average farmer would be six generations away from using certified seed from formal sector seed operations.

Reasons for the preponderance of the informal sector came out clearly in a World Bank survey conducted in the mid1990s. The purchasers of certified seed from PSC were interviewed by the Operations Evaluation Department of the World Bank.[2] On average, they sold three times as much seed to their neighbours from their first harvest as they had bought from PSC. Thus, assuming that 8 per cent of the seed being used was certified, 32 per cent of the seed was at most one generation away from being certified; and all farmers had ready access to seed at most two generations away from being certified. Farmers apparently used the best seed they had seen growing in other farmers' fields. Even most farmers who saw greatly increased yields on demonstration plots, would rather have had their neighbour use the new seed first. They would then buy from him the following year, after verifying the higher yield in the neighbour's field. If, as happened with the first generation of high yield varieties, farmers observed a spectacular difference in yields, then the informal market provided for almost universal adoption within a few crop generations. If farmers saw little improvement, it could be generations before a switch was made.

Seed Regulation

After independence in 1947, Pakistani farmers remained dependent for over two decades on seeds that they retained themselves, or obtained from other farmers. The Departments of Agriculture of each of Pakistan's four provinces had nominally been responsible for making arrangements for the production, quality control and distribution of major crop seeds. However, they were unable to perform this function properly, and the seed situation remained deficient regarding the production and supply of pure seeds of improved varieties. After 1960 it was clear that major improvements were required. In 1961 the Government of Pakistan created the autonomous West Pakistan Agricultural Development Corporation (WPADC). This body was authorized to implement integrated agricultural development in the country, including the responsibility to produce and distribute seed. The first step had been taken in the formal provision of better quality seeds of improved varieties. However, WPADC was unable to adequately meet its heavy mandate, owing, among other reasons, to weak linkages with research and plant breeding activities.

Further developments occurred in the 1970s. In 1973 the government invited the World Bank to appraise the seed programme of the country. On its recommendation, and with the assistance of the United Nation's Food and Agriculture Organization, a Seed Industry Project was launched. A more prominent role for the private sector initially envisaged in the project could not be realized because of the low profile of business in the 1970s, with the government following a major nationalization strategy. Most importantly, to provide a legal regulation and control of the quality of seed, the Seed Act of 1976 was promulgated. The Act provided a regulatory framework for variety registration and seed quality control, by setting up an institutional infrastructure that included the National Seed Registration Department and the Federal Seed Certification Department, as executive arms of the National Seed Council. In 1997, these two Departments were amalgamated into FSCRD.

[2] OED, 1996, The Seed Industry in South Asia, World Bank, Washington

The National Seed Council and the Provincial Seed Councils were also established (see Exhibit 4).

The National Seed Council, chaired by the Federal Minister for Food, Agriculture and Livestock, became the supreme body for formulating national policies and regulating the seed sector. It became responsible for providing approvals and sanctions for seed standards, and for regulating inter-provincial movements of seed. It also approved variety registration and release at the national level. In addition, provincial seed councils were established, to approve crop varieties for seed production, and to make arrangements for seed multiplication, processing and marketing in their respective provinces. These councils had a wider representation of major institutions and stakeholders concerned with the seed industry, such as institutes, registration/certification agencies, seed producers and farmers.

The government also encouraged the participation of the private sector and enacted the Truth-in-Labeling (Seeds) Rules 1991. These rules allowed the marketing of seed by declaring and correct labeling of quality attributes and related information. Moreover, the seed business was declared a seed industry in 1994, providing it with concessions and privileges given to other industrial sectors. This policy encouraged the development of the private sector. Several companies were granted permission to produce and market seed in the country. The free market economic policy adopted by the government further promoted private sector seed operations.

Quality Control and Certification

Under the Seed Act of 1976, FSCRD provided quality control through registration of crop varieties, crop inspection and seed testing. FSCRD thus acted as the quality control agency for all seed categories. Seed quality control was mainly based on crop inspection and laboratory testing, to ensure that the seed met minimum standards laid down in the regulations. FSCRD was attached to the Ministry of Food, Agriculture and Livestock. It performed its regulatory functions through 17 laboratories, located in various parts of the country.

All seed quality control activities were enforced under the legal framework of the Seed Act of 1976. The Truth-in-Labeling (Seed) Rules 1991 were also introduced under the same Seed Act, to encourage the emerging private sector. Seed certification became compulsory for the domestic production of the notified crop varieties, registered and approved either by the National Seed Council or Provincial Seed Councils. In Pakistan the seed registration system had four recognized categories: pre-basic seed, basic seed, certified seed and approved seed.

The Pakistan Agricultural Research Council (PARC) was responsible for the evaluation of the agronomic value of all crop varieties (except cotton) in National Coordinated Variety Trials spread throughout the country. The Pakistan Central Cotton Committee (PCCC) was responsible for evaluation of cotton varieties only. These trials were used to determine the suitability, adaptability and disease response of the variety. After two years of testing, the Variety Evaluation Committee of PARC and PCCC were required to inform the breeder, provincial governments and Federal Seed Registration Committee of the suitability, adaptability and disease responses of the candidate varieties.

Pakistan spent large amounts to import seeds. In 1997-98 alone, 10,954 mt of seeds, valued at Pak Rs 733 million, were imported to the country. The actual value was considerably higher, through unaccounted imports, smuggling across Pakistan's porous borders, and value under-invoicing to save import cesses and customs duties. These imports ensured the availability of quality seed for those crops in which local seed production did not exist, or was not of good quality. The FSCRD was authorized to regulate the quality of the seed imported and exported. Under the Truth-in-Labeling (Seeds) Rules of 1991, import and export of seeds were allowed subject to the following requirements:

a) All imported seed had to bear a label with information concerning crop/species; variety; quantity, lot number, per cent purity, per cent germination, per cent other seeds, month/year of production, and date of expiry;
b) Seed import was allowed only of those varieties that were approved in the National Register for seed and crop production in Pakistan;
c) Seed lots up to 10 kg were imported for experimental use upon approval of the Ministry;
d) The importer needed to inform the FSCRD of the probable date of arrival of the shipment, and notify FSCRD for drawing samples for testing.

For safeguarding the interest of the seed industry and farmers, the FSCRD monitored the quality of seed by enforcing the Seed Act of 1976 and Truth-in-Labeling (Seeds) Rules of 1991 for seed imported from other countries. This provided a check against the entry of virulent pathogens. However, the problem of indiscriminate seed imports by unauthorized traders continued to elude these checks.

Research and Variety Development

At the national level, agricultural research was coordinated and funded by the PARC and PCCC. PARC had seven major research establishments in Pakistan, conducting research according to the agro-ecological needs of various regions. The government also established the Provincial and National Seed Councils, which had wider representation from research, registration/certification agencies, seed producers and farmers. The councils approved release varieties for general cultivation within the provincial and national territories. Seed research, relating not only to seed technologies but also to germination and crop establishment in variable planting conditions, as well as on harvesting and post-harvest seed management, remained limited.

Nonetheless, provincial and federal research institutes did develop a substantial number of crop varieties. Crop variety development remained the domain of the public sector. Provincial and federal research institutes developed a substantial number of these crop varieties through conventional plant breeding. The Pakistan Atomic Energy Commission used mutation breeding to develop grain legumes, rice and cotton varieties. The recently established National Institute of Biotechnology and Genetic Engineering was expected to contribute in the release of genetically modified crop varieties for use by farmers.

The privatization policy of the government also encouraged private sector plant breeding. Multinational seed companies started introducing, testing and submitting their hybrids of maize, sorghum, sunflower and sudax for registration and release. The multinationals stayed away from developing their own open pollination varieties because the government

had still to enact legislation on plant breeders' rights in Pakistan. Such legal cover could have provided greater protection than the minimum levels assured by Pakistan's signatory status of the WTO and TRIPS agreements.

Breeding lines, tested in micro-variety trials at research stations and sub-stations, were then evaluated for adaptability in out-station zonal variety trials. Such trials were conducted at government farms and in collaboration with progressive farmers in the proposed area of adaptation. Breeders collaborated with FSCRD to produce the pre-basic seed, which was further multiplied to basic seed by public sector organizations.

The national parastatals made a major contribution early on by increasing the physical supply of seed; making farmers, politicians, and the agricultural sector in general 'seed conscious'; and by providing an initial cadre of seed scientists and technologists. Decentralizing the seed industry to public, state or provincial seed companies provided a public sector dynamic that could not fail to impact the federal organizations. Many employment and promotion possibilities opened up to their staff. This introduction of competition within the public sector eased the subsequent entry of local and multinational private sector seed companies.

As a result of these efforts, the active wheat and cotton breeding program, and a rigorous seed registration and certification program, were established in the country. Pakistan also managed to establish a certified wheat and cotton seed marketing organization, and was able to develop an extensive cadre of well trained seed industry professionals. These efforts within the public sector, based on the operations of provincial seed companies, facilitated the entry of multinational seed companies, and the emergence of some more modest private sector national seed companies.

Thus the public sector seed agencies had established the foundations for the production of quality seeds in the major crops. They had created awareness in the farming community regarding the use of certified seed. However, the diffusion of such seeds remained constrained: to under 10 per cent of the total market size. Indeed, the public sector could not meet even the replacement rate of seeds of major crops. These constraints led the government to allow the entry of the formal private sector into the seed business. By the mid-2000s the seed industry was a combination of the public and private sectors, raising the share of the formal seed system probably to over 20 per cent of total estimated demand. The bulk of seed was still retained or exchanged by farmers, or traded within the informal sector.

Private Sector

National Seed Companies

The active participation of the formal private sector started in 1991, after which a large number of seed companies were established, supplying different crop seeds, including legumes and vegetables. Since 1994, when the Pakistani government recognized the seed business as an industry, the formal private sector share in the country's seed market had, it was claimed, risen to over 15 per cent. Within a decade over 400 national, and at least five multinational, seed companies were registered, and granted permission to produce and market seed. There were no restrictions placed on the private sector to sell seeds of any crop that offered favourable commercial opportunities. These companies were also

allowed to import and export seed. The seed sector was thus opened for the private sector to play an active role in the seed business.

To encourage investment in the seed industry, the Government of Pakistan declared the seed business at par with other industries in 1994. Till that time there were only 11 national private seed companies. After declaration of seed business as an industry, there was a steady increase in the number of seed companies. By 2000, according to FSCRD, these had increased to 319 companies, of which 289 were located in the Punjab, 20 in Sindh, four in NWFP, two in Balochistan, three in Islamabad, and one in Gilgit. The public sector maintained its focus on high volume, low cost seeds, mostly of major crops such as wheat and pulses. Private sector companies mainly traded in low volume, higher priced seeds. The multinationals dealt mainly in better quality imported hybrid seeds, in such crops as oilseeds, corn and forages. There was clearly potential for the development of local hybrid seed production, to be made available to the farming community at more affordable prices.

Pakistan's seed industry still had a long way to go in terms of seed processing capacity. Imported seed processing plants offered sophistication and were multi-purpose; but they were also very costly. In a FSCRD survey in 2000, only 28 imported seed processing plants existed in the public sector, another three were owned by multinationals, and eight by national private seed companies. The remaining 74 seed processing plants located in Pakistan were found by FSCRD to be locally manufactured. By 2004 the number of seed processing plants was nearing 150, with a total investment close to Pak Rs one billion, of which almost two-thirds was in the private sector. By 2004 at least 13 organizations were involved with the local manufacturing of seed processing units; and there was further potential for joint ventures with international seed equipment manufacturing companies.

The private sector prices were invariably higher than the public sector, and every company had a different price for the same crop seed. Imported seed was much more expensive than that produced locally, particularly the prices of hybrid maize and sunflower seeds. The emerging private sector marketed seed using its own outlets, as well as through private dealers selling agrochemicals and other inputs. Competition between the public and private seed sectors was growing: both had developed linkages with over 12,000 seed dealers across the country.

Crop variety development was still the domain of public sector plant breeders, either in teaching or research organizations. After developing the pre-basic seed, they would pass it on to public sector seed agencies in their provinces. Only recently had national and multinational firms developed the infrastructure to produce basic seed, with the permission of the federal Agriculture Ministry. The production of certified seed was also developing rapidly in the private sector, which already had one of the largest seed volumes in the developing world. The Agriculture Ministry claimed to extend quality control services to these companies; and to take action against those that showed poor performance, had a bad reputation, or provided low quality seed. By 2003, 18 private seed companies had been deregistered by the Ministry.

One of the larger national companies in the seed business, but also a recent entrant, was Engro Chemicals[3]. Originally an Exxon subsidiary before undergoing a management buyout, the company had been involved in the fertilizer business in Pakistan since the

[3] http://www.engro.info

1960s. In 1991 Exxon decided to sell its 75 per cent equity share: the subsequent employee-led buyout was a first in the corporate history of Pakistan. Its shareholders became the employees, an employees' trust, local and foreign institutions, including mutual funds, and the general public. Engro launched three hybrid seeds after detailed trials to test adaptability under Pakistani environmental conditions (see Exhibit 5).

Multinational Seed Companies

Multinational seed companies operating in Pakistan included Monsanto, Pioneer (which later merged with DuPont), ICI and Syngenta. These companies primarily imported and distributed seeds of maize, sunflower, fodder, canola and sorghum hybrids. Having seen its potential, other multinationals were exploring opportunities in the Pakistani market. Established firms had also started seed production of self-pollinated crops like wheat, rice, legumes and cotton. Though some local production was carried out, the multinationals were predominantly seed importers.

Monsanto[4] was a global leader in agricultural production, pharmaceuticals and food and nutrition. Based in St. Louis, USA, this US $ 8.6 billion 'life sciences company' had been in operation for a century. Monsanto used plant biotechnology, genomics and breeding to improve productivity, reduce the costs of farming, and develop several leading seed brands, including Dekalb and Asgrow. It developed biotechnology traits that integrated insect and weed control into the seed itself, enabling farmers to reduce their tillage costs, maximize yields, and minimize pesticide use.

Monsanto was making Roundup, the world's best-selling herbicide, and other herbicides which combined with its seeds to offer farmers integrated solutions. Monsanto's branded and licensed seeds held leading positions in key corn and soybean seed markets across the world. Monsanto wanted its seed business to continue to focus on major crops, including corn, soybeans and cotton. The company expected to have an increasing effect on yield gains in commercial corn and soybean seeds.

Monsanto Pakistan was headquartered in Lahore. It had set up an extensive network of 35 sales and distribution centers, selling several varieties of improved and traditional seeds. In 1998, Monsanto acquired the Cargill hybrid seed business internationally. It subsequently also acquired Dekalb Genetics and Asgrow businesses worldwide, giving Pakistan access to a wide range of superior hybrids.

Monsanto dealt in proprietary corn, sunflower and forage sorghum hybrid seeds in Pakistan. Monsanto also produced and marketed wheat, cotton and rice certified seeds (see Exhibit 6). Monsanto claimed to be the first multinational in Pakistan to invest in research, production, processing, quality assurance and development of a viable marketing infrastructure. It tried to inculcate brand loyalty within the seed industry. It actively promoted brand recognition of its merchandise, in a market where the prevailing trend of seed identification used obtuse serial numbers, rather than easy to recognize labels.

Monsanto conducted regular surveys to ascertain customer demands, and to subsequently rationalize its products for its customers. The company focused on improving the product options, based on product demand, the availability or easy access to its products, and better customer service through trained personnel, to facilitate maximum yield through use

[4] http://www.monsantopakistan.com

of its products. Besides seeds, Monsanto also introduced herbicides that it claimed had proved effective in combating damaging weeds in an environmentally friendly manner.

Monsanto maintained higher seed quality standards than the official standards, owing to which the resulting yields were comparable with those found in developed countries. Monsanto had the distinction of launching single-cross corn hybrids that consistently exhibited yield beyond 10 mt/ha, over 300 per cent higher than the national average. Monsanto was registered abroad and passed the adaptability trials of the government, so there were no legal barriers to the sale of its seed products.

The expansion of multinational operations in the Pakistani seed market was not without controversy (see Exhibit 7). There were significant price differentials: seeds imported by multinationals sold at approximately 4-5 times the price of locally produced varieties. This price was justified by the 30-40 per cent higher yield potential of hybrids over open-pollinated varieties. Owing to the price differentials, the market shares of these companies remained limited. Yet amongst the multinational seed companies operating in Pakistan, Monsanto was the most established. In the 1999-2000 crop season, Monsanto distributed 67 per cent of seeds distributed by multinationals, followed by Pioneer Seed at 29 per cent.

Pioneer[5] had the second most prominent multinational presence in the Pakistani seed market. Founded in 1926 and headquartered in Des Moines, Iowa, USA, Pioneer developed, produced, and marketed a full line of seeds, microbial products and services, to grain and livestock producers, grain processors, and other customers in over 70 countries worldwide. Pioneer began operations in Pakistan in 1989 as a joint venture with Pakistan based partners. Its merger with DuPont gave an added advantage to both companies to market their products in Pakistan. Proprietary Pioneer brand corn or maize, sunflower, pearl millet and sorghum and fodder hybrids were also sold in Pakistan, through sales agronomists and dealers who linked Pioneer with Pakistani farmers (see Exhibit 8). In addition, Pioneer provided a wide variety of agronomic services. It also operated a large seed processing plant south of Lahore.

Imperial Chemical Industries[6] (ICI) Pakistan, a 76 per cent owned subsidiary of ICI Plc-UK, was established as a public limited company in Pakistan in 1952. ICI's presence in this part of the world predated the formation of the public limited company, and indeed Pakistan itself. ICI marketed seeds and agrochemical products in Pakistan, and also engaged in trading in various specialized chemicals for use in industries in Pakistan. In the seed business, it concentrated on oilseeds and fodder. It was the sole supplier of Canola seed and thus retained 100 per cent share of this market in Pakistan. By 2003 ICI had decided to exit from the agrochemical business in Pakistan, which it had actually pioneered in an earlier period. Industry analysts wondered whether this move signaled a deterioration of regulation and control over adulteration, brand counterfeiting and other market malpractices. Other analysts argued that this exit marked an inability by ICI to sustain its high margins and high price structure, in the face of competition from cheaper imported agrochemicals, especially from China. The impact of this decision on ICI's role in the seed business remained to be seen.

The cumulative role of the multinationals remained small, in comparison to the potential of the seed market. In 1998-99, for example, multinationals distributed 6,100 mt of seed,

[5] www.pioneer.com/pakistan
[6] www.ici.com.pk/files/seeds

in a market that required approximately 1.2 million mt of seed annually. However, these activities were concentrated in commercially important segments of Pakistani agriculture.

In further efforts to encourage the private sector, the government allowed even private seed companies to act as corporate seed farming entrepreneurs and establish contact with different seed growers. Farmers could also contract with the same seed company for the supply of inputs and assistance for farm operations, and for handling and marketing of their produce. The goal of an increased corporate role was to attract more private investment in seed production, processing, storage and distribution. Simultaneously, seed growers could also make more money, with deregulated markets and reasonably high prices for their seed products. In 2001 the Pakistan Board of Investment also announced incentives for corporate farming, to attract investment in this sector. These included the lifting of landholding ceilings for the corporate farming company. Regulatory duties were removed on import of new or used agricultural equipment, implements and machinery for use in corporate farming. State land could be purchased or leased for 50 years, and the latter extended for another 49 years. Tax relief was also provided to encourage local or foreign, private or public limited companies to invest in the seed business in Pakistan.

Informal Sector

The informal seed sector predominantly comprised seed production activities of mostly small-scale farmers, and was also known as 'local' or 'farmers' seed system(s)'.[7] Other terms for the informal sector included the 'bazaar' or unregistered sector. A clear-cut distinction between the informal and formal seed systems did not exist in situations where public or private institutions were engaged in the production of uncertified, unlabeled or unregistered seed lots.

The informal sector was the major seed supplier in Pakistan, since almost 90 per cent of total seed came from farmers or other sources like commission agents and small retailers. This sector provided approximately 23 per cent of vegetable seed, 45 per cent of cotton, 90 per cent of wheat, rice and maize (for fodder) and almost 99 per cent of legumes. To improve quality standards and enhance agricultural productivity, the informal sector needed far more attention than it had received in the past from negligent government policy-makers, international development agencies and the scientific community. It lacked the financial incentives and effective marketing strategies needed to significantly enhance the quantity of agricultural production. It also lacked the basic infrastructure and regulatory controls and provisions necessary to enhance and maintain seed quality. Yet the volumes obtained and disseminated through informal sources continued as an overwhelming proportion of the total seed trade in the country.

The informal seed sector had stood agrarian communities in good stead for centuries, and underpinned the evolution of agriculture throughout much of the world. A vital role was its support to genetic diversity at the ecological level, and to the sustainability and food security of small farmers at the farm level. Seed produced by farmers remained a vital seed source in the majority of developing countries. Efforts to replace farmers' seed by seed supplied by the formal sector, as part of agricultural development, had only been

[7] Almekinders C, 2000, The Importance of Informal Seed Sector and Its Relation With the Legislative Framework Technology and Agrarian Development, Wageningen University, Wageningen

partially successful. An estimated 80 per cent of seeds planted in developing countries were farmer-produced. Small-scale farming was estimated to contribute more than 50 per cent of the total food production in developing countries. Thus in Pakistan, as in many other developing countries, the informal sector still dominated the seed supply for crops vital to food security, such as pulses, wheat and rice.

Though extensive, the informal seed sector in countries like Pakistan was not able to address effectively many of the needs of small-scale farmers. It was of little help in providing them access to research or marketing support. Much of the information concerning agronomic performance, yield, disease resistance, quality, cultural preference and diversity of end uses within the informal sector was communicated by word of mouth. The quality and veracity of such information was seldom subjected to rigorous analysis or evaluation.

In the informal sector, local seed supply and diffusion were mostly based on traditional channels of information and exchange, within and between farmers and communities. Apart from cash transactions, a wide range of mechanisms existed for exchange and supply of seed. Such non-cash transactions included seed swaps, in-kind seed loans, and seed exchange for labour. Farmers in Pakistan also saved their own seed, and bought seed from local traders and the market within the informal seed system. Thus the informal seed sector in the country was very extensive. It could be characterized by a seasonal cropping cycle involving empirical selection of desirable seed types, farmers' seed harvesting, the cleaning and storing of their own seed, exchange of seed between family members and relatives, trade or barter in the local marketplace, and finally planting and cultivation. These farmer and community-based seed acquisition and distribution channels formed the basis of a dynamic, if ill-defined, seed system prevalent across Pakistan.

The informal seed sector survived almost entirely on its own resources, rather than on assistance from governmental or donor agency sources. The Pakistani government invested in research and development in the formal public sector, with the goal of maintaining or improving national self-sufficiency in food production. In the past five decades, the government invested considerable resources to strengthen its research and extension capacities in the formal seed sector. It focused on seed multiplication, certification, and marketing of modern varieties, as well as inputs that favoured the use of modern varieties. There was a general perception that the informal seed systems were backward, and needed to be replaced by 'improved' practices based on successful, mainly western agricultural models, particularly those adopted during the Green Revolution.

The regulatory and legal framework of the national formal seed system limited the development of the informal seed system. Informal seed dealers felt that seed produced by the governmental sector remained heavily subsidized, while informal seed producers, particularly in marginal areas, had no such support. National seed regulations were also usually based on international standards, incompatible with farmers' realities, since they often imposed restrictions on free exchange and marketing of alternative seed systems. With changes in international perceptions, as well as local advocacy on sustainable development issues, the importance of the informal system received more acknowledgement. Yet political recognition and tangible support remained poor. Little active assistance was given to the crucially important role that the poor farmers played in sustaining the informal seed sector, and more widely, in sustaining food security.

Although the informal seed system was well adapted to local farming environments, it faced numerous intrinsic constraints. Seed quality was often sub-optimal, owing to diseases and storage problems.[8] Exchange between communities did not easily cross valleys, watersheds or other geographical and cultural barriers. Access to local seed by the poorer farmers within a community was often limited. Local seed systems had reasonable buffering capacity to provide seeds where the formal system had collapsed under natural disasters, political or other turmoil. Yet if the informal sector itself collapsed, this age old system would not recuperate easily. In such a situation, local varieties were easily lost and replaced by relief supplied seeds. Therefore, complementarities between formal and informal systems offered practical opportunities to improve seed supply, while simultaneously supporting farmers' seed production and food security.

Seed Associations

There were six seed trade associations operating in the country. The Chamber of Private Seed Industry formed an exclusive association of national seed companies with 85 members. The Seed Companies Association of Pakistan (SCAP) was formed for multinational seed companies, like Monsanto, Pioneer, ICI and Syngenta. The chairmanship of SCAP was on a rotation basis shared annually by its members. It was involved in advocating its perspective on the Plant Breeders Rights to the Government of Pakistan, and was primarily interested in increasing the multinationals' share in the seed sector. The All Pakistan Seed Merchants and Seed Dealers Association operated on the national level and looked after the interest of vegetable seed dealers. The Pakistan Society of Seed Technologists (PAKSSET) provided a forum for professionals and scientists in the seed sector. PAKSSET worked for the development of seed technology and advancement of the profession in the country. The All Sindh Private Seed Companies Organization represented interests of seed companies situated in Sindh, whereas the Association of Seed Companies of Pakistan was established by private seed companies in Sahiwal, Okara and Pakpattan districts of the Punjab.

Seed Marketing and Pricing

Seed marketing was a vital component of the seed industry across the world. Its effective management had protected the interests of not only the plant variety originating institutes and companies, but also of seed producers, distributors and farmers. Effective seed marketing required advertising, public relations work, sales aids, awareness and information related seminars, and investment in demonstration plots. The marketing of quality seeds also required an effective transportation and delivery system, quality storage and packing, and effective technical support. Neither public nor even private sector organizations paid sufficient attention to seed promotion activities, such as publicity of quality seeds, establishment of seed demonstration plots, or dissemination of relevant literature on seeds. Very nominal publicity was carried out through the electronic media by seed companies. The PSC was perhaps the most active, but it too used advertising only at the onset of the wheat and cotton sowing seasons.

[8] Almekinders C, 2000, *The Importance of Informal Seed Sector and Its Relation With the Legislative Framework Technology and Agrarian Development*, Wageningen University, Wageningen

The provincial seed corporations operated through their own depots, seed dealers and other public sector organizations. In total they had over 2,000 outlets for seed distribution throughout the country. Only in Balochistan was seed sold directly to the farmers by agricultural extension services, agricultural research institutes, and through nineteen sales points established by the provincial Department of Agriculture. In the past seed marketing in the country had been dominated by public sector companies, but this was changing with the rapid emergence of the private sector seed business. The national private seed companies and multinationals had established over 8,500 seed outlets throughout Pakistan in a short time period. About 25,000 people were estimated by FSCRD to be directly engaged in seed production and marketing.

The sale price of quality seeds had always been higher than that of the actual crops, because quality seed production remained a highly technical and capital intensive activity. In the case of hybrids, the price of seeds had been many times more than self-pollinated and cross-pollinated crop seed varieties. Till recently the seed pricing system had not been very systematic. The public sector had generally paid a premium to contract growers, and followed an internal accounting system to include all costs incurred on the procurement price, to determine the sale price for seed. Yet several seed agencies, both public and private, arrived at seed prices differently, based on general demand and supply conditions, specific seed production and procurement circumstances, and competition with each other. Consequently, the pricing structure of various seeds continued to vary from year to year. Though the costs of certified seeds depended on a number of factors, those which had a direct bearing on the price of seed were:

1. Production costs including all inputs;
2. Harvesting, threshing and processing costs;
3. Storage costs;
4. Transportation and local taxes;
5. Retailing incentives including premiums to the seed growers;
6. Risk costs from procurement to marketing;
7. Import of seeds, as with vegetables, oilseeds and forage fodder.

Growth Potential in the Seed Industry

The availability of quality seed played an important role in enhancing the productivity of agriculture. However, the seed production and supply system was inadequate to meet the national requirements. The average annual certified seed distribution, from 1997-98 to 2000-01, by the public and private sector, was 108,879 mt for wheat; 2,936 mt for rice; 2,441 mt for maize, and 29,057 mt for cotton. The public sector provided the bulk of self-pollinated crops such as wheat and rice. The private sector provided nearly 80 per cent of the commercial crops such as cotton and maize, where seed demand was more predictable because of hybrid seed. In 2001, an estimated 209,026 mt of various seeds were distributed, covering 16 per cent of the estimated national seed requirement (Exhibit 9).

The formal sector seed industry in Pakistan provided less than 20 per cent of the seed requirements through both local production and import. While the informal sector filled the gap, the quality of seeds and their supply was not stable. There remained immense potential for growth given the persisting seed shortage in Pakistan. The market size and supply problem existed especially for high yielding varieties, of crops such as rice and wheat, which were self-pollinated. With self-pollinated seeds, even when new genetic materials were introduced, farmers could save seeds for several crop generations, without

a major decline in yields. This made it difficult for seed companies to recover the full cost of seeds. In hybrid varieties, by contrast, any seed retained from a crop performed much worse than its parents. Since development costs were more easily recovered, the private sector tended to dominate both breeding and marketing in the hybrid seed segment.

The fraction of seed sown that the farmer bought commercially was defined as its replacement rate. For hybrid varieties, the rate was required to be 100 per cent; for self-pollinated varieties it was as low as five per cent. But even seed of self-pollinated varieties had declining productivity when saved from generation to generation, owing to such factors as off-types, weed seeds and other impurities, and diminishing disease resistance. Several models of private-public cooperation were possible for self-pollinated varieties. Successful cases included public sector breeding and private sector marketing collaborations: but such examples could hardly be found within Pakistan.

THE INTERNATIONAL CONTEXT

Industry trends

Private sector investment in agricultural research and development, by all accounts, has grown rapidly in the developing world in the past quarter century. The growth rate of funding for agricultural research and development by public and international institutions has concurrently decreased. Private sector agricultural research investments in the developing world are also specific to a limited number of crops, markets, countries and technologies. These investments do not represent a comprehensive mechanism for technological transfer and progress, to sufficiently contribute to increasing rural incomes and poverty alleviation in most developing countries.

The growing focus on improving private sector incentives, such as intellectual property rights, has been closely related to the larger issue of open markets, information asymmetries, and efficiency in the agricultural seed and input markets, throughout the developing world. Yet there is unevenness, and no single growth pattern, in private sector investment in agricultural research and development in these countries. This absence of an identifiable pattern did allow for different and innovative approaches to public-private partnerships, which could potentially increase research productivity and spillover benefits. Openness to trade and investment, in products embodying new technologies, increased over the years in many developing countries. The result was increasing imports of improved seeds and other agricultural inputs, along with foreign direct investment in input sectors. Liberalization of domestic markets for agricultural inputs also made it possible for private sector agents to enter the agricultural market, including the seed business, and to compete successfully in local environments. Breakthroughs in genetic engineering and plant breeding from the mid-1980s particularly fostered a new round of technological innovation in agriculture. This factor increased the potential returns to private investment in agricultural research and development.

Agricultural biotechnology (agbiotech) improved the science of plant breeding by allowing for more precise and efficient selection of desirable plant traits, such as disease resistance, herbicide tolerance and valuable agronomic properties. This new technology reduced the time required to develop marketable products and to realize returns on investment. While research conducted by public institutions contributed to building the basic foundations of agbiotech, the private sector took the lead in developing agbiotech

products for the market.[9] Private sector investment in agricultural biotechnology focused on a wide variety of traits, including herbicide tolerance, disease resistance, and agronomic properties. The bulk of this research, however, was physically located in industrialized countries. The major biotechnological applications introduced to developing countries were limited to two traits, both based on technologies developed in industrialized countries.[10] The first was pest resistance, produced from the *Bacillus thuringiensis* (Bt) gene. The second was tolerance for the herbicide Roundup Ready, applicable to four crops: soybean, maize, cotton and canola.

In 2001, approximately 52.6 million ha were cultivated with transgenic crops worldwide, an increase of 19 per cent over the previous year. About a quarter of this area, or 13.5 million ha, was located in developing countries, a 26 per cent increase from 2000. Just three countries, the USA, Canada and Argentina, were host to approximately 96 per cent of transgenic crops under cultivation in 2001. China, Australia, South Africa and Brazil each cultivated between 100,000 - 400,000 ha of transgenic crops, and an additional seven countries cultivated smaller areas.[11] Most transgenic crops were cultivated with seed produced and distributed by the private sector, except in China, where public research institutions and their commercial enterprises played a significant role. By 2000 only 10 developing countries had conducted any sizeable field trials of transgenic crops; and an estimated 87 per cent of these were in the private sector.

Approvals for commercialization of transgenic crops followed a similar pattern of concentration in countries with large agricultural sectors and strong public research systems. Approvals were highest in China (35), followed by Argentina (five), Mexico (four), and Brazil, Uruguay, and Korea (one each), as of 2000-01.[12] These figures indicated that new agricultural technologies, particularly modern agricultural biotechnologies, emerged in only a limited number of developing country markets. However, the growth in cultivation, field testing, and approvals show that these new technologies expanded rapidly, especially in countries not fundamentally resistant to agbiotech. The primary factors in this expansion were twofold: Firstly, to what extent would the diffusion of new technologies be able to generate spillover benefits beyond the sale of improved seed and planting materials: would the new technologies result in increased technical capacity, adaptive innovation and other spillovers in developing countries? Secondly, and equally important, how would the economic welfare benefits of these technologies be distributed between agrarian producers and consumers? While both these issues received increased attention in the literature, there was little empirical evidence available from which to draw conclusions.[13]

---

[9] Spielman D, 2003, 'International Agriculture Research and the Role of the Private Sector', The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research Thematic Working Paper, World Bank, Washington

[10] James C. & Krattiger F, 1996, 'Global Review of Field Testing and Commercialization of Transgenic Plants, 1986-1995:The first decade', ISAAA Briefs No. 1, International Service for the Acquisition of Agri-biotech, Ithaca

[11] ibid

[12] Traxler G, 2001, 'Biotechnology in a Complete System of Genetic Improvement: A Perspective on Developed and Developing Countries', International Food Policy Research Institute Seminar Series, October 18, 2001, Washington

[13] Spielman D, 2003, 'International Agriculture Research and the Role of the Private Sector', The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research Thematic Working Paper, Washington: World Bank

The value of international markets in seed, planting material and other inputs, which embodied the new agricultural technologies, increased every year. Private sector investment in developing these technologies was increasingly dominated by a small number of large multinational enterprises. But the distribution chain and market access were being impacted by a number of intermediaries, often in the informal sector. The ability of multinationals to market inputs, embodying their technologies, was increasingly determined by smaller private sector agents in seed and input markets, rather than solely by the multinationals themselves or even by state-owned monopolies. The industry structure associated with this market was an increasingly complex environment comprising public agricultural research systems, multinational enterprises, private plant breeding and seed production firms, state-owned corporations, and a variety of other agents. Industry structures also varied from country to country, but certain general characteristics remained common to most.

The multinationals were amongst the most significant producers of agricultural research in the private sector. They were particularly important in the agbiotech field, and were increasingly represented by multinational 'life-sciences' firms, with overlapping research and development investments in medicines and pharmaceuticals, chemicals, seed and crop protection, and biotechnology. Life-sciences firms had been conducting basic and applied research on transforming plant varieties with desirable traits through traditional plant breeding, genetic engineering and other scientific techniques. Their outputs included biological improvements embodied in germplasm, planting materials and, most importantly, seeds. The research conducted by such firms was typically highly expensive, owing to the costs associated with scientific capital, product testing and approval processes.

The industry had, therefore, witnessed a rapid consolidation among life-sciences firms during the past decade, reflected in an ongoing process of mergers, acquisitions, joint ventures and other undertakings. Increasing industry concentration was common in sectors characterized by high fixed costs, and intensive use of intellectual property and knowledge capital. Thus, the consolidation process was strongly motivated by product complementarities, economies of scale and scope, acquisition of intellectual property rights and regulatory cost issues.[14] Some industry analysts predicted that this process of consolidation would continue through 2005, at which time only five or six major life-sciences firms would remain in operation, resulting in oligopolistic competition in most markets for products embodying agbiotech.[15]

Although the importance of multinationals as a generator of agricultural research cannot be understated, a significant role was also played by smaller, 'secondary-level' firms. These included companies that adapted traits, developed by life-sciences firms or public institutions, into marketable varieties or products. Secondary firms conducted small levels of applied research that were typically less costly than the research undertaken by multinationals or public research institutions. These firms produced their own stocks of breeder or foundation seed, or did so for the larger firms. With lower fixed costs, many plant breeding firms were more focused, often quite small in size, and operated either

[14] Fernandez-Cornejo & McBride W, 2000, 'Genetically Engineered Crops for Pest Management', Agricultural Economics Report 786, Economic Research Service, U.S. Department of Agriculture, Washington

[15] Spielman D, 2003, 'International Agriculture Research and the Role of the Private Sector', The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research Thematic Working Paper, World Bank, Washington

independently of larger firms or as their subsidiaries. Secondary firms primarily focused on the production, multiplication, conditioning, packaging, and distribution of certified seed and planting material. Multiplication and production was often conducted through contract growers, while the secondary firms did the conditioning and packaging. Their distribution and sales were usually conducted through networks of wholesalers, dealers, and retailers.

The international trade in seeds had grown rapidly over the past two decades. The value of seed and planting material exchanged between countries had more than doubled in this period. Exports of maize, horticultural and herbage crops constituted the largest portion of the seed export market. The international market for seed and planting materials, though significantly smaller than the markets for fertilizer and pesticides, was valued at approximately US $ 30 billion.

Country reforms in the seed sector

The efficiency of seed supply markets in distributing technology to agrarian producers was central to private sector investment in agricultural research. Without efficient markets through which to sell the seed and information, the fundamental incentives to private sector investment were severely limited. A strategy for improving regulatory systems and liberalizing seed markets could reduce the costs of technology transfers and market entry to the private firm, and consequently increase the supply of technology and information to the agrarian producers. After 1980 several countries began to initiate reform.

Regulatory reform in Turkey allowed private firms to increase their share of input markets, and allowed farmers to significantly increase yields and production. Turkey was one of the earlier developing countries to liberalize regulation of agricultural inputs, and welcome private firms delivering technology and inputs. For many years Turkey had regulated seed trade without any special seed law, taking authority from more general laws governing trade and investment. Turkey's seed legislation was first devised in 1963, with Seed Law No 308, which gave its Ministry of Agriculture and Rural Affairs (MARA) authority over seed production, domestic trade, imports, and exports. Prior to reforms in the 1980s, MARA used its authority to restrict private seed trade primarily to vegetables. Even here, smuggling provided a significant share of vegetable seeds, including for many years all hybrid watermelon seeds. Other inappropriate seed policies included government inability to popularize hybrid maize, while the large and expensive public seed agencies served less than 10 per cent of planted area.

Frustrated with these and other difficulties, officials decided to stimulate rapid expansion of Turkey's private seed industry, and to invite multinational seed companies to participate. In 1981, Turkey asked the International Finance Corporation (IFC) to help promote private seed production and trade. The IFC in turn asked the Industry Council for Development (ICD) to identify seed markets, to evaluate strategies for private participation, and to suggest policy changes. The ICD recommended that Turkey eliminate price controls on seeds, and allow free import by private organizations for testing and marketing purposes, subject only to phytosanitary import regulations. The ICD’s suggestion, of allowing free imports for marketing, entailed eliminating compulsory variety registration. The government acted quickly to liberalize the seed market, though reforms fell short of dismantling compulsory variety registration. The government also relaxed controls on private foreign investment, and made credit available for seed companies.

Following Turkey's seed reforms in the early 1980s, the number of improved varieties allowed for sale, with either import or production permits, began to increase dramatically. For sunflower, the number of varieties increased from three in 1982 to about 30 in 1987. For soybeans, varieties increased over the same period from two to more than 40. Many of these new varieties had been introduced and tested by private seed companies, as part of their efforts to expand seed sales. Even for crops with strong public sector involvement in the seed trade, the 1980s reforms brought increases in numbers of varieties available, through both public and private efforts. In wheat, the government allowed a total of only 21 improved varieties in 1982. After the reforms, the government approved an average of five new varieties per year between 1984 and 1994.[16]

Other countries similarly reformed the regulation of agricultural inputs. These included Chile (in the 1970s), Bangladesh and India (in the late 1980s), Malawi (in 1995-96), and Romania (in 1997). Constraints imposed on private sector development in agricultural research differed from country to country. In India government regulations barred both large Indian firms and firms with majority foreign equity from plant breeding and seed production until the late 1980s. Import regulations on germplasm further prevented private sector interests from importing germplasm for plant breeding purposes.[17] In the 1990s, economic liberalization allowed for private sector activity in plant breeding and seed production, including joint ventures and technical collaboration with foreign firms, and imports of new technologies.

The ICD also proposed reforms along the Turkish lines for Pakistan, in a 1986 report on developing a commercially viable seed industry. From freer imports of foreign varieties into Pakistan, the ICD recommended easing controls on the private sector in testing, certification, truth to labelling, production, marketing, extension and research. While several constraints were eased in practice, the government vacillated over a new national seed law, to provide legal and legislative cover for liberalization.

Information asymmetry problems in seed markets were also a key challenge to the diffusion of new and beneficial technologies to agrarian producers. Information asymmetries and market inefficiencies persisted even with the growth of market size, liberalization of overly regulated markets, and improvements in the incentives facing private seed firms. Specifically, since genetic qualities of seeds were indiscernible except through utilization, experience or reputation, firms and governments needed to improve their ability to transmit information on inputs appropriate to their consumers' specific needs. In many developing countries, the institutions and market incentives designed to reduce these information asymmetries remained weak. Thus poor certification systems, problematic incentives for input merchants, limited extension services, and weak consumer protection served to sustain information asymmetries and seed market inefficiencies.[18]

---

[16] Gisselquist D & Pray C, 2000, Deregulating Technology Transfer in Agriculture: Reform's Impact on Turkey in the 1980s, World Bank, Washington.

[17] Operations Evaluation Department, World Bank (1995). Bangladesh, India, and Pakistan Seed Projects. OED Project Evaluation, Operations Evaluation Department, World Bank, Washington, D.C.

[18] Tripp R, 2001, Can Biotechnology Reach the Poor? The Adequacy of Information and Seed Delivery', Food Policy No. 26, pp. 249 264.

There were numerous studies citing the need for improved seed market efficiency, to support the diffusion of improved seed varieties, and to stimulate private sector investments in agricultural development. World Bank evaluations of its seed projects in South Asia recommended the break-up of state-owned seed monopolies, the removal of barriers to entry by private agents, elimination of subsidies to the public sector, and independent testing and certification processes.[19]

An important distinction existed between market liberalization and deregulation policies designed to stimulate the entry of private agents into seed markets. Liberalization entailed privatization of state-owned seed monopolies, reduction of barriers to entry, and relaxation of germplasm and seed import restrictions, and was pursued in a number of developing countries. Deregulation, on the other hand, was a more complex issue. Regulations designed for seed markets were often established to reduce information asymmetries. Changes in the regulatory structure attempted to support the private sector's ability to protect systems that improved the transmission of information. An effective reform policy also needed to focus on strengthening the ability of government agencies and private firms to execute and manage regulations, such as standards for seed certification, packaging information, and other forms of information disclosure. Related reform measures included reorganizing regulations for variety registration and performance testing, shifting public regulatory agencies to technical and policy support, and simultaneously strengthening intellectual property rights pertaining to plants and plant materials.[20]

Regional case studies illustrated the relationship between efficient seed markets, institutional changes and private sector investment in agricultural research and development.[21] Seed industry reforms in India from the late 1980s expedited private sector involvement and growing competition in India's seed markets. Decline in restrictions on domestic and foreign investment, and on imported research and development inputs, led to increased investment and competition in India. The Indian experience showed that growth in private sector research investment could potentially lead to a productive reallocation of scarce public resources. Also, research and development focus widened from maize and sunflower to other crops, such as wheat, pulses, oilseeds and rice, and from applied to basic research, thereby generating spillovers valuable to the private sector. Significant increases in private investment in maize research also occurred, along with increasing competition from new private sector entrants into the maize seed market.[22] A similar trend in rice markets in Andhra Pradesh was noted, where private seed firms were marketing open-pollinated rice varieties.[23]

In sub-Saharan Africa, the relative absence of a commercial seed sector, and the related issue of low adoption rates of new plant varieties, was attributed to a number of persistent policy issues common to the region. Regulatory policy regimes across the region favored state-owned enterprises and inhibited commercial entry into the seed sector. For example, policies governing the testing, approval and release of new varieties often favoured those

[19] OED, 1996, The Seed Industry in South Asia, World Bank, Washington

[20] Tripp R, 2001, "Can Biotechnology Reach the Poor? The Adequacy of Information and Seed Delivery', Food Policy No.26, pp. 249-264.

[21] One example for Latin America and the Caribbean area is given in Kosarek, J., Garcia, P., & Morris, M. (2001). Factors Explaining the Diffusion of Hybrid Maize in Latin America and the Caribbean Region. Applied Economics, 26(3), 267- 280.

[22] Morris M, 1998, 'Maize Seed Industries in Developing Countries', CIM-MYT, Boulder

[23] Tripp R & Pal S, (2001), 'The Private Delivery of Public Crop Varieties: Rice in Andhra Pradesh', World Development No. 29(1), pp. 103 117.

produced by the national research systems, over foreign and private sector varieties. Added to these constraints were limited resources and capacity to facilitate private sector firms wanting to introduce new varieties to the market.

Seed produced by state-owned firms continued to dominate seed markets with effective monopoly power, despite poor cost recovery, high costs to agrarian producers and limited varietal offerings. Discussions over regional harmonization of regulatory regimes for agricultural seed, designed at reducing non-tariff barriers and promoting larger, more accessible markets for private firms, met with stiff resistance in regions such as southern and eastern Africa. These problems were compounded by free seed distribution programs in times of crisis, which often persisted even after the crisis had subsided, often providing seed of unknown or inappropriate quality. Even when such programs turned to private sector firms for purchasing seed, they tended to centralize purchasing through government or relief agencies, thereby discouraging the development of wholesale and retail trade channels.

Thus, policy options designed to expand private sector investment in agricultural research needed to address key institutional and market deficiencies. Apart from liberalizing regulations and markets dominated by the public sector, developing regions could also benefit from improvements in the linkages between public breeding programs and commercial seed production, distribution and marketing.

Public-private partnerships

The incentives to private sector investment in seed research and development across the world remained contingent upon improvements in the institutional deficiencies relating to efficiency and information in seed and input markets. These improvements included strengthening testing and certification systems, consumer protection, farmer education, dissolution of state owned monopolies, and other related strategies. They could only be accomplished with participation by both public and private actors. With a more constructive set of signals to private enterprise, agrarian producers could better recognize and adopt new technologies, thereby increasing agricultural productivity and output.[24]

In India, private firms frequently hired plant breeders from public agencies, who brought with them information and knowledge on improved plant varieties. AgriEvo/Plant Genetic Systems (PGS) conducted collaborations with the Brazilian Agricultural Research Corporation (EMBRAPA, a public institution), the International Rice Research Institute (IRRI) in the Philippines, and the International Potato Center (CIP) in Peru, to train staff from the public and international agencies. Exploitation of intellectual property rights were allocated in the latter two partnerships, such that PGS obtained exclusive rights for industrialized countries and non-exclusive rights for developing countries, while IRRI and CIP obtained non-exclusive rights for developing countries.

Another type of collaboration was joint ventures between the private sector, typically multinational firms, and public sector institutions. In Brazil, Monsanto and EMBRAPA entered into a joint venture on development of transgenic soybean. EMBRAPA supplied the soybean varieties and Monsanto provided the desirable gene sequences, while both

[24] Spielman D, 2003, 'International Agriculture Research and the Role of the Private Sector', The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research Thematic Working Paper, World Bank: Washington

collaborated on the transformation technology. Distribution of these transgenic soybeans occurred through Monsanto's commercial networks in Brazil. Royalties from sales accrued to EMBRAPA went to fund research into sustainable soybean production. In China, such collaborations worked in different directions: one foreign firm (Ricetec, a US company) worked with a public agency (the Hynan Hybrid Rice Research Center, which held a US patent on a hybrid rice production system) to improve grain quality and breeding techniques. Other foreign firms worked with public agencies to develop plant-breeding programs to supply seed markets in China, utilizing foreign cultivars owned and introduced by the foreign firm. However, there was limited progress on this front.

There was also a growing role of research foundations established and funded by the private sector. Because of their non-profit status, many of these foundations served as important conduits for technology transfers and investment between the public and private sectors. Research foundations were able to receive money from government agencies and private sector firms alike to undertake research projects and contract other public agencies and private firms to conduct research on their behalf. In India, the Indian Council of Agricultural Research, a public sector institution, received funding from the Maharashtra Hybrid Seed Company (MAYCO) Foundation, for hybrid rice research, while the MAYCO Foundation itself received funds from ICAR and the Rockefeller Rice Biotechnology Network for other research projects.

A unique approach to public-private partnerships was evident in China. China was pursuing new biotechnologies in a pattern quite distinct from other developing countries. It was doing so with support from large public sector research institutions, and commercial spin-offs set up by these bodies. China quickly expanded its plant biotechnology capacity, rapidly introducing Bt cotton, and testing a wide range of transgenic crops including rice, wheat, potatoes and peanuts.[25] The success of China could serve as a model to its neighboring developing countries, including Pakistan.

The GMO Debate and Pakistan

With rising populations and increased pressure on land and other resources around the world, agricultural productivity became an increasingly important consideration for governments. The Green Revolution tried to increase agricultural productivity using machinery and chemicals, which raised productivity but had adverse environmental costs and led to land degradation. The simultaneous need for food security and environmental sustainability implied focus on increased production, quality and competitiveness, and also brought attention to the bio-safety regime in both developed and developing countries. Proponents of GMOs argued that biotechnology boosted food security for the world's growing population, by raising sustainable food production. It was also advocated as being beneficial to the environment by reducing the need for more farmland, irrigation and pesticides.

The critics of biotechnology felt that it displaced traditional agriculture and farming in the Third World, eroded (agro) bio-diversity of the region and threatened livelihood of the very custodians of genetic agri-resources, poor farmers, making them dependent on food imports. GMOs, in the form of GM food, plants and animals, were considered a threat to bio-diversity that could potentially multiply the resistance and virulence of pathogens.

[25] Pray C & Fuglie K, 2001, 'Private Investment in Agricultural Research and International Technology Transfer in Asia', Agricultural Economics Report 805, U.S. Department of Agriculture, Washington

There were 5-80 million different species on this planet, of which less than 1.7 million had been described by institutional science. The innovators, be they in farming communities or in corporate or state laboratory settings, all sought to manipulate this genetic diversity. The multinationals capitalized on biotechnology, having secured patents on their innovations. They used these to maximize profits, through control of markets and supply chains, ranging from production to retail outlets. The control of global seed markets in general, and that of GM seeds in particular, was taken over by a handful global giants, including Monsanto, which owned Bt and glycophosphate resistance transgenic patents.

Multinationals expanded their markets during the Green Revolution, when farmers turned away from traditional varieties to adopt modern strains that promised better yields and better resistance to pests and disease. Although it provided incentives to plant breeders to develop the new improved varieties, the Green Revolution strengthened intellectual property rights, and was criticized for contributing to a decline in diversity. However, high-yielding varieties (HYVs) had already displaced less profitable crop seeds. With the advent of free trade arrangements, such as the forthcoming WTO agreements, corporations could increasingly prevent access to their patented genetic resources, through exercising their exclusive rights. The area planted with GM crops was estimated at almost 60 million ha, or 4 per cent of the world's arable land. Sales of GM seeds had fetched more than US $ four billion in 2002. Half of the world's soybean crop was genetically engineered. Four crops alone - maize, soy, canola and high yielding forms of cotton - accounted for an overwhelming share of the GM crop planted area. The production of GM wheat, as well as many horticultural crops, was also increasing.

GMOs were also recognized in international legislation, including the WTO framework. The WTO agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) set comprehensive rules and standards for intellectual property rights, to be adopted by all WTO member countries from 1996 onwards. Section Five of TRIPS obliged member states to provide patent protection for all inventions, both products and processes. Clause 27.3b of Section Five mentioned how plants and animals were to be patented. TRIPS also included the right of exemption to WTO members in granting patents for plants and animals (other than micro-organisms). However, if members wished to deny patents to plants, these required protection through some effective *sui generis* regime. The drafters of the TRIPS Agreement relied on the existing framework of the International Convention for the Protection of New Varieties of Plants (UPOV Convention), a regime that many countries were already using. Some developing countries created their own *sui generis* systems, citing aspects of UPOV on which they wanted to improve.

The TRIPS Agreement was criticized for being a protectionist device, promoting corporate monopolies of seeds, genes and medicines. Critics were concerned that transnational seed companies, through genetic modification technology, had acquired patents and would eventually control everything, from genes, seeds, plants, and agricultural harvests to foodstuffs. This prospect brought forth a fear of unfair and unequal competition between monopolistic multinationals, and farmers with little bargaining power. Farmers lacked the scientific capability to innovate and patent genetic materials, and were unable to catalogue the natural resources they possessed. On the other hand, biotech life science companies were putting increasingly more resources and expertise to patent these genetic materials.
The UN Convention on Biological Diversity had also recognized the sovereign rights of states over their biological and genetic resources. The Convention argued for the protection and promotion of the rights of communities, farmers and indigenous people, including their customary use of biological resources and knowledge systems. According

to the United Nations Environment Program, biotechnology had an immense potential for improving human welfare, but it also posed potential risks to biodiversity and human health. With the science of biotechnology advancing at such a rapid pace, it became vital for developing countries, and countries with economies in transition, to have the human resources and institutions needed for promoting biosafety.

Trade-related standards, particularly those related to food quality and safety, had to take into account the specific needs of the stakeholders in developing countries. For this purpose, broader participation of all stakeholders was needed. National governments needed policy space to decide whether a GM crop, food and animal should to be introduced and propagated in their country or not. The EU exercised this right when consumer activism compelled their governments to place a moratorium on GMOs, and GM food was recalled from retail outlets. Given the prospects of biotechnology, and with regard to valid criticism regarding GMOs, an institutional mechanism for weighing benefits and burdens, and assessing risks and rewards, of GMOs became vital for all countries, whether developed or developing.

The Pakistani government opened its agricultural markets to foreign investment under international trade agreements. In addition, the government moved to introduce the Plant Breeders' Rights law to fulfill obligations under the TRIPS agreement, a long-standing demand of multinational agribusiness companies. The government stated its support of the public breeding program, in order to ensure the availability of better varieties, and quality seed, for the benefit of farmers. Pakistan had a breeding program that until recently was entirely dominated by the public sector. With the emergence of the private sector, and its linkage to international trade, the seed market expanded rapidly. The multinational seed companies required legal protection to introduce and market their seed varieties. Pakistan was a signatory to the WTO and TRIPS agreements, and was thus obliged to provide minimum levels of protection, either by patents or an effective *sui generis* system, or by any combination thereof, under Section 27.3b of the TRIPS agreement.

The FSCRD initiated the draft of Plant Breeders Rights (PBR) Act, in accordance with 1978 and 1991 International Union for the Protection of New Varieties of Plants Conventions.[26] The Government of Pakistan did not include most of the concerns expressed by food rights activists in the final draft of the PBR law. For example, there was no provision in the PBR that would require companies responsible for genetically modified or new transgenic varieties to pay compensation for hazards and damages to the environment and human health. The draft PBR Act was accepted in principle, and awaited ratification by the parliament. By the mid-2000s this had still not occurred.

A major concern in countries like Pakistan was that indigenous genetic assets, and livelihood resources of the already disadvantaged and marginalized small farmers, not be eroded. There were fears that under the TRIPS agreement and the PBR Act, farmers would be restricted from continuing centuries old traditional systems of seed storage, sharing and multiplying. The needs of increasing productive capacity, as well as seed regulations, were also pressing. It was reported that unidentified GMOs were entering the Pakistani market from Australia, the United States and neighboring China, and could be potentially hazardous. The only way to mitigate damage could be to regulate, by asking the importers to obtain a certificate from the seed department, after disclosing the name of the

[26] FSCRD 2002, *Focus on Seed Programs,* Federal Seed Certification and Registration Department, Islamabad

manufacturer and other characteristics of the seeds. Government officials maintained that obliging importers to show the source of their GM seed imports at least allowed the government to keep track of seeds coming into the country.

The black market in GM seeds continued to thrive. GM corn, wheat, cotton and vegetable seeds, with a reputation of producing high-yielding crops that required few outlays on pesticides or fertilizers, were also available unimpeded in Pakistan. With weak and ineffectual governments, and with public functionaries actually living off the rents from corruption, and hence representing the wrong doer rather than the public interest, markets like Pakistan threatened to be inundated by GM seeds and products. A packet of such genetically altered cottonseeds was estimated to cost as little as US $ 2.[27]

Pakistani policy makers had hoped that, by lifting the ban on imports of such seeds, and going for better regulation (Truth in Labeling Act, 1991), they would get more control over the use of genetically altered products. Yet activists worried that the Pakistani government was easing up on GMO rules, at a time when its budding biotechnology sector was still without comprehensive guidelines to regulate the commercial use of GMOs. Biotechnology experts, working on indigenous GMOs at the National Agriculture Research Center and the National Institute of Biotechnology and Genetic Engineering, were pressing the government to enact bio-safety laws under the UN Convention on Biological Diversity, which Pakistan ratified in 1994. Farmers' rights activists and non-government groups claimed that the government's rules for GMOs needed to go beyond laboratory or transportation handling, as outlined in UN instruments. They argued that these guidelines did not cover the trade in GM products, nor adequately protected against potential adverse effects on the environment and on human health.

The seed industry in Pakistan has been fairly contentious. An effective agribusiness strategy would need to recognize the complementarities between different stakeholders. Only on the basis of these strategic fits can the seed industry be structured to simultaneously offer the private sector opportunities to grow, protect the seed security of local farmers, and ultimately meet the ongoing deficiency in the national seed supply.

[27] INSEAD Global Update, http://knowledge.insead.edu/index.cfm

Exhibit 1
The Seed Business in Pakistan

Agricultural Profile of Pakistan

NUMBER AND AREA OF HOLDINGS CLASSIFIED BY SIZE OF TOTAL AREA OF HOLDINGS		
Holding size classes	Number of holdings	Area (ha)
Total	5 071 112	19 252 672
Under 0.5 ha	678 538	193 126
0.5 and under 1 ha	689 233	510 397
1 and under 2 ha	1 036 286	1 446 796
2 and under 5 ha	1 698 682	5 283 232
5 and under 10 ha	623 110	4 134 346
10 and under 20 ha	237 929	3 032 872
20 and under 60 ha	91 831	2 613 767
60 ha and over	15 354	1 935 101
Government holdings	149	103 035

LAND TENURE OF HOLDINGS (excluding government holdings)	Number of holdings	Area (ha)
Total	5 070 963	19 149 637
Holdings under one form of tenure	4 444 545	15 514 874
Owned or in ownerlike possession	3 490 988	12 433 598
Rented from others	953 557	3 081 276
For a fixed amount of money/produce	-	716 429
For a share of produce	-	2 305 793
Under other rental agreements	-	59 054
Holdings under more than one form of tenure	626 418	3 634 763

FARM POPULATION BY AGE AND SEX	Total	Male	Female
Total	93 973 600	49 017 400	44 956 200
Under 10 years	34 740 300	17 954 700	16 785 600
10 years and over	59 233 300	31 062 700	28 170 600

EMPLOYMENT IN AGRICULTURE	Holdings reporting	Workers
Household members, 10 years of age and more, engaged mainly in agricultural work on the holding	-	17 455 931
Hired permanent workers	228 526	486 913
Hired occasional workers	2 556 946	-

LAND USE	Area (ha)
Cropland	15 631 547
Land under crops	14 980 612
Land temporarily fallow	650 935
Wood or forest land	304 380
All other land	3 316 745

IRRIGATION	Area (ha)
Normally irrigated land	12 566 861

Source: Pakistan Agricultural Research Council

Exhibit 2
The Seed Business in Pakistan

Seed Production and Supply in Pakistan

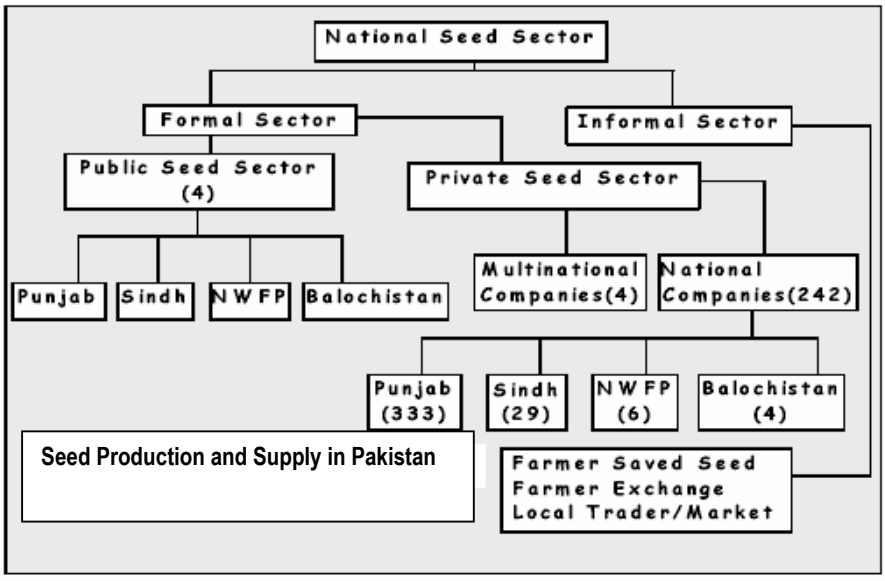


Exhibit 3
The Seed Business in Pakistan

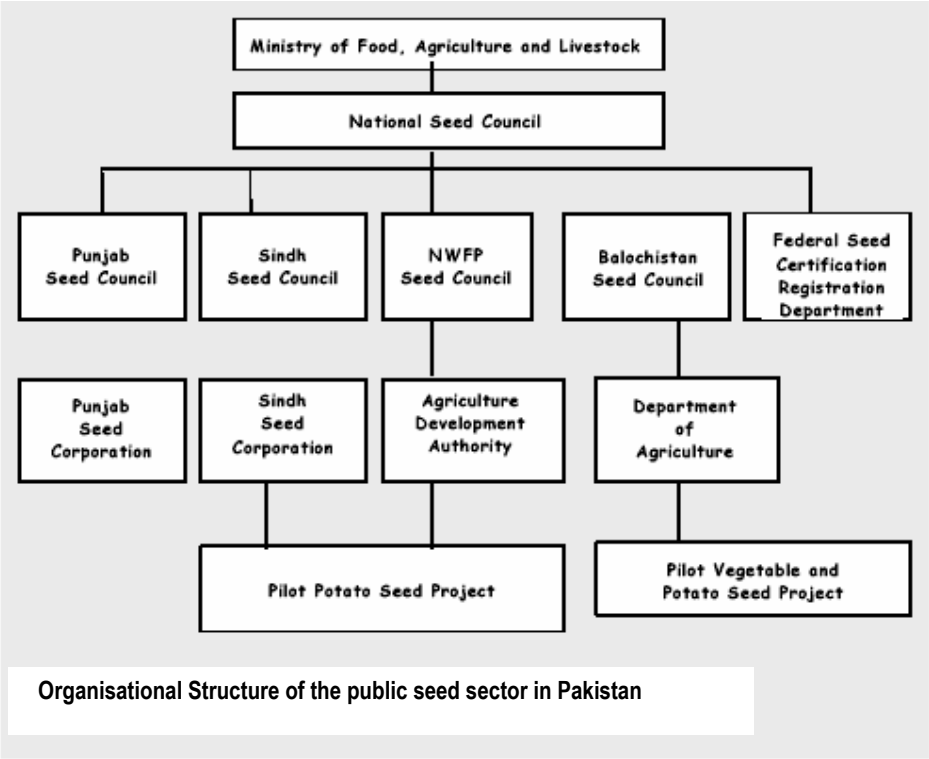
Seed processing and storage capacity in Pakistan - 2000

Seed sector	Seed processing			Seed storage capacity(mt.)
	No. of plants/ units	Cost Rs. (Pak.) million	Processing capacity (mt.)	
Public sector seed agencies	36	178.872	216150	50623
National private seed companies	103	229.783	239496	178772
Multinational seed companies	4	410.00	19408	14325
Total (Pakistan):	**143**	**818.655**	**442654**	**243720**
Percentage of seed processing and storage capacity against the estimated seed requirement.			**(35.43%)**	**(18.17%)**

Source: Federal Seed Certification and Registration Department

Exhibit 4
The Seed Business in Pakistan

Organizational Structure of the Public Seed Sector



Organisational Structure of the public seed sector in Pakistan

Source: Federal Seed Certification and Registration Department

Exhibit 5
The Seed Business in Pakistan

Engro's Hybrid Seeds

1. Maize

Bemisal 202 is a yellow grain hybrid with a yield potential of 120 monds per acre. It suits best to spring climate of Faisalabad, Chiniot and Gujranwala, whereas autumn climate of Sahiwal, Okara, Pakpattan and NWFP.

2. Sunflower

Bemisal 205 has highest oil contents of 47 per cent with a yield potential of 35 monds per acre. It suits to the climate of lower Sindh.

3. Sorghum

Bemisal 203 is high protein fodder and suits all climates of Pakistan. It gives 5-6 cutting with 500 monds per acre potential for each cutting.

Source: Engro-Pakistan

Exhibit 6
The Seed Business in Pakistan

Monsanto's Seeds

Spring Corn

7877 / 7777 -- Remained industry standard for several years; yield potential of over 10 MT / Ha.

- Early maturity.
- Excellent standability.
- Very high seed recovery.
- Quick dry-down.

7878 -- Yield beyond 10 MT per Ha.

- Extended pollination time.
- More heat tolerance.
- Hot product for late planting.

MAGIC -- New introduction during 2000.

- Good tolerance against mites, heat and stress.
- Yield potential beyond 10 MT / Ha.

Autumn Corn

922 -- Big / uniform Cobs.

- Excellent heat tolerance.
- Yield potential beyond 9 MT / Ha.

919 -- Yield potential beyond 9 MT / Ha.

- Excellent kernel weight and color.
- Stable performer even in the low-tech segment.

707 -- Yield potential beyond 6 MT / Ha.

- Short maturity.
- Excellent standability.
- Most suitable for green cobs.
- Excellent tolerance to drought and other stresses.

3549 / 2021 -- White hybrids for NWFP.

- Good yield.
- Good standability.
- Resistance against leaf blights.

Sunflower

SF - 187 -- High yield.

- High oil contents.
- Excellent adaptability.
- High disease resistance.
- Medium duration.
- Medium height.
- Excellent standability.

SF - 177 -- High yield.

- High oil contents.
- Medium height and duration.
- Excellent standability.

CRN - 1435 -- Yield potential; 4 MT / Ha.

- Full season hybrid.
- Big flower and head.
- Good heat tolerance.

SH - 3322 -- Good yield.

- Short duration.
- Wide adaptability.

Forage Sorghum

- Excellent and fast re-growth.
- Nutritious green fodder.
- Excellent palatability.

Wheat, Cotton and Rice

- Promised high yield varieties.
- Exceptional genetic and physical purity guaranteed.
- Seed quality standards better than official standards.

Source: Monsanto-Pakistan

Exhibit 7
The Seed Business in Pakistan

Monsanto and the Bt Cotton Controversy

Monsanto maintains that its Bt cotton is genetically enhanced to resist major caterpillar pests, including tobacco bollworm, bollworm and pink bollworm, among the most damaging insect pests worldwide. Having made inroads into India, Monsanto is trying to break into the Pakistani market to sell GM cottonseeds. Pakistan is short of water and Monsanto argues that Bt (bioinsecticide) cotton needs less water than the staple food crops. Monsanto points out that countries using Bt cotton have reported a significant drop in the use of insecticide sprays. In China and Mexico, total insecticide use has fallen by 60-80 per cent following the introduction of Bt cotton. In India, cotton farmers account for the sale of nearly 50 per cent of broad-spectrum insecticides. But, in the case of pest attacks on conventional crops even 12-14 sprayings with insecticides could not save the crop. Since insecticides are costly, it may not make much economic sense for farmers to spray their fields when the level of infestation is low. With the use of Bt seeds, plants are protected all the time, so farmers don't need to forgo even small portions of the crop. However, opponents of Bt cotton say it will become vulnerable to pest attack in the long run as pests will develop resistance. Also Bt genes escaping from pollen grains will harm neighboring crops' bio-diversity.

Cotton is vital for Pakistan's economy. Cotton is Pakistan's major cash crop, accounting for 40 per cent of its US$10 billion foreign exchange earnings annually. Research work on transgenic cotton began in the mid-1990s. This was conducted by Pakistan's Nuclear Institute for Biotechnology and Genetic Engineering, after successive cotton harvests were hit by pests, causing extensive damage to the country's economy. In September 2002, farmers in Pakistan's Hyderabad district complained to the Ministry of Agriculture that 1,600 ha of planted cotton had been hit by an unknown disease, turning the otherwise white flower of the cotton plant red. Following an inspection of the site, government scientists declared that genetically engineered cotton, or Bt cotton, smuggled from Australia through luggage, had been sown on the land, despite a government ban on such imports. The exact cause of the reddening disease is still being investigated. In January 1998, the National Biosafety Expert Committee was established. Despite the ill effects recently attributed to GE cotton, Pakistani scientists have long held that GE cotton varieties could be created to ensure a disease-free crop that would result in low costs for farmers and greater predictability in export earnings. Cotton curl-leaf disease alone causes $ 120 million in losses every year.

Monsanto has publicly denied reports that it is planning to introduce transgenic cotton in Pakistan, but maintains that it can increase farmers' profitability, reduce environmental pollution and enhance quality of life. The National Commission on Biotechnology wants to take a 'balanced approach' towards Bt cotton. The Commission rejects the idea that Monsanto will acquire a monopoly on the seed business, arguing that this could happen only if Pakistani scientists were prohibited from undertaking research. However, farmers' rights activists allege that under this, farmers will not be able to save, exchange or share seeds for commercial use. At present, more than 85 per cent of farmers in the country set aside a portion of the annual harvest for future use as seed. Opponents of transgenic cotton also argue that it would hurt exports of the crop. It is felt that introduction of transgenic cotton will badly hurt export earnings. Such varieties have failed to earn acceptance in many countries where Pakistani exports of cotton and its products are destined, including western European markets, where genetically engineered crops are facing severe resistance from consumer groups.

Source: Sustainable Development Network

Exhibit 8
The Seed Business in Pakistan

Pioneer's Seeds

Types of Major Seeds **Characteristics**

Pioneer single cross hybrid seeds have many varieties under this category: 32F10, 3335, 34G13, 3203W.

Their seed rate is 10-12 Kg per acre. The average yield from this seed ranges between 120-150 mounds per acre.

Pioneer Hybrid Sorghum seed is designed to be disease resistant and can survive water shortages. Its seed rate is 2-3 kg per acre.

A farmer can earn 5-6 cuttings from this fodder. The total yield of this fodder is on average 2000 mounds per acre. It survives well during the hot season.

Source: Pioneer-Pakistan

Exhibit 9
The Seed Business in Pakistan
National Seed Requirement (in 000 mt) for 2000-01

Crop	National Seed Requirement	Seed Available			per cent	Gap (per cent)
		Local	Import	Total		
Wheat	846.2	161.4	-	161.4	19.1	80.9
Cotton	59.3	32.0	-	32.0	54.0	46.0
Gram	38.9	0.23	-	0.2	0.5	99.4
Paddy	50.3	3.82	-	3.8	7.6	92.4
Lentil	1.1	0.00	-	0.001	0.1	99.9
Mung	4.4	0.3	-	0.3	6.9	93.1
Potato	221	0.4	0.83	1.2	0.5	99.5
Maize	26.8	2.1	3.143	5.2	19.5	80.5
Canola	0.7	0.1	0.04	0.1	20.1	79.9
Sunflower	1.3	0.1	0.36	0.5	36.4	63.6
Soybean	0.8	0.1	-	0.1	12.9	87.0
Fodders	14.5	0.04	10.98	11.0	76.1	23.9
Vegetables	5.1	0.2	3.37	3.6	70.34	29.7
Total	1270.4	200.8	18.7	219.4	17.3	82.7

Source: Federal Seed Certification and Registration Department