AGRICULTURAL RESEARCH IN PAKISTAN'S PRIVATE SECTOR

A Consultant's Report

by
Dr. Mumtaz Ahmad
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sponsored by PARC, USAID, and the MART Project

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1. SUMMARY

Private research in agriculture and related fields is limited to adaptive research as an off-shoot of business related activities of the corporate sector engaged in marketing, distribution, and processing of agricultural commodities and inputs. The political and economic environments of past eras have deterred the private sector from investing much in research activities which did not provide immediate gains. Although some private research and development efforts were being done as early as the 1950's, the task of conducting agricultural research remained largely with the public institutions. The Pakistan Tobacco Company, Burmah Shell, and British Cotton Growers' Association, (Khanewal) can rightly be called the pioneers of private sector research in Pakistan.

The launching of the Fifth Five-Year Plan in 1978 revived the private sector because it liberalized some of the industrial controls and provided incentives. During the Plan period (1978-83), the industrial growth rate was over 9 percent a year. The Sixth Five-Year Plan (1983-88) envisaged a shift of emphasis from a strategy of agricultural growth based on subsidized inputs and price support policies to "vertical improvement" policy packages, more deregulation and reduction or elimination of subsidies. It was during this period that most subsidies on fertilizers, pesticides, and wheat were withdrawn. Deregulation of rice procurement also came during this period.

It has been the politico-economic environment of the past ten years that encouraged private sector research investments in agriculture and related fields. A small but sure beginning of the private seed industry owes its birth to this environment. Strong problem-oriented plant protection research activities in the private sector, independently and in cooperation with public institutions, also were initiated during this period upon the implementation of the New Agricultural Policy in 1980, when the subsidy on pesticides was completely withdrawn. These activities, made worthwhile by the prospects of economic returns, generated a wealth of information in plant protection technology and its application to agriculture in Pakistan. The phenomenal breakthrough in cotton yields is one major contribution of research and development by private sector pesticide companies. In the agricultural machinery sector the denationalization of tractor imports and production in 1981 induced entry of three private sector companies into tractor assembly-cum-manufacture ventures.

In the processing of agricultural commodities liberalized policies helped processors set up a variety of agro-based industries. These industries brought in imported machinery and the technology that came with it. Considering existing local conditions and available raw materials, the adoption of imported technology usually requires an adaptive R&D program. These developments brought with them expatriate technician-trainers as well as provided opportunities for local manpower to be trained

within the country and abroad.

With the introduction of imported machinery and manufacturing plants the need for spare parts and maintenance created an entrepreneurial opportunity for the development and manufacture of spare parts. In certain areas local expertise was developed to the extent of fabricating complete units, using locally manufactured components.

In the case of tractor manufacture, a 50 percent deletion of imported parts has already been achieved. In the case of paper and board mills, food processing, and milk and dairy plants as much as 60 percent deletion is now possible with locally produced machines. In the manufacture of irrigation pumps, electric motors and medium sized diesel engines Pakistan enjoys virtual self reliance.

Over the years, primary industries based on agricultural output, such as wheat milling, rice husking, and oil extraction have mostly come to depend on local manufacturers of machinery. In the case of secondary industries like sugar refining, milk and milk products, packaged meat and poultry products, processed and preserved fruits and vegetables, biscuits and cereal products, fish products, cigarettes, cotton textile and yarn, paper and board, and leather products local manufacturers are now capable of 30 to 70 percent deletion. A similar situation exists for tertiary agriculture-based industries.

It is very difficult to estimate the amount being spent by the private sector on research in agriculture and related

disciplines. Often the figures given for R&D include promotional expenses that the company spent on the lengthy and tedious process of registration. However, a reasonable estimate of R&D expenses of major private sector establishments may be as follows:

Industry	Expenditure Rs(m)	Manpower in R&D			
		Ph.D	M.Sc.	B.Sc	Technician
Seed Industry	5.3	4	13	15	32
Fertilizer Industry	4.2	3	15	26	35
Plant Protection (Pesticide Industry)	9.8	1	40	47	242
Paper & Board Industry	2.5	1	3	2	5
Tobacco Industry	8.6	2	36	41	118
Poultry, Livestock & Dairy Industry	3.8	-	80	70	130
Food Processing Industry (including Milk Plants)	2.0	2	10	15	60
Sugar Industry	2.0	3	4	6	10
Miscellaneous	1.0	-	10	20	40
Total :	39.0	16	211	242	672

From the estimates of R&D expenditure of the private sector, it would appear that against 1985-86 agriculture sector contribution of Rs 113 billion to Gross National Product (GNP), private sector investment on R&D of Rs 39.2 million is only 0.03%. In nearly all cases research and development activities of the private sector are interlinked with each other. This is true of major investors in R&D, i.e. pesticide, seed, fertilizer,

poultry, livestock, and dairy industries. Their real investment in research, divorced from development, comes to about 40% of the aggregate amount spent on R&D. Investment by the tobacco and the sugar industries is, however, mainly on research.

OVERVIEW OF PAKISTAN'S AGRICULTURAL PRODUCTION

Agriculture is the mainstay of Pakistan's economy and provides the livelihood for the majority of its population, directly or indirectly. The well-being of Pakistan's citizens lies in their success in the field of agriculture. During the years immediately after independence the performance of the agriculture sector was poor. The low productivity growth rate of the agriculture sector, coupled with the high population growth rate, decreased per capita availability of domestic food. The poor performance of the agricultural sector was mainly because government considered economic development to be synonymous with industrial development. Although the First Plan (1955-60) recommended high priority for agricultural development, government policies continued to favor industries. In fact the policies of government envisaged a transfer of resources from agriculture to finance industrialization. The terms of trade operated against agriculture and in favor of industry through the over-valued rupee, which affected agricultural exports adversely. Consequently, Pakistan had to export scarce resources to import food grains. However when the production of agricultural raw materials for industries declined, the government realized that it should give more serious attention to agricultural development.

The Land Reforms of 1959 presented a rational land tenure policy for creating an economically viable, socially free, and politically stable society. On the recommendation of the Food

and Agriculture Commission an Agricultural Development Corporation was constituted for providing knowledge and means to the farmers for increasing agricultural productivity.

The stage was set for increased agricultural productivity and this sector achieved accelerated annual growth rates. Unfortunately, these achievements were partly neutralized by a drought in 1962-63. The increase in production was the result of improvements in yield, increase in cultivated area, more availability of irrigation water, and emphasis on agricultural research. During the Second Plan period compulsory procurement of wheat below market prices was abandoned and the roles of agricultural education, research, and extension were greatly emphasized. The establishment of the Agricultural Development Bank of Pakistan facilitated the procurement and distribution of agricultural inputs and credits. The input subsidies also prompted use of fertilizer and pesticides, and the price support policy for major crops helped the farmer in increasing Production. WAPDA became active in reclaiming water-logged and saline lands. The implementation of the 1959 Land Reforms and the initiation of efforts for rapid agricultural development of the Indus Basin contributed towards the growth of the agriculture sector.

Due to the satisfactory performance of the agriculture sector in the Second Plan period, the government continued to accord high priority to it during the Third Plan period. It was during this period that the Green Revolution made its debut in

Pakistan and ushered in an era of prosperity for Pakistan's agriculture sector. The Gross Domestic Product (GDP) for agriculture increased by 6.3% per annum during this period and the per capita GDP for agriculture increased by 5.6% per annum. In comparison, the Gross National Product (GNP) increased by 6.6% per annum and the per capita GNP increased by 3.6% reflecting a major boost to the economy by the agricultural sector The principal factors for this remarkable increase in agricultural output were the availability of more irrigation water due to the completion of the Mangla Dam and the introduction of high yielding varieties of wheat and rice. The total supply of irrigation water at the farmgate increased by 18% during the Plan period (or 4.3% per annum) and the increase in supply from tubewells increased by 71% (or 14.3% per annum), increasing both cultivated and irrigated areas. Better varieties produced higher yields especially when used with fertilizer. The government organized the supply of high yielding varieties of wheat and rice seeds and fertilizer to farmers. The area planted under high yielding varieties rose to more than 50% for wheat and rice by the end of the Plan period. The total quantity of fertilizer used during the Plan period was 925,000 nutrient tons which was about 3.5 times that applied during the Second Plan period. The improved profitability of agriculture induced even medium and small scale farmers to greater use of agricultural inputs and the adoption of the modern production technologies.

The Third Five-Year Plan targets were achieved, by and large. In fact production was higher than even the revised

targets in case of several crops.

The Fourth Five-Year Plan could not serve even a transitional function due to the separation of East Pakistan from West Pakistan in December 1971.

The government announced that the new long term development plan would be prepared and made ready for implementation by about July 1974. During the two years intervening between the end of the Third 5-year Plan and the adoption of the new Fourth 5-year Plan, production and yield per hectare of principal crops did not compare well with the performance in 1969-70. Except in the case of cotton and maize, production declined, and in the case of gram the increase was nominal.

The Fifth 5-Year Plan was completed in June 1983. It was successful in consolidating the over stretched development program in the public sector and in sharpening development priorities and re-introducing Plan discipline. It was a matter of satisfaction that policies of financial discipline and economic management introduced during the Plan succeeded in:

1. Maintaining a consistent GDP growth of over 6% a year.
2. Converting huge food deficits into a modest food surplus.
3. Lowering the inflation rate from an average of 16.5% in 1977-78 to around 5% in 1982-83.
4 Consolidating over-extended investment programs and investment priorities.
5. Accelerating the development of less developed regions, particularly Baluchistan which witnessed an acceleration of five times in its development expenditure over this period.

6. Reviving the industrial growth rate to over 9% a year and liberalizing some of the industrial controls and incentives.

7. Electrifying more villages during the last five years than in the previous 30 years.

8. Extending social safety nets for the poorest 20% of the population both through the introduction of the Zakat system and because of a major inflow of remittances to lower income groups.

There were two areas, however, in which the performance was rather disappointing during the Fifth Plan period. First, total investment as a percentage of GNP declined from 16.4% in 1977-78 to 15.5% in 1982-83. Second, there was not sufficient long term investment either in physical infrastructure or in human resource development. This has created shortages of energy, telephones, water, and other infrastructure and resulted in a very low level of literacy and poor health facilities.

The Sixth Plan envisaged a "shift of emphasis" from a strategy of agricultural growth based on subsidized inputs, price support policies, and additional water from Tarbela to one based on "vertical improvements" in the shape of policy packages and a strengthened institutional infrastructure including modernized marketing and agro services. The objective was to move agriculture from self sufficiency to export. The Plan recognized that considerable investment would be required in supporting services, organizations, and arrangements which would link domestic agriculture with international markets. The growth rate envisaged for the sector was 4.9% annually, composed of 3.6% for major crops, 7% for minor crops and 6% in the remaining sub-

sectors.

The achievement of Plan objectives was dependent upon implementing the following programs and policies:

1. Significantly greater emphasis on production-oriented research.

2. More efficient dissemination of known technology through a modernized extension service and partial privatization of some inputs.

3. Expansion of water availability at the farm level through a larger program of on-farm water management.

4. Improvement of seed supply.

5. Substantial increases in agricultural credit and mechanization of small farms.

6. Improving the efficiency of fertilizer use through more appropriate N:P:K balance and timing of application.

7. Extension of the price support system to new crops.

8. A set of policies which "linked" domestic agriculture with world markets, cost effectiveness, efficiency of production, concern for quality, arrangements for grading, and responsiveness to the market signals from abroad.

The above instruments required significant strengthening of existing institutions (agricultural extension and research, agricultural credit system) and creation of new ones, like the Oilseed Development Corporation. They also required selectivity in investments to favor, among other things, agricultural research, extension and on-farm water management. Participation of small farmers was seen as central. These policies also called for increased emphasis on livestock, fisheries, and forestry development.

The Sixth Plan agricultural sector growth rate target was 4.9%. Achievement on the basis of the latest projections for

1987-88 is 5.1%. This is impressive and is higher than the growth rate achieved during the Fifth Plan or any period since the early seventies. However, when the growth rate is disaggregated into its components, the picture that emerges is not good either from the point of view of achievements of the Sixth Plan strategy or from that of the long term supply and demand requirements.

The major success of the Sixth Plan was the rapid increase in the production of wheat and cotton. By Fiscal Year (FY) 1986, cotton output had exceeded the Plan's FY 1988 target of one million tonnes and wheat had reached 90% of target. This was the result of high yielding varieties, greater use of fertilizer and, in the case of cotton, improved plant protection.

Extension of price supports to new crops with export potential could not be implemented with the existing storage and market infrastructure, but removal of control over prices and distribution of urea and other nitrogenous fertilizers, replacement of monopoly procurement of Basmati rice by voluntary procurement in May 1986, lifting of the existing ban on the movement of Basmati, and the SCARP Transition Pilot Project were major initiatives to implement government's policy of providing incentives for private sector participation in agriculture. Although aggregate investment performance in both agriculture and irrigation fell short of that envisaged in the Sixth Plan, the share of extension and research increased from 21% to 33% of total expenditure in the agricultural sector, while the share of public storage fell from 30% to 17%. The shift of resources towards extension and research was in accordance with the general

policy to focus on research and the dissemination of research results.

The Sixth Plan strategy was to convert agriculture from self sufficiency to export. The main objective was diversification into high value crops and oilseeds and the creation of an export-oriented infrastructure. This did not happen. Even though production of fruits and vegetables increased, markets abroad were not discovered and post-harvest facilities and technology were not put in place. Oilseeds were a failure. Support prices for oilseeds were good, but extension was poor and marketing was disastrous. Basmati was another failure mainly because of poor plant protection and the compulsory procurement scheme which was finally abandoned only in FY 1986. Sugarcane can also be included among the failures. The most serious failure of the Sixth Plan was that significant under-investment took place in critical long term activities -- forestry, watershed management and soil conservation. The pace of construction of additional public storage was also significantly below targets.

The main focus of the Sixth Plan was announced to be on the small and medium farmers, but no specific policy instrument was devised for this purpose. While overall agricultural development might automatically improve the lot of the small farmer, the Sixth Plan policies of input subsidies and price supports for cash crops did not suit the small farmer. The bulk of increased agricultural production came from a small minority of large farmers who pre-empted the major portion of the subsidy on credit,

fertilizer, and pesticides.

The performance of the water sub-sector has been significantly below Plan targets; only 39% of the Plan's target for protecting land from waterlogging and salinity had been reached after three years, the achievement rate for "disaster areas" was even lower, and for irrigation the achievement rate was 50%. In view of the critical contribution of irrigation and drainage towards sustained agricultural growth over the long run, the under investment in these activities is a significant failure of the Sixth Plan effort.

Pakistan is currently facing the multiple problems of high rate of population growth, low literacy rate, low rate of investments, low rate of savings, and inefficient resource use in agriculture.

One major factor that is responsible for poor performance of the agriculture sector is its lag in research. Unfortunately the importance of agricultural research has not received the emphasis it deserves. Allocation of funds for agricultural research are low, around 0.05% of GDP and 0.17% of the value of agricultural products. Table 3, giving public sector expenditures on agricultural research in some developing countries, portrays the position of agricultural research in Pakistan.

Table II-1. **Agricultural Research Expenditure in Selected Developing Countries**

Country	Year	Percent of	
		GDP	Agricultural Production
Pakistan	1979	0.05	0.17
Kenya	1979	0.35	1.14
Thailand	1979	0.07	0.27
Nepal	1980	0.15	0.23
Malaysia	1979	0.20	0.79
Sri Lanka	1980	0.15	0.64
Philippines	1979	-	0.47
Bangladesh	1980	0.26	-
Brazil	1978	0.11	1.19
Colombia	1976	0.06	0.22

Source: Resource Allocation to Agricultural Research Proceedings of Workshop held in Singapore (June 8-10,1981).

However public sector research, in spite of severe financial and resource constraints, has produced tangible results. The green revolution of the mid-sixties was a result of wheat and rice varieties bred through research. The recent revolution in cotton production was a product of research in new varieties, plant protection, and agronomy. Had resources and financial manpower been available, similar breakthroughs in edible oils, sugar, and other commodities would have been possible. Another deterrent to growth in agriculture is the reluctance of the private sector to make substantial investments in research activities.

Research pays substantial dividents. Studies made in the United States of America[1] , India and Mexico indicate that expenditure incurred on agricultural research is one of the best forms of investment, because the rate of return on investment may range from 50 to 700% for different commodities. Apart from the high pay off, research in agriculture allows substitution of technology for resources.

In a study[2] in Pakistan conducted in 1983 it was estimated that the internal rate of return was between 36% and 44% for research investment before partition and between 30% and 37% for the investments made during the period 1947-75.

In another study[3] in Pakistan completed in 1984, an internal rate of return of 58% was estimated for wheat research investment and 19% for maize research. The study cited occurence of wheat rust and gram blight epidemics of 1977-78 and 1979-80 as potential costs of under investment in research. In both cases losses to a single epidemic were far higher than the cost of maintaining a scientific capacity to deal with such emergencies.

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1. Ruttan, Vernon V. 1982. Agriculture Research Policy, Minneapolis, University of Minnesota Press.

2. Pray, Carl E. 1983. Under Investment and the Demand for Agriculture; A Case Study of the Punjab, Food Research Institute Studies, Vol.XIX No.1.

3. Nagy, Joseph G. 1984. The Pakistan Development Model; An Economic Evaluation of Agricultural Research and Extension Expenditures. University of Minnesota Ph.D.Dissertation

Agriculture in Pakistan is characterized by a relative abundance of land in comparison with other Asian countries. However, population growth has been much more than the growth of crop land area, thus increasing pressure on the land. The 1980 Census of Agriculture showed 300,000 more farm units than in 1972. According to the 1980 Census, average farm size was 4.7 ha.

The two fundamental characteristics of agricultural organization in Pakistan are the skewed distribution of land holdings and the high proportion of tenancy. There exists a great number of very small units with nearly 75% of all farms being of 5 ha or less. At the top of the distribution 2% of the land holders control 23% of the total farm land. Importance of agricultural research becomes paramount if productivity and prosperity of small farmers and tenants are considered.

The Land Reform Act of 1972 disallows forming joint stock companies to hold large tracts of land, because in agriculture it treats a joint stock company as a "person", who cannot hold more than 500 acres of irrigated or 1000 acres of unirrigated land. This legislative ban has placed a limit on the area to be owned by new economic ventures in agriculture which could invest in agricultural research. Reduction in area has meant a reduction in private research and development in agriculture, at least in one case. For example, the British Cotton Growers Association, Ltd., which had developed land, introduced upland cotton, and was undertaking problem oriented research work, was brought under the Land Reform Act of 1972, reducing its incentive and capacity to

undertake research and development activities.

Manpower deficiency in the field of agricultural research is another problem which is a result of low priority of financial allocation to this sector. It has reached the point that some research programs had to be abandoned due to lack of trained research scholars in specific disciplines or crops. This worrisome situation was revealed in a survey report that appeared in the DAWN daily newspaper on July 25,1986, which showed that provincial researchers and institutes had suffered heavy losses in efficiency and output. The survey assumed that a doctorate was necessary for conducting meaningful agricultural research. The survey also noted that more than 40 major agricultural commodities were being grown in Pakistan, and that each commodity needs many research disciplines, entailing the need of at least 2000 Ph.D.s for agricultural research. The Dawn article said that there were only 260 Pakistanis with Ph.D.s, and to make matters worse, a substantial number had taken higher paying jobs elsewhere.

Private Sector in Agriculture Research

The private sector, through investment in large, private farms and specialized business, and autonomous bodies does conduct some adaptive research to disseminate improved techniques and technologies. The following organizations, private companies, associations, and autonomous bodies are engaged in business related formal or informal research and development activities:

A - Private Sector	Nos.
1. Seed Companies	11
2. Pesticide Dispensing & Contract Spraying Companies	45
3. Tobacco Growing Processing & Manufacturing Companies	14
4. Solvent Extraction Oil Plants	14
5. Specialized Plant Extraction Establishments	4
6. Agricultural Farms	4
7. Fish Farms, Deep Sea & Sweet Water Fishing	4
8. Silk Culture	1
9. Mushroom Growing	1
10. Pesticide Manufacturing	1
11. Fertilizer Manufacturers, Chemicals(4) and Organic(3).	7
12. Sugar Mills (Total = 41) Private Sector	28
13. Specialized Oil Extraction Plants	3
14. Livestock & Stud Farms	14
15. Milk & Milk Products Plants	35
16. Poultry Breeding Farms & Hatcheries	102
17. Food Processing Units	43
18. Feed Mills	66
19. Paper & Board Mills	21
Machinery Manufacturers:	
20. Cattle & Poultry Feed Plants	5
21. Cotton Ginning Machinery	3
22. Poultry Machinery & Processing Equipment	5
23. Rice Husking Plant Machinery	14
24. Tannery Machinery	6
25. Pulse Milling Machinery	6
26. Seed Processing Equipment	1
27. Oil Expeller Machinery	15
28. Paper & Straw Board Machinery	7
29. Dairy Equipment	1
30. Cold Storage Machinery	27
31. Wood Working Machinery	8
32. Farms Tools & Machinery (owning Basic Machine Tools) :	
- Punjab	475
- Sind	64
- NWFP	23
B - Private Research & Advisory Establishments	
33. Sind Sugar Industry Research Institute (SIRI)	1
34. Shakarganj Research Institute for sugarcane	1
35. Plant Protection Advisory & Service Company	1
C - Autonomous Bodies	
36. Pakistan Tobacco Board	1
37. National Fertilizer Marketing Limited	1

III. SEED INDUSTRY

Production and maintenance of seed in Pakistan has, in the past, been the sole responsibility of the public sector. Pakistan's public sector seed industry was formally initiated in 1976 with the passage of the Seed Act. This legislation allowed setting up of an official structure for the control of crop varietal introductions and specifications and procedures for the production of certified seeds.

The official sector is currently supervised by the National Seed Council. It has representatives from the Pakistan Agricultural Research Council, the Punjab Seed Corporation (Public), the Sind Seed Corporation (Public), and representation from the provinces. Under the National Seed Council are two organisations: The Seed Registration Council and the Seed Certification Service.

The Seed Registration Council functions as the authorizing organ for new varieties in Pakistan. It is required to test and evaluate varieties for three years within the provincial experiment station system. Upon completion of these tests, data submitted to the Seed Registration Council is the basis for authorizing the release and production of new varieties.

The Seed Certification Service is required to conduct field inspections of seed production under application for certification or registration. The Service has established quality specifications for isolation, purity, germination, etc. Nine regional seed laboratories perform seed analyses.

The production of improved seed goes through the following stages before it is released or sold for general cultivation :

(a) Pre-basic or nucleus seed: This is seed of high genetic purity and is produced under the direct supervision of the plant breeder at the research station or institute.

(b) Basic or foundation seed: This is the progeny of the pre-basic seed and is multiplied under the direct supervision of the technical personnel at the government seed farms or the farms of the Seed Corporation.

(c) Certified seed: This is the progeny of the basic seed and is produced by the Seed Corporations at the farms of the registered growers or at government seed farms under the supervision of technical personnel.

To date most attention has been given to the evolution of new varieties. The multiplication of seed along scientific lines leaves a great deal to be desired. Some efforts are being made to organize the production and multiplication of seed of wheat, rice, cotton, maize, and gram. For other crops virtually no institutional arrangements exist, but certain crop scientists have produced sufficient breeder seed to supply to leading farmers who function as seed producers for new crop varieties.

The private sector of the Pakistani seed industry is in its infancy. There are 11 registered seed companies and several dozens unregistered firms in the country. Only one of them possesses a seed processing plant. To say that the registered private sector seed industry has had little impact on the

nation's agriculture, up to this point, would be correct. However, this industry is undergoing rapid transition as some multinationals, pending official clearances, are ready to participate.

According to the production program of the 11 registered seed companies, they were to produce improved seed for wheat, rice, cotton, maize, other cereals, pulses, oilseeds (traditional and non-traditional), vegetables, and fodder totaling about 12,000 tons in 1982-83 and about 41,000 tons in 1987-88. Except in the case of cotton not much headway has been made by the private sector. The quantity of cotton seed produced by private sector firms and certified by the Seed Certification Agency in 1982-83 and 1985-86 was about 490 tons and 17,000 tons, respectively. Lack of adequate facilities for the production of pre-basic and basic seed seems to be the main inhibiting factors.

Seed Production in the Private Sector

Farmers in Pakistan are meeting more than 90% of their cereal seed needs and their needs for almost the entire requirement for vegetables, fodders, and oilseeds from sources other than public sector agencies. Cotton seed is perhaps the only one supplied by the public sector in quantities large enough to meet a substantial portion of the seed needs of the Punjab. Ginners, traders, and village shopkeepers continue to meet a large portion of the cotton seed needs in the Sind. Therefore, it can be said without any fear of contradiction that the bulk of the seed in Pakistan is handled by the private sector. Some of

next crops while many others buy whatever seed is available in the market. Even though 11 firms have so far been formally registered to produce, process, and market seed in the country, their output is still very low. The quality of seed available in the market is often poor and low germination often causes losses. In the 1970's, the government enacted seed legislation but this did not stimulate seed production in the private sector, and the public sector did not develop sufficient capability to meet the seed requirements of the farming community. Unregulated sale of seed continues to affect the productivity of crops, with the worst sufferers being vegetable and fodder growers. The sale of nondescript cotton seed has had severe economic implications, especially in the Sind where the public sector has failed to keep pace with the needs of the cotton farmers. As a result, farmers were forced to obtain their requirements of cotton seed from the Punjab, even though they knew the limitations of seed from a different ecological zone. Some of the incentives that could promote private sector investment in the seed industry are:

1. Protection of named cultivars of the private sector.
2. Relaxed rules for importing seed varieties for testing.
3. Duty free import of parent seed and seed processing machinery.
4. Grant of tax holiday.
5. Protection of quality of seed through compulsory labelling of the contents and its verification by the Federal Seed Certification Department.
6. Provision of credit facilities through Agricultural Development Bank of Pakistan and other commercial banks.
7. Facility for training personnel.

7. Facility for training personnel.

The above concessions might induce the registered seed companies to undertake meaningful research activity.

It would be desirable for the public and private sectors to cooperate so that a national commercial seed industry is promoted and sustained. In most cases crop breeding and initial seed increases may need to be carried out by government institutions or with their assistance. However, the large scale production and marketing of the seed can be done most effectively by the private sector because of the special management requirements of the seed industry.

It has been noted that the private sector does not normally get involved in the production of crops where profit margins are small. Thus, high volume, low-cost seed, by necessity, has to be produced by the public sector, perhaps with a subsidy to overcome losses. Even in such situations marketing could be profitably done by the private sector due to the flexibility of operations and quick pace of decision making with them.

Some of the important elements that make the seed industry unique are:

1. Both seed production and marketing are seasonal operations.

2. Unlike conventional manufacturing where most processes are under complete control, the seed industry is exposed to abrupt changes and risks of climatic conditions and varying threats of diseases and pests which force sudden changes in the production technology.

3. Production is spread over a large area and involves a a number of seed growers who vary in experience and

capabillity.

4. The end product - seed - is a living material that must be handled and stored carefully and used before it dies

These features of the seed industry make it a risky proposition requiring a great deal of vigilance and constant care. It also requires the development of more private research.

Research

None of the private sector seed companies are actually engaged in basic breeding research. Some companies are producing hybrids from imported lines, testing various combinations of lines, maintaining genetic purity of varieties, or producing disease-free seed (e.g. in potatoes).

Activities of the major private sector seed companies are:

Cargill Pakistan Seeds (Pvt.) Ltd. Lahore.

Current activities involve field trials of hybrids on varieties of sunflower, corn, soybean, wheat, and safflower; demonstrations; and seed processing. The company also plans to test rice hybrids under Pakistani conditions. They are currently marketing hybrids of sunflower, maize, and fodder crops from their offices at Lahore, Multan, Sahiwal, and Hyderabad, and through their appointed dealers elsewhere.

Research staff consists of one Ph.D., five M.Sc.,three B.Sc., and six trained technicians. The research budget reportedly is Rs.0.8 million/annum, and annual development expenditure is thought to amount to Rs 0.4 million.

According to the company's General Manager, the organization would welcome research grants and assistance from the public sector agencies. As to their major constraints, government restriction on import of breeding material, parent lines and foundation seed, excessive duty on laboratory and field equipment needed for research, and lengthy procedures for registration and certification of hybrid seed were cited.

Rafhan Maize Products Co. Ltd., Faisalabad.

This organization processes and markets a variety of corn-based products including starch, fructose, and oil. Raw material is obtained partly through contracts with growers made through a number of commission agents. Quality is assured through a proprietary hybrid seed program which supplies 400 tons of double cross corn seed to the company's contract growers. The corn hybrids are developed and produced in the Punjab. A parallel corn breeding program draws experimental lines from all over the world. Facilities are scanty but the quality control is commendable.

Rafhan charges twice the price of synthetics for its double cross corn hybrids and cannot keep up with demand. It was reported that the demand for Rafhan's hybrid seed is great but they issue seed only in accordance with Rafhan's requirement of maize. The research and development budget is around Rs 2 million per annum. R&D staff consists of one Ph.D., 3 M.Sc. and 5 B.Sc.

Pakistan Seed Corporation, Lahore.

This organization was formed in 1976. Headquartered in Lahore, it is an importing rather than a production company. It had been importing hybrid sunflower seed from Pacific Seeds (Australian-based subsidiary of Continental Grain), Interstate Seed Co. (the second largest hybrid sunflower seed company in the U.S.), and Northrup-King (a Minnesota-based subsidiary of Sandos). This corporation, in cooperation with the Ghee Corporation, formed the Pakistan Sunflower Association in the summer of 1982. The purpose of this organization is to promote sunflower in Pakistan and to disseminate seed and technical information to its grower members. The Pakistan Seed Corporation is also involved in the importation of vegetable seed. Except for its chief executive, there is no other professionally trained staff. There is little research budget.

Jaffer Brothers (Pvt) Seed Division, Lahore.

This company is engaged in diversified business, both in respect of trade and industry, with emphasis on heavy machinery and plants, equipment and instruments, defense systems, vehicles, and rolling stock. In 1983 the company entered into potato seed production. Although the company plans to produce other crop seeds in the not too distant future, potatoes are their major crop. The company has laboratory facilities located in Lahore, production in the northern areas, and marketing outlets throughout Pakistan. Current seed production (1986) was 2000 tons of seed potatoes.

Research staff consists of one Ph.D. (Adviser), 5 M.Sc., 4 B.Sc., and ten technicians. Research activities revolve around agronomic field trials and post harvest handling. The current research and development budget is around Rs 0.8 million.

Bukhari Corporation, Multan.

This privately owned establishment has, through the personal efforts of the owner, developed hybrid cotton seed. Also the company produces certified seed of established cotton varieties on a large scale. The corporation has its own modern cotton gin. Cotton production is undertaken through an unofficial cooperative of cotton growers of the Multan area. Purity of variety is ensured, in the field as well as in the gin. Seed extracted at the gin is further processed and cleaned before its sale. Agronomic field trials to establish optimum doses of fertilizer and timely use of pesticide are undertaken in cooperating farmers' fields. There is no special budget allocation. For the production of hybrid cotton seed the corporation has trained a team of 40 female workers to emasculate female lines for crossing.

Other Seed Companies

The other seed companies, namely, Dawood Corporation (Lahore), Rich Green Seed Industries (Lahore), Jhandar Corporation (Pvt) Ltd Malsi (Vehari), Tareen Seed Farms (Pvt) Ltd Mumtazabad (Multan), Mian Mahfooz & Co Malsi (Vehari), and Arain Brothers Grain Market (Gujranwala), are seed merchants who either procure seed from farmers or import from abroad. Of these, Rich Green and Arain Brothers handle vegetable seeds only. The rest

Green and Arain Brothers handle vegetable seeds only. The rest are cotton seed marketing companies. No research or development activities are undertaken by them.

In addition to these companies registered with the Government, there are numerous private seed, fruit, and floriculture nurseries throughout Pakistan that cater to the seed and fruit plant requirements of farmers. Almost all operate without any professionally qualified staff. An exception is K&N's Agriculture & Poultry Breeding Farms, a private organization basically engaged in poultry breeding and poultry feed manufacture, that has gone into floriculture and horticulture on scientific lines. The company owns a 20-acre farm outside Abbottabad and a 5-acre plot near Lahore. The organisation conducts varietal screening and agronomic trials. Since 1981 the company has been experimenting with flowering plants, tulips, daffodils, carnations, gladiolus, roses, gerbera, tuberoses, and lilies. Varietal and agronomic trials are also being conducted on six imported varieties of strawberries - - Ostra, Corolla, Corona, Elvira, Bogota, and Primella. Trials are underway on dwarf apple varieties, French pears, peaches, apricots, plums, and almonds. The company has sale outlets for its flowers in Karachi, Lahore, and Islamabad. There was no indication of a research budget, but an estimate is that Rs 1.0 million to Rs 1.5 million is being spent annually on research and development activities.

Staff consists of five professionals with no formal training but extensive experience in raising fruit and flowers. The major

constraint, the company reported, was dearth of qualified expertise in the field of floriculture and deciduous fruit horticulture.

IV. FERTILIZER INDUSTRY

The use of chemical fertilizer on a large scale began in Pakistan with the gift of 1000 tons of nitrogenous fertilizer from the USA in 1952-53. Consumption of fertilizer increased to 1.5 million nutrient tons during 1985-86. This is broken down into 1.1 million nutrient tons of N, 350 thousand nutrient tons of P2O5 and 22 thousand nutrient tons of K2O. This phenomenal increase can be attributed to the combined efforts of both the public and private sectors.

Fertilizer use is broadbased, that is, about 90% of all farmers use some form of chemical fertilizer. So convinced are they of the benefits of fertilizer use that progressive reductions in the rate of subsidy have not adversely affected the rate of increase of fertilizer use.

Much research and promotional work has been done in the past to bring fertilizer use to its present level, but much more remains to be done to improve the efficiency of fertilizer use.

In the 1960's and 1970's, when fertilizer usage was increasing at a much faster rate, a major force behind their popularity was research and development activities of both public and private sector. Public sector research and development actually began after the commissioning of the Pak-American plant in 1958, while the first private sector plant, EXXON, was not commissioned until 1968.

Fertilizer companies engaged teams of professionals and embarked on intensive research and development activities with fertilizer trials and demonstrations. These activities coupled with subsidies created fertilizer sales as shown in the following Table.

TABLE IV-1 : FERTILIZER OFF-TAKE

Year	Nutrient tons(000)	Growth Rate over Preceding 5 Years	10 Years
1955-56	6.6	-	-
1960-61	31.6	36%	-
1965-66	71.1	18%	27%
1970-71	283.2	31%	25%
1975-76	548.1	14%	23%
1980-81	1,079.5	15%	17%
1985-86	1,512.0	7%	11%

Research

In the past few years, the tempo of research waned and emphasis of the fertilizer companies shifted more to marketing and market related research. The following paragraphs describe private and public sector fertilizer manufacturers' current activities in the field of research and development.

Dawood Hercules Chemicals Ltd (Private Sector)

The company is a joint venture between the Dawood Group of Industries of Pakistan and Hercules Inc. of the United States. The plant is located at Chichoki Mallian, district Sheikhupura, near Lahore and was commissioned on October 13, 1971. The company is selling its product under the brand name Babr Sher Urea. Its production capacity is 345,000 metric tons per annum. Its

fertiliser is marketed through Dawood Corporation Ltd. The company currently does not undertake any substantial research.

EXXON Chemical Pakistan Ltd (Private Sector)

EXXON Chemical Pakistan Ltd was the first private sector company to manufacture fertiliser in Pakistan. It commenced manufacturing in December 1968 at its plant located at Dharki. Urea is produced which is marketed under the brand name 'ENGRO'. Its production capacity is 256,000 metric tons per annum. The marketing function is headed by a Senior Vice President, assisted by a Sales Manager, for domestic sales and a Marketing Services Manager, responsible for distribution, planning and technical (agronomic) services. Its area of operation covers the Sind, the Punjab, and Baluchistan. No formal research is currently being done, but EXXON was very active in agronomic research during 1968-72.

Fauji Fertiliser Co. Ltd (Private Sector)

The Fauji Fertiliser Co. Ltd. (FFC) was established in May 1978 as a public limited company, jointly sponsored by Fauji Foundation, a Welfare Charitable Trust of Pakistan, and Messrs Holdor Topsoe, a chemical company of Denmark. The FFC is manufacturing urea fertiliser and is marketing urea and other types of fertilisers. The plant came into operation in June 1982. The FFC ammonia and urea plant is based on Mari natural gas. The manufacturing plant is located at Goth Machhi, district Rahimyar Khan and its manufacturing facilities are ammonia (capacity

33,000 metric tons per annum) and urea (capacity 570,000 metric tons per annum).

On the field level, the FFC has seven sales regions, 35 sales districts, approximately 1,500 dealers, and 130 warehouses of different types throughout Pakistan. It sells urea manufactured at the company's plant under the brand name of 'Sona'. In addition imported fertilizers and other agricultural items such as gypsum, micro-nutrients, etc., are also being sold by the company in the domestic market.

In mid-1986, the FFC launched a massive agricultural extension promotion project with Italian aid. The project includes farm machinery, field demonstrations based on soil testing, and experimental plots. The project began in January 1987 for a period of 3 years and will cover the major agricultural production areas of Pakistan. Of the total amount of imported fertilizer, FFC is allocated a 30 percent share.

National Fertilizer Corporation of Pakistan Ltd (Autonomous Public Sector)

NFC was established on August 11, 1973, to take over the manufacturing facilities set up by the State-owned fertilizer plants.

The NFC acts as holding company which coordinates and controls the group activities and lays down guidelines for economic and technical development of the corporation. The following are its broad objectives:

1. Efficient functioning of existing fertilizer plants.

and compound fertiliser production facilities.

3. Achievement of self-sufficiency in chemical fertiliser

4. Promotion of scientific research and development in fertilisers.

The operations of 9 subsidiary companies in the NFC Group are managed by a technical team headed by a Managing Director or General Manager, depending upon the size of the company. The Chief Executive reports to the Board, upon which nominees of NFC and outside shareholders are represented. The operating units of the NFC are:

- Pak-American Fertilisers (Pvt) Ltd
- Pak-Arab Fertiliser (Pvt) Ltd
- Lyallpur Chemicals & Fertiliser (Pvt) Ltd
- Pak-Saudi Fertilisers (Pvt) Ltd
- Pak-China Fertilisers (Pvt) Ltd
- Technical Training Institute, Multan
- Hazara Phosphate Fertilisers (Pvt) Ltd
  Fertiliser Research and Development Institute, Faisalabad
- National Fertiliser Marketing (Pvt) Ltd

Pak-American Fertilisers (Pvt) Ltd (Autonomous Public Sector)

This plant was the first nitrogenous fertilizer plant built in Pakistan and was set up under the United States Technical Assistance Programme. The plant is based on indigenous raw materials, coal and gypsum, which are available at Makarwal and in the vicinity of the plant site. The plant, located in Iskandarabad (Daudkhel), district Mianwali, was designed to produce 50,000 tons of ammonium sulphate per annum and came into production in 1958. It was expanded in 1968 and the capacity was increased to 90,000 tons of ammonium sulphate. The plant went through a rehabilitation program recently at an expenditure of

Rs.78 million to improve its energy utilization.

Pak Arab Fertilizer (Pvt) Ltd (Autonomous Public Sector)

Pak Arab Fertilizers Ltd was incorporated on November 12, 1973, as a joint venture between WPIDC (now NFC) and Abu Dhabi National Oil Company (ADNOC) with the objective of modernization and expansion of the existing natural gas factory at Multan.

The project was completed in November 1978 and the plant went into commercial production on 1st January, 1979. It manufactures three products: urea (59,000 tons) nitrophos (405,000 tons) and calcium ammonium nitrate (450,000 tons).

Lyallpur Chemicals & Fertilizer (Pvt) Ltd.
(Autonomous Public Sector)

The plant consists of two separate units located at Faisalabad and Jaranwala. The unit at Faisalabad was the first phosphatic plant in the country. It was established in 1957 and currently produces 20,000 tons of single superphosphate (SSP) per annum. The unit at Jaranwala was built in 1967 and its capacity was doubled in 1976 to 80,000 tons of SSP per annum. Both units utilize imported phosphate rock and sulfur.

A small unit has also been set up for the production of zinc sulfate which has been found to be extremely useful for increasing the output of the rice crop.

Pak-Saudi Fertilizers (Pvt) Ltd (Autonomous Public Sector)

The plant, commissioned in 1980-81, utilizes natural gas available from the Mari gasfield. The project is located at

Mirpur Mathelo, district Sukkur. The foreign exchange requirement for the plant was met with loans from the Government of Saudi Arabia and the Saudi Development Fund as well as from the Asian Development Bank. It is a large, single-train urea plant with designed capacity of 557,000 metric tons per annum.

Pak-China Fertilizers (Pvt.) Ltd (Autonomous Public Sector)

The plant and machinery for this unit were given by the Peoples' Republic of China as a gesture of good will. The plant, located at Haripur Hazara, utilizes natural gas as a raw material, and came into commercial production in April 1982. Its designed capacity is 96,000 tons of urea per annum.

Fertilizer Research & Development Institute (Autonomous Public Sector)

The Fertilizer Research & Development Institute was established at Faisalabad in January 1986 with the technical assistance of UNDP/UNIDO. The main objectives of the Institute are to provide assistance to NFC units and to bring about improvements in their operational performance.

The institute operates through a Board of Directors headed by the NFC Chairman. All Managing Directors of NFC's plants are members of the board, besides two nominees from the Ministry of Production. There is an Advisory Committee composed of Federal and Provincial Agricultural Research Institute staff members.

The short term studies include calcium ammonium nitrate (CAN) caking problems, fertilizer quality control, fertilizers

analysis, superphosphate granulation, and others. The long term studies include process development for mixed fertilizer, improving quality of CAN, beneficiation of local phosphate ores, development of slow release N fertilizer, and micro nutrient fertilizers.

National Fertilizer Marketing Ltd (Autonomous Public Sector)

National Fertilizer Marketing Ltd, a subsidiary of NFC, was established in May 1976 to develop a marketing system based on a private dealer network. Its area of operation is all of Pakistan. The Managing Director is the Chief Executive of the NFML and is supported by five departments - marketing, distribution, technical, finance, and administration & personnel. It has ten regional offices spread throughout the country, each headed by a Regional Manager. With these Regional Managers are 32 Sales Officers, supported by 9 Field Agronomists. It operates through five bulk storage units having 108,000 metric tons capacity and a dealer network of 2500. During the peak season, NFML establishes about 70 storage units located in key consumption areas.

The company has also a technical department which provides agronomic and advisory services to the farming community. The agronomists based throughout the country provide practical guidance on farm management and modern agriculture production technology. They arrange seminars and meetings of farmers where knowledge on the proper use of fertilizers as well as pesticides and other farming techniques are imparted.

The technical department also publishes a quarterly magazine under the name of 'Zari Service' (Agriculture Service) which provides comprehensive information on fertilizer use.

The NFML caters to the marketing needs of the public sector fertilizer plants. The company has also undertaken research and development under its Technical Department, which is headed by a General Manager (Ph.D.), two Deputy General Managers (Ph.D.s), and 17 Field Officers (10 M.Sc. and 7 B.Sc.).

The major emphasis in recent years has been on the development of fertilizer use through demonstration plots. Also soil testing facilities are provided. The company operates on a no-profit, no-loss basis. Total manpower in 1984 was 607, comprising four members of management, 168 executives, 81 supervisors and 354 non production workers. In 1983-84, expenses were Rs 60.37 million, of which 5% can be attributed to research and development activities.

TABLE IV-2 FERTILIZER PLANTS IN PAKISTAN

Company and location of plant	Year start up	Product	Design capacity (1000 nutrient Tons)	
			N	P_2O_5
NFC/Pak American Iskandarabad	1958	* Ammonium Sulfate	90	-
NFC/Lyallpur Chemicals Faisalabad	1957	Single Superphosphate	-	20
Jaranwala	1967	*** - do -	-	80
NFC/Pak Arab Multan	1962	** Calcium Ammonium Nitrate	405	-
	1962	Urea	59	-
	1979	NP (23-23)	305	305
EXXON, Daharki	1968	Urea	173	-
Dawood-Hercules Chichoki Mallian	1971	Urea	348	-
NFC/Pak-Saudi Mirpur Mathelo	1980	Urea	557	-
NFC/Pak-China Haripur	1982	Urea	96	-
FFC, Goth Machi, Sadiqabad	1982	Urea	570	-
Pakistan Steel Mill	1981	Ammonium Sulfate	17	-

* Original capacity was 50,000 tons which was expanded to 90,000 tons in 1968.

** Original capacity was 103,000 tons which was expanded to 405,000 tons in 1978.

*** Original capacity was 40,000 tons which was expanded to 80,000 tons in 1979.

TABLE.IV-3 FERTILIZER PRODUCTION : PUBLIC & PRIVATE
(Current capacity in '000' tons)

	--- Current Capacity ---		
Product	--N--	--P--	
PUBLIC SECTOR			
NFC:			
Pak-Saudi, Urea	557	256	0
Pak-Arab , Urea	59	27	0
Pak-Arab , CAN	450	117	0
Pak-Arab , NP	305	70	70
Pak-China, Urea	96	44	0
Pak-American, AS	90	19	0
Lyallpur C&F, SSP	100	0	18
*Pak Steel, AS	5	1	0
Total:	1662	534	88
PRIVATE SECTOR			
Fauji Fertilizer Company, Urea	570	262	0
Dawood-Hercules, Urea	348	160	0
EXXON, Urea	256	118	0
Total:	1174	540	0
GRAND TOTAL :	2836	1074	88

* Pak Steel is not part of NFC

Source: Chemonics, based on data provided by producers.

Among the three private sector fertilizer manufacturers, Fauji Fertilizer and EXXON conduct field trials and demonstrations. Dawood Hercules conducts only demonstrations. Each of these three maintains 6-10 qualified agriculture graduates and post-graduates. There was no indication of an R&D budget. However, estimates were arrived at as follows :

Company	R&D Staff				R&D Expenses Estimate Rs. Million
	Ph.D	M.Sc	B.Sc.	Trained Super-visor	
Fauji Fertilizer	-	2	8	15	2.0
Dawood Hercules	-	1	5	10	0.3
EXXON	-	2	4	10	0.7

Among the fertilizer importers, Jaffer Brothers is the only company which invests in fertilizer trials through assistance and grants to research stations and by themselves on leased plots. Their main thrust is to evaluate and popularize several formulations of complex NPK fertilizer for various crops such as, sugarcane, tobacco, cotton, and wheat. They use the services of their technical staff engaged in pesticide marketing and seed production for these purposes. Their annual R&D expenses on fertilizer research is estimated to average Rs. 2 million.

V. PESTICIDE & PLANT PROTECTION INDUSTRY

Research in the field of plant protection has been most impressive and has brought tangible results in the form of increased productivity in agriculture. Adaptive field research is conducted both by public and private sector establishments. After the private sector was allowed to enter into this field following the announcement of the New Agricultural Policy in February 1980, use of pesticides increased dramatically. The New Agriculture Policy included the following salient features :

1. Withdrawal of subsidy on pesticides
2. Transfer of pesticides import and distribution to private sector
3. Discontinuation of free aerial spray service
4. Encouragement of local formulation and manufacturing of pesticides
5. Strengthening of pest scouting service

The policy was responsible for the activation of the private sector which is now actively engaged in distributing pesticides in the Punjab, the Sind, and the NWFP.

Since independence, plant protection in Pakistan has passed through various phases as summarised below :-

Phases	Period	Pricing	Mode of distribution
I	1947-65	Free of cost	Public Sector
II	1966-74	From a flat rate of Rs 0.25 per litre to 75% subsidized price.	Public Sector
III	1975-79	50% subsidy on ECs/WPs 75% subsidy on granules	Public Sector - 25% Public Sector - 75%
IV	1980	Complete withdrawal of subsidy.	Private Sector -100% in Punjab, Sind & NWFP Public Sector in FATA, Azad Kashmir and Baluchistan.

Following the implementation of the New Agriculture Policy in 1980, there has been a notable increase in the consumption of pesticides which speaks of the growing inclination among the farmers towards adoption of plant protection measures to prevent crop losses. The growth in pesticide sales during the past few years is presented below:

Year	Pesticides Sales (tons a.i.)	Annual Increase (%)
1981	915	-
1982	1,290	40.98
1983	1,810	40.31
1984	2,517	39.06
1985	3,453	37.18

Source: Federal Department of Plant Protection

With the withdrawal of subsidy in 1980 the usage of pesticides declined sharply in 1981 but in the subsequent years the consumption of pesticides grew dramatically, thereby resulting in a significant increase in plant protection coverage, as shown below:

Year	Treated Area* (000 spray acres)	Annual Increase (%)
1982	4,456	
1983	7,182	61.17
1984	11,176	55.61
1985	13,132	17.50

* = All crops

In spite of a quantum jump in the consumption of pesticides plant protection coverage on the national level is still only 25% of the total cropped area. However, in the case of the cotton crop, which alone accounts for over 70% of the total consumption of pesticides, the area covered has increased considerably over the past few years from 2.8 million hectares during 1982-83 to 4.0 million hectares during 1985-86.

In the past the transfer of plant protection technology from the public sector research organizations to the farming community at the grassroots levels was the weakest link in the agricultural chain. Despite efforts made by the public sector agencies only a small percentage of farmers, particularly well-to-do progressive growers, were motivated to adopt modern plant protection technologies. It was the private sector's profit-motivated effort that created mass awareness of plant protection technologies and made available to medium and small farmers the necessary

chemicals.

Research

Private sector companies in the pesticide business number over fifty. Of these,ten are multinational companies. Others are local companies associated with suppliers outside Pakistan. In the private sector there is only one local manufacturer of pesticides.

Invariably all pesticide companies do some research to ascertain suitability of the pesticide, application techniques, and to collect economic data which is a basic requirement of registration of a brand name and formulation by the Government of Pakistan. Once this is done most local companies discontinue further research and vigorously begin sale activities. However, this is not true for a number of multinational companies that continue research activities both for accumulation of additional data and for demonstration towards their marketing ends. The most active multinationals are Hoechst, Ciba-Giegy, Dow Chemicals Pacific, Chemdyes (Bayers), ICI, Sandoz, and Burmah Shell. A brief description of research activities of these companies follows.

Hoechst (Pak) Ltd. Agricultural Division

The company has been active in plant protection research since the 1970's conducting collaborative research trials at public agricultural research establishments as well as on their own. It has an independent research division with a budget

consisting of about 2% of sale proceeds. Their research activities in Pakistan not only provide new data that is useful for marketing their products in Pakistan but also is used for their worldwide operations.

Their R&D staff consists of 18 agronomists and entomologists, 10 M.Sc. and 8 B.Sc., who coordinate their activities with their sales staff throughout Pakistan. The Research & Development Division, headquartered in Lahore, produces an annual report, which is circulated throughout the subsidiaries of Hoechst worldwide. Total R&D investment is estimated to be Rs 4 million annually.

Ciba-Giegy (Pak) Ltd

The agricultural division of the company has a small R&D wing manned by four entomologists. Their R&D activity is integrated with their sales infrastructure. Approximate annual expense is Rs 2.00 million.

Sandoz (Pak) Ltd

The agricultural division of this multinational company has a small R&D cell manned by three entomologists. R&D expenses are about Rs 0.60 million per annum.

Dow Chemical Pacific Ltd

This U.S. based company has engaged a small but highly qualified team which conducts adaptive research on their own and in collaboration with government agencies. The company had a

sales.

Chemdyes 'Bayer' (Pak) Ltd

There is only one qualified researcher with the company, located in Peshawar. Their marketing and sale activities have been sublet to another private group. Annual research expense is Rs 0.2 million.

ICI (Pak) Ltd.

The company has become active in the pesticide business only during the past two years. It has currently four persons to look after its adaptive research in collaboration with official government agricultural research stations. Estimated R&D budget is Rs 0.4 million per annum.

Burmah Shell (Pak) Ltd.

The company had a very active R&D team in the 1960's but, with the chlorinated hydrocarbons going into disuse, their R&D activities became dormant in the 1970's. The company has revived its interest in research and development during the past five years with a new generation of pesticides. Their R&D staff consists of three agronomists or entomologists. The budget estimate for R&D was Rs 0.25 million in 1986.

All other pesticide companies engage professionally qualified entomologists and agronomists but their major function is to work with government institutions where trials are conducted in preparation for formal application to the Government

of Pakistan for registration of their products.

It is doubtful that the R&D activities of most pesticide companies can be truly termed research. In most cases these activities would fall within the category of adaptive trials. The exception is Hoechst Pakistan, whose activities would fall within the purview of pesticide research, even under the strictest definition of research.

There is also an example of good development research work that has taken place in Pakistan in the field of pesticides. Degesch Pakistan installed the first private sector specialized pesticide plant in Pakistan in 1981 82. The company initially manufactured a solid fumigant with technical collaboration of Degesch of West Germany by importing the basic raw material - red phosphorus and micro - fine aluminum. In 1986 the company was deprived of raw material supply by Degesch West Germany because Degesch was taken over by another manufacturer of solid fumigant. Degesch Pakistan, through its own research efforts with local chemical engineers, has developed an indigenous capacity to manufacture aluminum phosphide and is now producing a solid fumigant of high quality in the country. There was no formal R&D budget but the company spent about Rs 1.0 million during 1985-86 to develop a locally fabricated basic chemical plant and packing containers.

PESTICIDE RESEARCH/DEVELOPMENT PROFILE

Company	Activities	Trained Manpower								R & D Expense Estimate Rs Million	% of Sales	1985 Sale Rs Million
		Full Time				Part Time						
		Ph.D.	M.Sc.	B.Sc.	Others	Ph.D.	M.Sc.	B.Sc.	Others			
Hoechst	R&D in pesticides, field trials, demonstration, collaborative Government agencies trials.	-	2	2	15	-	6	8	40	4.00	1.87	214
Ciba-Geigy (Pak) Limited	-do-	-	-	1	5	-	3	4	60	2.00	0.42	475
Sandoz (Pak) Limited	-do-	-	-	1	2	-	2	1	10	0.60	0.68	88
Dow Chemical Pacific Limited	-do-	-	1	-	2	1	1	-	4	1.36	1.18	115
Chemdyes (Bayer) Limited (BABCO)	-do-	-	1	1	-	-	-	-	-	0.20	0.01	130
ICI (Pak) Ltd.	-do-	-	1	-	2	-	3	2	-	0.40	2.00	58
Burma Shell (Pak) Limited	-do-	-	-	1	2	-	2	2	-	0.25	0.02	119
Others	Only collaborative evaluation trials with GOP	-	-	-	-	-	18	24	100	1.00	-	1102
Total:		-	5	6	28	1	35	41	214	9.81	0.47	2301

VI. TOBACCO INDUSTRY

The tobacco industry deserves recognition for its substantial contribution to agricultural research in the field of agronomy, fertilizer, pesticide, and varietal selection, mainly on tobacco, but indirectly on other crops. One major contributing factor was the adequacy of financial resources and the pioneering company's association with a research and development minded multinational, the British American Tobacco (BAT) Group. Pakistan Tobacco Company, which is 60% owned by BAT, embarked on major research and development activity in 1949, after its inception. At that time there was neither any cigarette type tobacco nor the technology available for growing it in the country. The Company organized scientific research that has brought self-sufficiency in production of tobacco of the desired quality and types needed and has made yields in Pakistan among the highest in the world. Tobacco yields, which were around 1000 kg/ha in the 1950's rose to 2044 kg/ha in 1985. In addition to problem oriented research on tobacco the company also undertook research involving other crops that were grown in the cropping patterns with tobacco. It included work on pulses, sunflower, fast growing fuel wood plants, pesticides, herbicides, appropriate tools and equipment, and labor saving technologies in crop production. Pakistan Tobacco Company is the only company which makes special arrangements for producing true-to-type seed of tobacco varieties through scientific methods of maintaining genetic purity and seed processing. Eighty percent of all cigarette-type tobacco grown in the country comes from the seed produced and

distributed, free, by this company.

The company has a well staffed research and development wing under its Leaf Division, with laboratories and farms leased for their research activities. Research and development activities on tobacco continues to rest mainly with this single tobacco company, although two other multinationals, Philip Morris International of USA and Rothman's International of U.K, have entered into the Pakistani cigarette industry through acquiring 49% and 30% equities in two local companies, respectively. These two tobacco companies also have staffs for research and allocate budgets for the purpose. The following is a brief on these companies:

Research

Pakistan Tobacco Company

The company has its research and development headquartered at Akora Khattak in the NWFP. It is headed by a full-time research and development executive, trained in agronomy. The R & D Department has two full time agronomists and 11 field supervisors. In addition the research activities are integrated with the 14 tobacco-buying management teams located throughout the growing area. All of these managers perform the development and extension work in close association with the research and development department. All of the field managers have a basic degree in agriculture and several have M.Sc. degrees in a specialized discipline of agriculture. The field management is further augmented by 42 field supervisors. The annual R&D budget

is about Rs 3.5 million. The company also participates in collaborative research with the Pakistan Tobacco Board.

Premier Tobacco Industries

This company, associated with Philip Morris Int., has a research and development wing headed by an M.Sc. in agriculture There are six field supervisors assisted by a field team of eight managers, among whom seven are M.Sc. and one B.Sc. in various disciplines of agriculture. In addition there are 40 field technicians and supervisors. The research and development office is located at Jehangira in the NWFP. The type of research conducted is similar to that of the Pakistan Tobacco Co. The annual research and development budget is estimated to be Rs 1.5 million.

Lakson Tobacco Company

An associate of Rothman's International, the company has no formal research and development activities. However, in some years they use the services of some of their field extension staff to undertake agronomic trials. There is no fixed allocation for research.

Apart from these three companies, there are 11 small tobacco groups who undertake no research activity.

Pakistan Tobacco Board

Pakistan Tobacco Board, an autonomous body, jointly financed by the tobacco industry, came into being in 1968. Its finances come from a levy at the rate of Rs 0.02 per kg. on tobacco used

by the cigarette industry. In 1984-85 the cess thus collected was Rs 63,65,000. The Pakistan Tobacco Board also receives grants from the Federal Government for fixed assets, such as buildings and other durables. The Board, though an autonomous body, comes under the Ministry of Commerce. However, its rules allow a broad-based membership that includes growers, dealers, tobacco companies, and representatives of Chambers of Commerce and Industry. Its functional image is that of a democratic body, with a tilt towards the private sector. When the Board was establish, Pakistan had become a substantial producer and manufacturer of tobacco, with a potential to export raw and manufactured product . At that time flue-cured Virginia tobacco had become an important cash crop in the country. Thus development and export of tobacco and tobacco products were the main objectives of the Pakistan Tobacco Board Ordinance. Since the bulk of the flue-cured Virginia was grown in the NWFP, the Board's headquarters were located there, at Nowshera. In 1972, its location was shifted to Peshawar.

The functions of the Board are:

1. To regulate, control, and promote the export of tobacco and tobacco products and to fix grading standards.

2. To undertake and assist research connected with tobacco industry, to impart training in tobacco testing, and generally to take measures in the interest of the tobacco industry.

3. To render assistance for the development of new tobacco growing areas and establishment of model farms, to organize and assist specific research connected with tobacco cultivation, and generally to render assistance for improving tobacco production.

4. To collect statistics on any matter relating to the

tobacco industry.

5. To perform such other functions as the Central Government may, from time to time, direct.

The Pakistan Tobacco Board is currently located in Peshawar and has a regional office in Lahore. There are research stations located in Mardan and Mansehra in the NWFP and at Kunjah and Okara in the Punjab. Besides these, there is a model farm located near Mardan.

Its research and development activities are headed by a Director. Manpower employed for research and extension are generally graduates and post graduates in various disciplines of agriculture. Research activities involve agronomic field trials, variety breeding, crop chemicals research, varietal evaluation research, soil testing, and chemical analysis.

The Pakistan Tobacco Board also conducts field trials in collaboration with participating tobacco companies. Annual research budget varies between Rs 3 to 4 million.

TABLE VI-1. TOBACCO RESEARCH & DEVELOPMENT PROFILE

Organization	Activities	Trained Manpower								R&D Expenses Estimate -Rs in millions	% value of sale. An indication of financial the company
		Full Time				Associating					
		Ph.D	MSc	BSc	Others*	Ph.D	MSc	BSc	Others		
Pakistan Tobacco Co. Ltd.	Tobacco and other crop related research.	-	2	-	11	-	6	8	42	3.5	0.09
Premier Tobacco Industries Ltd.	"	-	1	-	6	-	7	1	40	1.5	0.11
Lakson Tobacco Co. Ltd.	Sporadic field trials.	-	-	-	-	-	3	5	4	0.1	0.01
Pakistan Tobacco Board	Tobacco and other crop related research	-	10	15	11	2	7	12	4	3.5	0.70**
TOTAL :		-	13	15	28	2	23	26	90	8.6	

*Qualified/trained technician/supervisor **% of value of the tobacco crop 1985 crop = Rs 500 million

VII. LIVESTOCK, POULTRY & DAIRY INDUSTRY

Livestock farming in Pakistan is predominantly subsistence in nature. With the fragmentation of land holdings and the increase in number of landless tenants, livestock husbandry has become a means of providing some livelihood for millions of rural and urban people . Livestock is maintained for milk, meat, and power needs by 4 million farm and two million landless households. Cattle are raised for draft power, buffaloes for milk, and sheep and goats for meat. Meat from buffaloes and cattle comes as by-products when the animals outlive their usefulness as draft animals or milk producers. Poultry, sheep, and goats are also kept as scavengers.

There is a wide range in official publications and by various experts in estimates of the livestock population, their productivity, and of human consumption of animal products. In the past seven years the large influx of Afghan refugees with their herds of sheep, goats, and cattle has further confused the real population estimates of livestock. Agricultural Statistics of Pakistan for 1985 give the following estimates:

TABLE VII-1. ESTIMATED LIVESTOCK POPULATION

(000 heads)

No. of Livestock	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
Cattle	15585	15774	15964	16157	16352	16549
Buffaloes	11644	11917	12197	12483	12777	13077
Sheep	21439	22115	22812	23531	24272	25037
Goats	24953	25842	26763	27716	28704	29726
Camels	841	855	869	883	897	912
Asses	2414	2482	2553	2626	2701	2778
Horses	444	446	447	448	450	451
Mules	62	63	63	64	64	64
Commercial Poultry:	23189	25812	29701	43430	52071	62585
a) Layers	6909	6949	7832	8827	10352	12028
b) Broilers	15933	18476	21424	33952	40939	49620
c) Breeding Stock	347	387	445	651	780	937
Rural Poultry:	39440	41545	43763	46099	48560	51152
a) Hens	19512	20554	21651	22807	24025	25307
b) Cocks	3284	3459	3644	3838	4043	4259
c) Chicken	15754	16594	17480	18414	19396	20431
d) Ducks	619	652	687	724	762	803
e) Drakes	202	213	224	236	249	262
f) Ducklings	69	73	77	80	85	90
Total of Commercial/Rural Poultry:	62629	67357	73464	89529	100631	113737

Source: Livestock Division

Commercial poultry farming is one area of livestock production that has made substantial strides during the last few years. The critical year was 1963 when Pakistan International Airlines leased an experimental farm from the Government and, in cooperation with Shaver Company of Canada, developed a large, well-equipped commercial hatchery. The original idea was to meet locally PIA's own requirement and that of other airlines passing through Karachi. The success of this venture paved the way for other commercial enterprises in the country. The official contribution to development was the tax holiday provided to poultry farming. Private sector enterpreneurs were quick to participate in and to develop this industry.

The private sector is very active and progressive in poultry and in marine fisheries. Lately a spurt in private sector milk plants is also contributing to development of milk production. Milk plants have initiated their own extension services in the animal health sector, in feeds and fodder production, and a few have started their own cattle farms where they are engaging in breeding and improvement.

Research

Research conducted at public sector institutes with dairy cattle suggest that optimum producti ity comes from hybrids between indigenous and imported breeds. Increasing the proportion of exotic blood above 50% increases milk and meat

production but also increases susceptibility to diseases and heat stress. In the case of buffaloes which average 1800 liters of milk per lactation, the Nili-Ravi breed is considered the best. Private research on livestock and poultry relevant to their specific problems are conducted at some of the 102 private poultry breeding, 14 livestock breeding, and 35 milk plants or farms listed in the Annexure:

A new venture under the name of Uqab Breeding Farm has been established in the Sind. They have obtained development credit from the Agricultural Development Bank of Pakistan and plan to use embryo transplant techniques.

Professional manpower working in the livestock and poultry sector is estimated to be 80 veterinarians, 70 poultry science degree holders, and 130 trained technicians.

There is no indication of funds specifically allocated for research oriented activities in any of these private sector organizations.

The dairy industry, represented by milk plants, conducts little research. They do, however, invest in extension work. An industrial group, Packages Limited at Lahore, reportedly invests about Rs 2.5 million per annum to develop packaging materials for dairy products fruit juices, and meat. The group manufactures paper and board and has a plant to convert it into packaging materials for milk plants and other users. As such, their work cannot be classified as research but as a development activity.

Poultry Feed Mills

As a consequence of the phenomenal growth in the commercial poultry sector, the feed mill business was developed to supply the poultry industry. Lever Brothers were the first to bring out poultry feed, and over the years scores of feed mills have come into operation. At the end of 1986, there were 66 feed mills in the country -- 50 in the Punjab, 14 in the Sind, and two in the NWFP.

There is little nutritional research being undertaken by any of the feed mills. Almost all of the mills lack facilities for biochemical evaluation and testing of feed ingredients. This is done on an empirical basis. One exception is Kay's Poultry Feed in Karachi which has installed a modern, computerized unit to automatically substitute one or more ingredients with others. However, here too, no facility exists to analyse composition and quality of various lots of feed ingredients.

Remount Veterinary & Farm Corps

The Land based Armed Forces of Pakistan maintains a corps called Remount Veterinary & Farm Corps (RV&FC), which comes under General Headquarters' Quartermaster General's Branch. The RV&FC's mandate is to take care of the needs of the Armed Forces for livestock (milk animals, mules, horses, and dogs), operate agricultural and dairy farms, milk and milk product processing plants, and veterinary centers. No research is conducted, but this organization, in collarborative research with public sector institutions, could provide an excellent environment for

conducting nutritional research.

VIII. FARM MACHINERY INDUSTRY

The farm machinery industry has made substantial progress over the past 20 years. Currently over 562 establishments, mostly in the private sector, are engaged in producing farm machinery and implements. According to the Census of Agricultural Machinery[1] conducted in 1984, the increase in the number of tractors over the 1975 estimate was 339%. Similar data for tubewells and surface pumps showed a 53% increase.

Research

In the machinery manufacturing sector five units are currently assembling small, medium, and large tractors with varying degrees of locally made components. These units are:

Public Sector	
Millat Tractors	Massey Ferguson
Al-Ghazi Tractors	Fiat
Private Sector	
Allied Tractors	Ford
Belarus	Belarus
Associated Tractors	Tai Shan & IMT

In their programs for gradual elimination of imported components, all five units have fallen short of the target mainly because they are finding it difficult to develop local suppliers of quality components. The entire burden of developing a parts

1. Pakistan Census fo Agricultural Machinery 1984; Agricultural Census Organization.

manufacturing industry has been transferred to the private sector. Tractor manufacturers are faced with an uphill task as technology, management, and machines are virtually non-existent in the suppliers' shops. The suppliers are small, are inadequately financed, and have little technical capacity.

Some companies have attempted to help suppliers with foreign and local engineers and have made attempts at quality control, but they say that teaching suppliers that good quality saves them money is not always easy. When parts are constantly rejected, the suppliers simply withdraw and sell to other manufacturers who accept their parts.

Availability of materials to meet the modern tractor demands is poor in the local market. Local steel mills require a minimum order for special and high strength steels which makes it impossible to economically manufacture these parts. Plastic and plastic technology is lacking.

The emergence of second generation supplier plants is encouraging, but they fall short of what is required for a modern, high-quality industry which can become export oriented. However, starting from virtually no supply base in 1982, the tractor industry has achieved more than any of the other engineering industries in terms of producing parts locally.

The private farm machinery manufacturing industry has demonstrated that it can copy or modify almost any agricultural machinery or equipment. This strength of the private sector

entrepreneur has been demonstrated and proven in the case of pumps, electrical motors, miscellaneous tillage, planting, harvesting and threshing equipment, hand knapsack sprayers, and tractor- mounted boomsprayers. Technology seems to have been transferred and absorbed by the private sector through their own ingenuity. However, the private sector has the drawback of not having access to specialized alloys or materials which are necessary for high quality. Despite this disadvantage the performance of the private sector is commendable.

Almost all of the primary and secondary tillage implements in Pakistan are locally manufactured as are the medium and small diesel engines, tubewell pumps, electric motors, cane crushers, seed drills, reapers, rotavators, chisel plows, and land levelling blades. Threshers for grain crops have become available virtually everywhere.

Technology for manufacturing these equipment has not come in any organized, scientific way or through any research. It has been the result of empirical methods and the ingenuity of the metal workers and technicians. Demand for farm equipment and implements is on the increase and was assessed by a UNIDO expert as follows:

Type of Implement	Annual Demand
Cultivator	37,000
Mold board Plow	4,000
Disc Plow	4,500
Disc Harrow	3,500
Leveling Blade	16,000

Rotavator	1,000
Grain Drill	2,000
Thresher	10,000
Trailer Trolley	22,000

Source: W.J. Dzieciallewski 1982,..Capital Goods Project in Pakistan UNIDO Study 1982. Unpublished.

Further development of these machinery manufacturers also depends on their easy access to locally made and reasonably priced machinery such as, lathes, shapers, grinders, drills, welders, molding units, presses, cutters, electric motors and milling machines. There is also an ample supply of experienced operators for these machines. Their major constraints are the relative lack of access to or availability of quality control equipment, specialized steel and alloys, capital, and market intelligence. Chronic power breakdowns are also a sore point.

IX. SUGAR INDUSTRY

Introduction

There were 41 sugar mills operating in the country at the end of 1986 with designed crushing capacity of 85,000 Tons TCD (Total Crush Daily) and 1.2 million tons of sugar production annually. Out of the 41 mills, 28 mills are in the private sector and 13 are in the public sector. A consolidated list of the existing 41 sugar mills appears in the Annexures . Public sector mills account for 31% of total production capacity. The distribution is shown in Table-IX-1.

Twenty sugar mills are located in the Pubjab, 16 in the Sind, and five in the NWFP. There are no sugar mills in Baluchistan because production of sugar cane in this province is virtually nil. However, a feasibility study to set up two sugar mills, one each at Nasirabad and Lasbela districts of Baluchistan, is being conducted by the Sind Sugar Corporation on behalf of the Baluchistan Government.

The capacity distribution of sugar mills in the three provinces is as follows:

TABLE-IX-1 CAPACITY DISTRIBUTION AMONG PROVINCES AND BETWEEN SECTORS

PROVINCE	CAPACITY INSTALLED		CAPACITY %	
	PRIVATE SECTOR	PUBLIC SECTOR	PRIVATE SECTOR	PUBLIC SECTOR
NWFP	9,150	3,000	75	25
PUNJAB	29,300	10,600	73	27
SIND	19,100	12,500	60	40
ALL PAKISTAN	57,550	26,100	69	31

Trends in Output During the last fourteen years, between 1970-71 and 1983-84, the production of sugar increased at an annual compound rate of 6.15%, from 521,634 tons to 1,135,546 tons.

The increase was punctuated by declines during the years of limited availability of sugarcane. Sugar production registered an increase of 36% in 1973-74 which was followed by decline of 19% in the succeeding year. In the next three years sugar production increased successively by 30% in 1975-76, 16% in 1976-77, and 15% in 1977-78. This period of continuous increase was followed by decline in the level of output in the succeeding years of 1978-79 and 1979-80 when production declined by 27% and 6%, respectively.

The highest level of output attained by the industry during

this period was 1,268,334 tons which was occurred in 1981-82. In recent years the fluctuation in the production level have been relatively less sharp. This trend towards stabilization of production levels could persist, depending upon the future sugar policies of the Government.

Production of Sugar from Beet

Pakistan is one of those rare countries where sugarcane and sugar beet are cultivated in the same region and processed in the same factory. Successful cultivation of sugar beet requires a mean temperature of 18°C and good moisture conditions through irrigation. Production of sugar from beet is exclusively done in the Peshawar Vale of the NWFP.

Beet sugar comprises about 30% of the total production of sugar in the NWFP which accounts for 3-5% of national sugar production.

By-Products of the Sugar Industry

The potential for utilisation of by-products of the sugar industry has not been fully exploited. If the sugar industry in Pakistan is to remain viable, production of value-added goods from its by-products is imperative.

In Pakistan there are 7 distilleries which produce industrial alcohol primarily for export. There are two plants which produce hardboard and particle board from bagasse and another one which produces writing paper. There is hardly any effort to utilize the press cake to make compost which has a

great potential for internal consumption as well as for export.

With the advent of bioengineering, the scope of the new chemicals which can be produced from molasses and bagasse, will widen considerably. Sugar experts talked of numerous uses to which the by-products of the sugar industry can be put. It is beyond the scope of this study to enumerate possible uses, but it is important to point out that many possibilities do exist.

Molasses from sugar beet contains approximately 50% sugar. As much as 90% of the sucrose can be recovered from molasses in the same factory by a simple process. Sugarcane molasses normally contains 55% sugar consisting of 35% sucrose and 20% reducing sugars. Similary, as much as 50% of the sugar, which is dry and solid, can be recovered from sugarcane molasses by a chromatographic separation process called the Finn Sugar Pfeifer Langen Process.

Research

Although research and development in sugar extraction technology is being conducted by individual mills and introduction of technological innovations are being made, one sore point is the industry's inability to make any headway in research aimed at increasing sugar crop yields. There is virtually no research to breed or introduce new high yielding varieties. Most of the activities of the industry revolves around extension of area under sugarcane with emphasis on agronomic inputs, such as fertilizers and pesticides. Lack of breeding

research has already resulted in gradual fading of sugarcane production in the NWFP as a result of deteriorating yields of obsolete varieties of sugarcane.

A number of private sugar mills in the Sind sponsored a joint venture in 1977 and formed the Sind Sugar Industry Research Institute (SIRI). Headed by a sugarcane agronomist, SIRI was given the mandate to conduct research on sugarcane agronomy and to help participating private sector sugar mills in their sugarcane production ventures in the assigned zones.

SIRI acquired and developed a 50-acre research farm near Tando Mohammad Khan and began conducting problem oriented research. Results were extended to sugarcane growers of participating mills. The staff included an agronomist, a farm manager, an entomologist, and a chemist. In 1985 the farm research activities were stopped, the farm was sold, and the thrust of activities shifted to extension work for the participating mills. The institute has a technical staff consisting of a chief executive, an agronomist, a soil chemist and a plant pathologist. Their primary role is extension and development. Participating sugar mills are :

Al-Noor Sugar Mills

Bawany Sugar Mills

Mirpurkhas Sugar Mills

Mehran Sugar Mills

Habib Sugar Mills,

Shah Murad Sugar Mills

Faran Sugar Mills

The institute has its headquarters in Hyderabad and, besides technical staff, has ten administrative personnel. It would not divulge the amount of funds provided by the participating mills. However, their annual expenditure is estimated at Rs. 1.2 million.

In the Punjab, there is also a research oriented mill, Ittefaq Sugar Mills at Noorpur, Sahiwal. The mill has recently engaged a team of one senior plant breeder and two research agronomists and is sponsoring a sugarcane research establishment, the Shakarganj Research Institute. They propose to do variety breeding research besides agronomic work.

X. MISCELLANEOUS, TEA, MINT OIL

Tea Growing Venture

In 1959, a German employee of the Pakistan Tea Board started experimenting with tea growing in the Mansehra area of Hazara district in the NWFP. At that time, the objective was to establish plantations of high grown tea for blending with the tea grown in the then East Pakistan. Initial trials gave encouraging results and, at one time, it was considered feasible to establish plantations of high grown tea in Mansehra and the surrounding areas. However, in 1961, because of objections from the Eastern Wing, the tea plantation program was abandoned.

One local grower continued to experiment on his own lands and had established a 20-acre plantation by 1968. His interest in growing tea is such that he continues his informal research on tea growing in Mansehra and he also has visited tea growing countries outside Pakistan. His work involved selection of tea bushes, vegetative and seed propagation techniques, and tea processing using simple hand operated equipment which he designed himself. Based on this grower's experience a tea research station was established in Mansehra in 1985.

Mint Oil Production

When Geofman Pharmaceutical Co. of Karachi started an agro-division to grow pharmaceutical plants, their first venture was the introduction in 1984 of a number of imported mint varieties

which they grew in upper Hazara for selection of most suitable types. They engaged two Pakistani agronomists and had the services of a biochemist from Vicks Co. of UK. In 1984 initial trials were on one acre. In 1985 the area was increased to 4 acres. In 1986 commercial plantation went up to 20 acres and the company installed a simple distillation plant at Baffa (district Mansehra). Currently the venture has taken the shape of a profitable business, both for the contract growers and the company. An average of 5 tons of green harvest is obtained per acre which, with the rather crude distillation plant installed, gives 30-35 kg of mint oil. The company purchases the crop on the basis of recovery. An average mint grower earns about Rs 9,000 to 10,500 per acre.

XI. ROLE OF THE CORPORATE SECTOR IN THE PROCESSING OF AGRICULTURAL PRODUCTS

From the agricultural standpoint the public & private sector corporations are mostly responsible for the production and supply of inputs like fertilizers, seeds, and tractors. On the side of industrial processing of agricultural output, these industries may be divided into primary, secondary, and tertiary industries. Classified accordingly, estimated production of these industries during the year 1985-86 is given in Table XI-1.

TABLE XI-1. SUMMARY OF PAKISTAN'S AGRICULTURAL PROCESSING INDUSTRY

A.PRIMARY INDUSTRIES	UNIT	PRODUCTION '000 Tons	VALUE OF PRODUCTION Million Rs
1. Wheat milling	000 tons	12,400	34,813
2. Rice husking	000 tons	2,982	11,928
3. Cotton ginning			
4. Oil Extraction			
(a) Rapeseed	000 tons	127	1,562
(b) Cotton seed	000 tons	195	1,672
(c) Sunflower, saf-flower, groundnut.	000 tons	17	212
(d) Oilcakes	000 tons	1,700	3,672
TOTAL :	000 tons	17,421	53,859

B.SECONDARY INDUSTRIES	UNIT	PRODUCTION	VALUE OF PRODUCTION Million Rs
SECONDARY INDUSTRIES			
5. Sugar (a) Refined sugar	000 tons	1,306	10,122

(b) Molasses	000 tons	370	185
6. Packaged milk & milk products	000 tons	72	3,168
7. Packaged & frozen meat & poultry products	000 tons	0.5	15
8. Processed/preserved fruits and vegetables.	000 tons	11.0	165
9. Biscuits & cereal products.	000 tons	32.0	320
10. Fish products :			
(a) Frozen shrimps	000 tons	8.5)	
(b) Fish meal	000 tons	32.0)	
(c) Fish Oil	000 tons	1.5)	4,450
(d) Smoked/dried fish	000 tons	2.5)	
11. Cigarettes	Mil.No.	38,921	7,784
12. Cotton yarn	000 tons	431	12,068
13. Paper & paper board :			
(a) Writing & printing paper	000 tons	35	490
(b) Straw/particle & other boards	000 tons	11	143
14. Leather & leather products :			
(a) Chrome	Mil.sq.mtr.	21)	
(b) Sole	Mil.sq.mtr.	370)	1,200
TOTAL			40,110

C.TERTIARY INDUSTRIES	UNIT	PRODUCTION	VALUE OF PRODUCTION Million Rs
15. Fructose	000 tons	2	15
16. Fruit-based drinks:	Mil.packs	85	170
17. Cotton cloth	Mil.sq.mtr.	272	2,720
18. Textile madeups :			
(a) Readymade garments	Mil.pieces	42.5)	
(b) Other madeups	Mil.pieces	)	3,150
19. Carpets	Mil.sq.mtr	2.5	2,500
TOTAL			8,555

Research

The food processing industry is in its infancy. Fruit and vegetable drying and pickling, preservation of juices and milk to increase their shelf life, and cold storage of agricultural produce have not developed to a high degree. Of the many factors responsible for lack of development, the foremost was probably expensive packing materials. Other reasons were poor logistics, a very small base of food processing units, and poor marketing infrastructure dominated by the middlemen.

With the introduction of "Tetrapack" polyethylene lined paper board packing, a small milk and fruit juice packing industry is being developed in the country. However, these food processors conduct little research. In most cases plants and machinery imported bring with it the technology and little, if any, in house research is conducted except adaptive modifications to plants to cater to local materials and produce.

An exception is Packages Limited who not only are the sole manufacturers of "Tetrapack" material for packing, but also own a fruit and vegetable processing plant and milk packing plants. They have a division of product development which undertakes research in packing materials and new products. No other food processor has a research facility or conducts any research.

Bottlers of international name brand soft drinks do have small laboratory facilities but conduct little, if any, research.

XII. RESPONSE TO OF QUESTIONNAIRE SENT TO MAJOR PRIVATE SECTOR COMPANIES

In the course of this study personal visits were made to leaders of private sector agri-business ventures and a questionnaire was also sent to 482 private sector enterprises to solicit their responses and views on their research activities, financial and professional manpower inputs in research, and their strengths and constraints to undertake research. The following is a summary of their responses.

Tobacco Companies

Out of 8 companies approached by mail, four responded. Three of the companies said they were doing their business-related research in the field of agronomy, varietal trials and screening for yield, quality, and response to chemicals. Of the three respondents, two had in-house R&D establishments, and the other collaborated with the Pakistan Tobacco Board. Professional manpower was considered competent and qualified to conduct research. The annual R&D budget of the two companies having in house R&D facilities totalled Rs 5.0 million. None of the companies which responded wanted to have research grants or to conduct research under contract. In their R&D activities they received help from Pakistan Tobacco Board, but none from the Chambers of Agriculture, Commerce and Industries.

Seed Companies

Only four companies responded. Three of them had R&D programs with strong testing programs for hybrid seed production. One was involved in disease-free tuber production of potato varieties and research in post-harvest physiology. Three companies were well staffed with qualified personnel and were amenable to collaborative research and acceptance of research grants. However, all complained of receiving no assistance from public sector research institutions or from Chambers of Agriculture, Commerce, and Industries.

Agricultural Farms

The two respondents complained of the legal ban on commercial agriculture as a corporate industry because of clauses in the Land Reform Acts of 1969 and 1972. They said they did adaptive research when their land holdings were large but have stopped since coming under land reforms, due mainly to low profits.

Plant Extracts Companies

The single respondent said they are not doing any research, although they would like to. Presently, they obtain wild plants to extract alkaloids for pharmaceutical purposes. No help or assistance from any public sector organization or from Chambers of Agriculture, Commerce, and Industries was recognized.

Fish Farm, Deep Sea, and Fresh Water Fishing Industry

The sole respondent is engaged in deep-sea, bottom-trawling using bull-trawlers with on-board, instant freezing facilities. The company is involved in mapping and exploration of marine resources in Pakistan's EEZ. The company has 33 expatriates working for it aboard ship engaged in fishing, sorting, packing and freezing operations who are also imparting training to the Pakistanis working with them. The company received no technical assistance from public sector institutions. The company would contract research and accept grants to scientifically collect and compile data, explore the possibility of mid-water trawling, gillnetting and purse seines on marine life in the Pakistani EEZ.

Pesticide Plant

The respondent, Degesch Pakistan, is the only private sector industry making fumigants for agricultural use. It received no assistance from any public sector institution, but had no objection to conducting collaborative or contractual research.

Fertilizer Manufacturers & Marketing Companies

The three respondents conduct agronomic research demonstrating the effect of balanced fertilizer applications on yields. All three companies had highly qualified staff and Technical Services Division as part of their marketing activities. They do get some advisory assistance from public sector institutions, have research and development budgets, and

would welcome collaborative or contractual research with public sector institutions.

Organic Fertilizer Companies

- The responding company, a USAID and ADBP financed venture, is engaged in processed pelletized cow dung manure production. It is planning to conduct research involving use of their product on field and horticultural crops. They reported no assistance from public sector institutions and face difficulties from the official government functionaries. They would welcome research grants for collaborative research.

Cattle & Stud Farms

The two respondents have conducted research crossing local and exotic breeds and they felt that they have all the necessary technical knowhow and capability to conduct their own field related research.

Milk & Dairy Plants

The two respondents are involved in producing UHT milk, cream, butter, butter oil, and ice cream mix. They conduct product development research. They have competent and well-qualified staff and have a R&D budget of Rs one million. Most of the difficulties they faced were related to applying imported technology to local raw materials and the local environment. They have not received any assistance from public sector institutions. Both companies would welcome research grants and felt capable of

Poultry & Breeding Hatcheries

From among the total of 50 establishments that were sent questionnaires, four responded. None indicated doing any breeding research, but all admitted doing research in feed formulations. They also complained of poor and inconsistent quality of feed. There were no indications of accepting a research grant or inclinations toward conducting collaborative research with other institutions.

Feed Mills

The sole respondent among the 30 establishments producing feed for poultry and cattle that were approached said that its research activity involved utilising sugar mill by-products. They were receiving no technical assistance from any public sector institutions. The company agreed to undertake research on production of feed with high quality and economically feasible ingredients and would welcome research grants.

Food Processing Companies

The two respondents have been conducting research for new product line development and in improving the quality and shelf life of their existing lines. They have professionally qualified staff and received no assistance from any public sector agency. They would welcome research grants to conduct independent/ contractual or collaborative research.

Pesticides Companies

There are over 50 small, medium, and large pesticide companies operating in Pakistan. Of the 45 approached, six responded. Essentially importing and marketing companies, their major thrust is to demonstrate the efficacy of their products in order to obtain registration. However, there are three exceptions who support R&D divisions with highly qualified entomologists, agronomists, and chemists. One spends about 1.87% of its turnover on research and development. Comparible figures for the other two are 0.42% and 1.36%. Other multinationals spend much smaller amounts on research and development. Local companies' adaptive research activities stop when they acquire registration of their product.

Paper & Board Mills

The three responding companies said that their research activities involved producing quality pulp from wheat straw and innovation in processing techniques. They would like to collaborate in joint research to identify and produce long fibre pulpable plants within the country. One company mentioned a strong research programme in developing cheap packaging for short life foods, with an R&D budget of Rs 2.5 million and a team of 6 researchers headed by a Ph.D.

Agricultural Machinery Manufacturers

Only seven responded from among the 130 manufacturers. There

is no basic research in designing of agricultural implements except copying imported machines and making innovative changes in response to field complaints. They associate with the Agricultural Mechanization Research Institute at Multan. All respondents said that they possessed the capability to undertake design research if technical assistance and grants were forthcoming from public sector agencies.

TABLE XII-1. TOTAL NO. OF PRIVATE SECTOR ESTABLISHMENTS APPROACHED AND NO. OF RESPONDENTS

ORGANIZATION	Nos. Approached	Nos RESPONDING	% RESPONDING
Tobacco Manufacturers & Processors	8	4	50
Solvent Extraction Plants	6	-	-
Seed Companies	11	4	36
Plant Extraction Companies	4	1	25
Agricultural Crop Farms	4	2	50
Fish Farm, Deep Sea & Fresh Water	4	1	25
Silk Culture	1	-	-
Mushroom Farm	1	-	-
Pesticide Plants	1	1	100
Fertiliser Manufacturers & Marketing Cos.	5	3	60
Compost Organic Fertilisers	2	1	50
Specialised Oil Extraction	3	-	-
Cattle & Stud Farms	14	2	14
Milk & Dairy Plants	35	3	8
Poultry Breeding & Hatcheries	50	4	8
Feed Mills	30	1	3
Food Processing Units	25	2	8
Pesticides Companies	45	6	13
Paper & Board Mills	21	3	14
Cattle & Poultry Feed Plant Manufacturers	5	-	-
Cotton & Ginning Machinery Manufacturers	3	-	-
Poultry Making & Processing Equipment Manufacturers	5	-	-
Rice Husking Plants	14	-	-
Tannery Machinery Manufacturers	6	-	-
Pulse Milling Machinery Manufacturers	6	-	-
Seed Processing Equipment Manufacturers	1	-	-
Oil Expelling Machinery Manufacturers	15	-	-
Paper & Board Machinery Manufacturers	7	-	-
Dairy Equipment Manufacturers	1	-	-
Cold Storage Machinery Manufacturers	10	-	-
Wood Working Machinery Manufacturers	8	-	-
Plant Protection, Spraying Co.	1	-	-
Agricultural Machinery Manufacturers	130	7	5
TOTAL :	482	45	11

ANNEX-1

ITINERARY OF VISITS

Date	Organization	Persons
Feb 6, 1987	Private tea growing Venture; Mr.Rustam Khan's Farm Baffa - Hazara	Mr.Rustam Khan Landlord
Feb 7, 1987	Geoffman Pharma, Mint Growing Venture Mansehra - Hazara	M/s Muqadar Khan and Fida Hussain Agronomists
Feb 7, 1987	K & N's Poultry & Agriculture Farms, Mangli - Hazara	Lt Col (Rtd) Maqsood A. Khan,G/Manager
Feb 7, 1987	Agricultural Development Bank, Regional Officer, Abbottabad	M/s Khattak & Rehman, Development Officer
Feb 17,1987	Punjab University of Agriculture Faisalabad	Dr.A.D.Chaudhry, Head Dept. Farm Machinery, Khawaja Altaf Hussain, Associate Professor Farm Machinery.
Feb 17, 1987	Punjab University of Agriculture Faisalabad.	Dr.Haji Mohammad Chaudhry, Head Dept.Animal Nutrition.
Feb 17, 1987	Punjab University of Agriculture Faisalabad.	Dr.M. Amjad, Head Food Technology.
Feb 18, 1987	Ittefaq Industries, Samundari Road, Faisalabad.	Ch.Mohammad Sadiq Mr.Ahmed Hussain
Feb 18, 1987	Punjab Engineering, Samundari Road, Faisalabad.	Mr.Ahmad Bakhsh
Feb 18, 1987	Rachna Engineering, Samundari Road, Faisalabad.	Seth Mohammad Tufail
Mar 4, 1987	Cargill Pakistan Seed (Pvt) Ltd	Mr.Mohammad Amin General Manager
Mar 4, 1987	Hoechst (Pak) Ltd, R&D Division,	Mr.Mohammad Azim Pira, Division Head R&D.
Mar 5, 1987	Jaffar Brothers (Pvt) Ltd. Seed Division, 251 Shadman-I,	Mr.Azhar Iqbal, General Manager

Lahore.

ANNEX-II

TERMS OF REFERENCE

Preparation of a report on the current state of agricultural research in the private sector in Pakistan.

The objectives of this study is to describe the current research activities being carried out in the private sector in Pakistan, including a listing of firms doing research, a description of the research activity, an estimate of the budget available for the research for each organization, and an estimate of the number of research personnel involved and their level of training. The study should also indicate the major constraints the private sector faces in conducting research.

The consultant should review the pertinent reports, articles, and other literature pertaining to private sector reseach. He should also contact by telephone, by post, or in person the private institutions doing agricultural research in Pakistan to collect information about the nature and extent of their resesarch activities. He should also interview persons in the private or public sector who are knowledgeable about reaearch in the private sector. He would collect financial reports, annual reports, annual reports, and other publication prepared by agricultural organizations in the private sector. Further, he should contact the appropriate chambers of commerce and other organizations that coordinate and assist private business to determine the extent of their member's participation in agricultural research and the support provided by the organizations in support of agricultural research.

The findings of this study must be set down in a report that would describe the nature and level of research currently being done by Pakistan's private sector. It would, in so far as possible, indicate the amount of funding for each individual research effort, the number of personnel involved, and their level of training. The report should also indicate the ability of willingness of private sector research organizations to contract with or accept research grants from PARC or other government funding agencies. A brief history of each research project should be given, indicating how long the research has been going on and noting any substantial results of the research. The report should also indicate the relationship of these private research organizations to similar government-supported research institutions.

The consultant should also attempt to learn about any agricultural research, particularly research with livestock, being conducted by Pakistan's military organizations and include a brief description of this in his report.

Definitions:

Research: For the purpose of this study research is considered to be testing or experimentation that measures results quantitatively in a manner that can be consistently replicated. The qualitative observation of the performance of different kinds of primary tillage equipment would not be research as defined here. The measurement of soil bulk density, or seedling emergence, or weed density, or crop yield, replicated in space, in soils tilled by different implements would be research.

Agriculture: Agriculture refers to the production of food, fiber forest products or other plant or animal products consumed by man. It would include the production of primary inputs to agriculture such as fertilizer, pesticides, and agricultural machinery. It would include post-harvest processing of agricultural products, such as the production of corn flakes and starch from maize.

Private Sector: The private sector comprises firms and organizations that are either for-profit or not-for-profit that are at least partially funded by non-government monies. Semi-autonomous, government-funded organizations (such as PARC) would not qualify, nor would the Central Cotton Committee. Organizations such as Rafhan Maize Products, Cargill Ltd., and the Agha Khan Foundation would.

Reporting Requirements: A written report shall be prepared by the consultant. In addition an oral presentation of the findings of this study will be made to PARC and Provincial Research Organizations if requested by the MART/Winrock Chief of Party.

This work is expected to be accomplished in approximately eight weeks. In addition to a mutually agreeable salary all official travel expenses will be paid according to USAID rules and regulations.

ANNEX-3

QUESTIONNAIRE

1. Name of Organization/Firm, and address, with phone number, etc.

2. Present activities (for example, manufacturer, processor of)

3. Are you doing any research/development, relevant to your field of activity ?

4. Type of research and development work

5. Annual budget for research and development.

6. No. of personnel involved in research & development and their level of training.

7. Any difficulties you are facing in your research and development work ?

8. Do you get any technical assistance from public sector organizations in your research and development work ?

9. Do you get any assistance from Chambers of Agriculture and Commerce and Industries ?

10. Do you have the ability to conduct research and, if so, are you willing to contract with or accept research grants from PARC and other Government funding agencies ?

11. Any remarks or suggestions.