The Costs of Not Having An Effective Seed Industry for Major Cereals in NWFP

by

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Introduction

An effective agricultural development programme can be likened to an endless chain. The endless chain with a geared hoist is a marvelously simple piece of engineering. However, each link of the chain is critical if the chain is to work. If one of the links becomes rusty or was never strong in the first place, the whole chain is useless and cannot be used for lifting. Some repairs or rebuilding of links will be needed.

The agricultural development program of NWFP can be likened to a hoist, whose objective is uplifting agriculture and the well-being of people. For this hoist, however, a vital link is missing. This missing link is an effective seed industry. The fact that this workshop is being held is testament to this problem, although for more details, see Byerlee and Hussain (1986), Industry Council for Development (1987), CIMMYT (1987) and Heisey (1988).

The lack of an effective seed industry for major cereals in NWFP has been a major constraint to the adoption of improved varieties by farmers. For many years now, scientists have been saying that good varieties are available for major growing areas of NWFP. Considerable on-farm research supports this view (Byerlee and Hussain, 1986; Khan et al., 1986 ; Razzaq et al. 1988). Nevertheless, the varieties have been only slowly adopted (in the case of wheat) or rarely adopted (in the case of maize).

The purpose of this paper is to assess the costs to NWFP of not having an effective seed industry. This is only possible by comparing the situation that currently exists (the "without" case) against the situation that probably would exist with an effective seed industry (the "with" case). Such an analysis is termed a "counter-factual" one. It is the type that economists love, since it involves attempting to measure the value of opportunities foregone by not having an effective seed industry against the current arrangement.

We must admit that this is a challenging topic. Consequently, the scope of the paper has been narrowed. Basically, we have attempted to measure the obvious direct costs or opportunities foregone by farmers in not having an effective seed industry for major cereals. Time prevented us from assessing the less obvious or indirect opportunities foregone. These include income and employment opportunities foregone by NWFP, as well as potential export earnings from seed in the next few years.

In this paper, we have concentrated on wheat and maize; not because the authors are from CIMMYT, but, because these are the main food crops of NWFP. What is stated probably also applies to other cereals, oilseeds, pulses and legume crops of NWFP for which commercial seed is not readily available. We do not know enough about seed, seedling and rootstock availability for other major crops, especially sugarcane, tobacco, sugarbeet, vegetables and fruits, so have confined our analysis to major cereals.

The Problem Quantified

The areas of major cereals in NWFP in recent times are presented in Table 1. The data are presented by region for NWFP, for the most-recently available year, 1985-86. Note NWFP's share of Pakistan total wheat area (10%) and of total maize area (57%). For rice, NWFP is a comparatively small producer, while for other cereals (barley, sorghum and millet) the share of NWFP approximates that of wheat.

Table 1. Area of Major Cereals by Region, NWFP, 1985-86[1]

Region	Wheat	Maize	Rice	Others	Total
	'000 ha	'000 ha	'000 ha	'000 ha	'000 ha
Southern	267	30	7	35	339
Central	177	109	2	15	303
Mountainous	260	286	55	23	624
Western Tribal	78	27	6	40	151
NWFP Total	782	452	70	113	1417
Pakistan	7400	800	1900	1100	11200

Note:Southern NWFP includes D.I. Khan and Kohat Divisions (Districts: D.I. Khan, Bannu, Kohat and Karah); Central NWFP is Peshawar Division (Peshawar, Mardan and (now) Swabi Districts); Mountainous NWFP includes Malakand Division (Malakand, Swat, Dir and Chitral Districts) and Hazara Division (Mansehra, Abbotabad and Kohistan Districts); Western Tribal NWFP contains the Federally Assisted Tribal Areas (Mohmand, Khyber, Kuram, Orakzai, Bajour, Northern and Southern Wazirastan Agencies).

[1] It remains unclear whether the areas reported are the harvested areas or the planted areas. This should be clarified in future statistics on agriculture in Pakistan, as there will be a considerable difference between the two area measures.

The estimated seed requirements of farmers, given reasonable assumptions about planting rates by region, are presented in Table 2. These approximate the actual amounts of seed going into the soil, whatever the source and quality of the seed. While we might quibble over these assumptions, since little data exists on seed rates for any but the Mardan, Swat and Mansehra Districts, the overall magnitudes are of importance. Basically, wheat seed requirements are of the order of 150,000 tons for the province, while maize seed requirements are around 30,000 tons, given current planting rates by farmers.

Table 2. Estimated Farmers' Total Seed Requirements for Wheat and Maize in NWFP, 1985-86.

	Wheat			Maize		
Region	Area (000 ha)	Assumed Seed Rate (kg/ha)	Seed Planted (Tons)	Area (000 ha)	Assumed Seed Rate (kg/ha)	Seed Planted (Tons)
Southern	270	100	27,000	30	40	1,200
Central	180	100	18,000	110	40	4,400
Mountainous	260	100	26,000	290	80	23,200
Western Tribal	80	100	80,000	30	60	1,800
NWFP	790	..	151,000	460	..	30,600

Now let us see how much of these requirements are being met by the current commercial seed production system. A distinction has to be made here between commercial seed, and that retained by farmers. Wheat seed procured by the Agricultural Development Authority (ADA) of NWFP, as well as the little extra from Cereal Crops Research Institute, amounted to about 3,000-4,000 tons in recent years, some 2-3 percent of total farmers' seed planted. For maize, the amount procured was very much smaller, we have assumed a maximum of 200 tons, but could not be certain on this figure, as different agents are involved in seed multiplication. If our figure is roughly correct, this would represent less than 1 percent of total maize seed planted.

These tonnages suggest that considerable scope exists for seed industry development in NWFP. However, remember that farmers' needs for commercial seed of wheat (a self-pollinating crop) would be approximately 10-15 percent of total wheat seed planted (Heisey, 1988). The reproductive ratio of wheat seed in NWFP (the kgs of commercial wheat seed obtained from planting 1 kg of basic seed) would be about 40:1 (assuming a seed yield of 2000 kg/ha from seed planted at 50 kg/ha). Providing sufficient seed of newly-released varieties can be produced and rapidly multiplied by commercial seed producers, the farmers can readily build up seed supplies of new wheat varieties or replacement seed in one crop cycle (i.e. land preparation to harvest).

For open-pollinated maize varieties, the farmers' need for commercial seed as a percent of total seed planted would be somewhat higher than for wheat (say, 20-25 percent). This will depend upon the rate at which the seed retained by farmers from their own fields is contaminated. We do not know how rapidly the seed is contaminated in NWFP. However, we are very pleased to be planning trials on this very issue, this year in the Swat Valley, in collaboration with maize scientists of the Cereal Crops Research Institute (CCRI), Pirsabak. Probably, farmers need to replace their seed of open-pollinated varieties after 3-4 years, but let us reserve judgement on this. As a general rule, farmers growing open-pollinated maize are encouraged to replace their seed after 4-5 years (Wedderburn and Chatta, 1982). Hence the commercial seed needs for maize in NWFP could be about 8,000 tons per year, a dramatic increase over current levels of seed production or procurement.

To the extent that hybrid maize might enter the favoured maize environments of NWFP (Peshawar, Mardan, Swat Valley and other higher-yield potential areas), the commercial seed requirements for maize would increase further. For example, if 50 percent of the maize area of Central NWFP were under hybrids, and 20 percent of Mountainous NWFP (basically, the valleys), an additional 1,300 tons of commercial seed might be required to satisfy farmer needs (Table 3). The value of commercial seed used would be much higher in this case, as the hybrid seed would be of higher value.

Table 3. Potential Quantity and Value of Commercial and Maize Seed Under An Effective Seed Industry, NWFP

	Quantity		Potential	
	Now	Potential	Now	Potential
	(Tons)		(Rs. million)	
Wheat seed	3,500	6,600	10.5	32
Maize seed				
Open pollinated	200	2,600	0.6	20
Hybrid	0	2,800	0	35
Sub-Total	200	5,400	0.6	55
Wheat and Maize Seed	3,700	12,000	11.1	87

Note: Under potential seed industry assumptions, wheat planting rate declines on average from 100 kg/ha to 80 kg/ha, and commercial wheat seed price is twice the price of grain (i.e. 4.8 Rs/kg for seed). Maize seed planting rates decline from 80 kg/ha to 40 kg/ha in mountainous areas and from 40 kg/ha to 30 kg/ha in central NWFP. Hybrid maize seed is assumed to be planted at 25 kg/ha. The price of open-pollinated commercial maize seed is three times the price of grain (i.e. 7.5 Rs/kg for seed) and of hybrids is 12.5 Rs/kg. Current prices of wheat seed are 3 Rs/kg, and maize 3.5 Rs/kg. For more details see Appendix A.

Why Insufficient Commercial Seed?

At this juncture, it is important to understand why insufficient commercial seed is produced in NWFP. Basically, we believe it is for two basic reasons. Firstly, commercial seed production incentives are severely constrained by prices of seed fixed by government. Secondly, incentives and institutional arrangements which favour production and marketing (especially) of quality seed of sufficient quantity to farmers have not existed. We cannot blame ADA or CCRI or extension or the commercial seed industry for this. Each has been severely constrained in their ability to operate commercially, by the institutional arrangements and obligations imposed by government. The challenge is for NWFP policy makers to alter the institutional arrangements so that commercial seed can be produced and marketed effectively.

The latest available seed prices for wheat in NWFP were 3 Rs/kg. With wheat selling at about 2.4 Rs/kg, the seed to grain price ratio was of the order of 1.25:1. For maize the ratio has been slightly higher, around 1.3:1.

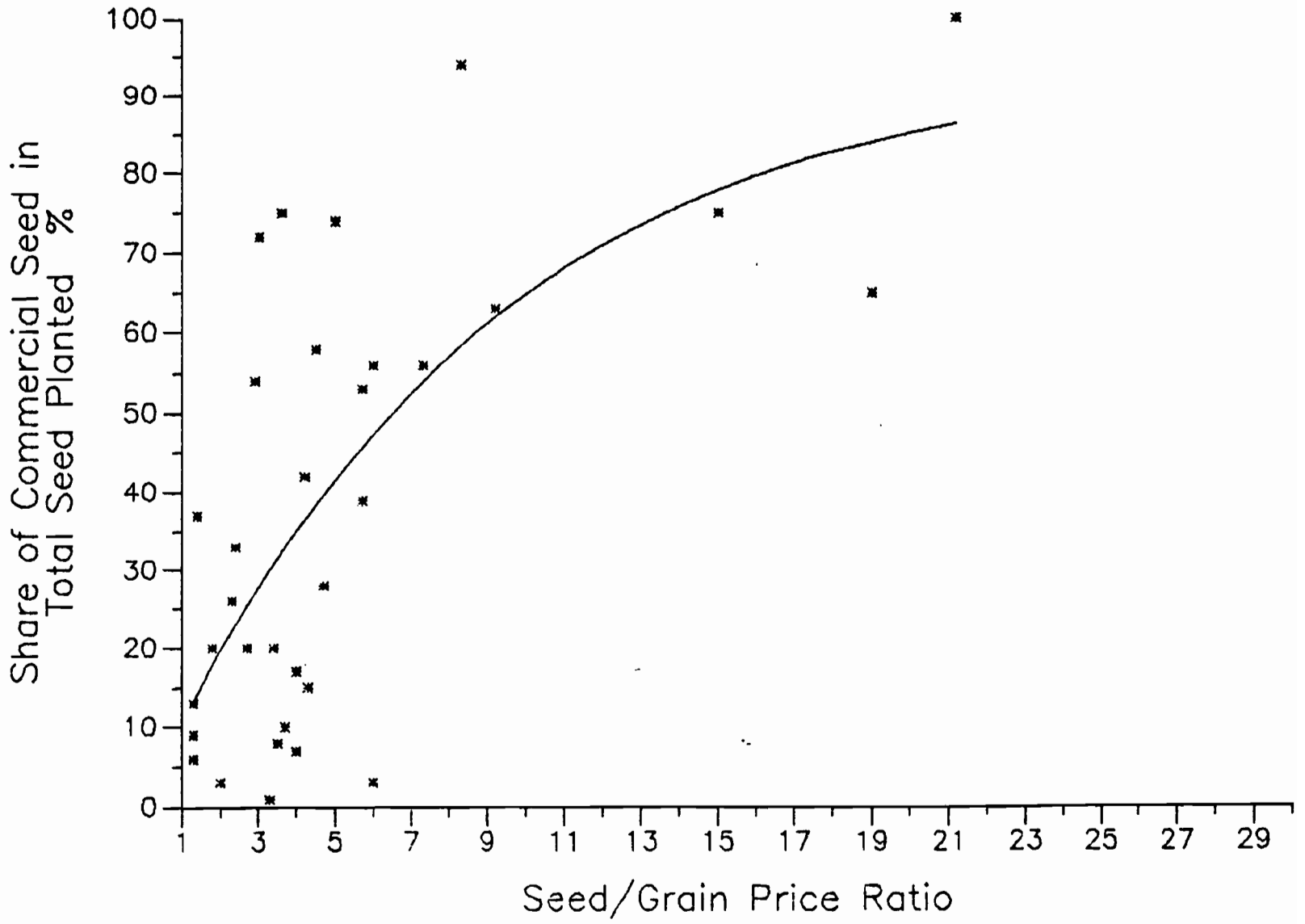
These prices of seed of wheat and maize are low by international standards. For example, wheat seed in a number of developing countries sells at between 1.5-2 times the price of grain (Byerlee and Heisey, 1988). The NWFP prices simply are insufficient to reward normal commercial practices in producing and marketing quality wheat seed. It is little wonder that wheat seed production has been stifled.

Similar findings about very low seed prices for maize in Pakistan are reported in CIMMYT (1987). With a seed to grain price ratio of 1.3:1, we can conclude that the incentives to produce and market quality maize seed have been negative, when allowance is made for reasonable costs and margins in growing, conditioning and marketing seed CIMMYT (1987, Fig.10).

Some evidence on the benefits of allowing seed prices to rise, relative to grain, is presented in Figure 1. In this, the relationship between the share of commercial maize seed in total maize seed planted by farmers is plotted against the ratio of the price of commercial maize seed to grain for 33 developing countries (for which data were available in 1985-86, see CIMMYT, 1987). The line of best fit indicates that additional use of commercial maize seed by farmers is positively associated with higher seed prices. This is not a perverse demand relationship for maize seed. It is simply reflecting the fact that countries who have higher seed prices have sufficient incentives to produce and market the seed. The opposite also applies for countries with low seed prices, generally.

With respect to institutional arrangements, those existing in NWFP are not conducive to seed industry development (see Industry Council for Development, 1987). In this study, we have assumed major changes in the institutional arrangements for the development of an effective seed industry in NWFP. Basically, this means that pricing of seed would be the normal commercial responsibility of the commercial seed producers. (We also assume that the pre-basic seed and inbred lines can be sold by CCRI at prices that they have the authority to determine through contracting with commercial seed enterprises.) As well, there would be no constraints on commercial maize seed production, other than the usual registration, quality, labelling and other obligations of seed enterprises (Douglas, 1980). Free trade in seed is also an essential part of the institutional arrangements for an effective seed industry.

Figure 1. Commercial Maize Seed Use Related to Seed/Grain Price Ratio



Note: For 33 developing countries. Source CIMMYT (1987).

Clearly, a number of years would be needed for a seed industry to grow and mature from the present situation. In this paper, this pattern of growth has not been of concern. Rather, we are interested in the situation likely to prevail after reasonable maturity of the industry, as compared with the current seed sector.

How An Effective Seed Industry Might Perform

From the point of view of wheat and maize, we will propose how an effective seed industry in NWFP might perform. This is based largely upon experience from other countries and from our knowledge of farmers' circumstances in Pakistan. A summary of the main assumptions underlying our picture of an effective seed industry are presented in Table 3.

Wheat Seed: With respect to wheat, an effective commercial seed industry would provide at least 10 percent of total seed needs of farmers as certified seed. This might vary somewhat from year-to-year, depending upon varietal release, growing conditions and price incentives (Heisey, 1988). An effective seed industry for wheat would also be a major source of information for farmers about newly-released varieties.

A survey of farmers in Mardan in 1986 found that only 14 percent of farmers obtained their seed of new wheat varieties from seed depots (Heisey, 1988, Table 5.6), and only 21 percent of farmers had actually visited a seed depot. This is exceptionally low, even by Pakistani standards, and Mardan is probably the most developed agricultural district of NWFP. One can only imagine how these figures might look for the Tribal Areas or the more isolated mountainous areas of NWFP.

With an effective seed industry, seed producers would be striving for highest quality, subject to minimal standards and would be selling seed with labels clearly identifying the variety and the seed producing enterprise. The seed might also be available in small packages, perhaps sufficient for one kanal, so that farmers could multiply their own wheat seed. Prices might range around twice the price of grain, and farmers would be encouraged to plant less commercial seed per hectare, perhaps with a drill or kera or pora method.

It is unlikely that large seed companies would monopolise the wheat seed market. More likely, several enterprises might contract with CCRI to buy pre-basic seed, multiply it and then sell it to contracting seed producing enterprises located strategically in different parts of the

province. Competition is always fierce with wheat seed, since farmers have the option of of retaining their own seed or buying from other farmers. Strong incentives to sell seed to farmers and to promote its use would also be a feature of an effective seed industry.

An effective seed industry would be highly-integrated with agricultural research. In particular, the seed industry would be monitoring closely farmers' attitudes to different varieties,as well as working closely with researchers to monitor diseases and other maker "biological breakdown" of varieties. The seed industry would also be keenly aware of new varieties under development and about to be released, and would be providing CCRI with information about pre-basic seed needs.

For wheat, opportunities might be taken to multiply seed by growing two seed crops per year, by shuttling seed from the traditional rabi growing areas, to the mountains for a kharif wheat crop. Also, seed for NWFP might readily be exchanged with seed of other provinces, depending upon demand and stocks of seed throughout the country. Seed would also be traded freely with Afghanistan, and other countries. Such trade would be subject to the usual quality and quarantine tests (Douglas, 1980).

Maize Seed: For maize, a very similar type of seed industry could develop and we would expect the seed producing enterprises to involved with seed of a number of crops, pastures and related products. Compared with wheat, however, maize seed to grain prices would be somewhat higher. For open-pollinated maize varieties, maize seed might sell to farmers at 3-4 times the price of grain, as is common in a number of developing countries (CIMMYT, 1987). Naturally, farmers would cut back on maize seed planting rates for commercial seed, perhaps by as much as half in areas where planting rates exceed 60 kg/ha.

Farmers would be expected to replace seed of open-pollinated maize varieties every 4-5 years, on average. This compares with an average replacement rate at present which is probably around once every 10-15 years in favored environments, or areas where special efforts have been made to encourage uptake of new varieties. For other areas, the replacement rate is negligible, with only very minor infusions of new varieties into the local maize. Farmers growing maize as a dual purpose crop for grain and fodder (Fischer and Javed, 1986) would continue to use their own seed retained from previous crops, although this would be of improved open-pollinated varieties.

One major difference between maize seed and wheat seed is the likely introduction of hybrids. Undoubtedly, the favoured maize environments of NWFP will provide sufficient

yield-responsiveness for farmers to adopt hybrids, when they become available. The experience of a number of countries, notably, Kenya, Zimbabwe, Turkey, India, Brazil and a number of other Latin American nations has shown that small resource-poor farmers will readily adopt hybrid maize seed, when it is highly profitable for them so to do. This has been well-documented in the Kenyan case (Gerhart, 1975), but has also been closely observed elsewhere. Such adoption would be more rapid if the hybrids were marketed in a form suited to small farmers, especially in small packages and available through village outlets.

We anticipate that about half of the maize area in Central NWFP could be under hybrids with an effective seed industry, and about 20 percent of the maize area of Mountainous NWFP. This would mean a quantity of sales of hybrid maize seed of some 2,700 tons per year. Assuming the presence of an effective seed industry, the quantities and values of wheat and maize seed that potentially could be sold per year are presented in Table 3. Note the striking increases in quantity and value from the present situation. The total value of seed sold would increase especially strongly, since the seed produced with an effective seed industry would be a very different product to that currently produced. It would be promoted, come with quality assurances, be readily available to farmers where and when they want it, and it would be packaged in a form suitable to them.

Assessing the Costs or Opportunities Foregone

Area Under Improved Varieties: To begin assessing potential productivity gains from having an effective seed industry, it is important to assess wheat and maize varietal use by farmers now. For NWFP, data on this are very sketchy. The only detailed data are for Mardan and Swat Valley, although we would be very interested to review data from other areas too.

Hussain, et al. (1985) in Mardan found that only 14 percent of farmers surveyed in Mardan District grew recently-released wheat varieties (Pak81), and another 37 percent grew Sonalika, already known to be susceptible to stripe rust at the time of survey. More recently, Heisey (1988) reports over half of the area of wheat grown in Mardan being planted to banned or mixed varieties. Pak81 was growing in about 30 percent of the wheat area in Mardan two years ago, and a total of 47 percent of area was planted to new recommended varieties (Ahmad, et al., 1988). For other areas of NWFP, the uptake of newly-released wheat varieties would presumably be much lower than Mardan.

For maize, Byerlee and Hussain (1986, Table 3) reported that only 4 percent of farmers surveyed in Hazara Division and Mardan Districts in 1984 were growing improved varieties. More-recent data from the Swat Valley suggest a similarly low use of improved varieties there (Khan, et al., 1986). Additionally, only 12 percent of farmers in the high-altitude maize based farming systems of Swat were growing improved varieties (Heisey et al., 1988) . An even lower percentage has recently been recorded for the Bunir Valley, where the AERU, Tarnab has been working in collaboration with the PATA Project.

To summarise, the percentage of area planted to improved wheat varieties is probably higher than the equivalent measure for maize in NWFP. Nevertheless, both are very low and considerable scope exists for increasing the uptake of new varieties by farmers. This is especially so when we realise that farmers' preferences for new varieties, at least in the favoured environments of NWFP for the major cereals, are strong. For maize, maturity was the only attribute that selected Mardan and Swat Valley farmers preferred in their local varieties when compared with Azam variety, in on-farm testing last year. This came from informally surveying farmers who had Azam on trial in their fields. We believe that similar results were found with FSR work in Mansehra.

Productivity Differences for Crops

Once-Only Effect: Data suggest that sizeable productivity differences exist between the latest improved wheat varieties and older and more-disease susceptible varieties for NWFP. Generally, for Pakistan's Punjab, Byerlee and Heisey (1988) found that the annual gains in wheat productivity attributable to varietal improvement have been 0.75 to 1%. This is probably a reasonable figure to apply to NWFP's wheat, but for maize the varietal improvement might be even higher in the future, given the high share of maize currently under local varieties and the potential productivity gains from planting some of the maize area of NWFP to hybrids in the future.

The specific productivity effects of using Pak81 in Mardan District were estimated by Byerlee, et al. (1985). In comparison with other varieties, Pak81 was providing a yield advantage of 525 kg/ha, when the average yield was 2,800 kg/ha. This suggests a direct productivity effect of 19 percent. For the purposes of our analysis, we could probably assume an advantage of 20 percent for favoured wheat areas, since there will also be positive interaction effects on productivity of other inputs. It is our belief that this productivity advantage would hold up well in most

growing areas of NWFP, except perhaps for the cool high-altitude wheat areas and the very dry barani areas.

The productivity gains from growing improved varieties of maize, compared to local varieties are probably higher than for wheat. It is not unrealistic to expect a 20-30 percent productivity advantage from farmers using improved varieties of maize, in place of local maize, although this will depend on the environment. Hybrid maize could add even more to productivity (Saleem Khan, 1987). In certain environments, the varieties have yet to be developed, especially for the mid to higher-altitude areas of NWFP, more than 1500 metres above sea level.

The calculations of the productivity differences that could be expected from an effective seed industry in NWFP are presented in Table 4. This is assuming that all farmers would adopt new varieties to the extent of 75 percent of total area of wheat and maize planted, and in the case of maize, one quarter of the area is planted to hybrids. Overall, a productivity gain of 10 percent is estimated for wheat and of 27 percent for maize.

Table 4. Differences in Productivity of Wheat and Maize Expected With An Effective Seed Industry

	Proportion Area Planted To Improved Varieties	Index of Productivity[1]	Weighted Average Productivity	Overall Productivity Difference
	%			%
Wheat				
Current Situation	25	1.20	1.05	
Effective Seed Industry	75	1.20	1.15	10
Maize				
Current Situation	5	1.20	1.01	
Effective Seed Industry	50	1.30		
Open Pollinated Hybrid	25	1.50		
Overall	-	-	1.275[2]	27

[1] Productivity of improved varieties or hybrids relative to old or local varieties.

[2] Calculated as $[(0.5 \times 1.3) + (0.25 \times 1.5) + (0.25 \times 1.0)]$, with weights 0.65, $.375$, and $.25$.

Sustained Productivity Gains: The above productivity gains are the once-only effects that could be achieved by extending much more widely the use of improved varieties of wheat and maize in NWFP. There are also the productivity gains that can accrue from more rapidly distributing seed of improved varieties and hybrids to farmers as they become available in the future. These have not been calculated for this workshop although we can hazard a guess that they might range between 0.3-0.5% per year. This is based on the expectation that future genetic gains in varieties over time will be around 1% per year (Heisey, 1988).

We will undertake later analysis to better approximate the estimated loss in productivity on a sustained basis. However, if farmers of wheat and maize in NWFP were to be losing 0.4% productivity gains per annum, this would amount to losses of some Rs.million 180 per year (since the total value of 1.7 million tons of grain is about Rs.million 4,500 in current prices.) Such a potential loss is sizeable, even if over-estimated by a factor of two.

Concluding Comments

In this paper we have attempted to estimate some costs of not having an effective seed industry for maize and wheat in NWFP. The opportunities foregone are very sizeable, in lost productivity, which will translate into lost income for farmers and the Province. An effective seed industry would realise two basic types of gains: the once-off increase in productivity from much wider adoption of improved varieties by farmers, and the sustained increase from more rapid uptake of newly-released varieties in the future. A number of other benefits will accrue and we hope to better quantify some of these less obvious benefits in later analysis. The challenge for now is for all to move ahead to strengthen a very weak link in the agricultural development process of NWFP. It is time for concrete change and action.

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