
THE SEED
OF
GROWTH

# III. The Seed of Growth

**Seed can make or break a crop.** The bedrock of a thriving agriculture sector is good quality seed. Seed determines more than any other element what results a crop can achieve. All other factors like crop management, application of inputs and their quality, and weather events come second. Low yield potential of a seed will not deliver high yields despite the best machinery, crop care, inputs, etc. Most of the explanation for Pakistan's low yields starts with poor quality seed. And the small farmer is typically the biggest loser due to poor quality seed.

**Good quality seed is 'agriculture's great equalizer' because it gives the small farmer a shot at the same results that large farmers have.** This chapter first illustrates how seed can make or break a crop through the maize success story and the cotton horror story. It then outlines how Pakistan's seed provision system is not organized to deliver good quality seed to all farmers. Finally, it shows how the legal and regulatory regime for seed is strangulating growth in the seed sector and identifies policy priorities for unleashing its potential for growth in agriculture.

## What is good quality seed?

In lay terms, good quality seed refers to seeds that have been produced, processed, and stored under appropriate conditions ensuring, at the minimum, three basic requirements:

- *High germination rate:* Good quality seeds will have a high percentage of viable seeds that sprout and grow into healthy plants. A high germination rate means farmers need to apply an appropriate number of seeds. Globally, a germination rate of 85 percent is considered the minimum acceptable. In Pakistan, the average cotton seed available hovers in the vicinity of 44 percent germination. This means 44 out of every 100 seeds sprout, all others are duds! The result is that farmers typically apply 16 kg of seed per acre which have uneven germination across a field (with good quality seed, only 8kg per acre would be required). So, one hill may have no plants while another hill has four plants—four plants feeding on the nutrition intended for one plant. These additional plants are pulled out by hiring labour later in the season—an added expense.

- *Varietal purity:* Good quality seeds will be uniform and true-to-type, i.e., all seeds in a bag are of the same variety (see Annex C for explanation of variety). This means that a bag of a certain variety of seed purchased for sowing can be trusted to be at 99 percent or more of the same variety, not contaminated with other plant varieties. A uniform crop is much easier to manage requiring less labor and leads to an easier transition to mechanization. Keeping with the cotton seed example, compared to a cotton crop cultivated with good quality seed (right panel in figure 17), a cotton crop cultivated with poor quality seed results in uneven plant height which is a nightmare for agronomy. Lack of purity also results in non-uniform fiber characteristics which is not desirable for the textile

industry and translates into a lower price.

- *Strong vigor:* Good quality seeds will produce plants that have strong roots, healthy leaves, and are able to tolerate stressors such as drought, pests, or disease. This reduces input costs as a healthy crop requires less synthetic nutrients or crop protection products.

Figure 17: Good cotton seed has high germination, uniform cotton variety, and same plant height

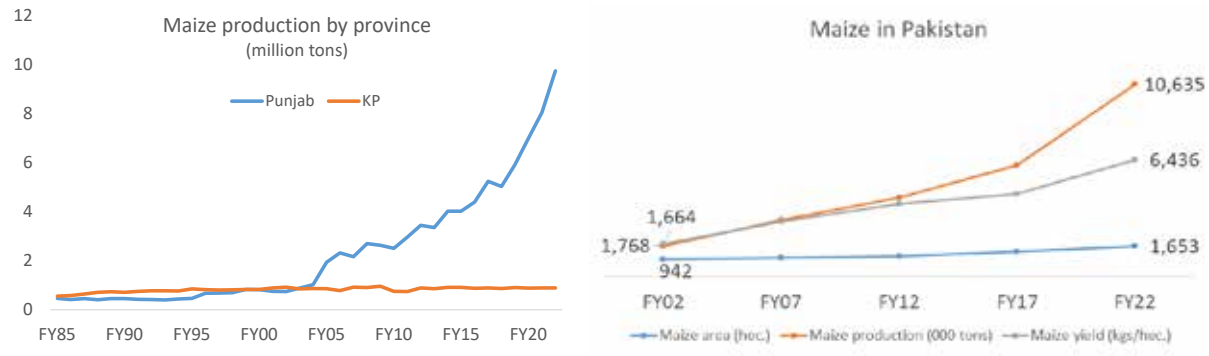
Reduced input costs, increased yields, and simplified maintenance practices lead to greater profitability for farmers. Farmers also tend to select crops that have a readily available supply of high-quality seed. The expansion of the more expensive hybrid maize seed (see Annex C for explanation of *hybrids)* across Punjab over the past two decades demonstrates that farmers are willing to pay for good quality seed.

## Pakistan's success story with hybrid maize seed

Over the past two decades, maize cultivation in Pakistan has experienced remarkable growth. Between FY02 and FY22, maize production surged more than six-fold from a mere 1.6 million tons to 10.6 million tons. This is partly because a number of farmers have shifted to cultivating maize resulting in an increase by 75 percent in area under maize during this period. However, the bulk of this increase comes from the increasing average yields (maize produced per acre) which have more than *tripled* in the last twenty years!

The government decision to allow hybrid maize seeds in 2001 has been the primary driver of this surge in maize production. This shift in production is evident in the change in the geographical distribution of maize cultivation. In 1995, KP province was the largest maize producer in Pakistan, accounting for 64 percent of the total maize produced with Punjab producing only 35 percent. However, by FY03, Punjab had overtaken KP, producing more than half of the country's maize. Today, Punjab is the major hybrid maize-producing province in Pakistan, responsible for over 90 percent of Pakistan's maize production with maize yields almost 4 times the average yields achieved in KP province. Unlike Punjab, where most of the poultry feed milling industry is located, KP does not much feed milling of maize. So, KP's farmers are typically not growing maize with poultry feed millers in mind—hence the choice of traditional varieties.

Figure 18: Introduction of hybrid maize seed in 2001 has led to a maize revolution in Pakistan




*Source: Economic Survey of Pakistan (various editions)*

The use of hybrid maize seed, most of which is imported, has been the main catalyst for the increase in maize production and rise in maize yields in Punjab. Multinational seed companies Bayer and Corteva dominate the maize seed market and import their seed. Some local seed companies also sell imported hybrid seed.

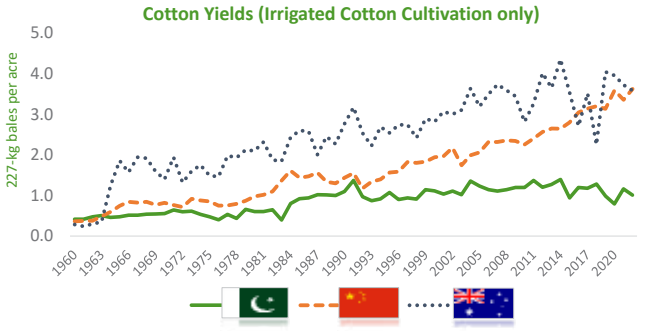
According to industry experts, over 70 percent of the maize produced in Pakistan is utilized by feed mills, while approximately 10 percent is used in wet-milling (mostly for producing industrial starches) and production of silage. The improved value chain of maize has had a far-reaching impact on various sectors, particularly the poultry industry, which has greatly benefited from the increase in feed mills that process a significant portion of the maize produced in Pakistan. Moreover, the growing maize production has opened up new market opportunities, particularly in the form of maize exports.

## Sad state of cotton seed in Pakistan

**Pakistan's cotton production suffers from stagnant yields and falling production.** According to the Pakistan Economic Survey 2021-22, Pakistan is still the fifth largest producer of cotton and exports of cotton and textile products were around 60 percent of country's exports. In FY20, Pakistan still had a 6 percent share in global cotton production and was also the third largest consumer of cotton, second largest yarn exporter, and third largest cloth exporter in the world. However, Pakistan's cotton production has declined over the years, with an average of 10 to 12 million bales per annum produced in the last two decades but falling precipitously in the last few years. This is in stark contrast to the exponential increase in area and yield of maize in Pakistan since the turn of the century.

**By contrast, cotton production and average yields have continued to increase in other countries.** China and Australia are major cotton producing countries that cultivate irrigated cotton like Pakistan. As figure 19 shows, their average productivity per acre has continued to rise over the years (barring years of drought) while Pakistan's yields have remained constant at around 1 bale per acre with a fall in recent years. Yield gains in China and Australia were mainly led by the adoption of improved seeds following by improved farming techniques, seedling transplantation, better crop management strategies to combat disease, more suitable irrigation, stronger fertilizer application, and the adoption of Genetically Modified (GM) technology traits in seeds for pest and weed control.

Figure 19: Pakistan's cotton yield: From stagnant to falling



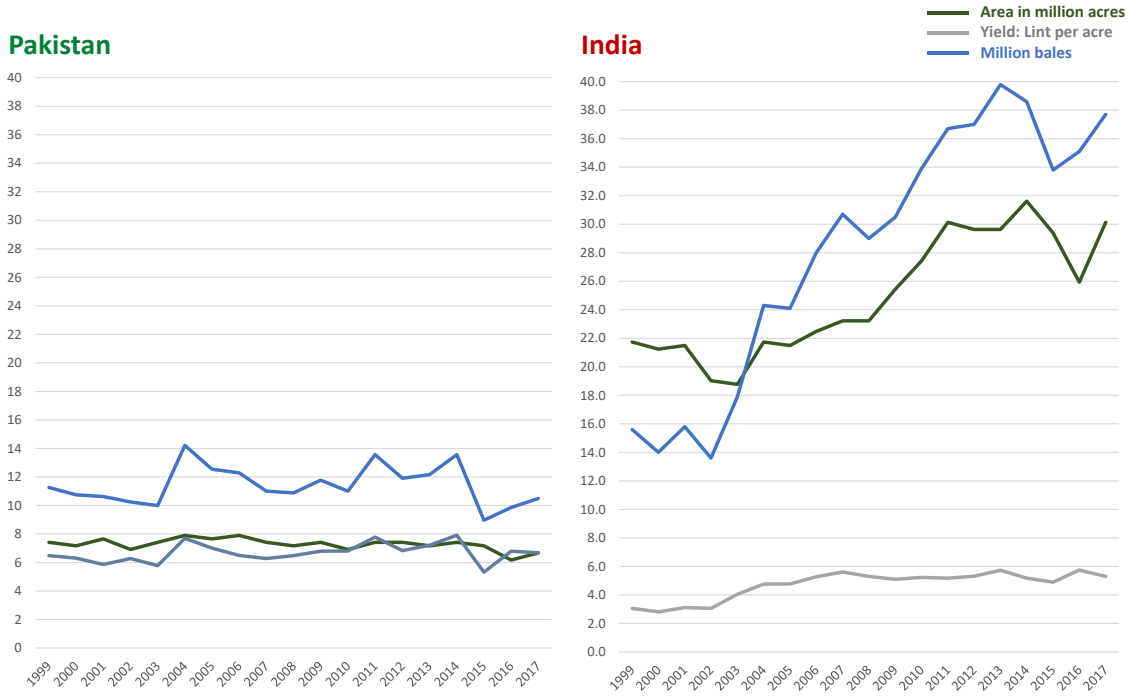

**The rise of cotton in India:** In the last twenty years, India's cotton production has more than doubled (figure 20). In the first few years of the 21st century, India's cotton production hovered between 14 and 16 million bales while Pakistan's cotton production ranged between 11 and 14 million bales. This was the period in which Bt cotton had been introduced in Pakistan—but without a robust seed industry. Yields rose sharply. In the subsequent decade, Pakistan's cotton production continued to stagnate within this range, India's cotton production skyrocketed to almost 40 million bales as early as 2013.

The rise in cotton production is primarily attributed to good quality hybrid cotton seed previously existing in the Indian market. This was a robust seed industry with adherence to quality standards which allowed international genetic technology providers like Monsanto to enter the Indian market with GMO technology (see Annex C for detail). This was Bt cotton under the brand name of Bollgard. This transgenic trait provided the cotton plant significant protection against bollworms ('*sundi*') which helped reduce the cost of pesticide sprays and increased yields. This raised farmers' profitability. As a result, average Indian cotton yields increased from an average of 3.1 maunds per acre in 1999 to 5.6 maunds per acre in 2007 which has plateaued since then. As more and more farmers switched to the profitable cotton crop, area under cotton also increased from 21.7 million acres in 1999 to 30.1 million acres in 2017. India's average cotton yield per acre is lower than Pakistan's, as shown in the two graphs below, because India grows rain-fed cotton while Pakistan's cotton is canal-fed.

**Introduction of GMO technology in Indian cotton seed was made possible due to a robust and dynamic seed industry.** Some of these seed companies were competing at the international level. This allowed a technology provider like Monsanto (now Bayer) to enter into a joint venture with a local company like Mahyco to establish Mahyco Monsanto Biotech (MMB). MMB became the master licensee of the relevant bio-technology and has sub-licensed Bollgard and Bollgard II technologies to over 45 Indian seed companies which have introduced this technology into their own seed varieties. The stewardship

provided by MMB for post-release management of GMO technology was crucial to ensure trait performance, management of the pest's development of resistance to the technology, high quality of seeds, and stronger intellectual property management.

Figure 20: Tale of two cotton producers



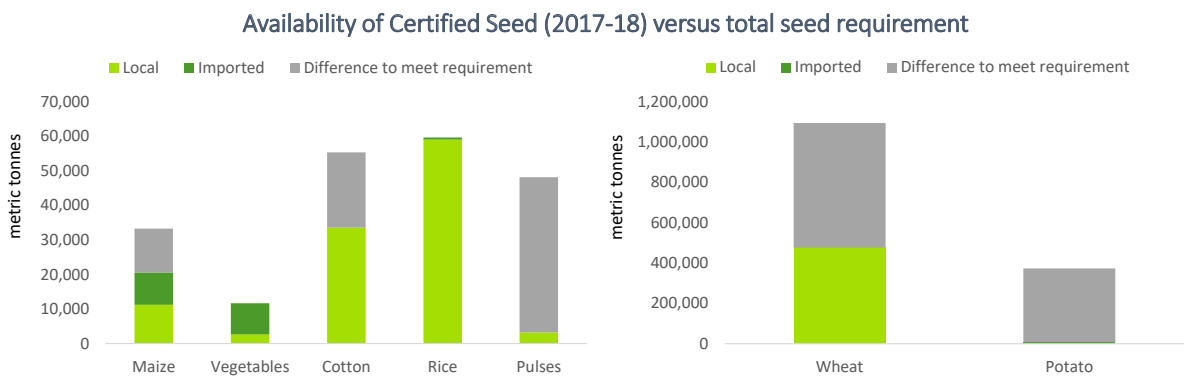

*Source: Cotton Advisory Board of India, Index Mundi*

**Another reason that an international GMO technology provider could enter the Indian market more readily was the prevalence of hybrid cotton in India.** By comparison, cotton produced in Pakistan is from open pollinated or OP seeds (the difference between hybrid and OP seeds is explained in Annex C). The production of cotton hybrids (unlike maize hybrids) requires substantial manual labor and a large number of people are already trained in India to develop hybrid cotton. Moreover, hybrid cotton seed in India also allowed easier implementation of intellectual property rights as farmers usually do not save hybrid seeds and purchase new seed each season which allows trait providers to earn from the sale of seed. Therefore, GMO technology providers enter markets with hybrid seed much more readily. If transgenic traits are introduced in OP seeds in a market with a weak Intellectual Property Rights (IPR) regime and poor regulations and enforcement, pilferage of technology is more common.

**The major reason for stagnant yields and falling area under cotton is the lack of good quality seed.** Poor quality seed means low germination levels leading to higher seed cost per acre and more labour cost. It means low yields which lead to low earnings. It also means a higher susceptibility of the crop to climatic effects, and disease and pest attacks, inability to compete against weeds, and poor uptake of nutrients. Moreover, Bt cotton was brought to Pakistan through irregular channels without any formal stewardship, which is why, although most of Pakistan's cotton has transgenic technology, its effectiveness remains questionable. All these factors culminate in sub-par cotton yields. The small farmer is the

biggest sufferer from poor quality seed. The fundamental challenge of seed in Pakistan emerges from the structure of Pakistan's seed sector and the legal/regulatory regime governing the development, certification and distribution of seed.

Figure 21: Pakistan's farmers have a large unmet demand for quality seed




*Source: Changing the Seedscape in Pakistan, Dr. Ahsan Rana* *Source: FSC&RD*

## Pakistan's seed system is not organized to provide quality seed to all farmers

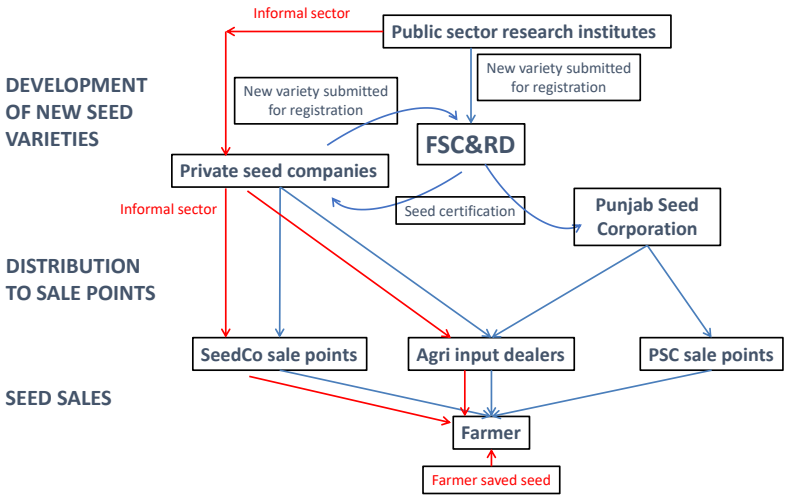
From the development of a seed variety to its delivery to farmers, the seed provision system can be divided into three main phases: development of new seed varieties, distribution of seed to sale points, and seed sales. This section draws on the work of Dr. Ahsan Rana.

**1. Development of new seed varieties:** new seed varieties are developed either by private sector seed companies (local or multinational) or public sector research institutes like Central Cotton Research Institute (CCRI) Multan, Ayub Agriculture Research Institute (AARI), Nuclear Institute for Agriculture and Biology (NIAB), National Institute of Biotechnology and Genetic Engineering (NIBGE), and others. New seed varieties are submitted for registration to the Federal Seed Certification and Registration Department (FSC&RD) which conducts various trials for two years to record the performance of the variety before registering it. This is typically a 2-year trial period of a new variety to check for yield performance as well as distinctness, uniformity, and stability (DUS) of the variety. If the variety passes these tests, it is registered after two years. But this is a step private seed companies generally fear. This step is often the source of pilferage of varieties where seed multipliers procure the pilfered seed, multiply it, and start marketing it before the actual developer/producer of seed has a chance to sell their registered product in the market. The registration certificate is valid for 10 years and can be renewed later. The registered varieties become eligible for quality control and certification through the Federal Seed Certification Department.

New seed varieties are also often imported by private seed companies, however, imported seed does not have to be certified by FSC&RD. Instead, the importing entity must ensure that the seed is accompanied by a certificate that confirms it has been thoroughly examined and approved in the country of origin.

**2. Distribution to sale points:** Once the seed is certified, the public sector research organizations and private seed companies multiply their seed to deliver it to their distribution points. Among public sector organizations, the Punjab Seed Corporation is the only active one and has its own seed farms, processing plants, and marketing network of input dealers (in Punjab and other provinces) and own sale points. Private seed companies also either have their own sale points (e.g. Naya Savera franchise network holds only Syngenta product) or they market their product through agri-input dealers.

Figure 22: Pakistan's seed provision system



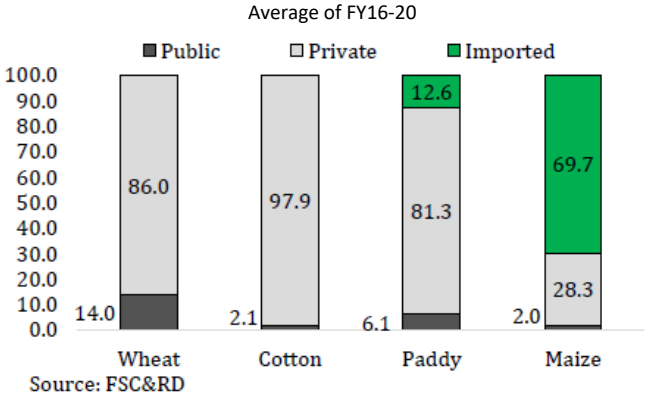

*Source: Changing the Seedscape in Pakistan, Dr. Ahsan Rana*

**3. Seed sales:** Farmers purchase the seed from either these public or private dedicated seed sale points or from agri-input dealers. Parallel to this formal seed provision sector, there is a vast informal seed provision sector which relies on a lot of the formal infrastructure. In 2018, 60 percent of the total seed requirement was fulfilled by uncertified seed. Informal seed sector consists of either farmer-saved seed for the next season or unregistered seed.

The informal sector bypasses the certification process and directly markets uncertified seed. The seed certification process is so tedious and open to pilferage that a number of unregistered seed varieties are popular in the market at any given time. For example, figure 21 shows that 55 percent of wheat seed and 40 percent of cotton seed requirement was met by uncertified seed in 2018. Uncertified does not necessarily equate to poor quality seed as seed companies often sell unregistered but pure seed in the market to avoid the laborious certification process for fear of pilferage and inefficiency of the process. Seed companies only sometimes sell uncertified seed under a brand name due to weak enforcement of seed laws, however, uncertified seed is usually sold as generic seed (seed sold in 'brown bags').

A weak intellectual property regime also helps the informal market flourish as seeds are often pirated (especially open pollinated varieties as they are easier to copy) by other seed companies and sold in the informal market. In 2019, around 850 local seed companies were registered with FSC&RD and more than a 100 of them were in the cotton seed business. Most of these seed companies are weak,

Figure 23: The private sector is the main supplier of seed



'fly-by-night' operators and act as seed multipliers with little or no seed breeding operations. They either procure uncertified seed developed by public sector organizations or they procure private-sector seed leaked at some stage with under-the-table deals. In comparison, the typical process followed by multinational companies for developing a seed includes:

- Getting market feedback to see what characteristics are being demanded by farmers and industry (in terms of crop color, yield, heat tolerance, etc.),
- Getting a couple of hundred seed lines to test against the desired characteristics,
- The better ones are short listed for planting again the next year and the process is repeated for a few more iterations,
- In the fourth year, a few varieties that meet the breeding objectives are then placed for commercialization.

Therefore, international seed companies prefer to market hybrid seeds in places with weak enforcement of the intellectual property regime. Today, both Bayer and Corteva import hybrid maize seed produced in other countries which are then marketed in Pakistan. These companies had at one time started producing hybrid maize seed locally to be more competitive and bring down the price of hybrid maize seed, however, the parents of these hybrids were also pirated and local hybrids entered the market. However, multinational companies recaptured the hybrid seed market over time when they stopped producing hybrids locally and resumed sale of imported new varieties. The farmers' verdict is clear. These two multinational companies dominate the maize seed market (figure 22). Wherever good quality seed is available, farmers respond by spending significantly larger sums on them.

## Policy priorities to the address legal and regulatory constraints to growth

**The Seed Act of 1976** was aimed at regulating and controlling the quality of seeds in Pakistan. It established three institutions to perform various regulatory and advisory functions: the National Seed Council, provincial seed councils, and the Federal Seed Certification & Registration Department (FSC&RD). The Act authorizes the federal government to prescribe seed quality standards and information to be printed on labels. It prohibits the sale of seed of an approved variety that does not meet quality standards and bear the required label. FSC&RD is responsible for registering new varieties and certifying seeds. And it has the power to control seed quality through inspections. The Act only focuses on the public sector development and delivery of seed and assigns no role to private seed companies except for seed multiplication, for which FSC&RD must register seed growers. There are restrictions on the sale of notified seed varieties, but none on the production or storage of non-notified varieties. The Act does not regulate farmers' seed saving or non-commercial exchange of seed.

Following the Seed Act of 1976, three sets of rules have been framed: the Seed (Registration) Rules of 1987, the Seed (Truth-in-labeling) Rules of 1991, and the Pakistan Fruit Plants Certification Rules of 1998. The Seed (Registration) Rules of 1987 established a committee to evaluate new seed varieties and prohibited the production of unregistered varieties which was at odds with the Seed Act. Somehow, the Seed Act was silent on the production of unregistered varieties and kept the registration and certification process of the seed optional which means that an unregistered variety could be marketed by the breeder at their own risk.

**The truth-in-labeling rules of 1991** dealt with labeling of seeds packaging with information on purity levels, germination rates, production month, expiration date, etc. The objective of a 'truth-in-labelling' regime is to allow a seed company to go into business with new varieties after a simple process. Farmers can themselves decide which seed meets their cultivation objectives more effectively. At any time, the authorities can pick up that company's seed and test it for the quality levels listed on the seed bag label. The authorities can easily proceed against the seed company if they conclude that it has not provided the truth in its labelling. This approach to seed regulation is successfully being followed in the United States, India, and many other countries. The key to its success is that it checks the seed at the point of sale (not during the production cycle) and this benefits farmers more.

**Unfortunately, the Seed Act of 1976, its accompanying rules, and the 2015 amendment to the Seed Act emphasize a minimal role for the private sector in seed** and impose lengthy and bureaucratic procedures for variety approval which exposes any seed breeders to piracy risk. Weak enforcement of seed laws has led to a large informal sector, and as a result, many companies and breeders market their new varieties without registering them. The regulation extends to all crops, including those that are not as commercially important, leading to an overly regulated system that discourages private sector involvement. Recent legislative changes add administrative burden without much benefit and require significant infrastructure for effective enforcement. Another important regulatory aspect is that quality control occurs during production, not at the point-of-sale.

**The Seed Act is in dire need of an overhaul to establish an enabling environment for seed regulation that encourages reputable private seed companies to invest with confidence in seed development** and which should only extend to crops of commercial importance. The role of FSC&RD needs to be reimagined at a higher level to specify standards for new varieties and hybrids, and operational standards for seed businesses. Only seed companies that meet these mandatory standards should be allowed to do business. A proactive and rigorous monitoring of seed businesses should be performed to ensure compliance with such standards. The role of FSC&RD needs to be re-envisioned with a reduced administrative burden while allowing a greater role of provincial governments in regulating the seed sector.

**A dual regime for commercial release of new OP and hybrid seeds needs to be adopted.** Under this, one tier would be registered seed companies and the public sector which will continue to release new varieties after the usual 2-year mandatory pre-release evaluation. Another tier would be seed businesses that meet higher standards of excellence and should be able to send their new varieties to FSC&RD for 'enlistment,' which does not require pre-release evaluation. FSC&RD should ideally evaluate enlisted varieties for the purity, germination, and agronomic performance of these varieties after they are released. This will shift the focus of regulation from the production stage to the point-of-sale. Under this system, seed certification will be a voluntary and paid-for service. A seed company 'enlisting' sub-standard varieties stands to lose its customers and status of meeting higher standards. The term of license for dealership can be extended to five years, with no need to register seed processing plants. The renewal of a seed company's registration and license should come automatically upon application, unless there is suspicion of a violation of conditions, which will be recorded in writing.

**Practical implementation of Plant Breeders' Rights is awaited.** Any individual or commercial entity that breeds a new seed variety has a right to the intellectual property associated with it. And this right needs to be protected if a commercial eco-system is to be developed for investment in seed development for agricultural growth. To address the intellectual property rights issues, a bill for the Plant Breeders' Rights Act was initiated by the Government of Pakistan in 1999. Subsequently, several draft bills were submitted and the draft of 2007 made it the farthest when it was presented to Cabinet in 2007. The final approval to the last draft was only granted in December, 2016, and the rules were subsequently framed and finalized in 2018. Under the law, a Plant Breeders' Registry was created to register new varieties and for cataloguing relevant information about the variety which will, upon approval, confer rights to develop, import, export, sell, and market that variety for 20 years (25 years for trees and vines). Concerns persist regarding the placement of the PBR registry within FSC&RD as it is severely under-resourced. Submission of a variety's information including DNA fingerprints for IPR protection under the Plant Breeders' Rights Act is a voluntary exercise. However, as no cases have arisen so far since the framing of PBR rules, it remains to be seen how a case involving PBR violation will be adjudicated.

## Conclusions

The farmers' verdict on seed quality is clear: good quality seed which performs is adopted by all types of farmers. The example of hybrid maize seed adopted across Punjab province makes it clear that even small farmers adopt more expensive seed if it gives them higher returns. In this context, it can be said that the biggest sufferer from poor quality seed is the small farmer. Pakistan's seed sector is the achilles heel of Pakistan's agriculture. It is time for the government-first approach of the Seed Act to give way to a seed act which encourages reputable seed companies from within and outside Pakistan to invest in seed development. It is time for seed regulation to shift from an approach of controlling the seed sector to an approach of maximizing benefit to the farmer.