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PACE Policy Paper: Seed Industry in Pakistan: Policy Challenges and Prospects

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PACE Policy Paper:

# Seed System of Pakistan: Policy Challenges and Prospects

*Prepared as part of the Technical Assistance to Ministry of National Food Security and Research (MNFSR), Government of Pakistan and Provincial Agricultural Departments*

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## Abbreviations and Acronyms

AARI	Ayyub Agriculture Research Institute
ABRI	Agricultural Biotechnology Research Institute
ABS	Access and Benefit Sharing
AGRI	Agribusiness Regulation and Institutions Index
APSA	Asia and Pacific Seed Association
APSMSDA	All Pakistan Seed Merchants and Seed Dealers Association
APTMA	All Pakistan Textile Mills Association
ASCOP	Association of Seed Companies of Pakistan
ASF	Australian Seed Federation
ASPSCO	All Sindh Private Seed Companies Organization
BADC	Bangladesh Agricultural Development Corporation
BRAC	Bangladesh Rural Advancement Committee
Bt	Bacillus thurengiensis
CBD	Convention on Biodiversity
CBSP	Community-Based Seed Production
CCRI	Central Cotton Research Institute
CEMB	National Centre of Excellence in Molecular Biology
CFIA	The Canadian Food Inspection Agency
CIMMYT	Centre for International Wheat & Maize Research
CPSI	Chamber of Private Seed Industry
DES	Dietary Energy Sufficiency
DUS	Distinctness, Uniformity, Stability
ECO	Economic Cooperation Organization
ECOSA	Economic Cooperation Organization Seed Association
FAO	Food and Agriculture Organization of the United Nations
FSC	Federal Seed Committee
FSC&RD	Federal Seed Certification and Registration Department
FSCA	Federal Seed Certification Agency
FSCs	Foundation Seed Cells
FSRC	Federal Seed Registration Committee
GMCs	Genetically Modified Crops
GPS	Global Positioning System
HYVs	High Yield Varieties
ICARDA	International Centre for Agriculture Research in Dry Areas .
IPCC	Intergovernmental Panel for Climate Change
IR	Insect-Resistance
IRRI	The International Rice Research Institute
ISF	International Seed Federation
ISTA	International Seed Testing Association
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUPOV	International Union for Plant Variety Protection
KP	Khyber Pakhtunkhwa
MAS	Marker Aided Selection
MNC	Multi-national corporations
MNFSR	Ministry of National Food Security & Research
MT	Metric Tons
NBC	National Biosafety Committee
NIBGE	National Institute for Biotechnology and Genetic Engineering
NIGAB	National Institute of Genomics and Advanced Biotechnology

NSC	National Seed Council
NSRA	National Seed Registration Agency
OECD	Organization for Economic Cooperation & Development
OFA	Organic Farmers' Association
OP	Open-Pollinated
PAKSST	Pakistan Society of Seed Technologists
PARC	Pakistan Agricultural Research Council
PBRA	Plant Breeders' Rights Act
PCCC	Pakistan Central Cotton Committee
PPV&FR	The Plant Variety Protection and Farmers Rights
PSC	Punjab Seed Corporation
PSCs	Provincial Seed Councils
PSD	Plants Sciences Division
PVP	Plant Variety Protection
QDS	Quality Declared Seed
R&D	Research & Development
RUSSL	Recommended Uniform State Seed Law
SAARC	South Asian Association of Regional Cooperation
SCAP	Seed Companies Association of Pakistan
SCOs	Seed Certification Officers
SSA	Sub-Saharan Africa
SSB	SAARC Seed Bank
SSC	Sindh Seed Corporation
TLS	Truthfully Labelled seed
TRIPS	Trade Related Intellectual Property Rights Agreement
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TTSMC	Variety Registration and Seed Certification Center
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UPOV	The International Union for the Protection of New Varieties of Plants
VCU	Value for Cultivation and Use
VEC	Variety Evaluation Committee
VRSCC	The Variety Registration and Seed Certification Center
WEMA	Water Efficient Maize for Africa
WPADC	West Pakistan Agricultural Development Corporation
WTO	World Trade Organization



## **Abstract**

*The seed industry in Pakistan has undergone significant developments since the 1950s and has transitioned from 'Green Revolution' to 'Gene Revolution'. The 2015 amendment in the Seed Act, 1976, and the enactment of Plant Breeders' Rights Act and Rules have provided long awaited intellectual property protection for proprietary seed. Notwithstanding this fundamental change, the challenge of effective enforcement of intellectual property rights remains. This paper presents how the seed industry has evolved over the years through evaluating the regulatory and institutional framework along with looking into the major challenges that still plague the seed system of Pakistan. It also explores how the private sector can be incentivized to invest in the seed sector while protecting the farmers' rights. Findings reveal that there seems to be a lot of scope for strengthening the seed system of Pakistan via encouraging private sector participation mainly through developing proactive markets with strong institutional mechanism along with scientific and time bound regulatory approval framework. An appraisal of the international best practices divulges that technological backstopping, developing public-private partnerships, building institutional capacity for effective enforcement of regulatory regime and availability of information to farmers for selecting quality seed are equally vital for creating a well-functioning seed system in Pakistan*

**Key words:** *Seed system, regulations, technology, investment, breeders*

## Executive Summary

**Seed plays a central role in dealing with triple challenge of improving food security and nutrition, supporting livelihoods of farmers and rural communities, and contributing to sustainable resource use and climate change adaptation and mitigation** (Euroseed 2020). Efficiency gains and innovation are essential to improve the productivity, sustainability, and resilience of food and agricultural production. Plant breeders have long emphasized the importance of varietal turnover as a means of protecting yield from the evolution of plant disease and sustaining yield gains over time in modern farming systems. New plant breeding techniques potentially reduce the need for agricultural inputs such as fertilizers and pesticides and reduce harvesting costs by managing plant height and ripening time.

**Quality seed is a vital determinant of yield and productivity.** The enhanced use of well-adapted, high-quality seed, and related planting inputs by farmers has been a central element in national action plans in transforming agriculture and improving food security. Therefore, a sustained increase in agricultural productivity and production necessitates an efficient and robust seed system for developing new and improved as well as certified seed varieties suitable for different agro-climatic conditions. The efficient and effective distribution of these seeds to farmers especially smallholder farmers in sufficient quantity at a time and price which meets their requirements requires continuous public and private sector investment in agricultural research and development (R&D).

**Seed system relies on the performance of interconnected critical functions** including research and experimentation, development of varieties (innovation), production (multiplication), seed market (distribution and sale), access and awareness through extension services for crops, trees, and forage, and regulations to provide the fundamental building block to farmers for attaining food security. This requires better coordination among the wide range of seed system actors, i.e., researchers, national and sub-national governments, development agencies, private enterprises, farmers, consumers, community-based organizations, and extension workers.

**The existent regulatory regimes are broadly categorized into the following :** (i) overregulated national seed system; (ii) national lax regulatory seed system recognizing breeders' rights and allowing farmers' exchange and sale of seed varieties; (iii) truth-in-labelling with government setting the standards, procedures and certification protocols; (iv) truth-in-labelling with independent and self-financed devolved regulatory system and the seed industry setting the standards and procedures; (v) regional regulatory system with regional seed/gene banks (Nordic Ministerial Declaration on Access to and Rights over Genetic Resources placing accession to Nordic GenBank under common Nordic management and control, European Union seed system based on '11 vertical and 1 horizontal directives, SAARC Seed Bank through an Agreement); (vi) Seeds without Borders, and (vii) international charter for seed. The seed sector in various developing countries follows complex and lengthy procedures for variety registration and testing which constitute a significant barrier to seed trade and inhibit the spread of new varieties within and beyond national boundaries. This leads to delays in release and often rejection of useful varieties that do not meet the criteria and procedures.

**The seed system in Pakistan has undergone enormous changes since its inception and can broadly be categorized into five phases:** (i) 1947 to late 1950s-absence of a formal system with small scale research and development in the public sector; (ii) late 1950s to mid-1970s-emergence of institutional structures for research and Green Revolution of 1960s through introduction of high yielding varieties, use of fertilizers,

pesticides, improved irrigation system, adoption of new technology, investment in agricultural research, intensive extension efforts, and agricultural credit; (iii) mid-1970s to mid-1990s-reforming the seed sector through legislative and regulatory framework, establishment of formal institutions for seed variety approval, registration and certification, and incorporation of public sector entities for basic seed multiplication with marginal role assigned to the private sector and advent of multinational companies; (iv) mid-1990s to 2010-rapid growth of private sector seed companies overtaking public sector entities; and (v) post-18<sup>th</sup> Amendment, legal regime was permeated with tensions between the roles of federal and provincial governments.

**Seed system in Pakistan is an ensemble of** (i) formal system managed by public agencies which generally follow government-approved laws and regulations with public and private companies providing certified seed of registered, distinct, uniform, and stable varieties; (ii) informal system managed by farmers and farming communities, providing seeds of preferred varieties saved for farm production or distributed to other farmers based on customary and informal practices; and (iii) intermediate system which integrate elements of formal and informal system. The intermediate system is generally supported by projects or non-governmental organizations for certification and distribution of farmer-produced seed in line with national rules and regulations.

**The Seed Sector in Pakistan faces a plethora of challenges including:** (i) stringent regulatory framework; (ii) weak incentives for breeders to get their varieties registered; (iii) thin presence of multinational or foreign companies; (iv) lengthy and taxing varietal approval, Value for Cultivation Use / Spot Examination process; (v) poor seed quality and widespread sale of unapproved varieties or outdated varieties and low supply of certified seeds resulting in low yield; (vi) large gap between supply and demand of certified seeds at 66 percent; (vii) presence of large informal sector; (viii) low penalties for non-certified or illegal seed sellers; (ix) absence of consumer courts to adjudicate seed adulteration cases; (x) weak enforcement of seed laws and regulations including Plant Breeders' Rights and intellectual property rights; (xi) low usage of hybrid seed because of high imported cost and intensive management and technological requirements; and (xii) lack of internationally accredited laboratories, insufficient skilled and trained human resource, and robust institutional structures.

**Recognizing the necessity to fill supply-demand gap in certified seed,** acknowledging the role of private sector's participation in the market, and to quench the increasing discomfort of the provinces, several reforms have been introduced by the federal government in collaboration with the provinces. These include: (a) Seed (Amendment) Act, 2015 envisaging an expanded role for the private sector (b) Seed (Business Regulation) Rules, 2016; (c) Plant Breeders Rights Act, 2016 to incentivize foreign investment in this sector; (d) Plant Breeders Rights' Rules 2018.

**Notwithstanding these reforms, these enactments have not significantly changed the incentives for private investment particularly the foreign investment in the seed sector as they have not addressed many of the issues related to the legal and institutional framework.** *Firstly*, the 2015 amendment has expanded the regulatory control of the government rather than expanding the entrepreneurial opportunities available in the seed sector. *Secondly*, empowerment of FSC&RD to inspect the seed production fields, which are dispersed throughout the country, for quality control has significantly increased its administrative burden which with its current staffing capacity is not able to handle. *Thirdly*, the Seed Amendment Act does not elaborate the role of the provincial governments and provincial seed councils post 18<sup>th</sup> Amendment. *Fourthly*, the Seed amendment assigns the discretionary powers to FSC&RD to keep any

function related to the seed sector with it for which it does not have the required manpower. *Fifthly*, a critical analysis of the PBR Act reveals that it is not fully aligned with the requirements of the Union for the Protection of New Varieties of Plants Convention of 1991 which is delaying the membership of Pakistan. *Sixthly*, as a member of the World Trade Organization and the International Treaty on Plant Genetic Resources for Food and Agriculture, Pakistan has the obligation to provide a mechanism for protection for plant varieties and recognize the right of farmers to save, use, exchange, and sell farm-saved seeds. However, functional regulatory framework including the registry is still not in place for implementation of laws relating to plant breeding. *Seventh*, the country still needs to formulate commercialization of biotech seed policy which is restraining foreign companies to commercialize their patent biotech seed. *Lastly*, despite these reforms, Pakistan's seed sector continues to rank far below China, Kazakhstan, Turkey, and India and suffers from low investment. Six countries in South and South-East Asia continue to attract most investment in local seed sector development, *viz.* India, Thailand, Indonesia, Vietnam, the Philippines and Bangladesh in breeding, production, processing, and extension services. The low presence of global and regional companies in Pakistan is a cause of concern. Development of a strong seed industry requires that government creates an enabling environment and level playing field for all the actors in play through infrastructure improvements and giving intellectual property rights to breeders depending on the context in Pakistan. The regulatory mechanisms need to be designed as such that catalyze the entry of private sector in the seed industry while ensuring the rights of farmer population

**Several policy measures are suggested to help reforming the seed sector which are in two parts: (i) recommendations to incentivize foreign investment; and (ii) systemic reform recommendations.**

### **Incentivizing the Foreign Investment in Seed Sector**

1. ***Establishing required regulatory mechanism stipulated under Plant Breeders' Rights Act:*** It is almost 6 years since the Plant Breeders Rights Act was enacted. However, the Ministry has yet to establish the necessary regulatory framework including the Plant Breeders' Rights Registry to monitor and implement the stipulated system. It is imperative to put in place this framework to implement the laws related to plant breeding. This will not only encourage local and international researchers and organization to introduce new technologies in agriculture sector but will also lead to yield improvement. Currently, crops protected by the regulations are limited. There is an urgent need to expand protection to other crops as well.
2. ***Enforcement of intellectual property rights (IPRs) is the key to attract foreign investment in seed sector.*** IPRs recompense seed developers for their efforts and permits organizations to recuperate their research and development investments. It promotes further research and development and protects the innovation which will end up providing improved technologies to meet country's food and feed challenges. Breeding investments require an effort of around 10 years and without the incentive of rewards, no rational producer may invest his time and money on research and development. Intellectual property rights are a source of recovering the cost of R&D as the breeder obtains exclusive rights for his innovation. Section 45 of the PBR Act entitles the breeder(s) or scientist(s) of a new plant variety to a minimum of 40% of the royalty or the profits gained by the institute through any commercial deal. This provision may encourage plant breeders and seed organizations

in the public and private sector to invest in research and plant breeding and help generate revenues for research organizations. Secondly, Section 12 of the said Act lays out the criteria for intellectual property rights protection through the DUS (Distinctness, Uniformity, Stability) testing to be performed by FSC&RD. This ensures that only superior varieties of crops are going to be developed and certified. It will also facilitate the accessing of protected foreign varieties and new technologies. Proper implementation of the PBR Act through a dedicated agency and necessary infrastructure can help create a competitive environment for variety development among the public and private sector organizations. India has established Protection of Plant Varieties and Farmers' Rights Authority.

***The FSC&RD lack the required intellectual property (IP) management capacity and resources*** to perform product clearance analyses and evaluations that facilitate the legitimate import, use and/or export of technology advanced products. Therefore, capacity building in IPR management is vital from both the donors and recipient side to facilitate transfer of appropriate agri-biotech to the country. Two international treaties govern terms of Access and Benefit Sharing (ABS) for genetic resources, viz. the Convention on Biological Diversity (CBD) (1993) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (2004). In October 2010 a Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (the Nagoya Protocol) was adopted as a supplementary agreement to the CBD.

3. ***Enforcement of Biotech Variety Registration.*** The Ministry of National Food Security and Research (MNFS&R) is also postponing the biotech variety registration process as prescribed in the Seed (Amendment) Act 2015 and Seed (Business Regulation) Rules 2016 issued vide S.R.O. 907(I)/2016 dated September 28, 2016, under the reported pressure of private seed sector under the pretext of non-availability of commercialization of biotech variety policy. It frustrates the foreign and local seed companies of repute to invest in R&D and new technology. It is important for the Ministry to take necessary measures to streamline the process and enforce relevant provisions of the law. Current policies and regulations allow biotech commercialization of all crops and private companies have made investment in this regard since last one decade. However, the Ministry is still of the view that it needs to develop a crop specific biotech policy for commercialization. There is a need for an urgent decision on this issue to attract investment in this area.
4. ***Need for establishment of a tracking system for sale of seed.*** The Seed (Business Regulation) Rules 2016 has been amended to provide for the establishment of a trace and tracking system including digital printing facility located at each seed company but linked with central database system maintained by FSC&RD to enable traceability and verification of seed produced or offered to the farmers through a unique algorithmic label or a scratchable card, which could be affixed on or put inside each seed bag or container. However, there is a need to develop such system in consultation with the seed industry to enable growers to verify whether the seed in a bag or a container that he has acquired is of approved variety and duly certified.
5. ***Moving towards "Truth-in-labeling" (also called "truthful labelling") gradually.*** Truth-in-labeling (self-certification of seed by companies) as a means to incentivize foreign investment

private companies is a bridge too far at this point in time for Pakistan, mainly because of weak legal recourse and most seed companies lack adequate investment in research and development, internal quality protocols, and standards. **Truthful labelling** works best if: (a) the national law and regulations set out requirements for seed standards, sampling, testing, grading, packaging and labelling as well as use of variety names, advertising, seed crop inspection, seed import, and certification of seed as well as listing of varieties; (b) investment in quality research and development to align with the international standards; (c) market and legal enforcement is strong and proactive; (d) the country has an elaborate accredited testing system with high integrity; (e) Small Causes or Consumer Courts' system is well equipped and speedy to dispose of violations; (f) the companies are sensitive to their reputation; and (g) majority of the seed is being sold by reputable entities under their brand name that have their own internal quality assurance procedures. Only in these circumstances, 'truthful labeling' can be considered to replace all the technical procedures required for certification and transfer responsibility for seed quality to the seller. Effectively the reputation of the seller becomes the motivation for quality assurance, rather than the threat of legal sanction. In the absence of the above framework, there is a risk that much of the seed in the market is of poor quality and the farmer may lose confidence in purchased seed. However, the national policy as well as the implementation plan may include necessary measures to move towards this regime gradually.

6. ***Regional harmonization of regulatory framework:*** Regional harmonization of regulatory frameworks for seeds is a challenging task and may require bilateral and sub-regional agreements and protocols and shared objectives and goals. It will not only be a time-consuming exercise but also needs strong trust amongst the regional countries. However, mutual recognition of variety lists, to the extent possible, and a common agroecology may reduce the time required for testing, accelerate access to innovations and facilitate trade and could possibly deter illegal traffic of unregistered varieties. The convergence of standards and procedures may be a more realistic beginning. The harmonization of regional seed procedures in Latin America have led to a 23 percent increase in regional seed trade in two years.<sup>1</sup>
7. ***Effective enforcement of the legal framework including intellectual property rights(IPR) will promote entrepreneurship in the seed sector.*** The goal of promoting entrepreneurship and attracting local as well as foreign investments in research and development directed at the agriculture sector could be achieved by implementing the Seed Act and the PBR Act in letter and spirit. Federal and Provincial should step up in disseminating the benefits of intellectual property rights to the farmers and take measures for effective implementation of IPR. Plant variety protection supports the long-term investments in plant breeding as well as attract private investors for investing in seed varieties.
8. ***Membership of UPOV will support in seed trade.*** Pakistan is not yet a member of International Union for the Protection of New Varieties of Plants (UPOV). The advantage of obtaining UPOV membership is that it has conformity of laws across nations, hence, trading in seeds become less complicated and involves fewer documentation and tests. The current PBR Regulations is non-

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<sup>1</sup> USAID-EAT project, "Building an Enabling Environment for Seed Sector Growth," Policy Brief No.1 (2011).

compliant (see Annex V) which may impede securing the membership of UPOV. It is important that the Ministry may align the PBR Regulations to secure the membership.

9. ***International Seed Testing Association (ISTA) accreditation of Pakistan's seed testing laboratory will help in improving sellers' credibility and international trade in seeds.*** Formal accreditation of Pakistan's seed testing laboratory will affirm that it is technically competent to test seed using ISTA methods and producing reliable results. ISTA accredited laboratory's certificate results in increased acceptance of seed lots which reduces cost and improves sellers' credibility for their products and minimizes risks of shipping faulty seeds. It also provides confidence to the seed buyer as it confirms that seeds have been tested by internationally accepted methods and that the quality of seed is acceptable. The Ministry should encourage all public labs to get ISTA Certification.
10. ***The federal and provincial governments need to take necessary measures for adoption of hybrid seed and incentivize local production of hybrid seeds.*** The high cost of imported hybrid seed and its technological requirements and intensive management are the key impediments to its adoption. In view of the scope and potential to enhance farm income using hybrid seed, it is important to address challenges confronting the farmers including their problems, apprehensions, grievances about these seeds, black marketing and overcharging by local distributors during shortages, etc. At the same time, it is equally important to enforce IPR regime with punitive action to encourage multinationals for local production of hybrid seed which can benefit the agriculture tremendously. Any legislation for local production without visible and satisfactory enforcement of IP protection regime will not raise the confidence level of the private sector and will not yield the desired results.
11. ***Adjustment of regulations for facilitating vegetable seeds:*** The regulations may be adjusted to reflect the characteristics of vegetable seeds crops, given their regional and global growth, as the national regulatory system was originally designed for cereals and other field crops. The FSC&RD may consider relying on agronomic validation trials data conducted by breeder or importer for vegetable varieties because of their rapid turnover. VCU testing requirement in a slow testing system may place immense burden on testing authorities.
12. ***Third Party Quality Seed Assurance Mechanism:*** To ensure seed quality in the context of seed certification agency which is plagued by physical, budgetary and human resource constraints, private sector can be made responsible for ex ante quality assurance through accreditation by third party seed certification providers. The third-party quality assurance mechanism is common in South America and Europe and is also being practiced in Morocco, South Africa and Zambia.<sup>2</sup>
13. ***Need for predictability and certainty of regulatory regime:*** The foreign and local investors take decisions based on the predictability and certainty of regulatory regime of the sector. Any abrupt change in mid-stream discourage investment decisions. In case changes in the current or new regulations are necessary, the local industry may be consulted from compliance perspective in accordance with global practice.

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<sup>2</sup> State of the Evidence: Seed Policy Reform. USAID.

14. ***Developing a security and operational protocol for use of Unmanned Aerial Vehicle (UAV):*** Countries are increasing deploying UAV in different agriculture sub-sectors, such as: (a) applications of pesticides on crops; (b) Monitoring of weeds, pests, and nutritional deficiencies; (c) Geographical survey of crops, area and water resources; (d) Research and development. Needs for progressive farming have changed in this era. Precision or Site-Specific Agriculture practices considers Right input at the Right time at the Right place at the Right rate. The Government may develop a security and operation protocol for using UAVs in agriculture sector.

**Systemic Reform Recommendations:** These include:

15. ***Seed regulations should remain a federal subject*** as provincial laws would complicate not only the inter-provincial seed trade and but may also impede the foreign investment because of different regulatory regimes for testing, approval, registration, and release of seed. Provinces should be delegated control for compliance, monitoring, and enforcement of seed regulations at local level. There should be a clear demarcation of responsibilities and authority between federal and provincial governments.
16. ***Develop a National Seed Policy, Strategy, and a Plan for implementation:*** The federal government in collaboration and consultation with the provincial governments and key stakeholders should develop a national seed policy encompassing laws, regulations, conventions, programs, investment choices, research and development, and guidelines for tolerance thresholds for pest and disease presence in seed, which shape the acquisition, production, and distribution of materials for propagation purposes. Examples of Seed Policy include India (1989, 2002), Bangladesh (1990), Sri Lanka (1997), Afghanistan (2012), Myanmar (2015), Cambodia (2017) and Lao People’s Democratic Republic (2017). The Government may also develop a strategy and implementation plan to achieve the objectives of the policy as done in Turkey with National Seed Council to oversee and monitor the implementation of the policy.
17. ***Promote a public-private dialogue to optimize the seed supply system.*** With the emergence of diverse seed industries and predominance of the private companies in seed supply, both local and imported varieties, it is necessary to have greater consistency in decision-making to gain and retain the confidence of entrepreneurs and investors. This is especially important for investment in research and development, which has a planning horizon of at least ten years. This requires a platform, representing key stakeholders including foreign private companies, for public-private sector dialogue and much closer collaboration to optimize seed supply system within the country generally, and specifically within Punjab province. For this to happen, the National Seed Council and Provincial Seed Councils must be made more representative and effective.
18. ***Pakistan needs to increase public sector investment as well as incentivize the private sector to invest in research and development in seed sector.*** The investment in agriculture research and development is highest in developed countries. Nevertheless, this trend is shifting. World Bank figures show that public and private expenditures on agricultural R&D in high-income countries fell from 69% of the global total in 1980 to 55% in 2011. Meanwhile, middle-income countries (including the Peoples Republic of China – hereafter “China”, Brazil and India) were responsible for 43% of global spending on agricultural R&D; up from a share of only 29% in 1980 (Pardey



et al., 2016). Heisey and Fuglie (2018) argue the world may become more dependent on the public sector research of countries like China, India, and Brazil when it comes to the innovation needed to address food and environment challenges, and plant breeding in these emerging economies may enable greater spill overs to developing countries that have similar climatic zones.<sup>3</sup>

19. ***The Seed industry needs strong support and enabling environment for attracting investment.*** Notwithstanding the need for quality control and market enforcement, the seed industry in Pakistan needs strong support, enabling environment for attracting investment, both local and foreign, and facilitation through banking system, to pace with the technological advancements and requirement of modernization. It must be recognized that increasing crop production and productivity are pivoted on the expanded supply of improved and certified seed for crops and horticulture. This investment is required in science, plant breeding, agronomy, biological and molecular science, and constant revision of seed production, regulation, and distribution systems (Rana et. al., 2014). The measurement of performance, innovation, and competition in seed systems is required to inform policymaking to boost agriculture productivity (Spielman and Kennedy, 2016).
20. ***Online submission of application for registration to do business in seed:*** The Seed (Business Regulations) Rules 2016 may be amended to provide for online submission of application along with relevant documents, availability of information, approval process and timelines to make the entire process transparent.
21. ***Inclusion of representative of private seed sector in policy development Working Group.*** The Working Group set up by the Government from time to time may include representatives of private companies/ associations of private companies to make the entire process more transparent and participative.
22. ***Performance Contract:*** The MNFS&R, under the current regulations, has rolled out the performance contract last year. However, the Government has not achieved consensus on the draft performance contract so far because of opposition from local companies. It is important to finalize this performance contract at the earliest and stringent action may be taken in case of default by any company to ensure compliance and enforcement.
23. ***Developing an effective sui generis system:*** Pakistan is also a member of WTO and is a signatory to Trade-Related Aspects of Intellectual Property Rights (TRIPS) **Agreement and Article 27.3 (b) of the said Agreement requires** “members to protect breeders' rights either by patents or by an effective *sui generis system* or with a combination of both.” The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and other international Conventions, such the Convention on Biological Diversity (CBD), set out that it is the responsibility of national government to realize the farmers’ rights related to plant genetic resources for food and agriculture.<sup>4</sup> The Plant Variety Protection and Farmers Rights (PPV&FR) Act 2001” has put forth the right content through adopting a *sui generis* legislation that create an equal space for Indian farmers and breeders. The PPV&FR Act

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<sup>3</sup>OECD

<sup>4</sup> Barizah, N. 2017. Protection of Farmers’ Rights through a *sui generis* system in Indonesia. *Advances in Social Science, Education, and Humanities Research (ASSEHR)*, volume 131.

has twin purposes.<sup>5</sup> Indian IP laws, which are TRIPS compliant, make it clear that seeds and plants or parts thereof cannot be patented.<sup>6</sup> Article 3j of the Indian Patent Law states that the following are not inventions, hence not patentable: “plants and animals in whole or in any part thereof other than microorganisms; but including seeds, varieties, and species, and essentially biological processes for production or propagation of plants and animals”.<sup>7</sup>

Pakistan can take a cue from Ethiopia, India, Malaysia, or the Philippines which have chosen to develop their own *sui-generis* systems. For instance, The Protection of Plant Varieties and Farmers Rights Act (2001) in India protects plant varieties and breeders’ rights as well as farmers’ rights to save, use, sow, re-sow, exchange, share and sell farm produce, including seeds of varieties protected by plant breeders’ rights. Likewise, the African Union developed an African Model Law for the Protection of the Rights of Local Communities, Farmers and Breeders, and for the Regulation of Access to Biological Resources.<sup>8</sup> Pakistan is also a signatory to ITPGRFA and Nagoya Protocol.<sup>9</sup> Article 9 of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) can also be referred to provide a pretext for developing the *sui-generis* legislation in Pakistan where Article 9.3. explicitly states that “Nothing in this Article shall be interpreted to limit any rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law and as “appropriate”.<sup>10</sup> Farmers’ protection rights in Pakistan are in **Box 2** below.

24. ***Need for a national seed registration system:*** In principle, a variety could be bred and tested within a province and released by its Seed Council without going through the FSC&RD registration process. However, it would then not be eligible for certification or marketing in other provinces. This illustrates the need for a truly national seed registration system so that seeds and varieties can move freely within the country.
25. ***Promoting higher standards for registration:*** The large number of registered companies, and the lack of robust criteria for registration, is a source of complaints coming from relatively small group of professional companies that would like to promote higher standards of conduct across the industry and the farmers. FSC&RD has been reviewing the list with a view to ‘deregistering’ inactive companies. A solution might be to require companies to renew their registration periodically with an objective criteria and intense process of due diligence.

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<sup>5</sup> Preamble to the PPV&FR Act, 2001.

<sup>6</sup> Available at <https://www.thehindu.com/opinion/letters/Patents-and-seed-industry/article16077890.ece>

<sup>7</sup> Available at <https://www.lifegate.com/monsanto-india-seed-patent-vandana#:~:text=The%20Supreme%20Court%20order%20of,and%20cannot%20have%20in%20India.>

<sup>8</sup> Golay, C. November, 2020. The Right to Seeds and Intellectual Property Rights. Research Brief. The Geneva Academy.

<sup>9</sup> Document name “Perspectives on implementation of the Nagoya Protocol and the ITPGRFA” in Pakistan

<sup>10</sup> International Treaty on Plant Genetic Resources for Food and Agriculture

26. ***Simplify and accelerate variety testing and registration process to create a competitive market.*** Opinions vary about the efficiency of the variety testing and registration process but on balance it seems that some simplification and acceleration would be beneficial to meet the needs of a more competitive market, especially in fast moving crops like vegetables.
27. ***Strengthen the testing and inspection system to ensure quality seed.*** In general, the reputable companies that engage in domestic seed production support the quality control work of FSC&RD and do wish to have official certification labels (tags) on their bags as an aid to sales. However, it is not clear if all seed crops are actually inspected in the field and in addition, many seed crops are not entered in the certification scheme at all. Moreover, the laboratories of FSC&RD have old equipment and would benefit from refurbishment. This could be a legitimate target for institutional strengthening/ investment for those labs that are located in the provinces. The largest laboratory at Khanewal could also be used for training purposes in a range of seed-related topics.
28. ***Digitalize field inspection and monitoring system.*** Computerization of field inspections of the seed crop and laboratory tests on samples of seed lots before they are sold can be an of immense benefit once the software has been developed and commissioned. Field inspections, in particular, require sufficient experienced staff who can travel extensively during the limited production season for each crop.
29. ***Need for varietal turnover:*** The relevant institutions, variety release systems, and government seed companies can speed up varietal turnover by: 1) clearly identifying the new varieties they recommend, describing their advantages over the variety they are replacing, supported by reliable data; 2) aggressively demonstrating and promoting these varieties; 3) de-certification of obsolete varieties when they are superseded by better ones; 4) withdrawal of seed subsidies for obsolete varieties; 5) withdrawing funds from the production of breeder and foundation seed of obsolete varieties; 6) setting targets for the average varietal age in foundation seed production and in farmers' fields; 7) Simplifying and harmonizing variety release processes regionally to build private sector confidence and participation in the seed sector A key element in generating a culture of rapid varietal replacement is convincing farmers that it is in their interest to change varieties as soon as a new one is endorsed and made available by the seed system.<sup>11</sup>
30. ***Need for focusing on climate resilient breeding program:*** Increasing climate variability and events of extreme weather are impacting food production, food stability and livelihoods of farmers. The national yields of almost all crops are low compared to peer group countries and productivity is declining over time because of climate change effects. It is important to reorient breeding programs to develop climate resilient cultivars. Advancement in the field of breeding/genetics, biotechnology, and simulation modeling has made it possible to develop climate smart and resilient crops species and livestock breeds. The National Food Security Policy 2018 underlines the policy measures towards this end. Some of the initiatives are already underway in Pakistan testing drought tolerant, heat tolerant, salinity tolerant varieties of wheat and rice for multilocation trials in 2022.

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<sup>11</sup> Gary N. Atlina, Jill E. Cairnsb , and Biswanath Dasc, (2017). Rapid breeding and varietal replacement are critical to adaptation of cropping systems in the developing world to climate change, *Global Food Security*, Volume 12, March 2017, Pages 31-37,

31. ***Reconstituting National and Provincial Seed Councils to make them more representative and participative to oversee the enforcement of Seed (Amendment) Act, 2015 and Plant Breeders' Rights Act 2016.*** The National and Provincial Seed Councils may be reconstituted to make them more representative, and their remit may be extended so that can provide a forum for discussion on all issues included in the policy. This could include the promotion of plant breeding research and local seed production, both potentially benefitting from closer public/private collaboration. These may also include representatives from private seed companies or their Associations having national character.
32. ***Broad-based Provincial Seed Councils will be more beneficial for seed innovation and protecting inventions.*** Beyond this specific task of variety release, the Provincial Seed Councils can provide an effective platform to benefit from a much closer relationship of stakeholders across a spectrum of activities and this could be implemented at the provincial level without challenging any federal responsibilities or authority. This platform may include the research community, academia, regulator and public sector, breeders, farmers, seed businesses, and other stakeholder to promote (a) wider collaboration between public and private sector stakeholders; (b) improve seed research and development; (c) create awareness among seed companies about innovative technologies; (d) explore opportunities for collaboration at international level to benefit from latest research in seed sector; (e) equip farmers with knowledge to choose best quality seed; and (f) understanding and implementation of seed standards, laws, and statutory requirements. At the same time, it should discourage groups pursuing sectional interests causing further division within the community of stakeholders. The challenge is to find a mechanism, and the goodwill, to make the public-private dialogue a reality.
33. ***The Government may restrict its role to specifying standards and quality of seed varieties, registration, and strengthening regulatory mechanisms.*** It will allow FSC&RD to focus its regulatory capacity on commercially important crops. It is important to assess suitability of new varieties for different agro-ecological zones. However, for this to happen the regulatory framework may extend to crops of commercial significance. Else, the large-scale evaluation may enhance the probability of piracy and stealing breeders' innovation.
34. ***The provinces may consider creating Provincial 'Seed-hub'.*** Many of the above themes contained in this report could be addressed by a bold initiative to establish an umbrella organization that would coordinate all seed activities within the province. The main participants would be:
- Universities with strong agricultural/science programs;
  - Public research centers, with strong breeding or biotech programs;
  - The Seed Corporation, in its revised format;
  - Private companies that engage in research and or contract seed production;
  - The main office(s) of FSC&RD that could contribute to training in seed-related topics;
  - The extension service – if they are involved in carrying out trials and demonstrations;
  - Premium seed growers who produce seed on contract for local companies; and
  - Manufacturers of agricultural equipment related to seeds.

The Seed-hub would promote research, development, and production within the province but without encroaching on federal responsibilities. It should have a small secretariat that would, above all, provide information for its members and facilitate collaboration between them. In the past there

was a biannual magazine known as ‘The Seed News’, the last edition of which was published in 2010. This provided a digest of information on the seed sector, and it could be revived at very modest cost as a vehicle for communication among stakeholders. It could be a simple newsletter format and could also be made available online. Similar publications exist in most countries that have a significant seed industry.

35. ***Offices of FSC&RD in the provinces need to be strengthened.*** At the level of physical investment, the offices of FSC&RD within Provinces, especially in Punjab and Sindh, should be upgraded and properly staffed so that they can serve the needs of companies and farmers in the province.
36. ***FSC&RD may invoke delegation of powers’ provision in the Seed (Amendment) Act 2015 to discharge its functions.*** The Amendment empowers the federal government to delegate all or any of its powers to (i) a Provincial Government; or (ii) an officer or authority subordinate to the Provincial Government; or (iii) an officer or authority subordinate to the Federal Government. It can engage provincial extension or research departments to conduct the field monitoring. Currently, FSC&RD is understaffed with only 100 seed officers who are required to provide services to more than 700 seed companies and to conduct the regulatory functions in the fields throughout Pakistan. FSC&RD can utilize the manpower of the provincial extension or research departments by delegating its functions and powers as the field extension agents have far greater reach and can better serve the seed markets in the respective provinces. Provinces can be supported to arrange for necessary manpower and building their capacity and manpower.
37. ***Need for a National Seed Association:*** There is a need for effective national seed association for better representation of the private sector and developing a culture of professionalism instead of too many associations representing groups interests.
38. ***Promoting Organic Farming:*** The government may create enabling environment to promote organic farming to capture the niche market as well as share in the global demand.

### **Management Information System**

39. ***Big data and its application in farming can go beyond simple production and even influence the food supply chain.*** The FSC&RD and provincial authorities should publish regular data on variety-specific production data, company registrations, varietal releases, biosafety approvals, etc. Public disclosure of statistics will ensure better analysis and policymaking. Data driven policy and impact evaluation is the key to success. The big data and its application in farming can go beyond simple production and even influence the food supply chain. Data is being used around the world to predict farming operation, driving real-time decision and redesigning of business processes.

Big data is proving to be a helpful source in improving seed qualities and increasing the yield and lowering the input cost. A recent research at Iowa State University worked on big data and machine learning for sorting out seed varieties stored around the world in the gene banks. They determined which seeds could be more useful for the breeders in an act to prioritize superior versions. The sample included 200 seeds varieties. The yield predictions that were generated by data-driven analytics resulted in 76 percent accuracy rate (Yu, 2016).

By monitoring yield data, GPS field maps and using machinery with variable rate technologies, farmers can adjust the seed planting density as well as the application rates for pesticides, herbicides, and nutrients, depending upon the variations in moisture, topography, and soil quality. The precise planting with use of data and technology can lower the input costs and increase the yields.

40. ***Developing a Seed Information Management System (SIMS) for FSC&RD will be a step forward to digitize its services.*** Developing a Seed Information Management System for FSC&RD will be a step forward in transforming manual data recording to digitize FSC&RD services. This will not only provide access to real time data but will also improve the efficiency and transparency in activities pertaining to seed quality regulation. Track and traceability of certified seed in collaboration with provincial extension departments will enable the impact assessment of various interventions at the farm level. It is important to design a unified format for major crops i.e., wheat, cotton, and paddy. It may be made mandatory for the companies to share information regarding sale of certified seed to the dealers with provincial extension departments for traceability of certified seed at the farmer level.
41. ***Modern communication technologies may be more effective at a moderate cost.*** FSC&RD may digitalize national variety lists which may be available online along with security codes on packages to confirm their origin and contents. It can benefit both the regulators and private sector companies.

## 1. Overview

**Seed plays a pivotal role in dealing with the triple challenge of** improving food security and nutrition, supporting the livelihoods of farmers and rural communities, and contributing to sustainable resource use and climate change adaptation and mitigation.<sup>12</sup> The seed sector also plays an important role in conservation of plant genetic resources (Euroseeds, 2020) and genetic diversity to adapt to changing environment (FAO, 2015).

**The food security imperative has inspired many countries to undertake policy and regulatory reforms to encourage investment and strengthen the seed market to enhance agriculture productivity (Pray et al. 2001).** Most government interventions were in cereal improvement since the 1950s by augmenting public investments in infrastructure and research which doubled the yield and output of rice and wheat between 1965 and 1985 (Hazell, 2010; Fan et al., 2008). Pakistan has been no exception in reforming its research system and improving seed varieties. The Green Revolution of 1960s is widely acclaimed as a success mainly because of High Yield Varieties (HYVs) (Khan and Maki, 1980), usage of fertilizers, pesticides, and improved irrigation system (Chaudhry, 1982; and Chaudhary, 1994), adoption of new technology and investment in agricultural research (Muhammad, 1986; Javed et al, 2010).

**Quality<sup>13</sup> seed is a vital determinant of yield and productivity and drives the impact of other inputs, such as fertilizer, water, and cultural practices in crop production leading to food security.** The enhanced use of well-adapted, high-quality seed, and related planting inputs by the farmers have been a central element in national action plans in transforming agriculture and improving food security. Therefore, sustained increase in agricultural productivity and production necessitates an efficient and robust seed system for developing new and improved as well as certified seed varieties suitable for different agro-climatic conditions and distribution of these seeds to farmers in sufficient quantity at a time and price which meets their requirements. The simultaneous use of HYV seed, fertilizers, irrigation, agricultural credit, adoption of new technology, and intense extension efforts for improved farm practices contributed to accelerated agricultural production moving Pakistan from a food deficit country in the 1950s to that of food security and exportable surpluses.

**The principal goal of a functional seed system<sup>14</sup> is to guarantee that seeds are available and accessible to all end users,** particularly smallholder farmers, in sufficient quantity, quality and diversity to produce adequate nutritious food in a sustainable way. To achieve this goal, the seed system relies on the performance of interconnected critical functions including research and experimentation, development of

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<sup>12</sup> OECD (2020), Case study: The Contribution of the Seed Sector to the Triple Challenge, Available at [https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/CA/APM/WP\(2020\)19/FINAL&docLanguage=En](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/CA/APM/WP(2020)19/FINAL&docLanguage=En)

<sup>13</sup> “Quality” refers to seed that has high purity (i.e., the seed sold corresponds to the variety it is claimed to be and does not have foreign elements such as weed seeds, dirt, and seed of other varieties) and high germination rates, is free from pests and diseases, and has a low moisture content (to prevent early germination and quality losses). These quality parameters are guaranteed by official certification systems in formal seed markets but are not guaranteed in the case of farmer varieties exchanged in informal settings.

<sup>14</sup> The term “seed systems” is used to describe any system in which propagation materials for crops, trees, forages, livestock, and fish are produced, conserved, exchanged, and used. The term “variety” refers to crop varieties, tree and forage species, livestock breeds, and fish strains, along with the genotypic or phenotypic characteristics that distinguish them. The term “farmers” includes small-scale farmers, agricultural laborers, livestock keepers, fisher-people, and people who derive livelihoods from forestry and agroforestry (CGIAR System).

varieties (innovation), production (multiplication), seed market (distribution and sale), access and awareness through extension services for crops, trees, and forage, and regulations. It requires better coordination among the wide range of seed system actors, i.e., researchers, national and sub-national governments, development agencies, private enterprises, farmers, consumers, community-based organizations, and extension workers. The learning, innovation, and coordination are essential at multiple levels—global (international forums, research available), national and sub-national—for production of quality, productive, nutritious, climate resilient, genetically modified varieties, while conserving genetic resources for future generations, and maintaining high varietal turnover.

**The environmental stress around the globe is underlining the significance of developing varieties with greater tolerance that can adapt well with the fluctuating water availability.** Changing weather patterns are already affecting sowing and growing seasons and crop production, more so in tropical regions (Access to Seeds Index, 2019).<sup>15</sup> These problems are expected to worsen as temperature and extreme weather events increase (Challinor et al., 2016). The annual mean temperature in Pakistan has increased approximately 0.5°C (0.9°F) in the last 50 years and so has annual precipitation variability including untimely rains and storms. The number of heat wave days per year has increased nearly fivefold during last 30 years.<sup>16</sup> The cumulative effect of these changes are altering the settled weather affecting the productivity of crops. This shifting weather pattern is an emerging challenge for policy makers, researchers, and farmers. To address these challenge, there is a need for higher investment in research, training, international exposure of scientists, and increased linkages with international partners. Advancement in technology has accelerated the plant breeding process which can play a critical role in climatic adaptation strategies (Rosegrant, et al., 2014). Moreover, through public-private partnerships, the Water Efficient Maize for Africa (WEMA) project is developing drought-tolerant maize varieties for smallholder farmers of sub-Saharan Africa (SSA) countries. This project will help farmers to have reliable yields during drought time (Oikeh et al., 2014).

**Efficiency gains and innovation are essential to enhancing productivity, sustainability and resilience of food and agricultural production.** Innovations in plant breeding on continuous basis can largely address the triple challenge.<sup>17</sup> The cultivation of genetically superior seed can result in higher and stable crop yield (Longhurst, 1988), lower losses due to pests, disease, or adverse climate conditions, leading to higher outputs and higher value from production. Plant breeders have long emphasized the importance of varietal turnover as a means of protecting yield from the evolution of plant disease and sustaining yield gains over time in modern farming systems (Spielman and Smale, 2017). New plant breeding techniques potentially reduce the need for agricultural inputs such as fertilizers and pesticides and reduce harvesting cost by managing plant height and ripening time (Heisey and Fugile, 2018). Access to new varieties of food staple crops helps in increasing agricultural productivity, improving the quality of crops and ensuring resilience to pests and disease, thus improving rural livelihoods (Spielman and Smale, 2017).

**Over the years, increased yield because of plant breeding has led to enhanced affordability of many nutritious crops including fruits and vegetables** Nonetheless, malnutrition and undernutrition remain a challenge for poor and food insecure communities in both developed and developing countries. The

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<sup>15</sup> Available at <https://www.accesstoseeds.org/app/uploads/2019/06/Access-to-Seeds-2019-Index-Synthesis-Report.pdf>

<sup>16</sup> United States Department of Agriculture (Foreign Agriculture Service), Report No. PK2021-0002, June 24, 2021

<sup>17</sup> OECD (2019), *Innovation, Productivity and Sustainability in Food and Agriculture: Main Findings from Country Reviews and Policy Lessons*, OECD Food and Agricultural Reviews, OECD Publishing, Paris, Available at <https://doi.org/10.1787/c9c4ec1d-en>.



countries are now addressing nutrition issue through biofortification<sup>18</sup> of plant breeding (Osendarp et al., 2018) which target foods generally consumed by low-income families globally (such as beans, rice, maize, sorghum, sweet potato, cassava (WHO, 2020). More than 15 million people in developing countries now grow and consume biofortified crops (Saltzman et al., 2017). Agronomic Zn biofortification not only helps in reducing the dietary Zn deficiency but it also improves e crop yield and productivity. In Pakistan, zinc-biofortified seed increased wheat grain yield in all four locations where the experiments were conducted (Rashid, et.al., 2019).

**Researchers and experts suggest that improved varieties contributed 40 percent of the growth in crop production in developing countries between 1981 and 2000** (Evenson and Golin, 2003). Similarly, improved maize varieties accounted for more than half of the sevenfold increase in yield between the 1930s and the present in the United States (Fernandez-Cornejo, 2004). Increases in cereal yields since 1982 were mostly due to better varieties in the United Kingdom (Mackay, 2011). In Pakistan, wheat yield tripled, rice and potato yield more than doubled and other crop yields, except for groundnuts, increased as well between 1960 and 2000. As a result, the Dietary Energy Sufficiency (DES) a measure of calories consumed per capita, for Pakistan increased from 1748 in 1960 to 2462 in 2000 (Evenson, 2005). Recent findings suggest that there is still considerable scope to increase crop yields through genetic improvement (Huang et al., 2002).

**The Stokes-Ruttan framework suggests a significant role of the public sector in funding the basic and applied scientific research as well as technology development.** The private sector will concentrate its R&D spending on research where it can be expected to make sufficient commercial returns on that investment. This research paradigm also suggests that boundaries between public and private R&D may shift over time as the structure of economy changes and new commercial opportunities evolve (Heisey and Fuglie, USDA, 2018). Evidence from the United States shown that application of biotechnology to agriculture and strengthened intellectual property rights with expanding the scope of Plant Varietal Protection Act of 1970 induced significant private R&D investment in crop breeding (Fuglie and Toole, 2014). Other factors that have influenced private investment in agriculture R&D include changes in industry structure, liberalization of input markets, and environmental and food safety regulations (Pray and Fuglie, 2015).

**The National Food Security Policy 2018 highlights the need for achieving modern seed system development in collaboration with provincial partners through policy measures,** such as: (i) strengthening and restructuring Federal Seed Certification and Registration Department; (ii) establishing Foundation Seed Cells (FSCs) at major research institutes; (iii) strengthening research facilities for the development of hybrids of potential crops e.g. vegetables, oil seeds, food grain and fodder crops; (iv) up-scaling Fruit Plant Certification Program; (v) establishing Seed Technology Research and Training Institute; (vi) implementation of Plant Breeders Rights with the requisite institutional arrangements in collaboration with provinces; (vii) development of requisite legislative and regulatory support system for development of modern seed industry; and (viii) developing village based seed enterprises, seed banks and fruit plant nurseries.

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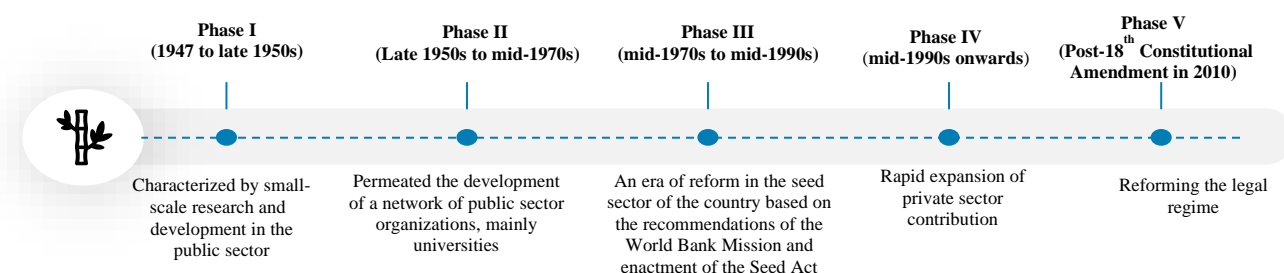
<sup>18</sup> a process that increases the density of vitamins and minerals (e.g., zinc, iron, and vitamin A) in a crop using either conventional breeding methods or genetic engineering.

**More recently—National Program for Enhancing Profitability Through Increasing Productivity under Prime Minister’s Agriculture Emergency Program, 2019**—co-shared by the Federal and Provincial Governments--seeks to boost production of wheat and rice through improvements in farming practices, adoption of modern technologies, promoting mechanization, development of high yielding hybrid varieties, improved provision of certified seed, upgrading crop processing methods and reorganizing extension services at all levels: agronomy, plant protection and marketing (Economic Survey of Pakistan, 2018-19).

**This paper provides an in-depth analysis of the seed sector in Pakistan, key challenges restraining foreign investment in the sector, an overview of international best practices, and suggests plausible policy recommendations with the aim to strengthen the seed sector and to attract investment.** The paper is divided into thirteen sections. Section 2 provides an overview of historical perspective on seed sector development in Pakistan. Section 3 identifies key players in the seed business. Section 4 highlights the legal regime regulating seed sector in Pakistan. Section 5 mirrors the institutional framework for seed registration while Section 6 describes variety approval, registration, release, and seed certification procedures. Section 7 looks at seed supply system including the informal market in Pakistan. Section 8 evaluates the regulatory and institutional framework. Section 9 reviews the international best practices and present different approaches to regulate the seed sector. Section 10 discusses international treaties and protocols. Section 11 underlines the challenges facing the seed sector including entry barriers to seed market, especially for the foreign companies. Section 12 comments on the ranking of Pakistan with regards to creating an enabling business environment. In conclusion, Section 13 provides policy recommendations.

## 2. Historical Perspective

Pakistan's seed system has undergone enormous changes since its inception and can be categorized into five phases:



Details of each phase are given in **Annex-I**.

## 3. Key Players in the Seed Sector

Seed system in Pakistan is an ensemble of (i) formal system managed by public and private agencies which generally follow government approved regulations and provide certified seed of registered, distinct, uniform and stable varieties; (ii) informal system managed by farmers and farming communities, who are both the producers and consumers of seed, providing seeds of preferred varieties saved for production on farm or distributed to other farmers based on customary and informal practices; and (iii) intermediate system which integrates elements of formal and informal system. The intermediate system is generally supported by projects or non-governmental organizations for certification and distribution of farmer produced seed in line with national rules and regulations. The value chain of seeds is in **Annex-II**.

### 3.1. Formal Seed System

#### 3.1.1. Public Sector Seed Companies

1970s saw the establishment of seed corporations viz. Punjab Seed Corporation (PSC)<sup>19</sup>, Sindh Seed Corporation (SSC)<sup>20</sup>, and the NWFP [now Khyber Pakhtunkhwa (KP)] Agricultural Development Authority<sup>21</sup> to streamline the seed value chain. The Government of Balochistan was made responsible for seed provision in the province. The Government invested considerable resources in research and development in the formal public sector during the last six decades focusing on seed multiplication, certification, and marketing new varieties but with limited success.

#### 3.1.2. Private Seed Sector

**3,655 private seed companies were registered with FSC&RD as of December 30, 2020.** Nevertheless, the directory of private seed companies provides a list of only 873 companies; 82.5 percent of which are in Punjab (721), 12.8 percent in Sindh (112), 3.7 percent in KP (32), and 0.6 percent in Balochistan (5), and 0.3 percent in Gilgit and Baltistan (3) as of March 2020<sup>22</sup> dealing in wheat, rice, cotton, maize, gram, vegetables, fruits, and nursery plants. Most of these companies function from Southern Punjab which is

<sup>19</sup> Punjab Seed Corporation Act, 1976.

<sup>20</sup> Sindh Seed Corporation Act, 1976.

<sup>21</sup> North-West Frontier Province Agricultural Development Authority Ordinance, 1980 (dissolved in 2001)

<sup>22</sup> FSC&RD, Ministry of National Food Security and Research, Available at <http://www.federalseed.gov.pk/Download>, November 26, 2021.

well-positioned for access to Sindh and Balochistan seed markets. The private sector which was restricted to multiplication of basic seed is now the lead seed provider for cotton, vegetables, oilseeds, maize, and fodder. The details of these registered companies are in **Annex-III**.

### 3.2. Informal Seed Sector

**The informal seed sector chain, providing about 80 percent of the total seed requirement annually, encompasses** (a) farmer-to-farmer seed exchange on non-commercial basis; (b) small scale farmer-to-farmer seed sale; (c) farmer-saved seed for planting in subsequent years; and (d) medium-to-large scale sale of seed in brown bags. The informal seed system is well adapted to local farming practices and buffers for formal sector during natural disasters or during crisis situations. Renewal of seed stock in terms of varieties and crops happens when farmers face seed loss, seed degeneration or when farmers wish to switch their crops or test different varieties (Van Etten et al. 2017). The informal seed sector survived almost entirely on its own resources, rather than assistance from governmental or donor agency sources. It is the major seed supplier in the country providing approximately 23 percent of vegetable seed, 50 percent of cotton, 90 percent of wheat, rice and maize and almost 99 percent of the legumes.<sup>23</sup> Half of the cotton seed is provided by informal and through illegal channels.

### 3.3. Intermediate System

#### 3.3.1. Multinational Seed Companies

**Multi-national corporations entered the market in Pakistan between 1984 and 1999 (Table 1).** MNCs including Pioneer and Monsanto played a key role in introducing imported hybrid seeds of maize, sunflower, fodder, canola, and sorghum to the Pakistani market (Hussain and Hussain 2007). Monsanto also produced and marketed wheat, cotton, and rice certified seeds. It promoted brand recognition and brand loyalty of the merchandize achieving 67 percent of market share.

Table 1. List of Registered Multinational in Pakistan	
Year Registered	Multinational Companies (MNCs)
1984	Monsanto Pakistan Agri. Tech. (Pvt.) Ltd., Lahore. Acquired by Bayer in 2018.
1989	Pioneer Pakistan Seed (Pvt.) Ltd., Lahore, converted to Corteva Agriscience
1991	Syngenta Pak. Seeds Pvt. Ltd., Lahore. 1991
1996	ICI Pakistan (Pvt.) Ltd. (limited its seed business)- Agro Chemical & Seeds, Lahore.
1999	Bayer Crop Science Pakistan (Pvt.) Ltd., Karachi.

*Source: FSC&RD, Ministry of National Food Security & Research (MNFSR)*

**Bayer acquired Monsanto in 2018 and its world-wide crop science operations which had reached over 20 billion euros in 2020.**<sup>24</sup> It now has a large product portfolio for its seed and agrochemical businesses in Pakistan. The company developed its large portfolio through its aggressive trait and company acquisition strategy, along with its own continuous efforts in R&D (Mordor Intelligence, 2020). Corteva Agriscience<sup>25</sup> was founded on the rich heritage of Dow, DuPont and Pioneer (began its operation in Pakistan

<sup>23</sup> Akhlaq Hussain and Abdul Rauf Bhutta, “Focus on Seed Programs The Pakistan Seed Industry”, Federal Seed Certification and Registration Department, Available at <https://www.seedquest.com/statistics/pdf/Pakistan2002.pdf>

<sup>24</sup> Bayer ranked first globally in Access to Seeds Index 2021, Available at <https://www.worldbenchmarkingalliance.org/publication/access-to-seeds-index/rankings/>

<sup>25</sup> Corteva Agriscience ranked 14 globally

in 1989) in 2019 making this the world’s largest standalone agricultural company. Pioneer has been selling maize, sunflower, pearl millet, mustard and sorghum hybrids in Pakistan. They are pioneer in hybridization of corn in country along with introduction and promotion of corn silage which is now a critical piece of growth in Pakistan’s dairy industry.

### 3.3.2. Seed Dealers

**Seed dealers serve as an important link between farmers and the seed supplied from public and private companies.** They sell seeds of multiple crops besides other agricultural inputs, such as fertilizers, pesticides, etc. and act as retailers at tehsil (sub-district) level. The most popular of these seeds are wheat, maize, fodder, rice, vegetables, and oilseeds. Private seed companies registered or unregistered, and individuals are the major seed provider with 80 percent of the seed dealers obtaining seed from these sources. The government-owned seed corporations are the secondary source for seed procurement.<sup>26</sup> The seed marketing network in Pakistan is depicted in Table 2.

<b>Organization</b>	<b>Dealers</b>	<b>Sale Points</b>	<b>Others</b>	<b>Total</b>
Punjab Seed Corporation	1750	15	206	1971
Sindh Seed Corporation	75	7	-	82
Khyber Pakhtunkhwa	-	53	-	53
Balochistan	-	19	-	19
<b>Total</b>	<b>1825</b>	<b>94</b>	<b>206</b>	<b>2125</b>

*Source: Adapted from Hussain, et al. (2002)*

### 3.3.3. Associations

**Various seed trade associations represent different interest groups** viz. (i) Chamber of Private Seed Industry (CPSI) which is an exclusive association of national seed companies; (ii) Seed Association of Pakistan (SAP), an association of local seed companies; (iii) Crop Life Pakistan, an association of national seed companies; (iv) All Pakistan Seed Merchants and Seed Dealers Association (APSMSDA) which represents the interests of vegetable seed dealers; (v) All Sindh Private Seed Companies Organization (ASPSCO) representing interests of seed companies located in Sindh; (vi) Association of Seed Companies of Pakistan (ASCOP) established by the seed companies located in Sahiwal, Okara, and Pakpattan districts; and (vi) Pakistan Society of Seed Technologists (PAKSST) providing a forum for advancement of professionals and scientists in the seed sector and working for seed technology development.

### 3.3.4. International Cooperation

Pakistan is a member of Asia and Pacific Seed Association (APSA), South Asian Association of Regional Cooperation (SAARC<sup>27</sup>) Seed Bank, Economic Cooperation Organization Seed Association (ECOSA28), International Seed Testing Association (ISTA) and D-8 Umbrella Seed Bank (yet to be established formally) to standardize and harmonize seed certification and quality enforcement procedures among D-8 countries. Pakistan is also taking steps for accreditation and membership of key international organizations for official recognition of quality guaranteed seed, viz. Organization for Economic Cooperation &

<sup>26</sup> Hina Nazili and Saqib Shahzad, 2016. *How to Ensure Seed Quality: Results of Cotton Seed Dealers Survey 2015*, International Food Policy Research Institute.

<sup>27</sup> SAARC includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka

<sup>28</sup> ECO includes Afghanistan, Azerbaijan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan and Uzbekistan

Development (OECD), International Union for Plant Variety Protection (UPOV), and International Treaty on Plant Genetic Resource for Food & Agriculture (ITPGRFA). Following international organizations, cooperates with the public sector research organization in respect of seed sector on behalf of the Government of Pakistan: (i) Food & Agriculture Organization (FAO); (ii) Centre for International Wheat & Maize Research (CIMMYT); and (iii) International Centre for Agriculture Research in Dry Areas (ICARDA).

#### 4. Seed Regulatory Framework

**Pakistan’s legal framework regulating the Seed Sector has evolved since 1976** (Table 3).

S.No.	Statute	Year
1	The Seed Act	1976
2	The Seed (Amendment) Act,	2015
3	The Plant Breeders’ Rights Act,	2016
4	The Seed (Business Regulation) Rules,	2016
5	The Plant Breeders’ Rights Rules,	2018
6	The Seed (Registration) Rules	1987 amended in 1998
7	The Seed (Truth-in-Labeling) Rules	1991, amended in 1993 and 1998
8	The Pakistan Fruit Plants Certification Rules	1998
9	Pakistan Environmental Protection Act (PEPA)	1997
10	Pakistan Plant Quarantine Act	1976
11	Plant Quarantine Rules	1967
12	Pakistan Biosafety Rules	2005
13	Patent Ordinance	2000 as amended up to 2016

Details of above Acts and rules are in **Annex-IV**.

##### 4.1. Seed Act 1976 Amended in 2015

**The Seed Act of 1976 and rules framed provided principles for seed quality regulation**, certification, and registration of crop varieties, established an institutional framework for the seed sector for regulation and certification, laid down penalties for commercialization of unbranded or unregistered seed and defined various categories of seed.<sup>29</sup> The Act, as stipulated in the preamble “*controlling and regulating the quality of seeds of various varieties of crops*”, provided complete regulatory control to the public sector over the development, processing, distribution of seed varieties and marginalized the private sector. This created a major impediment for the private sector interest in the development of seed. Nevertheless, the registration of first private company in 1981 and declaration of *seed as industry* in 1994 saw private seed companies sprawling in the informal sector, as highlighted *supra*, to meet the rising demand. This phenomenon soon made the Act irrelevant.

The Seed (Amendment) Act, 2015 Bill was introduced in the Parliament after **recognizing the weaknesses in the Seed Act, 1976, as stipulated in the ‘Statement of Objects and Reasons’ that said** “the Seed Act 1976 does not fulfil the requirements of the modern seed industry. Over the years, the capacity of the public sector has been vastly impaired, and the private sector is playing stronger and more vibrant role in the development of seed industry, the world over. The new innovations in hybrid technology and Genetically Modified Crops (GMCs) have transformed the seed industry. The new Seed Amendment Bill has been

drafted in view of the emerging realities which will provide level playing field to both public as well as the private sector”.<sup>30</sup> The salient features of the Amendment Act are enumerated below.

## 4.2. Plant Breeders’ Rights Act, 2016

**Pakistan enacted the Plant Breeders’ Rights Act (PBRA) in 2016 to protect breeders’ rights either by patents or by an effective *sui generis* system or with a combination of both, to fulfill its obligations under Article 27.3 (b) of the Trade Related Intellectual Property Rights Agreement (TRIPS).** The agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), adopted at the World Trade Organization (WTO) in 1994, contains an Article 27(3) (b) that allows member states to use a “*sui generis*”<sup>31</sup> protection system, allowing countries to devise specialized and appropriate forms of protection regimes. In countries such as Pakistan where using farmer saved seed and farmer-to-farmer exchange of seeds is a common practice, a “*sui generis*” system of plant variety protection that is designed to better fit local specificities, is a preferred option to ensure both plant breeders’ and farmers’ rights.

**Pakistan is not a member of the International Union for Protection of New Varieties of Plants (IUPOV).** However, the Government of Pakistan has attempted to make PBRA, 2016 consistent with the standards set by the IUPOV Convention, 1991, and TRIPS compliant. A comparison of the PBRA 2016 and the standards provided by the International Union for Protection of New Varieties of Plants (IUPOV) Convention, 1991, is in **Annex-V**.

## 4.3. Seed (Business Regulations) Rules 2016

**The Seed Act of 1976 did not require the registration of private seed companies (businesses) which was addressed through administrative action.** The Economic Committee of the Cabinet in its meeting held on December 31, 1979, constituted an inter-ministerial Working Group made responsible for evaluating the proposals and registration as well as deregistration of new seed companies in the country. Since the Working Group was not backed by legal cover, the seed companies started establishing their businesses under the Companies Ordinance, 1984 (now the Companies Act, 2017). Nevertheless, this anomaly has been rectified. Now, Section 22B of the Seed (Amendment) Act, 2015 read with the Rule 4 of the Seed (Business Regulation) Rules, 2016 prescribes a detailed procedure as well as documents required for registration of seed business in Pakistan. The Working Group, now has legal cover, shall grant registration for five years to do seed business in respective categories on the recommendation of FSC&RD. The key features of the Seed Regulatory Regime Post 2015-16 Reforms are in **Box 1**.

## 5. Seed Registration and Certification System in Pakistan

### 5.1. Institutional Framework

**The Seed Act, 1976, established the following institutional framework for the seed sector**

1. National Seed Council (NSC) at the federal level
2. Provincial Seed Councils (PSCs) at the provincial level

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<sup>30</sup> Available at [https://senate.gov.pk/uploads/documents/1427261685\\_555.pdf](https://senate.gov.pk/uploads/documents/1427261685_555.pdf) accessed on November 30, 2021

<sup>31</sup> *Sui generis* is a Latin term meaning “a special kind”. This refers to a ‘special form’ of protection regime that is ‘tailored’ to meet a certain need in a specific context.

3. Federal Seed Certification Agency (FSCA) } Merged in 1997 to form Federal Seed  
 4. National Seed Registration Agency (NSRA) } Certification & Registration Department

BOX 1. Salient Feature of Seed Regulatory Regime Post 2015-16 Reforms		
Seed	Regulatory Regime	Private Sector
<ul style="list-style-type: none"> <li>• Redefining pre-basic, basic, approved, certified seed, and notified variety.</li> <li>• Specifying in detail the variety registration procedure and prohibiting storing and offering for sale of banned or unapproved varieties/hybrids</li> <li>• Placing strict verifications with the consent of the breeder/institute to provide source of seed material for multiplication by the company</li> <li>• Amending the Seed (Registration) Rules, 1987, for rapid multiplication of seed of unique new varieties after completion of 1st year DUS (distinctness, uniformity, stability) and NUYT (National Uniform Yield Trials) upon joint recommendation of Federal Seed Certification &amp; Registration Department (FSC&amp;RD) and PARC. Such varieties must satisfy the criteria of novelty, high yield, and pest/disease resistance</li> <li>• Establishing a System of Consumer Traceability for Seed Authenticity</li> </ul>	<ul style="list-style-type: none"> <li>• Delineating the role of registered seed companies, seed dealers, processing units and fruit plant nurseries established in the private sector</li> <li>• Requiring the seed businesses to set up a seed processing plant and seed dealers to register with federal seed certification and registration department (FSC&amp;RD), which is for a specified period after which it needs to be renewed, as the seed can be sold only by registered dealers</li> <li>• Disallowing (a) doing seed business without enlistment; (b) offering, bringing in, stocking, dealing, or generally providing seed of unregistered varieties; and (c) offering, and marketing etc., non-branded seed.</li> <li>• Strengthening the regulatory role of FSC&amp;RD as any seed can be categorized as “misbranded” if it is not aligned with its ingredients and training of the seed dealers</li> <li>• Enhancing the penalties for effective deterrence against sale of sub-standard seed in the market</li> <li>• Revising criteria for induction, performance evaluation and cancellation of seed companies. Conditions for cancellation of companies have been clearly mentioned</li> <li>• Delineating separate requirements for local seed producers, importers, and exporters along with defining technical parameters for each set of the company</li> <li>• Empowering the Federal Government to direct that, all or any of its powers under the Seed Act, 1976 and 2015 amendment, can be exercised by (i) a Provincial Government; or (ii) an officer or authority subordinate to the Provincial Government; or (iii) an officer or authority subordinate to the Federal Government.</li> </ul>	<ul style="list-style-type: none"> <li>• Permitting the private sector to produce basic seed for its multiplication and allowing its certification which could be produced only by the public sector previously</li> <li>• Allowing the private sector to establish accredited seed testing laboratories to produce genetically modified crop varieties (GMCs)</li> <li>• Setting out to cater for innovations and build a more favourable environment for foreign companies to invest in Pakistan’s seed sector</li> <li>• Preconditioning mandatory local seed production for importing companies along with submitting performance bonds by the candidate company</li> <li>• Authorizing the registration of genetically modified crops subject to two conditions: (a) undertaking by the applicant that no terminator technology/gene is involved in the development of the seed variety; and (b) a certificate from national bio-safety committee (NBC) certifying that the GM variety has no adverse effect on the environment will be a pre-requisite for the approval of the plant variety which would satiate the environmental concerns about GMCs.</li> </ul>

**The National Seed Council** is responsible to advice on policy for the development, operation, and regulation of the provincial seed industries, administering seed quality control service, prescribing seed standards, mobilizing investment in the sector, regulating the interprovincial movement, advise on import of seed, coordinating multiplication and supply of seeds of approved varieties, maintenance of genetic potential, and developing approved production farms. The Council can also recommend withdrawal of varieties that have deteriorated and outlived their useful life. The composition of the National Seed Council is in **Annex-VI. The Provincial Seed Council** in each province is established under Section 9 of the Seed Act, 1976. They perform concurrent functions in the respective provinces and can approve a variety, but notification is issued by the federal government after the registration process.

**Federal Seed Certification & Registration Department (FSC&RD):** FSCA and NSRA were merged in 1997 to function as the present day FSC&RD, the key department regulating the seed and seed industry. Its functions are enlisted in **Box 3**.



## BOX 2. Farmers' Right Protection in Pakistan

**Section 22 of the Plant Breeders' Rights Act, 2016**, provides exclusive rights to the owner of a protected variety, viz. (a) offering for sale or selling or marketing of the reproductive or vegetative propagating material of the protected variety in Pakistan; (b) importing the reproductive or vegetative propagating material of the protected variety into Pakistan or exporting it from Pakistan; (c) conditioning or multiplying the reproductive or vegetative propagating material of the protected variety; (d) carrying out of any of the acts identified in clauses (a), (b), and (c) in relation to an essentially derived variety provided the provided variety is not itself an essentially derived variety; (e) instigating or promoting any of the acts identified in clauses (a), (b), (c) and (d); (f) authorizing any person to produce, sell, market or otherwise deal with a protected variety; and (g) stocking for any of the purposes mentioned in clauses (a) to (d).

**Section 25 of PBRA stipulates that:** Nothing contained in this Act shall prevent, —(d) a farmer to be entitled to save, use, sow, re-sow, exchange, share or sell his farm produce provided that the farmer shall not be entitled to sell seed of a variety protected under this Act on a commercial basis without complying with the requirements of Seed Act, 1976(XXIX of 1976), and regulations made therein.

**Section 32 of the PBRA entitles the owner of the initial variety** to claim benefit sharing in plant varieties which are derived from the initial variety for which a Registrar is required, through advertisement, to invite claims of benefit sharing and after due hearing and scrutiny of claims, he will pass an order (a) variety relating to which the benefit sharing has been claimed; (b) the commercial utility and demand in the market of the variety relating to which the benefit sharing has been claimed; and (c) the amount of benefit sharing.

**International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) of which Pakistan is a signatory** and Article 9.3 of the said treaty mandates that “Nothing in this article should be interpreted as limiting farmers' rights to conserve, use, exchange, and sell farm-saved seed/ propagating material, pursuant to applicable national law” which is provided under Section 25 above.

## BOX 3. Functions and responsibilities of FSC&RD

- a) controlling the quality of seeds in relation to its purity, germination, viability, etc. as well as the quality of seed delivered to processing plants
- b) registering growers
- c) providing certifications after crop inspection, seed sampling and testing
- d) field inspection of the crops of registered varieties and released varieties intended for sale as basic seed or certified seed as well as sampling and testing of seed lots intended for sale in order to ascertain their purity, viability, germination capacity and health status in the prescribed manner
- e) issuance of certification tags for accepted seed lot which meet the prescribed standards of particular category of seeds
- f) carrying out post-control trials on pre-basic, basic and certified seed
- g) sampling and analyzing seed lots delivered to the processing plants to establish a basis for the purchase of such lots
- h) providing technical and specialist advice and assistance to the NSC
- i) conducting pre-registration checking of varieties submitted for the purpose of determining suitability for registration as a variety
- j) providing definitive botanical description of crop varieties
- k) providing information on genetic suitability and adaptability of varieties
- l) publish a list of registered varieties
- m) conducting research in seed science and monitoring the quality of seeds sold in the market
- n) arranging training courses for seed certification officer and persons engaged in seed businesses

**Various Committees:** The Seed (Amendment) Act, 2015, and the Seed (Business Regulation) Rules, 2016, have provided for constituting or amending the composition and functions of the following

1. Federal Seed Registration Committee (FSRC)
2. Federal Seed Committee (FSC)
3. Variety Evaluation Committee (VEC)
4. Variety Evaluation Sub-Committee
5. Regional Fruit Plants Nursery Registration Committees.

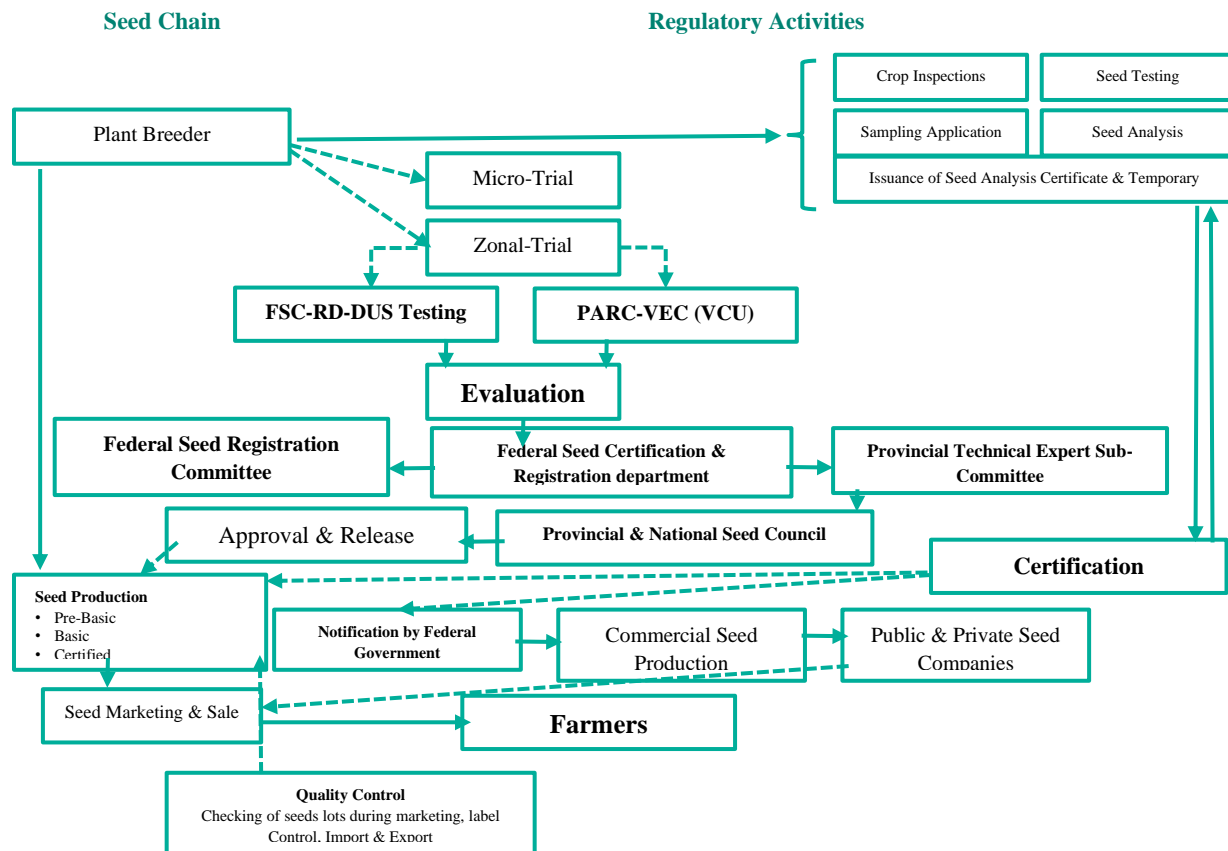
The composition and functions of these Committees is listed in **Annex-VII**.

## 6. Seed Variety Registration and Certification Process

### 6.1 Crop Variety Development and Release System

**Seed certification system recognizes the categories: pre-basic seed, basic Seed, certified seed, and approved seed.** Variety registration and certification process is quite cumbersome in Pakistan and usually takes around 2 years. Crop variety development is the domain of public sector organizations in the provinces while Pakistan Agriculture Research Council (PARC) coordinates all research pertaining to variety evaluation and testing at the federal level. Research on cotton crop is exclusively carried out by Pakistan Central Cotton Committee (PCCC). **The crop variety development and release system in Pakistan is illustrated in Figure 1.**

**Figure 1. Variety Development and Release System in Pakistan**



Source: FSC&RD

## 6.2 Seed Certification System

**Seed certification system is a legal and regulatory requirement.** It is performed by the Federal Seed Certification and Registration Department. To maintain and make availability of genetically pure seeds of improved varieties, the whole process is done in three main stages:

1. The crop raised to produce seed is inspected by FSC&RD for genetic purity.
2. The seed samples are drawn after harvest of the crop and analyzed in the laboratory for evaluation based on prescribed seed standard (analytical purity).
3. Pre and post control plots are laid out to ascertain the genetic purity of the seed and seed-borne diseases.

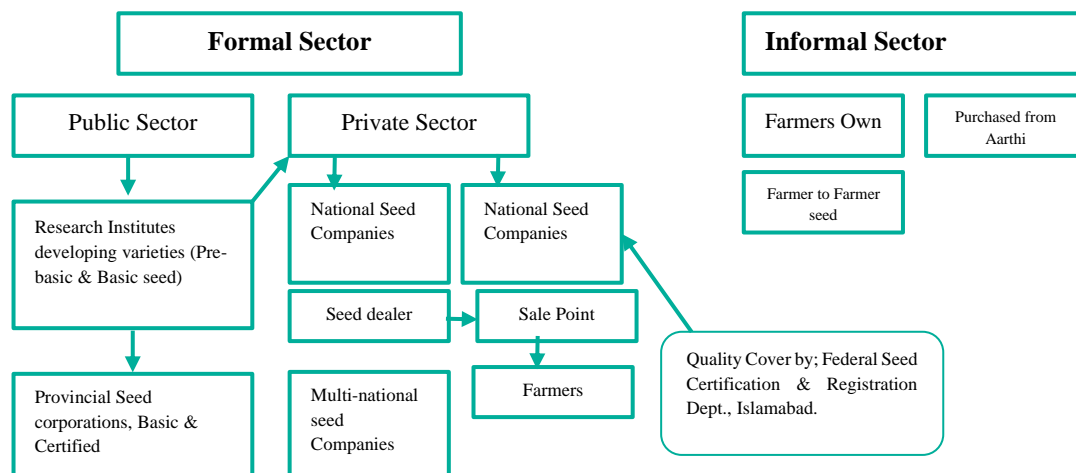
**The activities and agencies involved in seed registration and certification are in Annex-VIII.** The detailed process is elaborated in **Annex-IX**.

## 7. Seed Supply System and Seed Market in Pakistan

### 7.1. Seed Supply System

**Pakistan seed supply system comprises formal and informal seed channels.** The formal seed channel consists of breeding institutes, seed corporations, registered seed companies, regulatory organizations i.e., the seed councils and FSC&RD, National Biosafety Committee for GM crops, agricultural input dealers, and farmers. The informal system includes many of these same actors such as farmers, input dealers, seed companies, and breeding institutes. The seed market is largely dominated by the informal system including illegal produce of seed companies (almost 80%) compared to the formal (**Figure 2**).

**Figure 2. Seed Supply System in Pakistan**



Source: Ali, M. (2018)<sup>32</sup>

<sup>32</sup> Ali, M. (2018). Seed system in Pakistan (Standards and Procedures). Presentation at International Rice Trancing Workshop for Agriculture Professionals. October 2

## 7.2. Seed Market of Pakistan

The size of Pakistan's seed market, which was valued at USD 355.0 million in 2020, is projected to reach USD 458.6 million in 2026 registering a CAGR of 5.2%.<sup>33</sup> Pakistan seed market is segmented by product type (transgenic, non-transgenic, and open pollinated) and crop type (grains and cereals, oilseeds, vegetables, and other seeds). The total seed demand in Pakistan is around 1.75 million tons (Table 3) while availability of certified seed is approximately 0.653 million tons or 38 percent of overall demand in 2019-2020, which was even lower in 2014 around 20-23 percent, indicating the presence of large informal channel. The share of improved seed is much larger as not all seed traded through informal channel is of low quality (Rana, 2014). The requirement and availability trend of improved seed in previous years is exhibited in Annex-X.

## 7.3. Seed Requirement and Availability

The sowing area, seed requirements and seed availability for major crops since 2017-20 is in Table 3 and availability of certified seed (2009-2020) is depicted in Table 4. Tables 3 and 4 suggest three important developments: i) availability of seed for wheat and rice has significantly increased from 8 percent in 1995-96 to 48 percent in 2019-20, which may be sufficient to meet the annual replacement requirement, which is 20 percent of total seed;<sup>34</sup> (ii) share of the private sector companies in all major crops has increased substantially and they are now major players in wheat, rice, and cotton seed; and (iii) hybrid seed in maize is on the rise.

Year	Crop	Area (000 Ha)	Total Seed Requirement MT	Seed Availability (MT)				Seed Availability as %age of Total Requirement Percent			
				Public	Private	Imported	Local + Imp	Public	Private	Imported	Total
2017-18	Wheat	8,945	1,104,658	45,694	398,232	0	443,925	4	36	0	40
	Cotton	2,955	58,391	1,354	54,087	0	55,441	2	93	0	95
	Paddy	2,805	54,782	4,074	66,301	8,906	79,281	7	121	16	145
	Maize	1,170	35,079	220	6,537	16,653	23,409	1	19	47	67
	Oil Seed	830	10,790	7	357	147	511	0	3	1	5
	Pulses	1,185	42,674	902	2,392	0	3,293	2	6	0	8
	Vegetables	280	8,400	76	790	11,681	12,547	1	9	139	149
	Fodders	2,038	61,140	34	6,041	38,272	44,347	0	10	63	73
	Potato	166	415,000	0	0	7,126	7,126	0	0	2	2
	<b>All Crops</b>	<b>20,374</b>	<b>1,790,914</b>	<b>52,361</b>	<b>534,736</b>	<b>82,785</b>	<b>669,882</b>	<b>3</b>	<b>30</b>	<b>5</b>	<b>37</b>
2018-19	Wheat	8,833	1,090,925	58,874	424,478	0	483,352	5	39	0	44
	Cotton	2,955	58,391	1,569	64,323	0	65,893	3	110	0	113
	Paddy	2,879	42,393	5,217	67,707	9,947	82,871	12	160	23	195
	Maize	1,328	32,794	741	2,553	18,901	22,195	2	8	58	68
	Oil Seed	830	10,790	100	378	409	887	1	3	4	8
	Pulses	1,185	42,674	672	1,652	0	2,323	2	4	0	5
	Vegetables	280	8,400	109	5,296	5,681	11,085	1	63	68	132
	Fodders	2,038	61,140	43	27,534	50,506	78,083	0	45	83	128
	Potato	166	415,000	550	422	4,735	5,707	0	0	1	1
	<b>All Crops</b>	<b>20,495</b>	<b>1,762,507</b>	<b>67,874</b>	<b>594,342</b>	<b>90,179</b>	<b>752,395</b>	<b>4</b>	<b>34</b>	<b>5</b>	<b>43</b>
2019-20	Wheat	8,709	1,075,562	68,578	444,909	0	513,487	6	41	0	48
	Cotton	2,310	45,646	880	32,921	0	33,801	2	72	0	74
	Paddy	2,957	44,148	4,978	49,287	9,530	63,795	11	112	22	145
	Maize	1,339	33,071	212	2,289	13,114	15,615	1	7	40	47
	Oil Seed	830	10,790	356	429	893	1,678	3	4	8	16
	Pulses	1,185	42,674	504	2,329	0	2,833	1	5	0	7
	Vegetables	280	8,400	0	1,171	2,987	4,158	0	14	36	50
	Fodders	2,038	61,140	10	4,441	22,015	26,465	0	7	36	43
	Potato	166	415,000	10	0	5,996	6,006	0	0	1	1
	<b>All Crops</b>	<b>19,814</b>	<b>1,736,430</b>	<b>75,528</b>	<b>537,776</b>	<b>54,535</b>	<b>667,839</b>	<b>4</b>	<b>31</b>	<b>3</b>	<b>38</b>

<sup>33</sup> Mordor Intelligence, Available at <https://www.mordorintelligence.com/industry-reports/seed-sector-analysis-pakistan-industry>, accessed on December 16, 2021

<sup>34</sup> Abdul Salam, Abdul Salam, Review of Input and Output Policies for Cereals Production in Pakistan, International Food Policy Research Institute, October 2012.

Table 4. Certified Seed Availability for selected crops, 1996–2020 (FSC&RD)									
Year	Wheat			Paddy			Maize		
	Requirement	Availability	%age	Requirement	Availability	%age	Requirement	Availability	%age
2009-10	1,095,792	284,344	26	40,363	22,253	57	18,702	9,785	33
2010-11	1,085,400	319,023	29	42,480	28,895	68	31,914	9,041	28
2011-12	1,085,400	259,904	24	42,480	34,528	81	31,914	12,550	39
2012-13	1,085,400	259,904	24	42,480	49,492	116	31,914	14,008	44
2015-16	1,093,200	421,615	39	55,268	51,717	94	33,261	33,878	102
2016-17	1,093,200	375,442	40	55,268	59,629	108	33,261	20,334	61
2017-18	1,104,658	443,925	40	54,782	79,281	145	35,079	23,409	67
2018-19	1,090,925	483,352	44	42,393	82,871	195	32,794	22,195	68
2019-20	1,075,562	444,909	48	44,148	63,795	145	33,071	15,615	47

The availability of certified seed for previous years is depicted in **Annex-XI**.

#### 7.4. Hybrid Seed or Genetically Modified Organism (GMO)

**The genetically modified crop products fall into three categories:** (a) Herbicide Tolerant products; (b) Disease Resistant products; and (c) Insect Resistant products (chiefly from *Bacillus thuringiensis* (Bt) engineered into the plant. Pakistan has not benefited from the Gene Revolution despite that GM products can reduce costs of production.<sup>35</sup> Mechanisms that are suggested for cost reduction include: (1) GMOs for Rent--Developed Country Suppliers under which a private agro-biotech supplier of crop GMOs from a developed country provide GM products as well as technical services to a developing country in return for a technology fee or a seed price premium; (2) GMOs for Rent--Developing Country Suppliers which is similar to mechanism 1 except that a private firm or public organization is the supplier of GM products; (3) GMO for Rent—International Agency Purchase where an international donor agency negotiates with a GM product supplier to provide specific GM productions to farmers in identified countries. The international agency also makes the payment to the supplier; (4) GM Product Germplasm Conversion converting GM products into germplasm in the form of “breeding lines”; and (5) Quantitative Enhancement--Genomics, Proteconomics Research which entails “quantitative” trait breeding. It should be noted, however that Marker Aided Selection (MAS) techniques enable conventional breeders to achieve breeding objectives faster. There is a need to “upgrade” breeders in the use of these techniques.

**Pakistan is both a producer and importer of hybrid crops and products.** Cotton and maize are the two major genetically modified crops in Pakistan that are developed with resistance properties against insects and weeds. More than 80% of the hybrid seeds are imported by Pakistan which cost the country over \$50 million annually.<sup>36</sup> These genotypes reduced pesticides use resulting in increased farm income. The Variety Evaluation Committee (VEC) has recommended 12 new hybrids of rice in 2019 for commercial cultivation across the rice-growing areas of the country to enhance crop output.<sup>37</sup>

**Hybrid seed penetration is the highest in cotton with 96% of total cotton production in Pakistan being Bt cotton, planted on a total area of 3 million hectares.** Bt cotton was developed for the first time as a genetically modified crop in 2002 by National Institute for Biotechnology and Genetic Engineering

<sup>35</sup> Robert E. Evenson, *The Green Revolution and the Gene Revolution in Pakistan: Policy Implications*, The Pakistan Development Review 44: 4 Part I (Winter 2005) pp. 359–386

<sup>36</sup> International Maize and Wheat Improvement Center. (2018, May 19). CIMMYT. Available at: <https://www.cimmyt.org/news/cimmyt-helps-national-programs-to-enhance-maize-breeding-efficiency-in-pakistan/>

<sup>37</sup> Pakistan Seed Market Global Industry Overview by Size, Trends & Growth Forecast. (2021, November 17). Available at: <https://www.marketwatch.com/press-release/pakistan-seed-market-global-industry-overview-by-size-trends-growth-forecast-2021-11-17>

and commercialized its four varieties<sup>38</sup> in 2005 exhibiting insect-resistance (IR) i.e., across the country to sort out the issue of insect attack which was getting epidemic.<sup>39</sup> Hybridization in corn, paddy, and vegetables is also increasing.<sup>40</sup> About 40-60% of maize grown in the country is from hybrid seeds. The use of hybrid seeds is also increasing in crops, like maize, sunflower, sorghum forage, and vegetable crops, but there is still limited domestic hybrid seed production in the country. The seeds for maize and fodder crops are mostly sourced from East Asian countries while India and China are the major origins for vegetable crop seeds (Aazim, 2018).

**The retail price of hybrid maize seed is high in Pakistan compared to its neighbors in South Asia and beyond.** Imported seeds are much more expensive than those produced locally. For example, hybrid maize and sunflower seed imported by multinational companies are sold at around 4-5 times the price of locally produced, open-pollinated varieties in the country. In 2016, the USAID funded Agricultural Innovation Program provided new maize seed varieties to research organizations and Pakistani seed companies at the National Agricultural Research Center with an aim to jump start hybrid maize seed production in Pakistan.<sup>41</sup>

## 7.5. Province-Wise Varieties Registered and Released

**776 registered and released varieties are available in Pakistan.** Province wise and crop wise registration and release details are in **Annex XII**, which shows that the highest number of varieties are available for cotton followed by wheat and pulses. The least number of varieties are for flower and barley. Highest number of seed varieties are registered in Punjab followed by KP and Sindh. A positive aspect that arises from this data is that although KP is underdeveloped and underpopulated as compared to Sindh, yet the R&D in seed sector is better in KP, while Balochistan and Islamabad lag in the registered varieties.

## 7.6. Public-Private Sector Market Share

**Private sector participation has not only increased the market size but has provided quality seed in the market.** As a result, private companies have begun to outshine public seed enterprises in the certified seed market during the last decade. More than 80 percent of the certified seed is being provided by the private sector. About 12 percent of the seed is provided by the public sector and remaining 6 percent market is covered by imports. Markets reliance on imported seeds is limited to maize, fodder crops and vegetable crops. The share of seed availability by sector is given in **Annex-XIII** and the market share of seed in Pakistan is depicted in **Annex-XIV**.

## 7.7. Seed Import

Pakistan imported 46.5 million metric tons of seed at a value of \$127 million in 2019.<sup>42</sup> As depicted in Figure 3, the seed import has been steadily increasing since 2016, particularly of vegetables and fruits (watermelon, melon, strawberries, tomato, capsicum, cucumber, and coriander). The indigenous seed is

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<sup>38</sup> IRCIM-443, IR-CIM-448, IR-NIBGE-2, and IR-FH -901

<sup>39</sup> Ahsan Abdullah, An analysis of Bt cotton cultivation in Punjab, Pakistan using the Agriculture Decision Support System (ADSS), Journal of Agribiotech Forum. 2010;13:6.

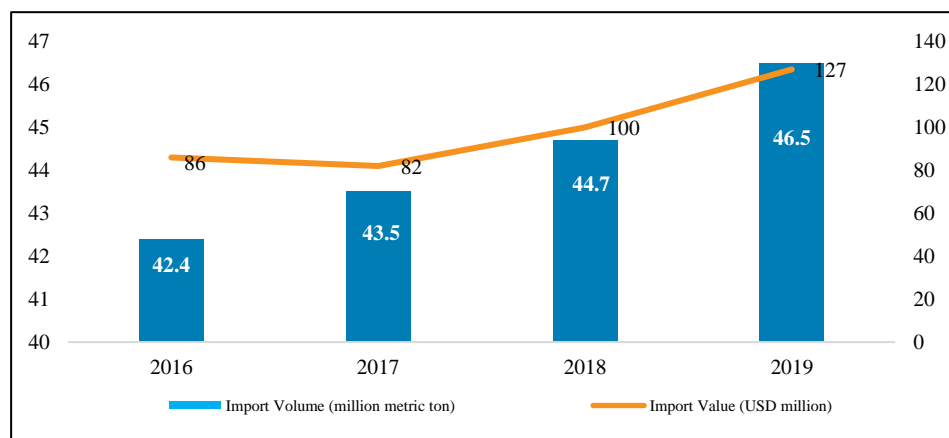
<sup>40</sup> Babar, U., Nawaz, M. A., Arshad, U., Azhar, M. T., Atif, R. M., and Golokhvast, K. S. 2019. Transgenic Crops for The Agricultural Improvement In Pakistan: A Perspective Of Environmental Stresses And The Current Status Of Genetically Modified Crops. GM Crops & Food. Biotechnology in Agriculture and Food Chain. <https://doi.org/10.1080/21645698.2019.1680078>

<sup>41</sup> USAID to make Pakistan self-sufficient in maize seed production. 2017, April 11. News and Information. USAID. Available at: <https://www.usaid.gov/pakistan/news-information/press-releases/usaid-make-pakistan-self-sufficient-maize-seed-production>

<sup>42</sup> <https://www.mordorintelligence.com/industry-reports/seed-sector-analysis-pakistan-industry> accessed on December 20, 2021

being replaced with imported seed as research and development on new varieties in the local research institutes have not been focusing on this area. Pakistan imported maize seed worth USD 55.7 million for sowing season of 2020, according to ITC Trade Map Database.<sup>43</sup>

**Figure 3. Seed Import in Pakistan**



Source: Mordor Intelligence

## 7.8. Seed Sale Share of Vegetables

**The data of seed market share remains highly scarce. As per available data, vegetable seeds dominate the sector sales in Pakistan.** Onion and tomato remain the most grown vegetables as they are feasible for tropical and sub-tropical climates. As per FAO estimates, about 208.6 thousand hectares, or 50 percent of the total vegetable acreage in Pakistan is used to grow tomatoes and onions. The crop wise share of vegetable seeds is shown in **AnnexXV** implying that onions account for 42 percent of the seed sales, followed by tomatoes at 16.4 percent, carrots and turnips at 8 percent, peas at 7 percent and okra at 4.4 percent. This shows that about 79 percent of the vegetable seed sales market is dominated by only five crops.

## 7.9. Organic Farming in Pakistan

**Pakistan has the potential to develop organic farming in highly fertile and productive virgin lands** within the command areas of Akhori, Basha-Diamer, Kalabagh, Kuram Tungi, and Munda dams. For details see **Annex-XVI**.

## 7.10. Public and Private Sector Companies

### 7.10.1. Public Sector Seed Companies

At the provincial level, only the Punjab Seed Corporation (PSC) is functional in developing varieties and selling seed whereas the other provinces have either not established or disbanded their seed corporations. Sindh Seed Corporation has not been able to produce a single variety yet while performance of Punjab Seed Corporation has been relatively satisfactory (Dawn, 2021). Seed developed by PSC for Punjab's agro-

<sup>43</sup> Imported seeds fast replacing local varieties in Pakistan. (2016, February 24). Available at: <https://www.arabnews.com/node/1381266/business-economy>

ecological zones and climate is sold in other provinces which is not recommended. Due to lack of government support, fiscal constraints, and stringent rules, public seed corporations remain ineffective in competing with the private sector. The primary purpose of establishing these corporations was to act as price trend setters to stimulate competition and reduce reliance of farmers on expensive and unregulated private sector seeds.

### 7.10.2. Private (Local & Multinational) Seed Companies

**Since the early 1980s, a total of 882 seed companies have been registered in Pakistan.** Out of which, 4 are public sector companies, 5 are multinational and the remaining are local/national private companies. During this period, 175 of the local private companies have been deregistered. As per 2018 statistics, 707 seed companies are registered in Pakistan and majority of these companies are located in Punjab (**Annex-XVII**).

**The local companies dominate the seed market with 60 percent share** (Mordor Intelligence, 2020). The local companies have the advantage of low prices as compared to multinational firms. Few of the major local seed companies include Four Brothers, Sky Vegetable, Haji Sons, Noble Seeds, Hico Seeds, Agrico Pak, and Shareef Sons Seeds World. The greater market share of these players can be attributed to their large geographical presence and highly diversified product portfolio. These players focus on R&D, large product portfolio, a wide geographical presence, and aggressive acquisition strategies.

## 8. Appraisal of Regulatory and Institutional Frameworks

**Seed regulatory frameworks aim to promote variety identity, seed quality, shield the farmers from planting sub-standard seed and regulate the seed market.** Seed laws generally regulate variety testing and release, seed certification and quality control, establish institutional framework of national seed councils and certification agencies and enforcement mechanisms. Variety and seed regulatory frameworks and seed control institutions exist in most countries to regulate formal seed sector. The laws and regulations, their interpretation and implementation by various committees, enforcement mechanisms, and associated costs tend to limit the availability of number of certified varieties in the market.

**Pakistan's seed system is identical to many countries.** It comprises a vast chain of research institutions/organizations, regulatory bodies, and seed producers and importers which interact in the market. The seed markets encompass the formal and informal seed system. The FSC&RD and National Biosafety Committee (NBC) established under the Pakistan Biosafety Rules 2005 have emerged as two key institutions for the governance of the seed sector in Pakistan. Both faced institutional uncertainty post-18<sup>th</sup> Constitutional Amendment, because of abolition of MINFAL and Ministry of Environment, discussed below. Finally, the NBC is now placed under the Ministry of Climate Change while FSC&RD, whose responsibilities were expected to be delegated to the provinces, has been assigned to the MNFS&R. An appraisal of Pakistan's regulatory and institutional frameworks is provided below.

### 8.1. Impact of Devolution

**One fundamental complication in the seed sector is that the Seed Act is enacted and administered by the federal government while the initiative for action now lies mostly with the provinces,** and especially with Punjab, being the major agricultural producer. While the '18<sup>th</sup> Amendment' to the



constitution further strengthened the role of the provinces in agriculture, devolution triggered (a) an inequitable sharing of skilled and research manpower both vertically: federal and provincial, and horizontally: inter-provincial; (b) incapacitation of FSC&RD as it was stripped off of required resources and manpower; (c) the formulation of agriculture policies at the sub-national level in Punjab (2018), Sindh (2018), and KP (2015); and (d) strong motivation for drafting of provincial seed laws in Punjab (2017), and Sindh (proposed in 2021)<sup>44</sup> in view of the long delays in seed approval as well as certification, and an urgent need for effective enforcement mechanism.

## 8.2. Seed Regulatory Regime Post 2015-16 Reforms

**The 2015 Amendment makes several changes that tighten the regulatory framework but on balance it supports the private companies.** Realizing the necessity to fill supply-demand gap in certified seed, acknowledging the role of private sector's participation in the market, and to quench the increasing discomfort of the provinces, several reforms have been introduced by the federal government in collaboration with the provinces. These include: The Seed (Amendment) Act, 2015, Seed (Business Regulation) Rules, 2016, The Plant Breeders' Rights Act, 2016, and the Plant Breeders' Rights Rules, 2018. The key features of these reforms' are at **Box 2**.

**Notwithstanding, the 2015 amendment in 1976 Seed Act has not significantly changed the incentives for private investment in the Pakistani seed market** since it does not address many of the issues related to the legal and institutional framework. More importantly, the 2015 amendment:

- (a) **expands regulatory control of the government** rather than expanding the entrepreneurial opportunities available in the seed sector. It has increased administrative burden. This underlying intent is under criticism as the sector is now under more restrictive regime;
- (b) **extends regulatory regime not only to all crops** but all seed businesses—companies, processing plants, dealers, breeders, etc.—now need to register with the regulator and get it renewed periodically;
- (c) **empowers the FSC&RD to inspect the seed production fields regularly for quality control** after commercial cultivation has been approved, and issuance of a tag for displaying on the seed bag if all the protocols are followed and standards are being met. Since seed production is dispersed throughout the country, it may be an inefficient method of quality control as it may require a very large cadre of inspectors to inspect the fields which seems impossible because of resource constraints;
- (d) **applies uniform regulatory regime to all crops despite varied dynamics of seed production across crops**, such as, (a) application of different set of commercial incentives to hybrids as compared to open pollinated varietal seed; and (b) seed saving is more convenient in some crops over other crops; and (c) it heavily relies on regulator's capacity to enforce the legal framework;
- (e) **causes incongruity between the responsibilities and institutional capacity of the regulator** which the regulator is expected to discharge through seed Inspectors' inspection, oversight, licensing, approvals, registration, certification, etc. With limited human resource and enormous task at hand, the regulator will be spreading too thin to do it effectively. Consequently, it is anticipated to open up avenues for increased rent-seeking and deter the private sector to comply with new stipulations;

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<sup>44</sup> Daily Dawn, dated September 30, 2021. Available at <https://www.dawn.com/news/1649173>

- (f) **lacks strong enforcement mechanism**, as the variety approval process is not protected by intellectual property rights, nor does it confer any market premium due to which seed companies and breeders market their varieties directly. Since the enforcement capacity of the governments, federal and provincial, is limited, the sale of unregistered seed under the company brand names continues unabated;
- (g) **lacks clarity on seed labelling mechanism**, the amended Act binds the seed industry not to sell misbranded seed, however, the mechanism for proper labelling is not defined in the Act. All the regulatory clauses related to ensuring seed quality in the original Seed Act have not been amended;
- (h) **leaves federal versus provincial roles unclear**, the Seed Amendment Act does not elaborate on the role of the provincial governments and seed councils. After the 18th Amendment, clarity is needed about the FSC&RD's role relative to the provincial authorities mandated to regulate seed markets within their administrative boundaries. The Seed Amendment assigns the discretionary powers to FSC&RD to keep any function related to the seed sector with it for which it does not have the required manpower. Unless proper regulations are prepared, the implementation of the Seed Amendment has led to unnecessary centralization with FSC&RD. These unclear provincial and federal roles in the Seed Act have led to duplication of efforts and delays in the variety approval process which occurs both at the federal and provincial level. At the national level, Variety Evaluation Committee is the body responsible for variety approval as per the Seed Amendment Act 2015, but it was notified only in 2019. Due to this lag, Provincial Expert Committee within the Department of Agriculture Punjab has been leading the variety approval process even though no such committee has been stipulated in the Seed Act.

### 8.3. Registration of Seed Companies and Growth of Private Sector

**This is a purely administrative process and for many years it was carried out without any criteria for determining the status of applicants.** Consequently, the total number of registered companies is closer to eight hundred but many of these are dormant or have never entered the trade at all. One may assume that many companies considered it 'commercially convenient' to register in case they decided to enter the seed business at some time. Among the total number, about 300 companies probably have some regular seed activity. Perhaps twenty companies have some serious technical capability, employing plant breeders, doing proper agronomic trials, or having a seed testing laboratory. The vast majority are importers and traders. Given the size of the global seed trade, and the high cost of breeding, this seems to be a legitimate business model, particularly in the vegetable seed trade, *albeit* general complaints of the farmers. Current status is as follows:

Total registered with the Ministry	786
Selling some seed on a regular basis	300 (approximately)
Members of Crop Life Pakistan	10 (approximately)
Members of Seed Association of Pakistan (SAP)	150 (as of December 2021) <sup>45</sup>
Having some technical capability	20 (approximately)

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<sup>45</sup> Available at <https://sap.com.pk/> accessed on December 17, 2021

## 8.4. Registration Procedure

The MNFS&R notified simplification of procedures and timelines in 2020 for different categories of registration (Annex-XVIII) titled as “Ease of Doing Business”.<sup>46</sup> Details for performing each procedural step including the steps are in Annex-XIX. Doing business indicators (DBI) are regarded as a largely theoretical exercise not reflecting the true business environment. In reality, procedures are quite cumbersome, and it takes too long to get a new variety registered which makes the plant breeders’ pre-basic and basic seeds vulnerable to piracy. Looking at these procedural steps, it is next to impossible to observe these timelines, particularly in view of the current capacity of the FSC&RD. Therefore, practical relevance of DBI for foreign direct investment (FDI) is considered limited as manifested in lack of correlation between improvement in indicators and level/growth of FDI in this area.

## 8.5. Regulation of Genetically Modified Organisms (GMO)

**Pakistan Biosafety Rules 2005 and National Biosafety Guidelines 2005** prohibit the import, export, sale, purchase, or trade of genetically modified organisms (GMOs) without a license from the federal government. The inter-ministerial National Biosafety Committee on the recommendations of a Technical Advisory Committee: which reviews biosafety data and analysis of GM products submitted for commercialization- approves the import, export, trial, and commercial release of GM cultivars. Limited technical capacity and understaffing result in long delays in processing of breeders’ applications for registration of varieties or biosafety approval for cultivar trials and commercialization.

## 8.6. Role of FSC&RD

**FSC&RD is the sole regulatory agency which undertakes several distinct functions, each of which may require different approaches and solutions, as mentioned below.** Details are in the Annex XX:

1. Testing and registration of new varieties through conducting (i) Distinctiveness, Uniformity and Stability, and (ii) Value for Cultivation and Use, tests.
2. Operation of seed certification scheme.
3. Establishing seed certification cost.

### 8.6.1. Challenges faced by FSC&RD:

**Lack of Capacity and Resources for Physical Activities:** The organizational capacity of FSC&RD is quite limited to carry out the gigantic task of seed registration and certification for all actors in the market. According to FSC&RD, limited manpower is the foremost challenge faced by the department. FSC&RD service delivery was restricted to the two public sector corporations i.e., the Punjab Seed Corporation and the Sindh Seed Corporation, and the agriculture departments of Balochistan and Khyber Pakhtunkhwa (KP) under the Seed Act of 1976.

- Post-2015, the federal agency with the same organogram, resources, and staffing capacity of only 100 officers has been mandated to provide services to the private sector with around 800 seed businesses. Secondly, FSC&RD spends most of its budget on staff salaries leaving little for the physical activities including market surveillance and enforcement, field visits, and other related

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<sup>46</sup> Available at <http://www.mnfsr.gov.pk/mnfsr/userfiles1/file/FSCRD%20-%20Ease%20of%20Doing%20Business-.pdf>

activities. This situation incentivizes the private sector to penetrate the market through informal channels and bypass bureaucratic and archaic registration and certification mechanisms of FSC&RD. Thirdly, in practice, certification is only carried out on those crops that have a completely domestic seed production system, namely cotton, wheat and rice. Almost all the seeds of hybrid maize, sunflower, forage crops and vegetables are imported and arrive with some quality declaration from the exporter. This dependence on imports, and lack of domestic breeding/production in several important crops is a negative feature of the seed sector.

## 8.7. Provincial Seed Laws

**Punjab has made efforts to enact its own provincial seed act but was advised against doing so.** Regardless of the aspirations of politicians at the provincial level to legislate their own seed law as indicated above, members of the seed industry are unanimous in their support for a Federal Act because they fear that creation of ‘internal borders’ between the provinces would make trade more difficult as it may require seed certification from four provinces and the federal government.

## 8.8. Increasing Reliance on Imported Seed

**Local companies have entered the market in large number but in this case, the focus has been on domestic varieties of open-pollinated (OP) crops such as cotton, wheat and rice from the public sector.** Hybrid rice and maize is being used to limited extent but again this is all imported. There is also a substantial import of vegetable seed from the global trade. The major multi-national corporations focus on maize (both grain and forage types), sorghum, sunflower and rice and they are virtually all high-value hybrids (see Box 4).

### BOX 4: Why So Little Domestic Seed Production in the Major Crops?

The major multi-national companies organize their production on a regional or global basis depending on factors such as cost, environment, harvest season and security of the inbred (parent) lines. They prefer locations where they can carry out large-scale production under good supervision to minimize both costs and risks. Countries such as Thailand, Egypt, Kenya, and South Africa may meet these criteria. Although these companies may have originally planned to do seed production in Pakistan, and in some cases made substantial investments for this purpose, they have largely withdrawn from this position. Anyone, or combination, of the above factors may contribute to this decision, but it may be concluded that they have ‘done the sums’ and come to the conclusion that importation is the better option, despite the additional costs of transport.

Security of inbreds is a ‘non-financial’ issue and it may be that the risk of theft was a factor, although that risk exists in all locations. The enactment of a plant variety protection (PVP) law may provide some confidence in this respect although it will take some time for the benefits to be reflected in new varieties and seed production.

## 8.9. Access to New Technology

The ‘Bt gene’<sup>47</sup> that provides protection against caterpillars has revolutionized cotton production in many countries by avoiding the need for repeated spraying with insecticides. Unlike food crops, cotton does not raise concerns about the impact of genetic modification on human health and GM varieties have been widely adopted globally. As explained in **Box 5** below, this technology belongs to Monsanto and they make strenuous efforts to protect it in all markets. This protection failed in Pakistan and the ‘Bollgard 1’ trait was quickly incorporated into many local varieties without reference to Monsanto. There have been negotiations, on and off, with the company to redress this situation retro-actively but without success so far. As result, Monsanto had been reluctant to release any further GM material in Pakistan until they have certainty that its use can be controlled through intellectual property rights regime, and due payments are made. There is a concern among the wider seed community that this could lead to a monopoly having control of this key crop. It should be noted that the next Bt trait from Monsanto (known as Bollgard 2) was reported to be failing to provide 100% protection against the pink-bollworm in India during the 2015 season. This emphasizes the point that even the strategic advances made by genetic modification can be eroded when strong selection pressures exist.

### BOX 5. The Cotton Chaos

This was a major feature of the seed sector between 2008–2012 approximately, although it still continues at a lower level. It arose because the Bt gene in cotton (trade-named as Bollgard by Monsanto) was introduced unofficially from overseas and was incorporated rapidly into local open-pollinated varieties. Cross-grafting of local cotton varieties with Bt material produced more varieties. Unapproved Bt cotton varieties were widely marketed through informal sector and covered 80 percent of the cotton cultivation in Sindh and 50 percent in Punjab by 2007 (Rana, 2014).Monsanto thus lost control of this patented trait in Pakistan and could obtain no revenue from it. These varieties offered significant benefits for growers and so were in great demand but none of them had been officially tested or released by FSC&RD. Consequently, large informal trade developed in unregistered varieties, the genetic status of which was unknown. Although many were probably resistant to pests, this uncontrolled market situation was open to abuse by companies who could make spurious claims for what they sell, and with considerable risks to farmers. Subsequently, FSC&RD did test and release some Bt cotton varieties, which eased the problem because (formal) certified seed became available. This does illustrate the point that in a fast-moving market, the regulatory system cannot keep up with demand.

A further, and regrettable, aspect of this is that cotton breeders in public institutes were widely reported to have released early material of promising lines unofficially to friends working in seed companies, presumably for financial gain. (This was sometimes referred to as the ‘Seed Mafia’) Such leakage of materials is a known phenomenon given the relatively low salaries of staff in public research institutes, but it can lead to serious confusion on the market if good varieties start to circulate under unofficial names. If the market is fast moving and competitive, it increases the incentive for malpractice of this kind, although it is difficult to gather firm evidence.

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<sup>47</sup> The first approval of genetically modified cotton was granted in 2010 for cotton containing genes from the soil bacterium *Bacillus thuringiensis* (Bt). The genes confer resistance to certain types of insects, namely bollworms and other insects in the lepidopteran order.

## 8.10. BT Corn Scenario in the Country

The Ministry of Environment (presently the Ministry of Climate Change) notified National Biosafety Rules 2005 vide S.R.O. (I) 336(I)/2005 dated April 21, 2005, to regulate the biotech crops,. Under these Rules, National Biosafety Guidelines were notified vide Notification No. F.2(7)95-Bio in May 2005. Subsequently a National Biosafety Centre was set up under Pakistan Environmental Protection Agency (Pak-EPA) and following two functional committees were formed to implement the said Rules & Guidelines:

- Technical Advisory Committee (TAC): Comprising of heads of agricultural, biotech research, health research institutes of country and DG EPAs of all provinces; Chaired by Director General Pak-EPA.
- National Biosafety Committee (NBC): Comprising of heads of ministries of food security, climate change, health, commerce etc. Chaired by Secretary Ministry of Climate Change

In line with the provisions of these regulations, companies selling corn seed in the country initiated Biosafety Field Trials of Biotech Corn with insect protection and herbicide tolerant technologies in different parts of Pakistan with the approval of National Biosafety Committee (NBC), Ministry of Climate Change. A brief chronology of activities is listed below:

- a) Biosafety field trials of biotech corn were started by these companies in 2009 as per the provisions of National Biosafety Guidelines 2005 and government enforced compliance of procedure of seeking approvals from NBC and companies only proceeded for seed import and planting field trials after the approvals were granted.
- b) A Field Trials Evaluation & Monitoring Committee was established by Technical Advisory Committee comprising of plant science and biotechnology scientists from government departments. This committee regularly visited these field trials for monitoring and data collection. The reports of this committee are available with all relevant authorities i.e NARC, EPA, FSC&RD etc.
- c) It is pertinent to mention here that TAC & NBC granted approval for planting of biotech corn biosafety field trials only when they had ensured that the companies had successfully met all the requirements laid out in the Biosafety Rules, Guidelines and seed import & trial permits.
- d) In 2011-12, companies submitted biotech corn commercialization applications containing field trial and risk assessment studies in lines with the provisions of National Biosafety Guidelines.
- e) Upon receipt of these applications, Technical Advisory Committee (TAC) formed two Sub-committees (one each for cotton and corn crop) for detailed technical review of commercialization applications and submitting their findings to TAC. These committees comprised of Heads of leading public Agricultural and Biotech Research Institutes. Sub-committee for biotech corn commercialization thoroughly reviewed all the field trial reports, safety studies, product profiling, molecular characterization, allergenicity studies, digestibility studies etc. to assess the risk and presented their findings before TAC.
- f) TAC and NBC in their meetings held in 2016 reviewed and discussed these findings and granted approval to commercialization of these companies' respective biotech corn events. Approval minutes of NBC meeting were signed jointly by the then Secretary of Ministries of Climate Change and Secretary of National Food Security & Research.

NBC, TAC and its Sub-committees followed the prescribed regulations to allow the commercialization as mentioned in National Biosafety Guidelines 2005 and a transparent, science based process was followed to make all decisions. It is the mandate of NBC under Chairmanship of Ministry of Climate Change to grant commercial approval of biotech events. Once approved Ministry of National Food Security is to register biotech hybrids as per the provisions of Seed Registration regulations.

### **Biotech Variety / Hybrid Registration**

After approval of technology by TAC & NBC, companies initiated registration process of corn hybrids containing approved technologies in line with the provisions of *Biotech Variety Registration Process* prescribed in the Seed (Amendment) Act 2015 and Seed (Business Regulation) Rules 2016 issued vide S.R.O. 907(I)/2016 dated September 28, 2016 under the authority of Ministry of National Food Security & Research. Following registration trials had been undertaken under supervision of federal and provincial agricultural departments:

- National Uniformity Yield Trials (NUYT); completed during 2017-18
- Spot Examination by officials of Federal & Provincial monitoring committees comprising of officials from NARC, FSCRDC, Punjab Agriculture Deptt; completed during 2017-18
- DUS trials conducted for 2years; completed during 2017-18

After completion of trials following federal and provincial committees review and grant approvals towards registration of biotech corn hybrids:

- Approval by VEC (Variety Evaluation Committee)
- Approval by Expert sub-committee of Punjab Seed Council
- Approval by Punjab Seed Council
- Approval by Federal Registration Committee

### **Current Issue**

VEC meeting was scheduled towards the end of January 2019 as per its prescribed schedule. However, it was postponed on the pretext of opposition from few local seed companies. Those opposing the introduction of technology in country are local seed companies most of which belong to non-compliant sector (selling unapproved, multiplying stolen germplasm etc.) who fear losing their business interests.

Companies introducing technologies have long history (20 plus years) of complying with regulations and creating a success story of corn in Pakistan with significant yield increase from corn variety due to hybrid conversions in country along with advanced field services and currently hold +90% market share of corn hybrid market in country. Companies are not asking for any relaxation in the rules & regulations of Ministry of National Food Security & Research except that Ministry honors its own regulations prescribed in the Seed (Amendment) Act; and Seed (Amendment) Rules mentioned above.

If VEC meeting does not consider biotech corn cases this will not only be non-compliance of national Seed regulations but will also have following impacts:

- Waste of time and investment by companies to meet regulations prescribed in the Seed Amendment Act and Seed Amendment Rules.

- Deprive farmers of latest technologies adopted globally to increase farmers' productivity (NUYT results demonstrate significant yield increase)
- Corn demand increase will lead to grain import hurting our local farmers:
  - Corn grain consumption in Pakistan
    - Poultry 65%
    - Dairy 15%
    - Industrial Use 10%
    - Others 10%
  - Over 65% of grain is consumed by the poultry feed industry. Poultry industry is growing at a rate which is more than the growth rate of corn grain.
    - Today corn demand and supply are equal and if not intervened the increased demand for corn grain would lead us to food insecurity issue.
    - In case we import corn grain to meet local demands that will not only impact our import bills but grain imported will be biotech.
    - So why deprive our local farmers with an opportunity of increased productivity through biotech corn.

## 8.11. Plant Breeder's Rights Act

**The Plant Breeder's Rights Act was enacted in 2016 to make Pakistan compliant to its international obligations under Article 27.3(b) of Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement**, which requires WTO members to protect plant varieties either through patents or through *Sui Generis System*, as underlined above. The Act aims at promoting "a viable seed industry and to ensure the availability of high-quality seed and development of new plant varieties while protecting rights of the breeders of such varieties". The Act is expected to strengthen private seed companies as it fends against the informal seed sector. Nevertheless, the provision of exclusive rights for plant breeders is expected to increase the price of seeds in the effectively regulated market which may create difficulties for the resource constraint small farmers to access affordable seeds. While the farmers are entitled to some exceptions under the Act to overcome this challenge, these exceptions are constrained by the requirements of the Seed (Amendment) Act, 2015.

The objectives of this Act are to: (i) elaborate the farmers' rights; (ii) incentivize plant breeders and seed associations to invest into research and plant reproduction to improve the prevalent assortment of field, vegetable and elaborate yields; (iii) protect against the falsification in the seed produced by plant breeders; (iv) establish Registry of the Plant Breeders' Rights; (v) constitute Plants' Variety Protection Advisory Committee; (vi) adjudicate benefit sharing claims; and (vii) ensure compulsory licensing.

### 8.11.1. Plant Breeders' Registry

This Act proposes to establish a Plant Breeders' Registry to be attached to the MNFS&R and housed in FSC&RD. The registry will perform several functions, such as: (a) registering new plant varieties developed by plant breeders; (b) facilitating protection of new plant varieties according to the defined conditions and issue certificate according to the Plants Breeders' Rights Act(c) ensuring the availability of seed of



registered varieties to farmers; and (d) documenting, and cataloguing plant varieties. It will help in the management of characterization and documentation of varieties. There is strong need to strengthen this Registry and make this fully functional at the earliest.

### 8.11.2. Plants Variety Protection Advisory Committee

The Committee is responsible to advise the concerned Ministry or the Registrar. It can take help from any other person who is an expert in a particular field when a question related to that field of technology is under consideration. With the permission of Ministry of National Food Security and Research, Committee has the right to make rules and regulations for regulating its business.

### 8.11.3. Benefit Sharing

The registrar is mandated to publish variety protection official document. “Any person or group of persons have right to submit their benefit sharing claim, if such person or every person constituting such group is a citizen of Pakistan; or firm or governmental or non-governmental organization, if such firm or organization is formed or established in or outside Pakistan”. The Registrar is empowered to decide the sum of benefit distribution to a variety under the Act.

### 8.11.4. Compulsory Licensing<sup>48</sup>

An imperative element of the Plant Breeders' Act is conceding mandatory licenses to guarantee accessibility of seed plant or regenerative material of the secured assortment at sensible cost under the accompanying conditions: (a) it is in the public interest; (ii) owner of license/certificate is anti-competitive; (c) three years have elapsed since the date of issue of an authentication of enrollment; (d) the seed or other spreading matter of the variety is not accessible to the general population at a competitive price. After giving a chance to the reproducer of such an assortment, the Authority may arrange the breeder to permit anybody to undertake creation, conveyance and offer of the seed or other engendering material of the varieties. The Authority will decide the period for which mandatory licenses are conceded in each situation.

**A critical analysis of the PBR Act reveals that it is not fully aligned with the requirements of the Union for the Protection of New Varieties of Plants Convention of 1991 which is delaying the membership of Pakistan.** The case of so-called Bt cotton varieties owned by Monsanto that provide protection against caterpillars is an infamous example of the failing regulatory environment in Pakistan. Unlike in other countries, in Pakistan the gene in the Monsanto variety was quickly incorporated into many local varieties without reference to Monsanto, the foreign investors resultantly remain reluctant to invest for development of genetically modified material in Pakistan until they are certain that its use can be controlled, and due payments are made.

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<sup>48</sup> The introduction of the idea of 'mandatory licenses' is connected to the commitment, presented by the United Kingdom (UK) Statute of Monopolies in 1623. Necessary permitting has been accounted for to be mainstream in Britain as ahead of schedule as 1850s. Later it was perceived by the worldwide group through Paris Convention for the Protection of Industrial Property of 1883.

## 8.12. Varietal Turnover

Plant breeders emphasize the significance of varietal turnover to protect yield or raising yields or improving grain or fodder quality. Optimal decision to replace wheat seed for varietal change is determined by (i) rate of gain in yield potential of new varieties; (ii) the rate of depreciation of retained seed; (iii) farmer learning; (iv) seed and capital costs; and (v) probability of loss of effective resistance, such as; the rate of mutation of disease organisms, and the structure of genetic resistance to disease in a variety.<sup>49</sup> Heisey (1990) concluded that varietal replacement has been slower than a “reasonable target” (once every five to six years, with optimal turnover of four years) and that more than 50 percent of the wheat area was planted to susceptible varieties. Current variety age of wheat (7.03 years), rice (6.25 years) and cotton (2.22 years) are considerably low in Pakistan.

## 9. Seed Regulatory Framework—Approaches and International Practices

**The fundamental principle underlying the regulatory systems to regulate access to seed, genetic resources, and protection of plant varieties** emanates from food sovereignty, food security, state sovereignty, biodiversity, and the World Trade Organization’s Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). A wide variety of regulatory regimes exist which can be broadly categorized as: (i) overregulated national seed system; (ii) national lax regulatory seed system recognizing breeders’ rights and allowing farmers’ exchange and sale of seed varieties; (iii) truth-in-labelling with government setting the standards, procedures and certification protocols; (iv) truth-in-labelling with independent and self-financed devolved regulatory system and the seed industry setting the standards and procedures; (v) regional regulatory system with regional seed/gene banks (Nordic Ministerial Declaration on Access to and Rights over Genetic Resources placing accession to Nordic Genebank under common Nordic management and control<sup>50</sup>, European Union seed system based on ‘11 vertical and 1 horizontal directives, SAARC Seed Bank through an Agreement); (vi) Seeds without Borders; and (vii) international charter for seed.

**There is a general recognition that seeds and varieties need some form of regulation due to their special nature and serious repercussions** for farmers if the seed or variety does not yield the expected results. Based on this recognition, certification of seed or varieties is meant to reassure the farmers. The challenge for regulatory agencies is the allocation of required resources and effective enforcement of regulatory framework.

**The seed sector has developed rapidly over the last two decades with the private sector playing the major role, particularly in vegetables and hybrid field crops.** The number of varieties and companies have increased substantially leading to a robust competition both in breeding and markets. Concurrently, the role of public sector has diminished in crops with strong commercial potential. It has posed a serious challenge to the regulators who wish to retain control of the market but have limited resources at their disposal for over expanded task. It is for these reasons that many countries are updating their regulatory frameworks including Pakistan.

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<sup>49</sup> David J. Spielman Melinda Smale, (201). “Policy Options to Accelerate Variety Change among Smallholder Farmers in South Asia and Africa South of the Sahara”, International Food Policy Research Institute,

<sup>50</sup> Available at <http://norden.diva-portal.org/smash/get/diva2:1537936/FULLTEXT01.pdf>

**The United Nations Convention on Biodiversity (CBD) 1992, International Plant Protection Convention 1997, Cartagena Protocol On Biosafety to the Convention on Biological Diversity 2000, International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) 2001, and Nagoya Protocol on the Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity 2011 are key in influencing national and international legislation to accommodate agro-biodiversity needs.** The United Nations Sustainable Development Goals (UN SDGs) also recognize the significance of genetic diversity to stall biodiversity loss (SDG 15) and achieve zero hunger (SDG 2). Intergovernmental Panel for Climate Change (IPCC) Report on Climate Change and Land also stressed the value of the use of local genetic diversity as a means to build resilience against extreme climate events.<sup>51</sup> The international practices in relation to seed regulatory mechanisms are discussed below.

### 9.1. International Approaches to Seed Regulation

**United States of America:** The U.S. regulatory system—centered on voluntary registration and certification in combination with truth-in-labelling—allows seed varieties to have relatively unrestricted market access. The Federal Seed Act (FSA) enacted in 1939 is the cornerstone of US seed regulatory framework. The United States Department of Agriculture (USDA) implements its provisions through Federal Seed Act Regulations. The FSA established the legal requirements for placing agricultural and vegetables seeds on the market for ‘interstate commerce’ (seeds traded between the states of the US or imported into the US, in line with the Commerce clause in the US Constitution (Section 8, Article 1). State laws govern the seed market within the borders of the States. The Association of American Seed Control Officials regularly updates its Recommended Uniform State Seed Law (RUSSEL) to guide States to model their own statutes and regulations and facilitate seed operation across the United States.<sup>52</sup>

All US Seed marketing laws are based on ‘truth-in-labelling’ that require seeds to be sold to must bear specific information (Section 201 (a) of the FSA). It establishes rules to prevent misrepresentation to ensure market transparency and provide legal basis for the public enforcement of those requirements. The only exception is for seed exchange between farmers. In addition to labelling requirement, the other conditions include: (i) testing the varietal purity and germination capacity of seeds for five months to determine the percentage of germination before placing it on the market (Section 201 (c) of the FSA); and (ii) to maintain records of origin, treatment, germination, and purity of each seed lot for three years from the date of marketing (Section 202). The rationale behind truth-in-labelling legislation is to provide consumers (farmers purchasing seeds) freedom to choose suitable varieties for their operation. This shifts the responsibility for quality control from the government to the consumer.

The system is based on honest representation but minimally regulated new varieties which must meet the quality standard for germination. The law requires operators to inform farmers if a seed variety does not meet the quality standard but can still be offered for sale. The underlying assumptions behind truth-in-labelling are that the market is fully informed to facilitate farmers to choose between varieties, operators/companies care for their reputation, and the market is self-regulated. Seed lot certification under

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<sup>51</sup> IPCC. Special Report: Climate Change and Land (p.468). Available online: <https://www.ipcc.ch/srccl/> (accessed on 13 September 2021).

<sup>52</sup> Lin Batten, et al., 2021. Decoding Seed Quality: A Comparative Analysis of Seed Marketing Law in the EU and the United States, Agronomy.

US law is voluntary. The only exception is that seeds from plant varieties granted protection by the US Intellectual Property Rights law, particularly by the Plant Variety Protection Act, cannot be marketed without certification by the official seed certifying agency (Section 501 of the FSA). The process of certification is regulated at both the federal and state level. Thus, voluntary certification of seed lot results in the application of the ‘distinct, uniformity and stability’ (DUS) and Value for Cultivation and Use (VCU) criteria identical to mandatory marketing requirements of European Union (EU). The United States also followed the lead of Europe and passed the Plant Variety Protection Act 1970.

**European Union:** Seed law in Europe has evolved over the last century influenced by the EU integration process. EU seed legislation is now spread over 11 ‘vertical directives’, each applicable to specific genera (seed families), and one ‘horizontal directive’ (the Common Catalogue) which applies across genera adopted between 1966 to 1992. Between 2008 and 2010, three derogations were issued with special interest in preservation and registration of conservation varieties threatened by genetic erosion. The goal of these directives is to ensure seed quality and increased agricultural productivity.<sup>53</sup> Seed lot certification is the central point of EU seed marketing law which aims to ensure varietal purity, germination capacity and freedom from disease, and regarded as ex-ante quality control mechanism, such as “Member States shall provide that beet seed may not be placed on the market unless it has been officially certified as ‘basic seed’ or ‘certified seed’”.<sup>54</sup> The directives also include rules on packaging, sealing, marking, labelling, and requirements of accreditation and registration of the supplier.

The main prerequisite for certification is acceptance of the plant variety in a National Catalogue and, for certain species also in the EU Common Catalogue. The goals of the Common Catalogue are to compile registration data for beet seed, fodder plant seed, cereal seed, potato seed, vegetable seed and seed of oil and fiber plants. It does not cover seed or propagating material for ornamental plants, forest plants, fruit plants, vegetable species, and vine which are registered either in national catalogue or in their respective registrars. EU harmonization requires that the variety must adhere to the criteria of ‘distinctiveness’, ‘uniformity’, and ‘stability’ (DUS-norms) to qualify for variety registration. Additional testing procedures are required for agricultural plant seeds to prove the variety brings ‘progress’ in quality and/or beneficial agronomic characteristics for the agricultural sector, which is assessed through ‘value for cultivation or use’ tests or VCU-testing. This includes beet, fodder, potato, oil, and fiber plants varieties, and on the marketing of vegetable seed.<sup>55</sup>

**In Europe, the commercial seed supply system is highly organized and controlled and protected with strong intellectual property rules.** There are rules enforced for the production of hybrids to ensure the quality of seed in the market. **United Kingdom (UK)** seed system is regulated by the Plant Variety and Seeds Act 1964<sup>56</sup>. UK’s varietal protection law provides a varietal indexing system, official trials for testing all varieties are submitted along with a list of acceptable varieties based on their performance. The participation in the official test is voluntary, nonetheless seed cannot be sold by varietal name unless it is

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<sup>53</sup> L.Batten et al., op.cit.

<sup>54</sup> Tine Winge, (2015). Seed Legislation in Europe and Crop Genetic Diversity, Sustainable Agriculture Review, 2015, 15, 1–64. <https://fni.brage.unit.no/fni-xmloi/bitstream/handle/11250/2485905/2015-TOW-SAR-Seed+Legislation+in+Europe+and+Crop+Genetic+Diversity.pdf?sequence=1>

<sup>55</sup> L.Batten et al., op.cit.

<sup>56</sup> Plant Varieties and Seeds Act 1964. Accessed from <https://www.legislation.gov.uk/ukpga/1964/14/contents> (accessed on April 22, 2021)

entered into the testing program. Similar legislation was passed in Netherlands, Denmark, Germany, and New Zealand. In all, 65 countries have signed the UPOV Convention and adopted plant breeders' rights legislation consistent with the requirements of the convention.

**France:** France has one of the most restrictive seed laws which are also used as a model by other countries. Seed varieties of most cereals, herbage crops, peas, horse beans, white clover and the important grasses can only be sold after the variety's name appears on the official list and are certified. Field trials for approval of varieties are conducted by an official government agency, usually for five years. France took initiative for the protection of new plant varieties and conducted convention for adoption of Union Internationale pour la Protection des Obtentions Végétales (UPOV) in 1961<sup>57</sup>.

United States and the European Union seed system serve multi-partite needs effectively through different regulatory mechanisms, overview of which is presented below in **Box 6**.

<b>BOX 6. Comparison Seed Regulatory Models: United States vs European Union</b>		
	<b>United States</b>	<b>European Union</b>
Registration of seed companies	Not required, although individual states may have requirements	Required but based on minimum criteria
Variety registration	Voluntary	Mandatory: 2 years of VCU and DUS tests for field crops; 1 year of DUS for vegetables
Seed Certification	Voluntary, although the owner of the variety can make certification required	Mandatory for seed crops; voluntary for vegetable seed
Developing economies adopting this model:	South Africa, India, Bangladesh, Pakistan, Philippines, Guatemala, Nepal	Turkey, Ukraine, much of Sub-Saharan Africa

*Source: USAID-AGP-AMDe Project, 2013*

**Canada:** The seed system is regulated by the Canadian Seed Control Act of 1905, amended three times through (a) Budget Implementation Act of 2012; (b) Agricultural Growth Act, 2015; and (c) Safe Food for Canadians Act. The law is based on truth-in-labelling system for trade but it is considerably more protective than the US FSA. The law provides a system under which only varieties that have been tested and found agronomically and economically desirable for Canadian agriculture are allowed to be sold, advertised and imported. The licensing of varieties is administered by the Plant Products Division of Agriculture and covers all agricultural and vegetable crop seeds. Seeds of root and vegetable crops, other than seed potatoes, are exempt. The Canadian seed legislation sets minimum standards for pure seed and grading system for all seeds. The Seed Branch of the Canadian Department of Agriculture provides the seed inspection framework for law enforcement. Canada also approved the Plant Breeders' Rights Act in 1990 to provide legal protection to plant breeders for new plant varieties.

Seed Regulations have introduced a three-tiered flexible variety registration system and varieties listed in Schedule III of these regulations require mandatory registration. Part I of these regulations deals with seed standards, sampling, testing, grading, packaging, and labelling as well as use of variety names, advertising,

<sup>57</sup> UPOV (2021). Accessed from <https://www.upov.int/portal/index.html.en#:~:text=The%20Convention%20was%20adopted%20in,for%20the%20benefit%20of%20society>. (accessed on April 22, 2021)

seed crop inspection, and seed import. Part II sets out the requirements for certification of seed potatoes, including standards, testing, and labelling requirements. The CFIA is wholly responsible for seed potato certification including field production standards/inspection as well as tuber standards/inspection, although some tuber inspections are conducted by authorized producers under official supervision. Part III deals with application for Variety Registration, eligibility requirements of varieties and the requirements for the Minister to approve recommending committees. Part IV enlists three types of registered seed establishments that Prepare Seed: i) approved conditioners that prepare (clean, process, pack, treat, etc.) seed of pedigreed status; ii) bulk storage facilities that store seed graded with a Canada pedigreed grade name in bulk (i.e., not in sealed containers) and iii) authorized importers that are able to import seed on minimum documentation and ensure that an import conformity assessment has been completed before further distribution or planting and Licensing of Operators. Part V deals with seeds with novel traits and the requirements for notification, information, decision of the Minister, confined releases and unconfined releases.<sup>58</sup> The Canadian Food Inspection Agency (CFIA) is responsible for the administration and enforcement of the Seeds Act and the Seeds Regulations. The Seeds Act sets out the broad parameters of Canada's seed regulatory framework while the Seeds Regulations describe in detail the requirements for compliance.

**Asia-Pacific Region:** Most countries in the region have regulatory arrangements which cover the main components of the seed sector. The core purpose of the seed legislation is to establish and maintain quality standards for seed offered for sale and consumer protection. However, the countries follow different frameworks to regulate seed industry based on their experiences in regulatory evolution. Some countries allow the “truthful labelling” under which the seller declare seed quality attributes on the container shifting risk element from government to producers and consumers.

#### **BOX 7. Australia Seed Regulatory Framework**

The responsibility for agriculture rests with the six states. The seed system is based on ‘truth-in-labelling’ under which seller declares seed quality attributes on the container.. Australian Seed Authority (ASA)<sup>1</sup> was established in 2003 as an independent self-funding entity, owned and run by the industry on behalf of members under a license renewed every five years by the Government. However, testing of varieties and seeds and seed certification are provided by three agencies under contracts with ASA. ASA has developed a range of standards and procedures to support the seed industry, including seed certification and quality standards, criteria for variety registration, a national variety list, various technical manuals, and National Code of Practice for Seed Labelling and Marketing.

The core charter of Seed Services Australia (SSA), an extension Division of Primary Industries and Regions South Australia (PIRSA), is to provide internationally accredited seed certification schemes and seed testing services to the Australian seed industry to facilitate the trade of quality sowing seed on domestic and international markets. SSA conducts: (i) OECD Certification based on the Rules and Directives of the OECD Seed Schemes and International Seed Testing Association (ISTA); (ii) Australian Seed Certification Scheme based on the principles of the OECD Seed Schemes for varieties not listed with the OECD or seed sold on domestic markets only; (iii) Association of Official Seed Certifying Agencies (AOSCA) Certification based on the rules of the North American Association of Official Seed Certifying Agencies. It comprised of equal members from Australian Seed Federation representing commercial seed and Grain Producers Australia, seed grower body.

<sup>58</sup> Canada Seed Regulations

**Australia and New Zealand:** Australia has a framework of standards and procedures, managed by the self-administered and funded Australian Seed Authority set up in 2003, to regulate the seed industry by agreement. The government has completely withdrawn from direct engagement and financial support devolving the system to industrial players because of financial constraints and policy changes (**Box 7**). Several documents and protocols developed by the Australian Seed Federation (ASF) assisted seed industry development.<sup>59</sup> The consumers are provided with consistent and accurate information about the suitability of seed for sowing. Australia's PBR is aligned with international protection of new plant varieties<sup>60</sup>. **New Zealand** has a similar arrangement with a different institutional structure.<sup>61</sup>

**China:** China has moved from a complete state-owned seed system and companies to devolution of authority (**Box 8**).

#### BOX 8 China Seed Industry

The first Seed Law of 2000 reflected the transition towards competitive market-based system allowing rapid development of the domestic seed industry and entrance of foreign companies. Revised law of 2015 include major changes: (a) reduction in number of crops needed to be registered from 28 to 5 (wheat, rice, maize, soybean and cotton); (b) devolution of responsibilities to stakeholders with severe penalties for misconduct; (c) simplified procedures for inter-regions movement of varieties; (d) greater focus on labelling and post-control; (e) seed certification; and (f) policy guidelines intended to support seed industry development. The law has reduced the intensity of control and devolved responsibilities.

The Seed Management Bureau is responsible for seeds at the national level while enforcement is done through Seed Management Stations. Companies can be registered at the national, provincial or region and/or county level, depending on the scale and complexity of their operations. The key lesson is that the government saw the need to revise the original law after just 15 years in order to reflect changing circumstances in the industry.

**India:** Under the existing Seed Act of 1966, seed certification is optional which encouraged the private sector, domestic and foreign, to set up companies. The draft legislation (Seed Bill of 2004) proposed self-certification or truthfully labelled seed (TLS) which prompted protests by farmer groups as they perceived self-certification by the company as a conflict of interest. Thus, it is on hold ever since. Apparently, it does not seem to be a major impediment to continuing growth of the seed industry in India.<sup>62</sup>

The Seed Development Policy (1988 - 1989) has transformed seed industry by giving access to Indian farmers to the best of seed and planting material available anywhere in the world (Gadwal, 2003). The policy has also encouraged investments by individuals, corporates, and multinational companies with strong R&D base for product development. As a result, the seed industry is set to work with a 'farmer centric' approach which is market driven. In addition, the seed system is also reinforced with India's Protection of

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<sup>59</sup> Australian Seed Federation (2021). Accessed from <https://www.asf.asn.au/>

<sup>60</sup> IP Australia (2021). *Plant Breeder's Right Basics*. Accessed from <https://www.ipaustralia.gov.au/plant-breeders-rights/understanding-pbr/pbr-basics>

<sup>61</sup> FAO. 2020. *Status of seed legislation and policies in the Asia-Pacific region*. Bangkok. <https://doi.org/10.4060/CA7599EN>

<sup>62</sup> FAO, op.cit.

Plant Varieties and Farmers' Rights Act of 2001<sup>63</sup> which is the most far-reaching legislation regarding establishing rights for farmers to save, use, exchange and sell farm-saved seed.

**Sri Lanka and Nepal:** Sri Lanka has yet to draft regulations under the 2003 Act regulating the quality of seed and planting material and all matters connected thereto. The law mandates that all seed dealers are registered and seed certified, though farmer-to-farmer sale or exchange is exempt. The apex body is the National Seed Board empowered to approve, release and register the seeds of new variety and to determine quality standards. **Nepal** is a classic example of overregulated seed system in which the public sector manages the research and develop new varieties giving monopoly to the public sector over variety development, testing and release but lacks capacity while the role of the private sector is to multiply the seed and sell it to the farmers. Resultantly, much of the seed available to farmers is of unregistered variety and low quality *albeit* existence of the Seed Quality Control Centre. National Agriculture Research Council is solely authorized to develop and release crop varieties, produce breeder seed, and conduct variety verification trials to register a new variety.

**Bangladesh:** The Seed Act of 1997 and Seed Regulation requires that the seed dealer be registered, and the seed is certified prior to sale for five notified varieties. However, the objective of 1998 National Seed Policy is to develop the seed industry in the private sector. The policy ensures private seed sector and NGO participation in the seed policy making. This has reoriented the Bangladesh Agricultural Development Corporation (BADC) to commercial activities. The services rendered by BADC Seed Processing Centres to private entrepreneurs, growers and agencies include seed drying, cleaning, grading, storing, germination, moisture and purity testing. BADC and the Bangladesh Rural Advancement Committee (BRAC) are actively engaged in hybrid rice seed production.

**Turkey:** The national seed industry now operates within the framework of Seed Law No. 5553 of 2006 supported by 14 sets of regulations<sup>64</sup>. The law established Turkey Seed Union, a public organization to design and regulate seed sector. It consists of seven sub-unions: Plant Breeders (BISAB), Sapling Manufacturers (FUAB), Seedling Growing (FIDEBIRLIK), Ornamental Plants Producers (SUSBIR), Seed Distributors (TODAB), Seed Industrialists and Producers (TSUAB) and Seed Growers (TYAB).<sup>65</sup> The foundation has promoted private sector and local seed producer companies reached a total of 858 in July 2018 while many international companies emerged. Today, Turkey exports seeds to 80 countries.

**Public research institutes, universities, private companies, or private plant breeders can register their developed varieties both in Turkey and abroad.** After registration and releasing in the National Variety List, they can produce and market their cultivars officially in Turkey. The Variety Registration and Seed Certification Center (VRSCC or TTSM) <sup>66</sup> is responsible both for plant variety registration and seed certification. After becoming a member of UPOV in 2007<sup>67</sup>, TTSM has been conducting DUS tests

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<sup>63</sup> The Protection of Plant Varieties and Farmers' Rights Act, 2001. Accessed from <https://indiankanoon.org/doc/1186622/> (accessed on April 22, 2021)

<sup>64</sup> It substitutes Seed Law No. 308 (21 August 1963) and Seed Law No. 3976 (21 February 1994) and the Crop Protection and Plant Quarantine Law No. 6968 of 1964

<sup>65</sup> Yalcin Kaya, Necmi Beser, (2018). Turkish Seed Sector: Current situation and future directions. *Field Crops Studies*, XI(2), 81-96.

<sup>66</sup> Republic of Turkey Ministry of Agriculture and Forestry Variety Registration and Seed Certification Center. (2021). Accessed from: <https://www.tarimorman.gov.tr/BUGEM/TTSM/Menus/71/Background>

<sup>67</sup> UPOV. (2007). *Plant Variety Protection Gazette and Newsletter*. Accessed from [https://www.upov.int/edocs/pubdocs/en/upov\\_pub\\_101.pdf](https://www.upov.int/edocs/pubdocs/en/upov_pub_101.pdf)



according to the UPOV rules in Turkey. Registration process is performed in two separate stages with simultaneously conducted Value for Cultivation and Use (VCU) and Distinctness, Uniformity and Stability (DUS) tests by TTSM. Vegetable, fruit, grapevine, and strawberry species are registered with DUS tests only. The varieties are registered for a certain period which is 10 years for field crops and vegetables. There is no time limit for fruits, grapevines, and strawberry varieties. The registered varieties are listed in the National Variety List.

**Furthermore, findings of USAID Agribusiness Regulation and Institutions Index (AGRI) underscore that countries with an inefficient variety registration process have lesser private investment in developing new seed varieties, while those with a faster mechanism in place had experienced yield increases.**<sup>68</sup> For example, Bangladesh has a variety registration process that is 30 percent faster and 68 percent less expensive than in Nepal, which has resulted in seed companies introducing a triple number of new varieties each year accompanied by increases in yields. Bangladesh prompted private sector investment through simplified business regulation requirements, automatic and free variety registration and truth in labelling rules instead of seed certification. The number of seed companies considerably increased in Turkey as well, where the government started accepting VCU test results submitted by the seed company and eliminated subjective rejection of submitted varieties post-testing (see **Table 5**).

Table 5. Impact on yields and income when government allow more varieties			
Country	Yields (tons/hectare)		Estimated impact on farm income (\$/year)
	Pre-reform	Post-reform	
Bangladesh	1 t/ha (1990)	>6 t/ha (2007-10)	\$125 million (2010)
Turkey	2.18 t/ha (1980-82)	4.13 t/ha (1990-92)	\$97 million (1990-92)

Source: USAID-AGP-AMDe Project (2013)

**Annex-XXI** presents the country wise comparison for Pakistan, India, Bangladesh, China, UK, France, Australia, Turkey, and USA.

**The key characteristics of the seed sector regulatory framework in various developing countries are:** (i) designing variety release procedures to meet the needs of public research institutes; (ii) procedures for variety testing and approval constitute a significant barrier to seed trade and inhibit the spread of new varieties beyond national boundaries which leads to delays in release and rejection of useful varieties that do not meet the criteria and procedures; (iii) a variety released in one country faced long battles to gain release in a second country. Insufficient variety testing and registration infrastructure is the case in most of the developing countries; and (iv) most of the varieties are released by public research institutes and hybrid varieties are imported, in the context where plant variety protection right is not widely applied in the developing countries.

## 9.2. Regional Approach

**Harmonized regulatory framework on regional basis which facilitates the movement of seed within defined geographical regions has been on the agenda for quite some time. European Union** manifests a positive experience, as legislation is harmonized across different governments. However, experience in **Africa** has not been encouraging despite similar agro-ecologies. Similarly, a strategy for coordinated development of the seed sector among countries of the **Economic Cooperation Organization (ECO)** was

<sup>68</sup> State of the Evidence: Seed Policy Reform. USAID.

approved in Antalya, Turkey in November 2015 and a Regional Seed Agreement was proposed. Harmonization of rules and regulations could facilitate partnerships to bring private sector and public/regulatory authorities on a same platform in order to build trust and foster collaboration on key issues. It could bring long-term benefits to individual farmers, rural communities, and national economies. The ECO member countries have established ECO Regional Seed Association (ECOSA). However, the proposed draft seed agreement has yet to be approved and ratified.<sup>69</sup>

**The situation in South Asia is more complex because of the diverse political and legal traditions as well as regional animosities.** The two main targets of harmonization are to set minimum standards of quality for seed lots and acceptance of common list of varieties to encourage a regional certification scheme with agreed standards and procedures for a range of crops and uniform labelling. The ISTA Orange International Certificate and the OECD seed certification schemes are both designed to assist international trade and they depend absolutely on maintaining confidence in the procedures used by all participating countries. The South Asian Association for Regional Cooperation (SAARC) Agriculture Centre has been quite active in seed issues to be addressed such as (a) reducing the period of testing for a variety that is already registered and/or in common use in another country with similar environments; (b) allowing information from other countries with similar agro-ecology to be submitted to the registration authority as evidence of commercial use and agronomic performance; (c) requiring the importer of a new variety to grow one or more trials to demonstrate performance and for these trials to be available for official inspection; and (d) providing a system of online registration of varieties (with some key information) that can be used by the importer on payment of a small fee.

**SAARC countries signed the SAARC Seed Bank (SSB) Agreement and the Framework for Material Transfer Agreement in November 2011.** The objectives of the Seed banks are to: (i) provide regional support to national seed security efforts; address regional seed shortages through collective actions; and foster inter-country partnerships; (ii) increase seed replacement rate with appropriate varieties at a faster rate as far as possible so that the use of quality seed for crop production can be ensured; and (iii) act as a regional seed security reserve for Member States of SAARC. The objective of Framework for Material Transfer Agreement is to facilitate supply/exchange of seeds of common varieties among the member states so that they can achieve food security in the region. The framework mentions that it will be implemented in accordance with the existing laws, regulations, and guidelines of SAARC member states and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The key points to note are (a) that the operationalization of the Seed Bank and the Framework will be at the formal level while informal seed system plays a major role in advancing farmers' rights to seeds and traditional knowledge. Most of the seed demand of farmers in the region is still being met through local exchanges and use of farm-saved seeds;<sup>70</sup> and SSB recognizes TRIPs but does not mention CBD and United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) which are key instruments on biodiversity and protecting the rights of indigenous and local farmers on genetic resources. The agreements have yet to kick off.

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<sup>69</sup> Turner, M. and Muminjanov, H. 2020. A strategy for coordinated development of the seed sector in countries of the Economic Cooperation Organization region. Rome, FAO.

<sup>70</sup> Development Fund. 2011. "Banking for the future: Savings, security and seeds". A short study of Community Seed Banks in Bangladesh, Costa Rica, Ethiopia, Honduras, India, Nepal, Thailand, Zambia and Zimbabwe. Oslo: Norway.

### 9.3. Seeds Without Borders

**The International Rice Research Institute (IRRI)’s led Seeds Without Borders initiative was pioneered by Bangladesh and India.** The protocol that was signed on February 17, 2013 at Dhaka between these two countries identified the areas of cooperation, *viz.* (i) joint varietal evaluation and release; (ii) reciprocal recognition of evaluation data for varietal release; (iii) reducing time for the evaluation of varieties released in neighbouring countries for similar agro-ecologies; (iv) reducing time for evaluation for MAS generated varieties; (v) pre-release seed multiplication & promotion; (vi) encouraging private sector by providing level playing field; and (vii) harmonization of seed system allowing varieties registered in one country to move more easily to another country and, thus, to become available to farmers much more quickly. It was followed by Kathmandu Protocol signed on October 18, 2014, joined by Nepal, wherein three countries agreed to share the evaluation data and varieties released in their respective countries for release and commercialization in other two countries for similar agro-ecologies. Siem Reap Agreement<sup>71</sup> signed in June 2017 extended the cooperation beyond rice to include other cereals, pulses, oil seeds, vegetables, sugarcane and fibre crops and recognized seed certification system of signatory countries. However, agreement will not cover GMOs.

**Sequel to above protocols, India has notified six rice varieties from Bangladesh, three from, one potato variety from Bhutan** (Janaiah et al., 2021) and is in the process of releasing three potato and two sweet potato varieties from Bangladesh; Nepal has released 2 Indian rice varieties and is expected to release two potato varieties from India; and Bangladesh is considering releasing a number of rice, lentil and potato varieties from India. It will save the countries 5 to 10 years’ time of variety development, testing and certification. It may also reduce ‘illegal’ trade of unregistered varieties. The Seed Policies of Bangladesh and Nepal have incorporated several provisions of these protocols and agreement.

**It is a healthy start but complete harmonization across diverse national laws and regulation of the signatory countries may not be possible in the short-term.** However, convergence of standards and procedures may be beneficial for trade. Therefore, it is imperative to frame the regulations that encourages stakeholders in the market to move towards compliance rather than engaging illegal trade. Given the geopolitics of the region, it is equally important to build trust amongst all countries. The initiative will need a comprehensive evaluation to delineate lessons learnt for other countries in the region.

### 9.4. Truth-in-Labeling

**Some of the countries have adopted ‘voluntary system of seed certification and quality control’ combined with a ‘trueness-to-labelling’ requirement instead of compulsory variety testing, release and certification (Gisselquist & van der Meer, 2001).** Voluntary system operates in the United States , Canada and Australia where farmers rely on branded seed and information and trustworthiness of the seed companies. It assumes that companies care for their reputation and are responsible for quality assurance system. This approach requires that all seed is sold under a brand name. Notwithstanding, these countries have stringent laws and strong enforcement mechanisms to ensure standards, quality, and prescribed procedures as discussed above. However, opponents to extending this system to developing countries points out to: (a) lack of knowledge among farmers; (b) lower literacy rate impairing their ability to read the information on the label; (c) market failures arising from lack of competition in seed markets resulting in lack of incentive to provide quality seed; (d) proliferation of fly-by-night seed suppliers; and (e) weak

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<sup>71</sup> Signed by Bangladesh, Cambodia, India, Nepal, Sri Lanka, Myanmar, Bhutan and IRRI

enforcement of regulatory mechanism. Yet another alternate is the ‘commercial seed’ meant to include non-certified seeds in the compulsory system which requires testing with less burden of certification. This system is practiced in countries where farmers’ seed system is excluded from the requirements of the seed law, like Argentina.

## 9.5. Quality Declared Seed System

**FAO Quality Declared Seed (QDS) System<sup>72</sup> relies on simplified and community managed processes.** It requires the seed producers to become accredited to conduct own seed quality control, and thereby replacing centralized seed quality control by the public sector organizations. It envisages a simplified procedure for variety release after evaluation of variety is done by farmers. This helps in fast tracking release or registration of new varieties. The system is based on the following principal points: 1) a list of varieties eligible to be produced as QDS is established, 2) seed producers are required to register with an appropriate national authority, and 3) the national authority will check at least 10 percent of the seed crops. The QDS regulations adopted in Ethiopia in 2013 have been reported to have the promise of considerably reducing the burden on government inspection as it requires only 10 percent of QDS seed to be inspected before sale.<sup>73</sup> The system is expected to provide quality control during seed production, which is less demanding on government resources than other more developed seed quality seed systems but is adequate to provide good quality seed both within countries and in international trade.

QDS is an attempt to reconcile the continuing need to improve seed supply to farmers and accommodating diversity of farming practices in areas where formal system is not functioning well. It is relatively an open scheme without compromising basic standards of seed quality.. However, relaxed variety registration and release has the risk of having endless series of nearly similar varieties, as happened in the case of Bt cotton hybrids, which may confuse farmers and may be an impediment in judging crop performance. As a strategy, it may require the farmers to maintain portfolios of traditional, crossed, and improved varieties to improve production and to manage different agroecological conditions and changing climate patterns. Secondly, it may be seen as a breach of intellectual property rights’ regimes.

## 9.6. Community Based Seed Production

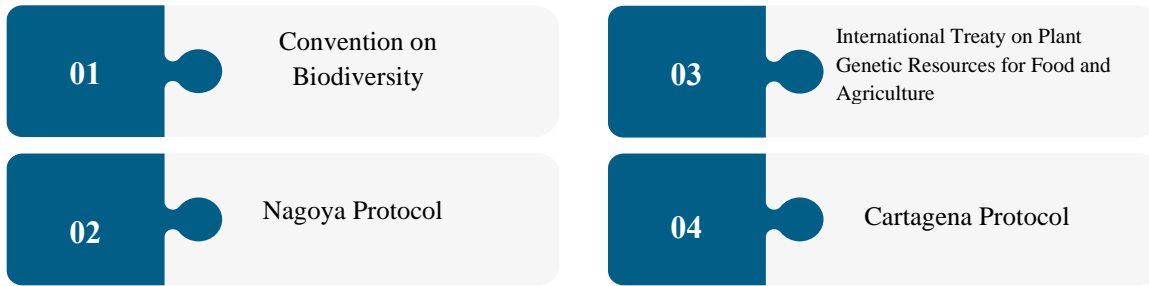
CIMMYT has proposed community-based seed production (CBSP) approach focused on food and nutrition security by multiplying and disseminating high yielding, stress tolerant, Zn and Fe enriched wheat varieties under new ‘conservation agriculture’ based crop management practices. It is based on three principles: 1) Minimum soil disturbance, 2) Residue management, and 3) Sustainable crop rotation (Tiwari et al., 2021). This approach assumes that locally produced seed adapts easily to local environment; therefore, seed should be produced in a similar environment where it is to be grown. It justifies the significance of village or CBSP. It will also help in dissemination of new and biofortified wheat varieties and Zero Till (ZT) technology that will aid in decreasing malnutrition and hunger and at the same time addressing the climate change stress..

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<sup>72</sup> FAO Quality Declared Seed <https://www.fao.org/3/a0503e/a0503e.pdf>

<sup>73</sup> World Bank, EBA Progress Report, 2014.

## 10. International Treaties and Protocols



Details of each treaty is given in **Annex-XXII**.

## 11. Challenges Facing the Seed Sector in Pakistan

To summarize, the seed sector in Pakistan faces a plethora of challenges including:

### Policy Domain

1. **Restrictive Regulatory Framework:** The restrictive regulatory frameworks suggest that they: (i) put severe restrictions on farmers' initiatives for seed production and development of small seed enterprises; (ii) do not support breeding for smallholders in ecologically diverse conditions nor the integration systems for crop improvement; (iii) lead to poor adaptation of the release procedures to farmers' seed system as the participation and representation of farmers in official bodies which are responsible for seed laws is generally low; (iv) discourage foreign and large scale commercial investments because of several years of variety testing requirement before they can market their seed;<sup>74</sup> and (v) excessive delays in variety release due to inefficiency of variety and seed control institutions (Tripp & Louwaars, 1997).
2. **No incentive for breeders:** A scheme of 'Seed Auction and Incentivization to Researchers' was notified by the Punjab Agriculture Department in 2018 and published in Gazette as well.<sup>75</sup> The scheme comprises 04 interventions viz. (i) auction of marketable research products; (ii) incentives to the scientists; (iii) creation of a revolving fund; and (iv) constitution of a research output retention Committee. Later, SOPs of the scheme were also notified by the Agriculture Department. However, due to bureaucratic hurdles, neither the auction has been approved nor a revolving fund could be created. As such, implementation of a scheme approved by the cabinet has been held up and scientists have been deprived of their legitimate incentives so far.
3. **It is important to study the factors that have resulted in the packing up of so many companies and finding out why most of the companies are struggling to survive.** A major factor could be that majority of the seed companies are engaged in marketing of seeds produced by other leading companies.

<sup>74</sup> Niels Louwaars, (2007). Seeds of Confusion: The impact of policies on seed systems, PhD dissertation, Wageningen, The Netherlands – with references – with summaries in English and Dutch, <https://edepot.wur.nl/121915>

<sup>75</sup> <https://www.dawn.com/news/1463693>, February 14, 2019

## Testing and Variety Registration

4. **Lengthy and taxing approval process.** The seed approval process is quite lengthy and taxing, which encourages the private sector to bypass the process and sell uncertified seed through their outlets and use a vast array of seed dealers. Most seed developers find it wasteful to go through the certification and waiting period of the FSC&RD, and prefer to market and distribute seed without legal certification (Rana, 2014). Lax enforcement regime allows them to operate in the informal rather than the formal sector. The seeds are sold in ‘brown bags’ without any information about their source and quality. This practice also implicates farmers, input dealers, and other value-chain actors in such shady transactions, often without legal sanction.
5. **Weak System of Varietal approval, VCU/Spot Examination.** The varietal, VCU and Experts Committees for assessment of candidate varieties through spot examination of field trials and laboratory testing needs have become redundant apart from complaints of conflict of interest. Secondly, post-amendment in 2015, some institutes and new players in the private sector have entered varietal development. Therefore, various committees of the provincial seed councils need to be reconstituted.

## Regulatory Enforcement

6. **While the role of private sector seed companies is increasing,** it is generally stained with complaints of low-quality control, varietal admixtures (more common in case of rice and wheat seed), under-weighting, and overcharging (generally common for maize seed).
7. **Presence of large informal sector.** A major concern in developing countries like Pakistan is the presence of large informal market. In Pakistan, the informal seed market consists of indigenous genetic assets and resources of the low-income and marginalized farmers. Traditionally, farmers have been saving, exchanging, and selling seeds within their circles. The farmers even perform non-cash transactions through seed-swaps, in-kind seed loans and even paying seed in exchange for labor is rampant.
8. **Low penalties for non-certified seed sellers / no dedicated courts:** Penalties given in the Seed Act, 1976 amended 2015 are as under:-(i) for the first offence, imprisonment for a term which may extend to three months or fine not exceeding two hundred thousand rupees; and (ii) for every subsequent offence, imprisonment for a term which may extend up to six months or fine not exceeding six hundred thousand rupees or both. The penalties are optional. Mostly, the cases end up with fines which are too meagre compared to business volumes of even smaller companies. Moreover, there are no dedicated courts due to which the offences are not seriously dealt with.
9. **Poor seed quality and widespread unapproved varieties resulting in low yield hurt farmers as their incomes decline.** Low yield may also create shortages which can lead to high market prices for agricultural products. As a result, local economy faces the consequence in the shape of persistent food inflation. On external front, it makes the country’s agricultural products less competitive.
10. **Availability of outdated varieties and farmers’ lack of access to quality seed.** While the current availability of improved wheat and rice seed appears to be sufficient to meet annual replacement requirement, existing varieties of cereals, wheat, and coarse rice are outdated and need to be replaced

by new germplasm. Secondly, there is a need for institutional mechanism to expand the access and coverage of improved seed rather than limiting it to small fraction of farmers.

11. **Low supply of certified seeds.** The seed industry consists of public, private, and multinational seed companies and research institutions. In 2018-19 the share of private sector in supplying certified seeds was overwhelming at 82 percent, followed by public sector at 12 percent and imports covering remaining 6 percent. The public sector institutions have their focus on cotton, wheat, and pulses only. There is virtually no preference for other crops.
12. **The gap between supply and requirement of certified seeds remains at 66 percent.** There is still significant underinvestment in the seed industry and opportunity exists in developing new varieties of seeds.

### Innovation, Investment and Intellectual Property Rights

13. **Adoption of new technologies to strengthen our agriculture** is most critical piece. New technologies adopted by the world should also be adopted in the country after careful review. However, these reviews should be science based and time bound without any personal biases. The benefits reaped by global farming community should also be provided to our farmers which is prime responsibility of government.
14. **Development of new varieties of seeds is an expensive affair.** The companies are required to test their seeds at specialized farms and then take the seeds to federal authorities to apply for certification. The rejection rate remains high as the local companies lack funding and technical inputs that are necessary for seed development. Even those who are successful in getting approvals, mass-scale production of their seeds remains a long-term affair. This process results in low rate of return on the investments and private sector is discouraged.
15. **Weak research and development base of private sector companies:** More than 800 seed companies are registered in Pakistan. Most of these seed companies are small and medium firms that lack resources for research and development activities and are therefore engaged only in marketing activities. Therefore, bulk of the seed supply is provided by 10 to 20 local companies and five multinationals.
16. **Failure to completely enforce the Seed Amendment Act 2015 and the Plant Breeders' Rights Act 2016 calls for immediate policy response.** The failure of ensuring property rights has created a major bottleneck for private enterprise development and innovation in the seed system of Pakistan. The result has been the growth of unregulated and informal seed markets that now comprises 60 percent of the seed market.
17. **Weak enforcement of intellectual property rights.** Intellectual property rights theft is another major reason for the private sector to bypass the seed approval process. Private companies have serious concerns regarding the leakage of breeder's seed during the testing and seed approval process. This mainly occurs due to a lack of controls and administrative oversight. This also discourages the private sector from undertaking R&D in the seed market. The intellectual property rights theft and lengthy seed approval process jointly help explain why the certified seed is only a small proportion

of the total seed requirement in Pakistan. However, the enforcement of intellectual property rights face criticism from the farmers of Pakistan.

18. **Fear of emerging monopolies.** After the enactment of PBR Act, farmers' apprehension of capitalist control on the seed variety has grown manifold. The Seed Act 2015 and PBR Act 2016 are also being challenged in the courts by the local farmers (Dawn, 2021). The major fear of farmers against implementation of intellectual property rights is that multinationals will hold control of the seeds and patents which will increase the price of seeds and crops.

### Institutional Domain

19. **Only four laboratories have been designated in Pakistan for gene testing (ABRI, CEMB, NIBGE, NIGAB) and 03 for fiber testing (CRI, CCRI, APTMA).** These laboratories do not have standardized procedures/processes and no ISO certification. The gene testing laboratories and the fibre testing laboratories, except APTMA, are themselves involved in gene / varietal development. As such, there is a serious conflict of interest. Moreover, the laboratories, except ABRI, do not have ISO certification. Similarly, the laboratories have no standardized procedures and trained manpower for specific purposes. Resultantly, there is a continuous debate on authenticity of results and credibility of the laboratories and their heads.
20. **Not enough seed certification officers are available to encourage commercialization.** As per prescribed procedures, Seed Certification Officers (SCOs) have to conduct 3 field inspections of standing seed crop, take samples from harvested crop in the field, take samples from seed processing units before and after processing and issue clearance accordingly. The number of SCOs are less given the quantum of work. Moreover, SCOs have no facilities of vehicles and drivers due to which they are forced to get favors from seed companies.
21. **Significant overlap and duplication of breeding program among the federal, provincial and universities is a waste of available resources.** The classic examples are Pakistan Central Cotton Committee (PCCC)'s Central Cotton Research Institute (CCRI) and AARI's Cotton Research Station, located across the road in Multan, which pursue the same mandate but rarely communicate with each other

### Hybrid Seeds

22. **High cost of imported hybrid seed and its intensive management and technological requirements are deterring their adoption by average farmers.** It is causing inefficient use of farm resources and economic losses.

#### **11.1. Entry Barriers to Seed Market for Foreign Seed Companies**

**Pakistan is shifting towards adoption of high quality and high-yielding seeds due to export potential of vegetables, fruits, and rice from the global demographics.** However, the demand for seeds in Pakistan is still untapped and provides multinational corporations various opportunities for expansion and a wide customer base. The factors such as the alarming rate of decreasing arable land, increasing adoption of hybrid seeds, government subsidies, and new favorable policies are driving the seed sector to high quality and high yielding variants in the country. However, rising concerns over water security, climate change, and



dominance of the informal sector may lead to restraint in the seed market during the forecast period. Global and regional companies are responding to the needs of farmers by offering open-pollinated and hybrid varieties for many crops. The rising investments in R&D of hybrid seeds are helping companies in introducing new varieties and pursue diverse portfolios.

**Access to Seeds Index 2021 highlights that:** (1) seed companies are present throughout the South and South-East region but reach only 20 percent of the smallholder farmers; (2) six countries are considered as seed hubs in the region because they have a range of companies with vertically integrated business activities, ranked in order these countries are India, Thailand, Indonesia, Viet Nam, the Philippines and Bangladesh; (3) vegetable seed is a key business driver, legumes are under-represented; (4) for the majority of crops, the newest varieties are less than three years old, and regional companies do more to release public research varieties; (5) hybrids dominate – regional companies extend the availability of open-pollinated varieties; and (6) most seed companies sell package sizes tailored to the needs of smallholder farmers.<sup>76</sup>

**India, Thailand, Indonesia, Vietnam, the Philippines, and Bangladesh** continue to attract most investments in local seed sector developments including breeding, production, processing, and extension services. Companies invest in one or two business activities in Myanmar, Nepal, Pakistan, and Laos. Global and regional companies report that 57 percent of the newest varieties on the market are less than 2 years, Sixty percent of regional companies' new varieties are from their own programs compared to 71 percent for global companies. Additionally, companies release new varieties through collaboration among their breeding programs and from public research.<sup>77</sup>

**India, Vietnam, Thailand, and Bangladesh have 15 or more regional and global companies present.** Pakistan, Afghanistan, and Laos have 5 companies present. Global companies East-West Seed (14 countries), Rijk Zwaan (13), Advanta (13), Takii (12), Sakata (12), Bayer (11) and Enza Zaden (11) have substantial sales activities in the region. Most of these companies reach remote rural areas. Significant efforts have been observed by Indian companies in reaching many countries beyond their home base, such as Namdhari Seeds (7), JK Agri Genetics (8) and Kalash Seeds (8), in addition to Bangladesh's Lal Teer (8) and Taiwan's Known-You Seed (12).

**Low presence of global and regional companies in Pakistan is a cause of concern. Entry barriers to seed market are listed below:**

A. **Inadequate legislative and institutional framework governing Pakistan's seed system**, in three major respects:

- i. *Weak legislation and institutional framework to enforce intellectual property rights:* 1976 Seed Act amended in 2015 and the PBR Act 2016 are unable to bring any value added to private seed

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<sup>76</sup> The purpose of the Access to Seeds Index is to survey global and regional seed companies in order to assess how well they are meeting the needs of smallholder farmers. It includes 32 indicators across 6 measurement areas: Governance and Strategy, Genetic Resources and Intellectual Property management, Research and Development, Seed Production, Marketing and Sales, and Capacity Building. Available at <https://www.worldbenchmarkingalliance.org/publication/access-to-seeds-index/findings/key-findings-for-south-and-south-east-asia/>

<sup>77</sup> Ibid. <https://www.worldbenchmarkingalliance.org/publication/access-to-seeds-index/findings/key-findings-for-south-and-south-east-asia/>

companies' business since it does not create patents and intellectual property rights that can be legally protected.

- ii. *Weak enforcement of legal regime:* Enforcement of the modified legal regime established in 2015 is weak because of lean human resource and institutional incapacity. The amended Seed Act empowers the Federal Government to delegate any or all its powers to the provincial governments though, it is yet to be made operative.
  - iii. *Absence of enforcement structure for Plant Breeders' Rights:* Even though Pakistan legislated a Plant Breeders Rights Act in 2016, its enforcement remains weak as the enforcement structure as well as the registry have not been instituted yet.
- B. ***Understaffed and underequipped regulatory institutions:*** Both the Federal Seed Certification and Registration Department (FSC&RD) and the National Biosafety Committee (NBC, responsible for evaluation of genetically modified cultivars for biosafety) are understaffed and underequipped. The end result is a slow and cumbersome cultivar registration process that renders new cultivars vulnerable to misappropriation by unscrupulous handlers at various stages of testing. This obviously discourages serious companies from entering the market (or at least from going beyond simple importation of seeds) and is a handicap especially for fast moving crops like vegetables. Ease of Doing Business requires effective measures for rapid approval of registering imported and local varieties to incentivize foreign investors.
- C. ***Slow and Cumbersome registration process and certification:*** As noted above, 57 percent of the varieties introduced by the global and regional companies are less than 2 years. It underscores the need for the national testing, approval, and registration system to accelerate the process for new varieties. Else, variety may be superseded by the time it is approved and released by yet another variety which implies that farmers would never have access to the latest varieties.
- D. ***Release of dubious quality seed:*** The above has led to a situation in which many private seed companies release seed of dubious quality without fear or enforcement of penalty system.
- E. ***VCU (Value for Cultivation and Use) testing is not normally applied to vegetable crops but is still done in Pakistan, creating an unwarranted business hurdle.*** VCU is intended as a filter to keep unsatisfactory varieties out of the market. Since vegetable crops have a very wide range of quality attributes such as seasonal adaptation, maturity times, taste, color, storability etc. all of which contribute to their overall merit for the grower and consumer, besides the general agronomic issues like disease resistance, in practice it is difficult to impose objective VCU criteria on vegetable crops. VCU is also not practical for vegetables given the short life of varieties due to intensive private sector breeding in those crops. The typical result of imposing VCU for vegetables is smuggling of varieties that are not yet listed but preferred by growers.
- F. ***Stealing of seed from test trials*** and seed multiplication fields. Security of the inbred (parent) lines is another concern.
- G. ***Oligopolistic tendencies in seed industry*** with involvement of (ex-) government officials constitute a potential market entry barrier.

## 12. Pakistan’s Ranking in Enabling the Business of Agriculture<sup>78</sup>

A comparison of country scores in different indicators ranked in the World Bank Report of 2019 on Enabling the Business of Agriculture is given in Table 6.

Country	Overall Score	Supplying Seed (0-100)	Time to register a new cereal variety (days)	Cost to register a new cereal variety (% of income per capita)	Quality of Seed Regulation Index (0-9)	Protecting Plant Health (0-100)	Quality of Phytosanitary Regulation Index (0-5)
Pakistan	47.87	67.80	409	17.6	4	20	1
Bangladesh	44.47	18.52	No Practice	No Practice	5	60	3
China	70.29	40.65	1575	267.1	5	60	3
India	62.23	73.16	397	80.5	6	60	3
Kazakhstan	68.01	68.94	730	0	7	60	3
Turkey	78.18	61.49	646	22	8	100	5

Source: World Bank Report on Enabling the Business on Agriculture, 2019

## 13. Recommendations

**The seed system in Pakistan is underdeveloped for several reasons.** First, until 2015 the system was governed by a complex and archaic legal framework which did not recognize the role of the private sector. Second, the Seed Amendment Act 2015 has some loopholes that slow down the variety approval process and creates duplication of efforts due to unclear provincial and federal roles. Third, the regulatory system for varietal testing and release is unreliable and fails to protect intellectual property rights. Fourth, the federal agency, FSC&RD, has weak capacity and enforcement ability to ensure that quality and certified seed is being traded in the provinces. Finally, failure to implement the Seed Amendment Act 2015 and the Plant Breeders’ Rights Act 2016 has created a major bottleneck for private enterprise development and innovation in the seed system of Pakistan. The result has been the growth of unregulated and informal seed markets serviced by private firms. It should be noted that development of new seed varieties is only ‘half of the story’. The other half is effective and timely marketing of seeds to the farmers. Several remedial policy measures are listed below to help tackle the challenges to seed market development in Pakistan.

### Incentivizing the Foreign Investment in Seed Sector

1. **Establishing required regulatory mechanism stipulated under Plant Breeders’ Rights Act:** It is almost 6 years since the Plant Breeders Rights Act was enacted. However, the Ministry has yet to establish the necessary regulatory framework including the Plant Breeders’ Rights Registry to monitor and implement the stipulated system. It is imperative to put in place this framework to implement the laws related to plant breeding. This will not only encourage local and international researchers and organization to introduce new technologies in agriculture sector but will also lead to yield improvement. Currently, crops protected by the regulations are limited. There is an urgent need to expand protection to other crops as well.

<sup>78</sup> Enabling the Business of Agriculture provides data on eight quantitative indicators: supplying seed, registering fertilizer, securing water, registering machinery, sustaining livestock, protecting plant health, trading food, and accessing finance, reported by the World Bank. The Report does not measure physical factors such as distance from major cities, the quality of connecting roads or any other issue related to infrastructure, natural factors affecting the productivity of farmers such as the type of soil, average temperatures and precipitation levels, the length of the growing season, or the risk of droughts and floods.

2. ***Enforcement of intellectual property rights (IPRs) is the key to attract foreign investment in seed sector.*** IPRs recompense seed developers for their efforts and permits organizations to recuperate their research and development investments. It promotes further research and development and protects the innovation which will end up providing improved technologies to meet country's food and feed challenges. Breeding investments require an effort of around 10 years and without the incentive of rewards, no rational producer may invest his time and money on research and development. Intellectual property rights are a source of recovering the cost of R&D as the breeder obtains exclusive rights for his innovation. Section 45 of the PBR Act entitles the breeder(s) or scientist(s) of a new plant variety to a minimum of 40% of the royalty or the profits gained by the institute through any commercial deal. This provision may encourage plant breeders and seed organizations in the public and private sector to invest in research and plant breeding and help generate revenues for research organizations. Secondly, Section 12 of the said Act lays out the criteria for intellectual property rights protection through the DUS (Distinctness, Uniformity, Stability) testing to be performed by FSC&RD. This ensures that only superior varieties of crops are going to be developed and certified. It will also facilitate the accessing of protected foreign varieties and new technologies. Proper implementation of the PBR Act through a dedicated agency and necessary infrastructure can help create a competitive environment for variety development among the public and private sector organizations. India has established Protection of Plant Varieties and Farmers' Rights Authority.

***The FSC&RD lack the required intellectual property (IP) management capacity and resources*** to perform product clearance analyses and evaluations that facilitate the legitimate import, use and/or export of technology advanced products. Therefore, capacity building in IPR management is vital from both the donors and recipient side to facilitate transfer of appropriate agri-biotech to the country. Two international treaties govern terms of Access and Benefit Sharing (ABS) for genetic resources, viz. the Convention on Biological Diversity (CBD) (1993) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (2004). In October 2010 a Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (the Nagoya Protocol) was adopted as a supplementary agreement to the CBD.

3. ***Enforcement of Biotech Variety Registration.*** The Ministry of National Food Security and Research (MNFS&R) is also postponing the biotech variety registration process as prescribed in the Seed (Amendment) Act 2015 and Seed (Business Regulation) Rules 2016 issued vide S.R.O. 907(I)/2016 dated September 28, 2016, under the reported pressure of private seed sector under the pretext of non-availability of commercialization of biotech variety policy. It frustrates the foreign and local seed companies of repute to invest in R&D and new technology. It is important for the Ministry to take necessary measures to streamline the process and enforce relevant provisions of the law. Current policies and regulations allow biotech commercialization of all crops and private companies have made investment in this regard since last one decade. However, the Ministry is still of the view that it needs to develop a crop specific biotech policy for commercialization. There is a need for an urgent decision on this issue to attract investment in this area.

4. ***Need for establishment of a tracking system for sale of seed.*** The Seed (Business Regulation) Rules 2016 has been amended to provide for the establishment of a trace and tracking system. However, there is a need to develop such system in consultation with the seed industry to enable growers to verify whether the seed in a bag or a container that he has acquired is of approved variety and duly certified.
5. ***Moving towards “Truth-in-labeling” (also called “truthful labelling”) as a means for private companies to self-certify their seed is a bridge too far at this point in time for Pakistan, mainly because of weak legal recourse and because most seed companies lack adequate internal quality protocols.*** Truth-in-labeling (self-certification of seed by companies) as a means to incentivize foreign investment private companies is a bridge too far at this point in time for Pakistan, mainly because of weak legal recourse and most seed companies lack adequate investment in research and development, internal quality protocols, and standards. **Truthful labelling** works best if: (a) the national law and regulations set out requirements for seed standards, sampling, testing, grading, packaging and labelling as well as use of variety names, advertising, seed crop inspection, seed import, and certification of seed as well as listing of varieties; (b) investment in quality research and development to align with the international standards; (c) market and legal enforcement is strong and proactive; (d) the country has an elaborate accredited testing system with high integrity; (e) Small Causes or Consumer Courts’ system is well equipped and speedy to dispose of violations; (f) the companies are sensitive to their reputation; and (g) majority of the seed is being sold by reputable entities under their brand name that have their own internal quality assurance procedures. Only in these circumstances, ‘truthful labeling’ can be considered to replace all the technical procedures required for certification and transfer responsibility for seed quality to the seller. Effectively the reputation of the seller becomes the motivation for quality assurance, rather than the threat of legal sanction. In the absence of the above framework, there is a risk that much of the seed in the market is of poor quality and the farmer may lose confidence in purchased seed. However, the national policy as well as the implementation plan may include necessary measures to move towards this regime gradually.
6. ***Regional harmonization of regulatory framework:*** Regional harmonization of regulatory frameworks for seeds is a challenging task and may require bilateral and sub-regional agreements and protocols and shared objectives and goals. It will not only be a time-consuming exercise but also needs strong trust amongst the regional countries. However, mutual recognition of variety lists, to the extent possible, and a common agroecology may reduce the time required for testing, accelerate access to innovations and facilitate trade and could possibly deter illegal traffic of unregistered varieties. The convergence of standards and procedures may be a more realistic beginning. The harmonization of regional seed procedures in Latin America have led to a 23 percent increase in regional seed trade in two years.<sup>79</sup>
7. ***Effective enforcement of the legal framework including intellectual property rights(IPR) will promote entrepreneurship in the seed sector.*** The goal of promoting entrepreneurship and attracting local as well as foreign investments in research and development directed at the agriculture sector could be achieved by implementing the Seed Act and the PBR Act in letter and

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<sup>79</sup> USAID-EAT project, “Building an Enabling Environment for Seed Sector Growth,” “Policy Brief No.1 (2011).

spirit. Federal and Provincial should step up in disseminating the benefits of intellectual property rights to the farmers and take measures for effective implementation of IPR. Plant variety protection supports the long-term investments in plant breeding as well as attract private investors for investing in seed varieties. It provides a framework to the private investors for investing in seed varieties that are suitable for farmers' changing needs. If there is an effective plant variety protection system in place, it may provide necessary advantages in an international context as it removes hindrances to trade. A check list is enumerated in Box 9.

**BOX 9. Checklist of possible improvements to the regulatory framework and FSC&RD implementation of it**

- The National Seed Council (NSC) should be reactivated, and it should meet on a regular basis.
- The implementation of the new Rules and Regulations under the 2015 Act should be closely monitored by NSC to check on their effectiveness and identify weaknesses or bottlenecks.
- The procedure for registration of seed companies should be reviewed to eliminate ghost companies. This task could be done jointly with the Seed Association.
- The procedure for registering imported varieties should be streamlined to make companies do more of the work in exchange for more rapid approval.
- The possibility of registering imported vegetable varieties on-line through a website should be investigated.
- One national laboratory should be accredited by the International Seed Testing Association (ISTA)
- The regulations to implement the Plant Breeders' Rights Act should be closely followed to ensure that a workable system of enforcement and royalty collection is put in place; without this the Act is of little value.

8. ***Market enforcement is a powerful tool if it is implemented with reasonable frequency and rigor.***

This is the final and critical stage in the quality control process in which FSC&RD inspectors act as policemen, taking samples from retail outlets and company stores to check the quality of what is being offered for sale. It needs to be done randomly but is usually targeted at those operators whose quality standards are suspect. Besides taking samples for testing, inspectors would also check the labeling of seed packages to ensure that they have the minimum required information. Market enforcement is a powerful tool if it is implemented with reasonable frequency and rigor. FSC&RD has detected several transgressions within the last year, and it is said that this made companies more alert to the risks of selling poor seed.

9. ***Membership of UPOV will support in seed trade.*** Pakistan is not yet a member of International Union for the Protection of New Varieties of Plants (UPOV). The advantage of obtaining UPOV membership is that it has conformity of laws across nations, hence, trading in seeds become less complicated and involves fewer documentation and tests. The current PBR Regulations is non-compliant (see Annex V) which may impede securing the membership of UPOV. It is important that the Ministry may align the PBR Regulations to secure the membership.

10. ***International Seed Testing Association (ISTA) accreditation of Pakistan's seed testing laboratory will help in improving sellers' credibility and international trade in seeds.*** Formal accreditation of Pakistan's seed testing laboratory will affirm that it is technically competent to test seed using ISTA methods and producing reliable results. ISTA accredited laboratory's certificate results in increased acceptance of seed lots which reduces cost and improves sellers' credibility for their products and minimizes risks of shipping faulty seeds. It also provides confidence to the seed buyer as it confirms that seeds have been tested by internationally accepted methods and that the

quality of seed is acceptable. The Ministry should encourage all public labs to get ISTA Certification.

11. ***The federal and provincial governments need to take necessary measures for adoption of hybrid seed and incentivize local production of hybrid seeds.*** The high cost of imported hybrid seed and its technological requirements and intensive management are the key impediments to its adoption. In view of the scope and potential to enhance farm income using hybrid seed, it is important to address challenges confronting the farmers including their problems, apprehensions, grievances about these seeds, black marketing and overcharging by local distributors during shortages, etc. At the same time, it is equally important to enforce IPR regime with punitive action to encourage multinationals for local production of hybrid seed which can benefit the agriculture tremendously. Any legislation for local production without visible and satisfactory enforcement of IP protection regime will not raise the confidence level of the private sector and will not yield the desired results.
12. ***Adjustment of regulations for facilitating vegetable seeds:*** The regulations may be adjusted to reflect the characteristics of vegetable seeds crops, given their regional and global growth, as the national regulatory system was originally designed for cereals and other field crops. The FSC&RD may consider relying on agronomic validation trials data conducted by breeder or importer for vegetable varieties because of their rapid turnover. VCU testing requirement in a slow testing system may place immense burden on testing authorities.
13. ***Third Party Quality Seed Assurance Mechanism:*** To ensure seed quality in the context of seed certification agency which is plagued by physical, budgetary and human resource constraints, private sector can be made responsible for ex ante quality assurance through accreditation by third party seed certification providers. The third-party quality assurance mechanism is common in South America and Europe and is also being practiced in Morocco, South Africa and Zambia.<sup>80</sup>
14. ***Need for predictability and certainty of regulatory regime:*** The foreign and local investors take decisions based on the predictability and certainty of regulatory regime of the sector. Any abrupt change in mid-stream discourage investment decisions. In case changes in the current or new regulations are necessary, the local industry may be consulted from compliance perspective in accordance with global practice.
15. ***Developing a security and operational protocol for use of Unmanned Aerial Vehicle (UAV):*** Countries are increasing deploying UAV in different agriculture sub-sectors, such as: (a) applications of pesticides on crops; (b) Monitoring of weeds, pests, and nutritional deficiencies; (c) Geographical survey of crops, area and water resources; (d) Research and development. Needs for progressive farming have changed in this era. Precision or Site-Specific Agriculture practices considers Right input at the Right time at the Right place at the Right rate. The Government may develop a security and operation protocol for using UAVs in agriculture sector.

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<sup>80</sup> State of the Evidence: Seed Policy Reform. USAID.

16. ***The Seed industry needs strong support and enabling environment for attracting investment.*** Notwithstanding the need for quality control and market enforcement, the seed industry in Pakistan needs strong support, enabling environment for attracting investment, both local and foreign, to pace with the technological advancements and requirement of modernization. It must be recognized that increasing crop production and productivity are pivoted on the expanded supply of improved and certified seed for crops and horticulture. The modern seed industry requires long-term investments in science, plant breeding, agronomy, biological and molecular science, and constant revision of seed production, regulation, and distribution systems (Rana et. al., 2014). The measurement of performance, innovation, and competition in seed systems is required to inform policymaking to boost agriculture productivity (Spielman and Kennedy, 2016).

**Systemic Reform Recommendations:** These include:

17. ***Seed regulations should remain a federal subject*** as provincial laws would complicate not only the inter-provincial seed trade and but may also impede the foreign investment because of different regulatory regimes for testing, approval, registration, and release of seed. Provinces should be delegated control for compliance, monitoring, and enforcement of seed regulations at local level. There should be a clear demarcation of responsibilities and authority between federal and provincial governments.
18. ***The federal government in collaboration and consultation with the provincial governments and key stakeholders should develop a national seed policy encompassing laws, regulations, conventions, programs, investment choices, research and development, and guidelines for tolerance thresholds for pest and disease presence in seed, which shape the acquisition, production, and distribution of materials for propagation purposes.*** Many countries have developed a seed policy in recent years to provide a medium to long-term vision for development of the seed sector, including India (1989, 2002), Bangladesh (1990), Sri Lanka (1997), Afghanistan (2012), Myanmar (2015), Cambodia (2017) and Lao People’s Democratic Republic (2017). The consultation process for preparing such a policy provides an opportunity to discuss all current issues and, hopefully, come to a consensus on the best way forward. The Government may also develop a strategy and implementation plan to achieve the objectives of the policy as done in Turkey. Once agreed and approved, a national apex body, such as the Seed Council would oversee and monitor the implementation of the policy. Although normally considered at the national level, there is no reason why provinces, as the most important seed-producer, should not develop their own policy for development of the seed sector without intruding on the federal responsibilities for legislation. This would be a better approach than introducing a provincial Act. In fact, it is logical that the provinces should have their own policy, given that they now have responsibility for agriculture and the production conditions vary between the four provinces. If such a policy is to be prepared, it would require that the national and provincial seed councils be substantially re-structured as an oversight body with a wider remit and full stakeholder representation. The policy should take account of all components of the seed sector, including for example the rainfed ‘Barani’ regions that tend to be overlooked and other crop groups such as forages and vegetables that are mostly imported at present.



19. ***Promote a public-private dialogue to optimize the seed supply system.*** With the emergence of diverse seed industries and predominance of the private companies in seed supply, both local and imported varieties, it is necessary to have greater consistency in decision-making to gain and retain the confidence of entrepreneurs and investors. This is especially important for investment in research and development, which has a planning horizon of at least ten years. This requires a platform, representing key stakeholders including foreign private companies, for public-private sector dialogue and much closer collaboration to optimize seed supply system within the country generally, and specifically within Punjab province. For this to happen, the National Seed Council and Provincial Seed Councils must be made more representative and effective.
20. ***Pakistan needs to increase public sector investment as well as incentivize the private sector to invest in research and development in seed sector.*** The investment in agriculture research and development is highest in developed countries. Nevertheless, this trend is shifting. World Bank figures show that public and private expenditures on agricultural R&D in high-income countries fell from 69% of the global total in 1980 to 55% in 2011. Meanwhile, middle-income countries (including the Peoples Republic of China – hereafter “China”, Brazil and India) were responsible for 43% of global spending on agricultural R&D; up from a share of only 29% in 1980 (Pardey et al., 2016). Heisey and Fuglie (2018) argue the world may become more dependent on the public sector research of countries like China, India, and Brazil when it comes to the innovation needed to address food and environment challenges, and plant breeding in these emerging economies may enable greater spill overs to developing countries that have similar climatic zones.<sup>81</sup>
21. ***The Seed industry needs strong support and enabling environment for attracting investment.*** Notwithstanding the need for quality control and market enforcement, the seed industry in Pakistan needs strong support, enabling environment for attracting investment, both local and foreign, and facilitation through banking system, to pace with the technological advancements and requirement of modernization. It must be recognized that increasing crop production and productivity are pivoted on the expanded supply of improved and certified seed for crops and horticulture. This investment is required in science, plant breeding, agronomy, biological and molecular science, and constant revision of seed production, regulation, and distribution systems (Rana et. al., 2014). The measurement of performance, innovation, and competition in seed systems is required to inform policymaking to boost agriculture productivity (Spielman and Kennedy, 2016).
22. ***Online submission of application for registration to do business in seed:*** The Seed (Business Regulations) Rules 2016 may be amended to provide for online submission of application along with relevant documents, availability of information, approval process and timelines to make the entire process transparent.
23. ***Inclusion of representative of private seed sector in policy development Working Group.*** The Working Group set up by the Government from to time to time may include representatives of private companies/ associations of private companies to make the entire process more transparent and participative.

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<sup>81</sup>OECD

24. **Performance Contract:** The MNFS&R, under the current regulations, has rolled out the performance contract last year. However, the Government has not achieved consensus on the draft performance contract so far because of opposition from local companies. It is important to finalize this performance contract at the earliest and stringent action may be taken in case of default by any company to ensure compliance and enforcement.
25. **Establishing a tracking system in each seed company:** This has been provided in the recently amended Seed (Business) Rules requiring the seed companies to establish and implement, on his own cost, a robust tracking mechanism, including a digital printing facility located in his premises but linked with a central database maintained by FSC&RD, to enable traceability and verification of seed produced or offered to the farmers through a unique algorithmic label or a scratchable card, which could be affixed on or put inside each seed bag or container. However, the practical implementation of this may not be viable as the Government does not have a central system. Even if they are able to have one, then the multiple systems used by different companies may not be compatible with the Government systems which may stall the implementation. The Government should consider a simple regulation which can be implemented in letter and spirit. Any regulation requiring compliance from local companies may have prior consultation with private companies for future compliance.
26. **Developing an effective sui generis system:** Pakistan is also a member of WTO and is a signatory to Trade-Related Aspects of Intellectual Property Rights (TRIPS) **Agreement and Article 27.3 (b) of the said Agreement requires** “members to protect breeders' rights either by patents or by an effective *sui generis* system or with a combination of both.” The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and other international Conventions, such the Convention on Biological Diversity (CBD), set out that it is the responsibility of national government to realize the farmers’ rights related to plant genetic resources for food and agriculture.<sup>82</sup> The Plant Variety Protection and Farmers Rights (PPV&FR) Act 2001” has put forth the right content through adopting a sui generis legislation that create an equal space for Indian farmers and breeders. The PPV&FR Act has twin purposes.<sup>83</sup> Indian IP laws, which are TRIPS compliant, make it clear that seeds and plants or parts thereof cannot be patented.<sup>84</sup> Article 3j of the Indian Patent Law states that the following are not inventions, hence not patentable: “plants and animals in whole or in any part thereof other than microorganisms; but including seeds, varieties, and species, and essentially biological processes for production or propagation of plants and animals”.<sup>85</sup>

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<sup>82</sup> Barizah, N. 2017. Protection of Farmers’ Rights through a sui generis system in Indonesia. *Advances in Social Science, Education, and Humanities Research (ASSEHR)*, volume 131.

<sup>83</sup> Preamble to the PPV&FR Act, 2001.

<sup>84</sup> Available at <https://www.thehindu.com/opinion/letters/Patents-and-seed-industry/article16077890.ece>

<sup>85</sup> Available at <https://www.lifegate.com/monsanto-india-seed-patent-vandana#:~:text=The%20Supreme%20Court%20order%20of,and%20cannot%20have%20in%20India.>

Pakistan can take a cue from Ethiopia, India, Malaysia, or the Philippines which have chosen to develop their own *sui-generis* systems. For instance, The Protection of Plant Varieties and Farmers Rights Act (2001) in India protects plant varieties and breeders' rights as well as farmers' rights to save, use, sow, re-sow, exchange, share and sell farm produce, including seeds of varieties protected by plant breeders' rights. Likewise, the African Union developed an African Model Law for the Protection of the Rights of Local Communities, Farmers and Breeders, and for the Regulation of Access to Biological Resources.<sup>86</sup> Pakistan is also a signatory to ITPGRFA and Nagoya Protocol.<sup>87</sup> Article 9 of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) can also be referred to provide a pretext for developing the *sui-generis* legislation in Pakistan where Article 9.3. explicitly states that "Nothing in this Article shall be interpreted to limit any rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law and as "appropriate".<sup>88</sup> Farmers' protection rights in Pakistan are in **Box 2** above.

27. ***Need for a national seed registration system:*** In principle, a variety could be bred and tested within a province and released by its Seed Council without going through the FSC&RD registration process. However, it would then not be eligible for certification or marketing in other provinces. This illustrates the need for a truly national seed registration system so that seeds and varieties can move freely within the country.
28. ***Promoting higher standards for registration:*** The large number of registered companies, and the lack of robust criteria for registration, is a source of complaints coming from relatively small group of professional companies that would like to promote higher standards of conduct across the industry and the farmers. FSC&RD has been reviewing the list with a view to 'deregistering' inactive companies. A solution might be to require companies to renew their registration periodically with an objective criteria and intense process of due diligence.
29. ***Simplify and accelerate variety testing and registration process to create a competitive market.*** Opinions vary about the efficiency of the variety testing and registration process but on balance it seems that some simplification and acceleration would be beneficial to meet the needs of a more competitive market, especially in fast moving crops like vegetables. This could be achieved by requiring applicants to provide more information when they submit a candidate variety and to carry out more of the testing work themselves, thus reducing the burden on the limited resources available to FSC&RD.
30. ***Strengthen the testing and inspection system to ensure quality seed.*** In general, the reputable companies that engage in domestic seed production support the quality control work of FSC&RD and do wish to have official certification labels (tags) on their bags as an aid to sales. However, it is not clear if all seed crops are actually inspected in the field and in addition, many seed crops are not entered in the certification scheme at all. Moreover, the laboratories of FSC&RD have old

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<sup>86</sup> Golay, C. November, 2020. The Right to Seeds and Intellectual Property Rights. Research Brief. The Geneva Academy.

<sup>87</sup> Document name "Perspectives on implementation of the Nagoya Protocol and the ITPGRFA" in Pakistan

<sup>88</sup> International Treaty on Plant Genetic Resources for Food and Agriculture

equipment and would benefit from refurbishment. This could be a legitimate target for institutional strengthening/ investment for those labs that are located in the provinces. The largest laboratory at Khanewal could also be used for training purposes in a range of seed-related topics.

31. **Digitalize field inspection and monitoring system.** Computerization of field inspections of the seed crop and laboratory tests on samples of seed lots before they are sold can be an of immense benefit once the software has been developed and commissioned. Field inspections, in particular, require sufficient experienced staff who can travel extensively during the limited production season for each crop. The regulations may be adjusted to reflect the characteristics of vegetable seeds and hybrid crops, given their regional and global growth, as the national regulatory system was originally designed for cereals and other field crops. The FSC&RD may consider relying on agronomic validation trials data conducted by breeder or importer for vegetable varieties because of their rapid turnover. VCU testing requirement in a slow testing system may place immense burden on testing authorities.
32. **Need for varietal turnover:** The relevant institutions, variety release systems, and government seed companies can speed up varietal turnover by: 1) clearly identifying the new varieties they recommend, describing their advantages over the variety they are replacing, supported by reliable data; 2) aggressively demonstrating and promoting these varieties; 3) de-certification of obsolete varieties when they are superseded by better ones; 4) withdrawal of seed subsidies for obsolete varieties; 5) withdrawing funds from the production of breeder and foundation seed of obsolete varieties; 6) setting targets for the average varietal age in foundation seed production and in farmers' fields; 7) Simplifying and harmonizing variety release processes regionally to build private sector confidence and participation in the seed sector A key element in generating a culture of rapid varietal replacement is convincing farmers that it is in their interest to change varieties as soon as a new one is endorsed and made available by the seed system.<sup>89</sup>
33. **Need for focusing on climate resilient breeding program:** Increasing climate variability and events of extreme weather are impacting food production, food stability and livelihoods of farmers. The national yields of almost all crops are low compared to peer group countries and productivity is declining over time because of climate change effects. It is important to reorient breeding programs to develop climate resilient cultivars. Advancement in the field of breeding/genetics, biotechnology, and simulation modeling has made it possible to develop climate smart and resilient crops species and livestock breeds.

The National Food Security Policy 2018 underlines the policy measures towards this end including: (i) impact assessment and optimization of adaptation strategies under climate change scenario; (ii) development of a well-coordinated crop-livestock breeding program that involves national and international research centers; (iii) conducting basic, strategic and anticipatory research involving federal and provincial research systems, and CGIAR organizations; (iv) development of climate-smart crop-livestock sectors while focusing on the use of bio-technology, resource conservation and harmonious production packages for diverse ecosystems of the country; (v) evaluation of the performance of breeding lines in Target Population of Environments (TPE) and identification of

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<sup>89</sup> Gary N. Atlina, Jill E. Cairnsb , and Biswanath Dasc, (2017). Rapid breeding and varietal replacement are critical to adaptation of cropping systems in the developing world to climate change, Global Food Security, Volume 12, March 2017, Pages 31-37,

the hot spots for dissemination of suitable varieties and animal breeds; (vi) enhancement of productivity and profitability while preserving environmental quality; (vii) undertaking an adaptation program in order to better deal with climate change impacts; (viii) promoting crop and livestock insurance schemes as risk coping strategy particularly in rainfed areas under public-private partnership; (ix) acquisition and judicious exploitation of bio-diversity and genetic resources from national and international sources; and (x) human resource development to address the new breeding and crop-livestock production challenges under emerging climate change regimes. Some of the initiatives are already underway in Pakistan testing drought tolerant, heat tolerant, salinity tolerant varieties of wheat and rice for multilocation trials in 2022.

34. ***Reconstituting National and Provincial Seed Councils to make them more representative and participative to oversee the enforcement of Seed (Amendment) Act, 2015 and Plant Breeders' Rights Act 2016.*** The National and Provincial Seed Councils may be reconstituted to make them more representative, and their remit may be extended so that can provide a forum for discussion on all issues included in the policy. This could include the promotion of plant breeding research and local seed production, both potentially benefitting from closer public/private collaboration. These may also include representatives from private seed companies or their Associations having national character.
35. ***Broad-based Provincial Seed Councils will be more beneficial for seed innovation and protecting inventions.*** Beyond this specific task of variety release, the Provincial Seed Councils can provide an effective platform to benefit from a much closer relationship of stakeholders across a spectrum of activities and this could be implemented at the provincial level without challenging any federal responsibilities or authority. This platform may include the research community, academia, regulator and public sector, breeders, farmers, seed businesses, and other stakeholder to promote (a) wider collaboration between public and private sector stakeholders; (b) improve seed research and development; (c) create awareness among seed companies about innovative technologies; (d) explore opportunities for collaboration at international level to benefit from latest research in seed sector; (e) equip farmers with knowledge to choose best quality seed; and (f) understanding and implementation of seed standards, laws, and statutory requirements. At the same time, it should discourage groups pursuing sectional interests causing further division within the community of stakeholders. The challenge is to find a mechanism, and the goodwill, to make the public-private dialogue a reality.
36. ***The Government may restrict its role to specifying standards and quality of seed varieties, registration, and strengthening regulatory mechanisms.*** It will allow FSC&RD to focus its regulatory capacity on commercially important crops. It is important to assess suitability of new varieties for different agro-ecological zones. However, for this to happen the regulatory framework may extend to crops of commercial significance. Else, the large-scale evaluation may enhance the probability of piracy and stealing breeders' innovation.
37. ***Effective regime to check monopolistic tendencies is likely to increase competition and efficiencies.*** Ensuring market competitiveness and effective measures against monopolistic tendencies is likely to encourage new firms to enter the market and improve efficiency.

38. ***The provinces may consider creating Provincial ‘Seed-hub’.*** Many of the above themes contained in this report could be addressed by a bold initiative to establish an umbrella organization that would coordinate all seed activities within the province. The main participants would be:

- Universities with strong agricultural/science programs;
- Public research centers, with strong breeding or biotech programs;
- The Seed Corporation, in its revised format;
- Private companies that engage in research and or contract seed production;
- The main office(s) of FSC&RD that could contribute to training in seed-related topics;
- The extension service – if they are involved in carrying out trials and demonstrations;
- Premium seed growers who produce seed on contract for local companies; and
- Manufacturers of agricultural equipment related to seeds.

The Seed-hub would promote research, development, and production within the province but without encroaching on federal responsibilities. It should have a small secretariat that would, above all, provide information for its members and facilitate collaboration between them. In the past there was a biannual magazine known as ‘The Seed News’, the last edition of which was published in 2010. This provided a digest of information on the seed sector, and it could be revived at very modest cost as a vehicle for communication among stakeholders. It could be a simple newsletter format and could also be made available online. Similar publications exist in most countries that have a significant seed industry.

39. ***Offices of FSC&RD in the provinces need to be strengthened.*** At the level of physical investment, the offices of FSC&RD within Provinces, especially in Punjab and Sindh, should be upgraded and properly staffed so that they can serve the needs of companies and farmers in the province.

40. ***FSC&RD may invoke delegation of powers’ provision in the Seed (Amendment) Act 2015 to discharge its functions.*** The Amendment empowers the federal government to delegate all or any of its powers to (i) a Provincial Government; or (ii) an officer or authority subordinate to the Provincial Government; or (iii) an officer or authority subordinate to the Federal Government. It can engage provincial extension or research departments to conduct the field monitoring. Currently, FSC&RD is understaffed with only 100 seed officers who are required to provide services to more than 700 seed companies and to conduct the regulatory functions in the fields throughout Pakistan. FSC&RD can utilize the manpower of the provincial extension or research departments by delegating its functions and powers as the field extension agents have far greater reach and can better serve the seed markets in the respective provinces. Provinces can be supported to arrange for necessary manpower and building their capacity and manpower.

41. ***Need for a National Seed Association:*** There is a need for effective national seed association for better representation of the private sector and developing a culture of professionalism instead of too many associations representing groups interests.

42. ***Promoting Organic Farming:*** The government may create enabling environment to promote organic farming to capture the niche market as well as share in the global demand.

43. ***The national research system is unable to sustain commercial seed production*** (Pakistan, PC 2009). It requires reform in the provincial and national research system, enhanced investment at both levels, and availability of skilled manpower. Active collaboration between the private and public sectors can play an important role in augmenting Pakistan's research system in all areas and ensuring equitable access to public research materials. Marketing public sector seed through private sector channels may help the public sector corporation to enhance their market share. The current seed replacement rate is abysmally low because the new qualities are rarely available at the appropriate time and location and the quantity is low while prices are high for small farmers. Diversification and strengthening of new seed varieties can be performed through decentralization of seed marketing and distribution network. This can be made possible by involving private sector in the marketing of seed varieties. A plausible solution is that public sector can contract a private company for marketing of public sector seeds through legally binding agreements.

### **Management Information System**

44. ***Big data and its application in farming can go beyond simple production and even influence the food supply chain.*** The FSC&RD and provincial authorities should publish regular data on variety-specific production data, company registrations, varietal releases, biosafety approvals, etc. Public disclosure of statistics will ensure better analysis and policymaking. Data driven policy and impact evaluation is the key to success. The big data and its application in farming can go beyond simple production and even influence the food supply chain. Data is being used around the world to predict farming operation, driving real-time decision and redesigning of business processes.

Big data is proving to be a helpful source in improving seed qualities and increasing the yield and lowering the input cost. A recent research at Iowa State University worked on big data and machine learning for sorting out seed varieties stored around the world in the gene banks. They determined which seeds could be more useful for the breeders in an act to prioritize superior versions. The sample included 200 seeds varieties. The yield predictions that were generated by data-driven analytics resulted in 76 percent accuracy rate (Yu, 2016).

By monitoring yield data, GPS field maps and using machinery with variable rate technologies, farmers can adjust the seed planting density as well as the application rates for pesticides, herbicides, and nutrients, depending upon the variations in moisture, topography, and soil quality. The precise planting with use of data and technology can lower the input costs and increase the yields.

45. ***Developing a Seed Information Management System (SIMS) for FSC&RD will be a step forward to digitize its services.*** Developing a Seed Information Management System for FSC&RD will be a step forward in transforming manual data recording to digitize FSC&RD services. This will not only provide access to real time data but will also improve the efficiency and transparency in activities pertaining to seed quality regulation. Track and traceability of certified seed in collaboration with provincial extension departments will enable the impact assessment of various interventions at the farm level. It is important to design a unified format for major crops i.e., wheat, cotton, and paddy. It may be made mandatory for the companies to share information regarding sale of certified seed to the dealers with provincial extension departments for traceability of certified seed at the farmer level.

46. *Modern communication technologies may be more effective at a moderate cost.* FSC&RD may digitalize national variety lists which may be available online along with security codes on packages to confirm their origin and contents. It can benefit both the regulators and private sector companies.



## Policy Action Matrix for the Seed Sector of Pakistan

Policy Area	Brief Description	Proposed Actions	ST/MT/LT <sup>90</sup>	Action Centre	Proposed Process	Capacity Building	Outcomes/ Verification
<b>Incentivizing foreign investment in the Seed sector in Pakistan</b>	Six countries in South and South-East Asia continue to attract most investment in local seed sector development, viz. India, Thailand, Indonesia, Vietnam, the Philippines and Bangladesh in breeding, production, processing, and extension services	<ul style="list-style-type: none"> <li>Establishing required regulatory mechanism as stipulated under the Plant Breeders' Rights Act</li> <li>Currently crops protected by the regulations are limited. There is a need to expand protection to other crops as well</li> </ul>	<b>ST</b>	MNFS&R FSC&RD	<ul style="list-style-type: none"> <li>Establish the Registry to ensure implementation of the system provided in the Act</li> <li>Policy measures for clusters development</li> </ul>	FSC&RD needs restructuring and revamping along with hiring professional staff as well as its capacity building	This will not only encourage local and international researchers and organization to introduce new technologies in agriculture sector but will also lead to yield improvement.
	IPRs recompense seed developers for their efforts and permits organizations to recuperate their research and development investments. It promotes further research and development and protects the innovation which will end up providing.	<b>Enforcement of intellectual property rights (IPRs) is the key to attract foreign investment in seed sector as provided under Section 12 and 45 of the Act since</b> Intellectual property rights are a source of recovering the cost of R&D improved technologies to meet country's food and feed challenges	<b>ST/MT</b>	MNFS&R FSC&RD	Establish dedicated agency with necessary infrastructure for the implementation of the PBR Act which can help create a competitive environment for variety development among the public and private sector organizations. India has established Protection of Plant Varieties and Farmers' Rights Authority.	<ul style="list-style-type: none"> <li>The FSC&amp;RD require capacity building in IPR management, use and/or export of technology of advanced products from both the donors and recipient side to facilitate transfer of appropriate agri-biotech to the country. Capacity building to administer and implement international treaties/conventions viz. the Convention on Biological Diversity (CBD) (1993) governing terms of Access and Benefit</li> </ul>	This provision may encourage plant breeders and seed organizations in the public and private sector to invest in research and plant breeding and help generate revenues for research organizations.

<sup>90</sup> ST:12 months, MT:1-2 years, LT:2-4 years

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						Sharing (ABS) for genetic resources, International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (2004) and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as a supplementary agreement to the CBD.	
		<p><b>Enforcement of Biotech Variety Registration</b> as prescribed in the Seed (Amendment) Act 2015 and Seed (Business Regulation) Rules 2016 issued vide S.R.O. 907(I)/2016 dated September 28, 2016 under the pretext of non-availability of commercialization of biotech variety policy. It is important for the Ministry to take necessary measures to streamline the process &amp; enforce relevant provisions of the law. in this regard since last one decade.</p>	ST	<p><b>Cabinet MNFSR Climate Change (CBD) FSC&amp;RD</b></p>	<p>Develop and approve bio-tech crop specific commercialization policy</p> <p>Current policies and regulations allow biotech commercialization of all crops and private companies have made investment</p>		<p>It will incentivize the foreign and local seed companies of repute to invest in R&amp;D and new technology.</p>

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		<ul style="list-style-type: none"> <li>• <i>Need for establishment of a tracking system for sale of seed as envisaged under amended The Seed (Business Regulation) Rules 2016 he has acquired is of approved variety and duly certified.</i></li> </ul>	ST/MT	MNFS&R FSC&RD	Need to develop such system in consultation with the seed industry to enable growers to verify whether the seed in a bag or a container that he has acquired is of approved variety and duly certified.	<p>Training of the training staff to manage Seed Trace and Tracking System</p> <p>Enforcement of Law</p>	It will ensure the availability of improved and certified seed to the farmers
	Truth-in-labeling (self-certification of seed by companies) as a means to incentivize foreign investment private companies is a bridge too far at this point in time for Pakistan, mainly because of weak legal recourse and most seed companies lack adequate investment in research and development, internal quality protocols, and standards.	<ul style="list-style-type: none"> <li>• <i>Moving towards “Truth-in-labeling” (also called “truthful labelling”) gradually.</i></li> </ul>	LT	Cabinet MNFS&R FSC&RD	<p><b>Truthful labelling</b> works best if: (a) the national law and regulations set out requirements for seed standards, sampling, testing, grading, packaging and labelling as well as use of variety names, advertising, seed crop inspection, seed import, and certification of seed as well as listing of varieties; (b) investment in quality research and development to align with the international standards; (c) market and legal enforcement is strong and proactive; (d) the country has an elaborate accredited testing system with high integrity; (e) Small Causes or Consumer Courts’ system is well equipped and speedy to dispose of violations; (f)</p>	<p>Training of Enforcement Staff and strengthening testing labs</p>	<p>Reputation Risk will shift to Seed Producing Companies, increase varietal Turnover, and reduce the hassle of seed registration process</p>

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					<p>the companies are sensitive to their reputation; and (g) majority of the seed is being sold by reputable entities under their brand name that have their own internal quality assurance procedures.</p> <ul style="list-style-type: none"> <li>• The national policy as well as the implementation plan may include necessary measures to move towards this regime gradually.</li> </ul>		
		<ul style="list-style-type: none"> <li>• <b>Regional harmonization of regulatory framework:</b> Regional harmonization of regulatory frameworks for seeds is a challenging task and a common agroecology may reduce the time required for testing,</li> </ul>	LT	Cabinet MNFS&R Provincial Agriculture Deptts.	<ul style="list-style-type: none"> <li>• Requires bilateral and sub-regional agreements and protocols and shared objectives and goals.</li> <li>• Needs strong trust amongst the regional countries.</li> </ul>	Strengthening Testing and Quarantine System	Mutual recognition of variety lists, to the extent possible, may accelerate access to innovations and facilitate trade and could possibly deter illegal traffic of unregistered varieties. The convergence of standards and procedures may be a more realistic beginning.

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	Pakistan is not yet a member of International Union for the Protection of New Varieties of Plants (UPOV).	<ul style="list-style-type: none"> <li>• <b>Making the PBR Regulation more compliant to UPOV to obtain Membership of UPOV which will support in seed trade</b> (See Annex-V)</li> </ul>	MT	MNFS&R FSC&RD Cabinet		Capacity to enforce PBR Regulations	Advantage of obtaining UPOV membership is that it has conformity of laws across nations, hence, trading in seeds become less complicated and involves fewer documentation and tests.
	Formal accreditation of Pakistan's seed testing laboratory will affirm that it is technically competent to test seed using ISTA methods and producing reliable results.	<ul style="list-style-type: none"> <li>• <b>International Seed Testing Association (ISTA) accreditation of Pakistan's seed testing laboratory will help in improving sellers' credibility and international trade in seeds.</b> The Ministry should encourage all public labs to get ISTA Certification.</li> </ul>	MT	MNFS&R FSC&RD Cabinet	Adopting the ISTA protocol for the labs	Training the technical staff and build their capacity	ISTA accredited laboratories results in increased acceptance of seed lots which reduces cost and improves sellers' credibility for their products and minimizes risks of shipping faulty seeds. It also provides confidence to the seed buyer as it confirms that seeds have been tested by internationally

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							accepted methods and that the quality of seed is acceptable.
	The high cost of imported hybrid seed and its technological requirements and intensive management are the key impediments to its adoption.	<ul style="list-style-type: none"> <li>The federal and provincial governments need to take necessary measures for adoption of hybrid seed and incentivize local production of hybrid seeds.</li> </ul>	ST/MT	MNFS&R Provincial Agriculture Departments and Extension Departments	<p>In view of the scope and potential to enhance farm income using hybrid seed, it is important to address challenges confronting the farmers including their problems, apprehensions, grievances about these seeds, black marketing and overcharging by local distributors during shortages, etc.</p> <p>It is equally important to enforce IPR regime with punitive action to encourage multinationals for local production of hybrid seed which can benefit the agriculture tremendously.</p>		Higher farm productivity and farmers income
	The regulations may be adjusted to reflect the characteristics of vegetable seeds crops, given their regional and global growth, as the national regulatory system was originally designed for cereals and other field crops	<ul style="list-style-type: none"> <li>Adjustment of regulations for facilitating vegetable seeds</li> </ul>	ST/MT	MNFS&R FSC&RD	The FSC&RD may consider relying on agronomic validation trials data conducted by breeder or importer for vegetable varieties because of their rapid turnover. VCU testing requirement in a slow testing system may place immense burden on testing authorities.		Will ensure latest variety and quality seed for horticulture in Pakistan

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	To ensure seed quality in the context of seed certification agency which is plagued by physical, budgetary and human resource constraints, private sector can be made responsible for ex ante quality assurance through accreditation by third party seed certification providers.	<ul style="list-style-type: none"> <li>• <b>Third Party Quality Seed Assurance Mechanism may be provided in the rules</b></li> </ul>	ST/MT	MNFS&R	The third-party quality assurance mechanism is common in South America and Europe and is also being practiced in Morocco, South Africa and Zambia. <sup>91</sup>		Accelerate the process of registration of seed
	The foreign and local investors take decisions based on the predictability and certainty of regulatory regime of the sector. Any abrupt change in mid-stream discourage investment decisions.	<ul style="list-style-type: none"> <li>• <b>Need for predictability and certainty of regulatory regime</b></li> </ul>	ST/MT/LT	MNFS&R Provincial Ag Departments	In case changes in the current or new regulations are necessary, the local industry may be consulted from compliance perspective in accordance with global practice.		It will ensure continued flow of foreign and local investment in the industry
	Countries are increasing deploying UAV in different agriculture sub-sectors, such as: (a) applications of pesticides on crops; (b) Monitoring of weeds, pests, and nutritional deficiencies; (c) Geographical survey of crops, area and water resources; (d) Research and development. Needs	<ul style="list-style-type: none"> <li>• <b>Developing a security and operational protocol for use of Unmanned Aerial Vehicle (UAV)</b></li> </ul>	MT	MNFS&R Ministry of Defense CAA Cabinet	The Government may develop a security and operation protocol for using UAVs in agriculture sector in consultation with the Ministry of Defense and Civil Aviation Authority	Training of the staff engaged in monitoring	Adoption of modern technology at farm level to improve productivity and Quality of crop

<sup>91</sup> State of the Evidence: Seed Policy Reform. USAID.

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	for progressive farming have changed in this era. Precision or Site-Specific Agriculture practices considers Right input at the Right time at the Right place at the Right rate.						
<b>Systemic Reforms in the Seed Sector</b>	Separate Federal and Provincial Seed Laws would complicate not only the inter-provincial seed trade and but may also impede the foreign investment because of different regulatory regimes for testing, approval, registration, and release of seed.	<b>Seed regulations should remain a federal subject and development of provincial seed laws must be discouraged</b>	ST	MNFS&R	Provinces should be delegated control for compliance, monitoring, and enforcement of seed regulations at local level. There should be a clear demarcation of responsibilities and authority between federal and provincial governments.		It will ensure the implementation of Common Market as envisaged under Article 151 of the Constitution
	The federal government in collaboration and consultation with the provincial governments and key stakeholders should develop a national seed policy encompassing laws, regulations, conventions, programs, investment choices, research and development, and guidelines for tolerance thresholds for pest and disease presence in seed, which shape the acquisition, production, and distribution of materials for propagation purposes. Examples of	<b>Develop a National Seed Policy, Strategy, and a Plan for implementation</b>	ST/MT	MNFS&R Provincial Governments Stakeholders	The Government may also develop a strategy and implementation plan to achieve the objectives of the policy as done in Turkey with National Seed Councils to oversee and monitor implementation of the policy		It will provide a framework within which the seed sector has to operate



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	Seed Policy include India (1989, 2002), Bangladesh (1990), Sri Lanka (1997), Afghanistan (2012), Myanmar (2015), Cambodia (2017) and Lao People’s Democratic Republic (2017).						
	With the emergence of diverse seed industries and predominance of the private companies in seed supply, both local and imported varieties, it is necessary to have greater consistency in decision-making to gain and retain the confidence of entrepreneurs and investors.	<b>Promote a public-private dialogue to optimize the seed supply system</b>	<b>ST</b>	MNFSR Provincial Governments (Ag Deptts.)	This is especially important for investment in research and development, which has a planning horizon of at least ten years. This requires a platform, representing key stakeholders including foreign private companies, for public-private sector dialogue and much closer collaboration to optimize seed supply system within the country generally, and specifically within Punjab province. For this to happen, the National Seed Council and Provincial Seed Councils must be made more representative and effective		With the emergence of diverse seed industries and predominance of the private companies in seed supply, both local and imported varieties, it is necessary to have greater consistency in decision-making to gain and retain the confidence of entrepreneurs and investors.

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	<p>The investment in agriculture research and development is highest in developed countries. Nevertheless, this trend is shifting. World Bank figures show that public and private expenditures on agricultural R&amp;D in high-income countries fell from 69% of the global total in 1980 to 55% in 2011. Meanwhile, middle-income countries (including the Peoples Republic of China – hereafter “China”, Brazil and India) were responsible for 43% of global spending on agricultural R&amp;D; up from a share of only 29% in 1980</p>	<p><b>Pakistan needs to increase public sector investment as well as incentivize the private sector to invest in research and development in seed sector.</b></p>	ST/MT	MNFS&R Provincial Agriculture Departments PARBs	<p>Gradually increase investment as percentage of AgGDP from current 0.1 to 0.4 percent over a period of 5 years</p>	<p>Strengthening the federal and provincial research system</p>	<p>It will lead to development of new varieties including heat and salt tolerant varieties, adoption of new technology, and increasing farm productivity, cropping pattern, cropping zoning</p>
	<p>Notwithstanding the need for quality control and market enforcement, the seed industry in Pakistan needs strong support, enabling environment for attracting investment, both local and foreign, and facilitation through banking system to pace with the technological advancements and requirements of modernization.</p>	<p><b>The Seed industry needs strong support and enabling environment for attracting investment.</b> It must be recognized that increasing crop production and productivity are pivoted on the expanded supply of improved and certified seed for crops and horticulture.</p>	ST/MT	MNFS&R FSC&RD Provincial Agriculture Departments	<p>This investment is required in science, plant breeding, agronomy, biological and molecular science, and constant revision of seed production, regulation, and distribution systems.</p> <p>The measurement of performance, innovation, and competition in seed systems is required to inform policymaking to boost agriculture productivity</p>		

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		<b>Online submission of application for registration to do business in seed</b>	ST	MNFS&R FSC&RD	The Seed (Business Regulations) Rules 2016 may be amended to provide for online submission of application along with relevant documents, availability of information, approval process and timelines		It will make the processes transparent and accelerate the registration
		<b>Inclusion of representative of private seed sector in policy development Working Group.</b>	ST	MNFS&R FSC&RD	The Working Group set up by the Government from time to time may include representatives of private companies/ associations of private companies to make the entire process more transparent & participative		It will ensure compliance of decisions at the policy level after informed discussions
	The MNFS&R, under the current regulations, has rolled out the performance contract last year. However, the Government has not achieved consensus on the draft performance contract so far because of opposition from local companies.	<b>Performance Contract</b>	ST	MNFS&R FSC&RD	Approval of performance is needed	Post-Approval enforcement mechanism stringent action may be taken in case of default by any company to ensure compliance and enforcement	and stringent action may be taken in case of default by any company to ensure compliance and enforcement
	Agreement and Article 27.3 (b) of the said Agreement requires “members to protect breeders' rights either by patents or by an effective <i>sui generis system</i> or with a combination of both.	<b>Developing an effective <i>sui generis system</i></b>	MT	MNFS&R FSC&RD	Pakistan can take a cue from Ethiopia, India, Malaysia, or the Philippines which have chosen to develop their own <i>sui-generis</i> systems.		

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					The Protection of Plant Varieties and Farmers Rights Act (2001) in India protects plant varieties and breeders' rights as well as farmers' rights to save, use, sow, re-sow, exchange, share and sell farm produce, including seeds of varieties protected by plant breeders' rights.		
	A variety could be bred and tested within a province and released by its Seed Council without going through the FSC&RD registration process. However, it would then not be eligible for certification or marketing in other provinces	<b>Need for a national seed registration system</b>					National seed registration system so that seeds and varieties can move freely within the country.
	The large number of registered companies, and the lack of robust criteria for registration, is a source of complaints coming from relatively small group of professional companies that would like to promote higher standards of conduct across the industry and the farmers	<b>Promoting higher standards for registration</b>			FSC&RD has been reviewing the list with a view to 'deregistering' inactive companies. A solution might be to require companies to renew their registration periodically with an objective criteria and intense process of due diligence		It will restrict the number of companies with R&D facility and high standards for producing quality seed

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	Reputable companies that engage in domestic seed production support the quality control work of FSC&RD and do wish to have official certification labels (tags) on their bags as an aid to sales. The laboratories of FSC&RD have old equipment and would benefit from refurbishment.	<b>Strengthen the testing and inspection system to ensure quality seed</b>	<b>ST/MT</b>	MNFS&R FSC&RD	Needs investment through PSDP		This could be a legitimate target for institutional strengthening/ investment for those labs that are located in the provinces. The largest laboratory at Khanewal could also be used for training purposes in a range of seed-related topics.
	Computerization of field inspections of the seed crop and laboratory tests on samples of seed lots before they are sold can be an of immense benefit once the software has been developed and commissioned.	<b>Digitalize field inspection and monitoring system</b>	<b>ST/MT</b>	MNFS&R FSC&RD	Developing a software Investment from PSDP for establishing the system		Field inspections, require sufficient experienced staff who can travel extensively during the limited production season for each crop.
		<b>Need for varietal turnover</b>	<b>MT</b>	FSC&RD	The relevant institutions, variety release systems, and government seed companies can speed up varietal turnover by: 1) clearly identifying the new varieties they recommend, describing their advantages over the variety they are replacing, supported by reliable data; 2) aggressively demonstrating and		A key element in generating a culture of rapid varietal replacement is convincing farmers that it is in their interest to change varieties as soon as a new one is endorsed and made available by the seed system.

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					<p>promoting these varieties; 3) de-certification of obsolete varieties when they are superseded by better ones; 4) withdrawal of seed subsidies for obsolete varieties; 5) withdrawing funds from the production of breeder and foundation seed of obsolete varieties; 6) setting targets for the average varietal age in foundation seed production and in farmers' fields; 7) Simplifying and harmonizing variety release processes regionally to build private sector confidence and participation in the seed sector</p>		
	<p>Increasing climate variability and events of extreme weather are impacting food production, food stability and livelihoods of farmers. The national yields of almost all crops are low compared to peer group countries and productivity is declining over time because of climate change effects. It is important to reorient breeding programs to</p>	<p><b>Need for focusing on climate resilient breeding program</b></p>	ST/MT	<p>MNFS&amp;R NARC Provincial Agriculture Departments</p>	<p>Some of the initiatives are already underway in Pakistan testing drought tolerant, heat tolerant, salinity tolerant varieties of wheat and rice for multilocation trials in 2022.</p>		<p>Advancement in the field of breeding/genetics, bio-technology, and simulation modeling has made it possible to develop climate smart and resilient crops species and livestock breeds. The National Food Security Policy 2018</p>

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	develop climate resilient cultivars						underlines the policy measures towards this end.
	These Councils are either inactive or not meeting regularly. Their composition is also not representative.	<b>Reconstituting National and Provincial Seed Councils to make them more representative and participative to oversee the enforcement of Seed (Amendment) Act, 2015 and Plant Breeders' Rights Act 2016</b>	ST	MNFS&R Provincial Governments	The National and Provincial Seed Councils may be reconstituted to make them more representative, and their remit may be extended so that can provide a forum for discussion on all issues included in the policy.  These may also include representatives from private seed companies or their Associations having national character.		Better coordination and transparent decision making
	It is important to assess suitability of new varieties for different agro-ecological zones	<b>The Government may restrict its role to specifying standards and quality of seed varieties, registration, and strengthening regulatory mechanisms</b>			However, for this to happen the regulatory framework may extend to crops of commercial significance. Else, the large-scale evaluation may enhance the probability of piracy and stealing breeders' innovation		It will allow FSC&RD to focus its regulatory capacity on commercially important crops
	Many of the above themes contained in this report could be addressed by a bold initiative to establish an umbrella organization that would coordinate all seed activities within the province.	<b>provinces may consider creating Provincial 'Seed-hub'</b>	ST	Provincial Agriculture Departments	The main participants would be: <ul style="list-style-type: none"> <li>• Universities with strong agricultural/science programs;</li> <li>• Public research centers, with strong</li> </ul>		The Seed-hub can promote research, development, and production within the province but without encroaching on federal

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					breeding or biotech programs; <ul style="list-style-type: none"> <li>• The Seed Corporation, in its revised format;</li> <li>• Private companies that engage in research and or contract seed production;</li> <li>• The main office(s) of FSC&amp;RD that could contribute to training in seed-related topics;</li> <li>• The extension service – if they are involved in carrying out trials and demonstrations;</li> <li>• Premium seed growers who produce seed on contract for local companies; and</li> <li>• Manufacturers of agricultural equipment related to seeds.</li> </ul>		responsibilities. It should have a small secretariat that would, above all, provide information for its members and facilitate and collaborate between them. It can also publish monthly ‘The Seed News’ including seed quality, availability, latest varieties, and extension work.
	FSC&RD within Provinces should be upgraded and properly staffed	<b>Offices of FSC&amp;RD in the provinces need to be strengthened</b>	ST/MT	MNFSR	Hiring professional and well trained staff for the provincial offices		To serve the needs of companies and farmers in the province.
	The Amendment empowers the federal government to delegate all or any of its powers to (i) a Provincial Government; or (ii) an officer or authority subordinate to the Provincial Government; or	<b>FSC&amp;RD may invoke delegation of powers’ provision in the Seed (Amendment) Act 2015 to discharge its functions</b>	ST	MNFS&R FSC&RD	FSC&RD is understaffed with only 100 seed officers who are required to provide services to more than 700 seed companies and to conduct the regulatory		It will reduce the burden of FSC&RD and will make the provinces more responsible for enforcement



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	(iii) an officer or authority subordinate to the Federal Government.				<p>functions in the fields throughout Pakistan.</p> <p>FSC&amp;RD can utilize the manpower of the provincial extension or research departments by delegating its functions and powers as the field extension agents have far greater reach and can better serve the seed markets in the respective provinces.</p> <p>Provinces arrange for necessary manpower and building their capacity and manpower.</p>		
	There are too many associations representing groups interests.	<b>Need for a National Seed Association</b>	<b>ST</b>	Private Sector MNFS&R			It will lead to effective national seed association for better representation of the private sector and developing a culture of professionalism
		<b>Promoting Organic Farming</b>			The government may create enabling environment to promote organic farming		Help capturing the niche market as well as share in the global demand.

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Management Information System	Big data and its application in farming can go beyond simple production and even influence the food supply chain. The precise planting with use of data and technology can lower the input costs and increase the yield	<b>Need to develop big data and machine learning system</b>	MT	MNFS&R FSC&RD	The FSC&RD and provincial authorities should publish regular data on variety-specific production data,		Public disclosure of statistics will ensure better analysis and policymaking.  By monitoring yield data, GPS field maps and using machinery with variable rate technologies, farmers can adjust the seed planting density as well as the application rates for pesticides, herbicides, and nutrients with variations in moisture, topography, and soil quality.
	Developing a Seed Information Management System for FSC&RD will be a step forward in transforming manual data recording to digitize FSC&RD services.	<b>Developing a Seed Information Management System (SIMS) for FSC&amp;RD</b>  FSC&RD may digitalize national variety lists which may be available online along with security codes on packages to confirm their origin and contents	MT	MNFS&R FSC&RD	Making it mandatory for the companies to share information regarding sale of certified seed to the dealers with provincial extension departments for traceability of certified seed at the farmer level. <b>Modern communication technologies may be more effective at a moderate cost</b>		This will not only provide access to real time data but will also improve the efficiency and transparency in activities pertaining to seed quality regulation.  It can benefit both the regulators and private sector companies

## Annexures

### Annex-I History of Seed Development in Pakistan

**Phase I (1947 to late 1950s)** was characterized by small-scale research and development in the public sector<sup>92</sup> focusing on few major crops with no formal system of approval and registration for new seed varieties, as provincial agricultural departments after getting the seed from breeders were producing and distributing seed to farmers.

**Phase II (late 1950s to mid-1970s)** permeated the development of a network of public sector organizations<sup>93</sup>, mainly University of Agriculture (UAF Faisalabad), Ayub Agriculture Research Institute (AARI), West Pakistan<sup>94</sup> Agricultural Development Corporation (WPADC), designed to develop and deliver high yielding varieties, and promulgation of the West Pakistan Seeds and Fruit Plants Ordinance 1965 for providing legal instrument to register growers for production of certified seed for sale to the government, and establishment of nurseries. However, the Ordinance did not prohibit production of uncertified seed for the market.

**Phase III (mid-1970s to mid-1990s)** ushered an era of reform in the seed sector of the country based on the recommendations of the World Bank Mission under the Seed Industry Development Project (Salam, 2012) in early 1970s putting in place the key legal, physical, and institutional framework. The objective was to underpin the achievements of the ‘Green Revolution’ by providing a secure delivery channel for good quality seed of improved varieties from public research institutes to farmers. Major reforms included: (i) enactment of the Seed Act 1976, providing the regulatory framework for seed variety registration, quality control, and approval, and setting up the institutional infrastructure; (ii) establishment of Federal Seed Certification Agency and the National Seed Registration Agency as executive arms of the National Seed Council for quality seed regulations. The two agencies were merged in 1997 called the Federal Seed Certification and Registration Department (FSC&RD) (iii) establishment of public sector seed corporations; and (iv) establishment of seed production farms, setting up of testing laboratories, installing seed processing plants, and training seed technologists to strengthen the public sector. Thus, all the functions in the seed development chain—variety development, production of breeder nucleus seed,<sup>95</sup> pre-

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<sup>92</sup> Punjab Agricultural College and Research Institute, Lyallpur.

<sup>93</sup> It included bifurcation of Punjab Agriculture and Research Institute into UAF for research and teaching, and AARI for seed development and establishment of the WPADC for seed production in 1961 which ceased its operations in 1972 and was then administratively divided in the respective provinces, namely, the Punjab Agricultural Development and Supplies Corporation and the Sindh Agricultural Supplies Organization. The provincial governments took on seed production, multiplication, procurement, and distribution functions. Balochistan and the Northwest Frontier Province (NWFP, now Khyber Pakhtunkhwa) continued to rely on seed produced by Punjab and Sindh.

<sup>94</sup> The provinces of Punjab, Sindh, North-West Frontier Province, Balochistan, princely states, and Tribal Areas were merged into a single province called West Pakistan on October 14, 1955 after National Assembly of Pakistan passed a bill about their merger on September 30, 1955, which was dissolved on July 1, 1970.

<sup>95</sup> Breeder nucleus seed is the purest seed of a variety prepared by the breeder. Its progeny, called pre-basic seed, is also produced by a breeding institute or a seed company.)

basic seed and basic seed,<sup>96</sup> seed testing, and certification<sup>97</sup> remained with the public sector. The private seed sector was assigned a marginal role for seed multiplication at farmers' fields while truthfully labelled (local or imported) uncertified seed<sup>98</sup> continued to be sold by the private sector.

**Phase IV (mid-1990s onwards)** saw dramatic changes in the global industry with the rapid expansion of private sector contribution, even in many developing countries. The same trend has been observed in Pakistan in line with trade liberalization and reforming agriculture factor markets' policies of the government with the registration of a first seed company in 1981. Moving on, in 1994, seed business was categorized as an industry. Since then, there has been a rapid growth of indigenous seed companies, with emphasis on cotton and vegetable seeds, the latter being mostly imported from the global seed trade.

**Phase V (post-18<sup>th</sup> Constitutional Amendment in 2010)** is imbued with reforming the legal regime as well as tensions between federal and provincial entities. Agriculture has remained a provincial subject under the 1973 Constitution and therefore, provincial governments were empowered to regulate the seed business within their jurisdiction. Nevertheless, the provincial governments, on the persuasion of the federal government, delegated their legislative power to the latter under Article 144 in the interest of legislative harmony and the Seed Act 1976, was enacted. Post-18<sup>th</sup> Constitutional Amendment, the Ministry of Food, Agriculture, and Livestock (MINFAL) was abolished, and its functions were devolved to the provinces in 2010 followed by enactment of: (i) The Seed (Amendment) Act, 2015; (ii) Seed (Business Regulation) Rules, 2016; (iii) the Plant Breeders Rights Act, 2016; and (iv) the Plant Breeders Rights' Rules 2018.

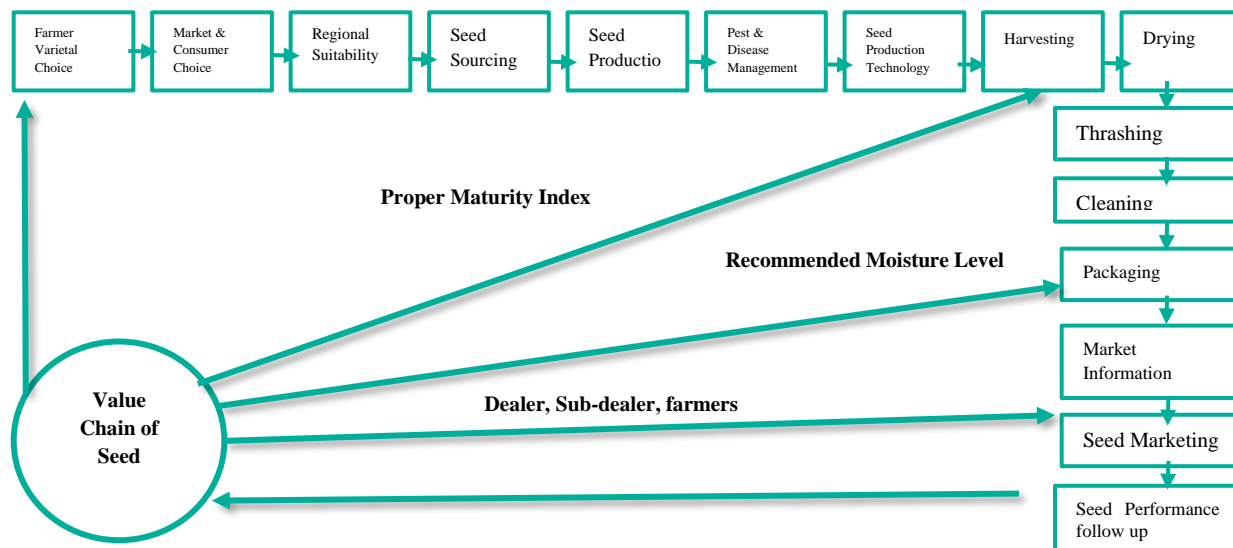
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<sup>96</sup> Basic seed is the progeny of the pre-basic seed. Under the Seed Act, 1976, basic seed may be produced only by a public-sector organization (e.g., a seed corporation). In practice, however, seed companies also produce basic seed of their own varieties.

<sup>97</sup> Certified seed is the progeny of basic seed, produced by registered growers of seed-producing entities and certified by the government.

<sup>98</sup> Truthfully uncertified seed is sold under the Seeds (Truth-in-Labeling) Rules, 1991.

## Annex-II Seed's Value Chain



Source: Adapted from various sources of literature

## Annex-III No of Registered Seed Companies

Type of company	Punjab	Sindh	KPK	GB	Balochistan	Total
Public sector	1	1	1	–	1	4
Private (national)	721	112	32	3	5	873
Private (multinational)	4	1	–	–	–	5
<b>Total registered</b>	<b>726</b>	<b>114</b>	<b>33</b>	<b>3</b>	<b>6</b>	<b>882</b>

## Annex-IV Details of Various Acts and Rules Regulating the Seed Industry in Pakistan

### 1. Seed Act 1976

The Seed Act of 1976 and rules framed under it provides principles for seed quality regulation, certification, and registration of crop varieties, establishes an institutional framework for the seed sector for regulation and certification, lays down penalties for commercialization of unbranded or unregistered seed and defines various categories of seed.<sup>99</sup> The Act, as stipulated in the preamble of the Act “controlling and regulating the quality of seeds of various varieties of crops”, provided complete regulatory control to the public sector over the development, processing, distribution of seed varieties and marginalized the private sector. This created a major impediment for the private sector interest in the development of seed. Nevertheless, the registration of first private company in 1981 and declaration of *seed as industry* in 1994 saw the sprawling of private seed companies, as highlighted *supra*, operating in the informal sector to meet the rising demand. This phenomenon soon made the Act irrelevant.

### 2. Seed (Amendment) Act, 2015

Recognizing the weaknesses in the Seed Act, 1976, as is observed from the ‘Statement of Objects and Reasons’ signed by the Federal Minister for the Ministry of National Food Security and Research (MNFS&R) “the Seed Act 1976 does not fulfil the requirements of the modern seed industry. Over the years, the capacity of the public sector has been vastly impaired, and the private sector is playing stronger and more vibrant role in the development of seed industry, the world over. The new innovations in hybrid technology and Genetically Modified Crops (GMCs) have transformed the seed industry. The new Seed Amendment Bill has been drafted in view of the emerging realities which will provide level playing field to both public as well as the private sector,” the Seed (Amendment) Act, 2015 Bill was introduced in the Parliament.<sup>100</sup>

### 3. Delegation of Powers under the Seed Act

The Federal Government is empowered to direct that, all or any of its powers under the Seed Act, 1976 and 2015 amendment, can be exercised by (i) a Provincial Government; or (ii) an officer or authority subordinate to the Provincial Government; or (iii) an officer or authority subordinate to the Federal Government.

### 4. Seed (Truth-in-Labeling) Rules, 1991, amended in 1993 and 1998

The Seed (Truth-in-Labeling) Rules, 1991, regulating the imported seed in Pakistan stipulates that:

- a. Varieties approved by the Agriculture Research Institutes and notified by the Federal Government in the National Register for seed and crop production in Pakistan can be imported.

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<sup>99</sup> (i) “Pre-basic seed”, seed of high genetic purity produced by a plant breeder; (ii) “Basic seed”, seed produced by an organization set up by a Provincial Government for the purpose, redefined in 2015 as progeny of the pre-basic seed produced by any public sector or private sector organization and certified by the Federal Seed Certification and Registration Department; (iii) “Approved seed”, seed true to species as approved by the Federal Seed Certification Agency, renamed as Federal Seed Certification and Registration Department in 2015; (iv) “Certified seed”, seed certified by the Federal Seed Certification and Registration Department in 2015; and (v) “Notified variety” or species as a variety or species which has been notified under Section 10 of the Act.

<sup>100</sup> Available at [https://senate.gov.pk/uploads/documents/1427261685\\_555.pdf](https://senate.gov.pk/uploads/documents/1427261685_555.pdf) accessed on November 30, 2021.

- b. Only experimental quantity not exceeding 10 kg is allowed to be imported.
- c. The seed container must carry the name of the person or company who produces or packs and markets the seed. The marking or labeling information will be shown conspicuously, legibly and indelibly in English or Urdu including the following information while marketing the seed: (a) Lot No; (b) Crop/Species; (c) Variety; (d) Pure seed %; (e) Germination %; (f) Other crop seeds %; (g) Weed seeds %; (h) Inert matter %; (i) Month/Year of production; and (j) Date of expiry.

FSC&RD issues around 3000 seed testing certificates annually for seed import consignments.

## 5. Plant Breeders' Rights Act, 2016

**Pakistan enacted the Plant Breeders' Rights Act (PBRA) in 2016** to protect breeders' rights either by patents or by an effective *sui generis* system or with a combination of both, to fulfill its obligations under Article 27.3 (b) of the Trade Related Intellectual Property Rights Agreement (TRIPS)<sup>101</sup>. Pakistan is not a member of the International Union for Protection of New Varieties of Plants (IUPOV), the Government of Pakistan has attempted to make PBRA, 2016 consistent with the standards set by the IUPOV Convention, 1991, and TRIPS compliant. A comparison of the PBRA 2016 and the standards provided by the International Union for Protection of New Varieties of Plants (IUPOV) Convention, 1991, is in Annex-V.

## 6. Seed (Business Regulations) Rules 2016

**The Seed Act of 1976 did not require the registration of private seed companies (businesses) which was addressed through administrative action.** The Economic Committee of the Cabinet in its meeting held on December 31, 1979, constituted an inter-ministerial Working Group<sup>102</sup> made responsible for evaluating the proposals and registration as well as deregistration of new seed companies in the country.<sup>103</sup> Since the Working Group was not backed by legal cover, the seed companies started establishing their businesses under the Companies Ordinance, 1984 (now the Companies Act, 2017). Nevertheless, this anomaly has been rectified. Now, Section 22B of the Seed (Amendment) Act, 2015 read with the Rule 4 of the Seed (Business Regulation) Rules, 2016 prescribes a detailed procedure as well as documents required for registration of seed business in Pakistan. A Working Group, now have legal cover<sup>104</sup>, shall grant registration for five years to do seed business in respective categories on the recommendation of FSC&RD.

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<sup>101</sup> Members may also exclude from patentability: (a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals; (b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO Agreement.

<sup>102</sup> The Group included the Director General of FSC&RD, Secretaries of provincial agriculture departments, Managing Directors of the Punjab and Sindh Seed Corporations, a representative of the Planning Commission of Pakistan and Chaired by the Agriculture Development Commissioner of the Federal Ministry of Food and Agriculture.

<sup>103</sup> Akhlaq Hussain, 2011. "Status of Seed Industry in Pakistan." Presentation at World Bank Roundtable Discussion on Agriculture and Water, Islamabad, Pakistan. March 10–11.

<sup>104</sup> The Working Group now comprises of an officer of BS-21 of MNFS&R to act as the Chairman, Secretaries Agriculture of the Provinces, Chief (Food and Agriculture Section), Planning and Development Division, Food Security Commissioner-(II), MNFS&R, Director General Federal Seed Certification and Registration Department, Cotton Commissioner, Ministry of Textile Industry, Director Intellectual Property Organization(IPO-Pakistan), Managing Directors, Punjab Seed Corporation and Sindh Seed Corporation, representative of the Seed Association of Pakistan and Deputy Food Security Commissioner (II), MNFS&R to act as Secretary of the Group.

## 7. Bio-safety Rules and Bio-safety Guidelines 2005

**These Rules have been legislated under Pakistan Environment Protection Act, 1997.** These Rules and Guidelines set up three Committees: (i) National Bio-Safety Committee (NBC); (ii) Technical Advisory Committee (TAC); and (iii) Institutional Bio-Safety Committee (IBC). The first two Committees are constituted at federal level and are part of the Ministry of Climate Change while the third is required to be instituted at all private and public institutes handling living beings at the molecular level. Leading research companies and institutes have established Institutional Bio-Safety Committees to oversee biosafety aspects of their research and development projects. The evaluation reports of these Committees are sent to the TAC. The TAC assesses IBCs applications and evaluation reports, observe field activities, and gather data necessary for biosafety purposes. The recommendations are then present to NBC (Arash, et al., 2013).

**The Federal Government substituted MINFAL and Ministry of Environment with the Ministry of National Food Security and Research and the Ministry of Climate Change respectively, assigning them functions not devolved to the provinces in 2010.** The FSC&RD was first assigned to the Ministry of Science and Technology and then to the MNFS&R. Similarly, jurisdiction of administering biosafety rules is now the responsibility of the Ministry of Climate Change. Punjab (2014) and Balochistan (2020) have framed their own biosafety rules under respective provincial Environment Protection Agency Act. Concurrent jurisdictions regarding biosafety rules is causing confusion.

## 8. West Pakistan Seeds and Fruit Plants Ordinance, 1965

The law requires enrolment of cultivators of the confirmed seeds and foundation of nurseries. The government will sell the certified seed and surplus licensed seed could be sold in the open market. However, the law does not disallow creation of uncertified seed which caused a large number of private nurseries and seed in the informal market.

## 9. The Pakistan Fruit Plants Certification Rules of 1998

The Rules regulates the systems for enlisting plant ‘nurseries’, ensuring organic product plants, and labeling guaranteed root stock. It requires that Prebasic class (Foundation Block) – A planting of fruit trees should be grown at research institutes or universities. These trees of such planting shall be certified and serve as a primary source of propagating materials. Certified Nursery Plants have been defined as a nursery grown seedlings, colonel root-stocks, and nursery grown trees propagated by using scion from registered trees and rootstock originating from registered trees.



## Annex-V Comparison of PBRA 2016 and IUPOV Convention 1991

<b>Topic</b>	<b>IUPOV</b>	<b>PBRA</b>	<b>Deviation</b>
Plant Variety	Article 1(vi)	Section 2(xxii)	Fully consistent
Criteria of new plant Variety	Articles 5 (1) to 9	Must meet the features of novelty (if it has not been sold or marketed by or with the agreement of the applicant for more than one year in Pakistan, for more than six years in the case of trees or vines, and for more than four years in the case of all other plants in a foreign country before filing of the application for the certificate), distinctness (if it clearly differs by one or more identifiable morphological, physiological or other characteristics from any other variety whose existence is a matter of common knowledge on the date of filing of the application for a certificate), uniformity (if, subject to the variation that may be expected from the particular features of its propagation, it is sufficiently uniform in its essential characteristics), stability (if its relevant characteristics remain unchanged after repeated propagation, or in the case of a particular cycle of propagation, at the end of each cycle) and designated by an acceptable denomination as described (FSC&RD) carries out a technical examination for distinctness, uniformity and stability of a plant variety of an application filed for protection of a new plant variety in Pakistan) under Section 12 of the Act	Fully consistent
Requirements for Protection of Rights	Article 10	Section 15 described the requirements for an application for protection of rights by plant breeders	
Publication of Accepted Application		Section 18 requires the Registrar to publish accepted applications for protection in the Plant Breeders' Rights Journal in a prescribed manner	
Opposition to Protection		Section 19 allows a person to give written notice of opposition to the grant of rights, along with documentary evidence, to the Registrar within four months from the date of advertisement. The opponent may invoke any of the following grounds: (a) the opponent is entitled to rights for the new variety; (b) the variety does not meet criteria for protection under the Act; (c) the grant of certificate is not in public interest; and (d) the variety may have adverse effects on the environment, human, animal or an opportunity for both the applicant and the opponent to be heard.	
Rights of a Plant breeder	Article 14	Section 22 provides exclusive rights to the owner of a protected variety, viz. (a) offering for sale or selling or marketing of the reproductive or vegetative propagating material of the protected variety in Pakistan; (b) importing the reproductive or vegetative propagating material of the protected variety into Pakistan or exporting it from Pakistan; (c) conditioning or multiplying the reproductive or vegetative propagating material of the protected variety; (d) carrying out of any of the acts identified in clauses (a), (b), and (c) in relation to an essentially derived variety provided the provided variety is not itself an essentially derived variety; (e) instigating or promoting any of the acts identified in clauses (a), (b), (c) and (d); (f) authorizing any person to produce, sell, market or otherwise deal with a	Fully consistent

Topic	IUPOV	PBRA	Deviation
		protected variety; and (g) stocking for any of the purposes mentioned in clauses (a) to (d).	
Disclosure of Origin of a variety		<p>Section 15(f) of the PBRA, 2016, requires a full disclosure while applying for protection of variety including “a complete identification data of the parental lines from which the variety has been derived along with the geographical location in or outside Pakistan from where the genetic material has been taken setting forth its novelty, parentage or pedigree, breeding history and drawing or photograph to understand and evaluate the novelty of the variety.”</p> <p>Likewise, clauses (g) and (h) of Section 15 of the PBRA requires that the application for protection of variety must be “accompanied by written consent of the authority representing the public sector, private sector, or the local community in cases where the plant variety is developed from traditional varieties” along with “documents relating to the compliance of any law regulating access to genetic and biological resources.”</p>	
Exceptions	Article 15	<p>Section 25 provides exception to the farmers entitling them to save, use, sow, resow, exchange, share or sell his farm produce provided that the farmer shall not be entitled to sell seed of a variety protected under the Act on a commercial basis. However, these exceptions have been constrained by the requirements of the Seed Act, 1976.</p> <p>Section 12 of the Seed (Amendment) Act, 2015, provides that sharing and selling of unbranded and unregistered seeds is prohibited under the Act. Under the Act, the farmers are left with the only choice to purchase registered varieties of seeds from licensed seed companies or their agents. The Seed (Amendment) Act clearly protects the private interests of foreign companies. The Act has redefined the ‘basic seed’ to include private sector organizations in its definition. Under the Act, the ‘basic seed’ means ‘progeny of the pre-basic seed produced by any public sector or private sector organization and certified by the Federal Seed Certification and Registration Department.’<sup>30</sup> One of the main purposes of the Act is to deter the sale of fake and substandard seeds, but it can potentially create a commercial monopoly of profit-driven seed companies and make farmers pay higher prices for protected seed varieties.</p>	Fully consistent
Benefit Sharing		Section 32 of the PBRA entitles the owner of the initial variety to claim benefit sharing in plant varieties which are derived from the initial variety for which the Registrar is required, through advertisement, to invite claims of benefit sharing and after due hearing and scrutiny of claims, he will pass an order (a) variety relating to which the benefit sharing has been claimed; (b) the commercial utility and demand in the market of the variety relating to which the benefit sharing has been claimed; and (c) The amount of benefit sharing.	

<b>Topic</b>	<b>IUPOV</b>	<b>PBRA</b>	<b>Deviation</b>
Safeguards against the abuse of exclusive rights	Article 17	<p>Sections 33, 34 and 35 of the PBRA provides safeguards against potential abuse of exclusive rights as the law authorizes the Registrar to grant a “compulsory license” after providing an opportunity of being heard to the owner of the certificate as well as the interested persons and that too only after the expiry of 3 years from the date of grant of a certificate. The grounds on which a compulsory certificate can be issued include: (a) the public interest, in particular, the nutrition or health so requires; (b) the Registrar has determined that the manner of exploitation, by the owner of the certificate or his licensee, is anti-competitive; (c) reasonable requirements of the public for seeds or other propagating material of the variety have not been satisfied or that the seed or other propagating material of the variety is not available to the public at a reasonable price; (d) the owner of the certificate refuses to grant a license to a third party on reasonable commercial terms and conditions; or the right under the certificate has not been exploited in a manner which contributes to the promotion, transfer and dissemination of technology. The Registrar is empowered to determine the duration of compulsory license not exceeding 5 years and can revoke the license if any of the terms and conditions have been violated.</p> <p>Nevertheless, there is a general perception that the compulsory licensing safeguard clause may not be invoked as there is not a single instance when similar provision for compulsory license included in the Patent Ordinance 2000 was invoked.</p>	



## Annex-VII Composition and functions of Various Committees

### 1. Federal Seed Registration Committee (FRSC)

#### Composition of FSRC

1. Food Security Commissioner-II, MNFS&R	Chairman
2. Director Generals of Agriculture Research, Punjab, Sindh Khyber Pakhtunkhwa and Balochistan	Member
3. Director General, Federal Seed Certification and Registration Department	Member
4. Member Plant Sciences Division / Representative of PARC	Member
5. Director Research, Pakistan Central Cotton Committee	Member
6. One representative from Pakistan Atomic Energy Commission (PAEC)	Member
7. Professor of Plant Breeding and Genetics of Agricultural Universities (on rotation basis)	Member
8. One Representative from Seed Association of Pakistan	Member
9. One representative from Multinational Seed Companies	Member
10. Director (Seed Registration), FSC&RD	Secretary

**Functions of FSRC are to:** (a) assess suitability of varieties for registration in regard to, inter alia, distinctness, uniformity, stability and value for cultivation and use based on recommendations of the provincial government; and (b) recommend the registration of new varieties and areas for their suitability.

### 2. Federal Seed Committee (FSC)

#### Composition of FSC

1. The Secretary, Ministry of National Food Security and Research	Chairman
2. Chairman, Pakistan Agricultural Research Council	
3. Secretaries Agriculture, Government of Punjab, Sindh, Balochistan and Khyber Pakhtunkhwa	
4. Managing Directors, Punjab and Sindh Seed Corporations	
5. Representatives of the Agriculture Universities	
6. Nominated member of Seed Association of Pakistan (02)	
7. Nominated Member of Multinational Seed Companies.	
8. Progressive farmers from Provinces (04)	
9. The Director General Federal Seed Certification and Registration Department	Secretary

**Functions of the FSC are** to (a) review an overall requirement and availability of quality Seed in the country; (b) recommend on initiation of seed sector development projects at national level; (c) recommend National Seed Standards for the production of quality seeds of various crops; (d) approve and review rate of fee to be levied for the provision of seed certification and regulatory services; (e) facilitate the provincial seed councils on matters pertaining to release of crop varieties in more than one province; and (f) recommend to the government on any supplementary or incidental issue pertaining to seed industry.

### 3. Variety Evaluation Committee (VEC)

#### Composition of VEC

1. Member, Plant Sciences Division (PSD), PARC	Chairman
2. Vice President Pakistan Central Cotton Committee (PCCC)	
3. Food Security Commissioner-II, Ministry of National Food Security and Research	
4. Secretaries of the Provincial Seed Councils	

5. Director General of Agriculture Research (All Provinces)
6. Directors of concerned crop commodity Research Institutes/Stations (all provinces)
7. Director General Agricultural Research, AJK and Gilgit Baltistan
8. Representatives of private seed sector (02)
9. Director General, Environmental Protection Agency
10. Director Crop Disease Research Institute (CDRI), NARC
11. Director General, Federal Seed Certification & Registration Department
12. National Coordinator, (Concerned crop commodity) PARC

**VEC is responsible to** (a) ensure the impartial evaluation of candidate varieties and hybrids of public and private seed sector across the country or areas of special interest as proposed by the concerned institutes and seed company or seed importers; (b) carry out National Uniform Yield Trials<sup>105</sup> in coordination with FSC&RD; (c) ensure that sites for conducting National Uniform Yield Trials are kept across the country involving all stakeholders of the crop concerned; (d) convene at least one meeting for each crop during a calendar year; and (e) performance of its function may co-opt technical members from any public or private sector organization.

#### **4. Variety Evaluation (VE) Sub-Committee**

##### **Composition of VE Sub-Committee**

- |  |           |
|--|-----------|
| 1. Director (Seed Registration), FSC&RD                                    | Chairman  |
| 2. Representatives of the Provincial Research Institute (respective crops) |           |
| 3. one representative of the Seed Importers                                |           |
| 4. Program Leader/ National Coordinator (Respective Crop), PARC            |           |
| 5. Deputy Director, Seed Registration, FSC&RD                              | Secretary |

**Functions of the VE Sub-Committee are to:** (a) recommend varieties or hybrids for enlisting and import on behalf of the Variety Evaluation Committee; (b) propose on conducting adaptability trials of minor crops and recording and processing of data; (c) recommend to delist an enlisted variety or hybrid in case it loses its stability of characters for which it was listed originally; and (d) meet 3-4 times during a calendar year as mutually agreed.

1. Adaptability trials will be conducted by the designated public sector research institute *i.e.* Pakistan Agricultural Research Councils' respective crop commodity programs or Vegetable Research Institute, AARI, Faisalabad or Agricultural Research Institute, Tarnab, or Agriculture Research Institute Tandojam or Agriculture Research Institute, Sariat, Quetta. Importers, if deemed necessary may send their varieties and hybrids with temporary designations (codes) but original names will have to be disclosed for recommendation of variety or hybrid for import and distribution in Pakistan and eventually would be enlisted with the original name;
2. The data generated during evaluation shall be submitted to the VEC sub-committee for further recommendation for import or enlisting of a variety or hybrid;
3. The exporting company which owns a variety or hybrid shall be entitled to decide about the exclusive or inclusive rights for import of a specific enlisted variety or hybrid;
4. Imported hybrids of rice, maize, and oilseeds, shall be recommended by the VEC on the basis of two seasons' multi-location trials. The varieties of seed potato and oilseeds shall be dealt with similar procedures. In addition to VEC recommendation, evidence pertaining to varietal or hybrid development history and essential morphological characters shall be required to be submitted to FSC&RD for regulation under Seed (Truth in Labeling) Rules, 1991 along with its subsequent amendments. If desired, for potato, fodders and oilseeds imported

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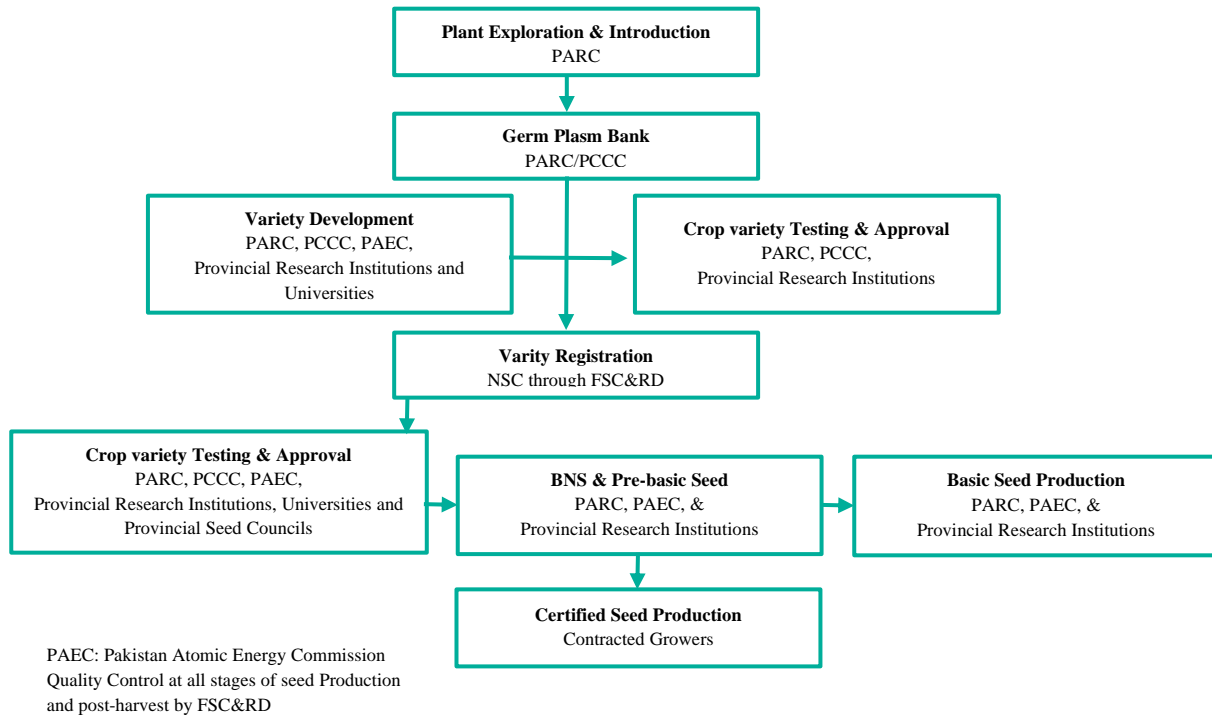
<sup>105</sup> **National Uniform Yield Trials** means "trials conducted throughout Pakistan by PARC for evaluation of candidate varieties by the collaboration of Provincial and Federal research institutes, private seed sector, public seed corporation farms etc."

crop varieties, the DUS trials for registration shall be conducted along with the Value for Cultivation and Use (VCU) or NUYT trials to enable local certified seed production;

5. To facilitate the local production of enlisted hybrids, in addition to two seasons' multi-location trials by the VEC, the seed producers shall be required to submit morphological characters of inbred lines as well as the hybrid to FSC&RD for ascertaining purity of the hybrids at the time of seed production;
6. National Register of enlisted varieties shall be maintained and regularly updated by FSC&RD as well as it will be made accessible on line; and
7. the seed of enlisted varieties and hybrids, imported or locally produced shall be sold as truthfully labeled under **Seed (Truth in Labeling) Rules, 1991** along with subsequent amendments in it.
5. **Regional Fruit Plants Nursery Registration Committees** shall be constituted and responsible for (a) recommending the applicant fruit tree nurseries of the area to be registered by the FSC&RD for a period of 5 years; and (b) recommending de-registration of fruit nurseries which are non-compliant of rules and procedures.

## Annex-VIII Seed Registration and Certification

**Figure A-VIII. Activities and Agencies Involved in Seed Registration and Certification**



Source: FSC&RD



## Annex-IX Process of Variety Registration and Release System in Pakistan

1. **Crop Inspection:** The purpose of crop inspection is to determine whether the crop is suitable to produce seed of the standard required. The genetic purity of seed crop is assessed through field crop inspection. Inspection is carried out only for notified varieties based on physio-morphology characteristics developed through DUS studies. Before carrying out crop inspection, the following preliminaries are verified: (i) Verification of the source from the labels, seals, bags or receipt of seed purchased; (ii) Acreage and location of the seed field; (iii) Cropping history of the field where the seed crop is grown; (iv) Isolation distance of seed crops from other crops; (v) Condition and health of the crop to carry out crop inspection properly. Crop must not be very much weedy or damaged; (vi) Application from grower or seed agency, requesting for crop inspection. If all these conditions are found satisfactory then a detailed assessment of the crop is carried out to determine the following factors: (a) Admixture with other cultivars; (b) Admixture with other species; (c) Presence of weeds particularly obnoxious weed plants; and (d) Presence of seed-borne diseases.

After the crop inspection, the grower or seed company is informed about the decision/recommendations or other measures, necessary to bring the crop up to the prescribed standards. At final inspection, a certificate is issued by the department on the prescribed form.

2. **Seed Testing:** Seed testing is carried out to assess the analytical purity of seed lot. The following steps are taken to ensure quality of seed lot.
3. **Submission of application for sampling:** Seed samples are drawn from the produce whose fields have been certified subject to the prescribed written request by the grower. Three samples are drawn from each seed lot by the officer of the FSC&RD according to the method as prescribed in ISTA rules (1990). One sample is given to the respective seed testing laboratory and 2nd is handed over to the grower or seed agency. The 3rd sample is submitted to the central seed testing laboratory for post control check.
4. **Requirement for seed lots to be sampled:** It should be ensured before seed sampling that seed lot must be homogeneous. The credibility of results depends on the representative samples. Number of seed samples are drawn according to the size of seed lot.
5. **Seed analysis:** Working samples are made from the submitted samples in the laboratory. Each seed of the working seed samples is physically examined using magnifying lens. Doubtful seeds are further examined under stereo-microscope. Every crop seed is examined for purity based on morphological characters of particular crop variety. Seed sample is analyzed for the assessment of the following factors: (i) Purity (pure seed); (ii) Mixture of the crop seed (other distinguishable varieties); (iii) Presence of weeds; (iv) Inert matter; (v) Seed-borne diseases; (vi) Moisture test; (vii) Thousand seed weight; (viii) Germination; and (ix) Seed lots are rejected or accepted on the basis of seed standards prescribed by the National Seed Council for individual crops.
6. **Issuing of seed analysis certificate and temporary labels:** After the seed analysis in the laboratory for the above-mentioned factors, certificate of fitness is issued by the department and temporarily labels are also issued. These labels carry the following information printed on it: (i) Federal Seed Certification and Registration Department; (ii) Reference number; (iii) Species; (iv) Cultivar; (v) No. of bags/containers; and (vi) Approximate weight of seed lots.
7. **Seed sampling during processing and issuing of final labels and seals:** All the seed lots are processed at processing plants/units by the seed agency. During processing, seed samples are drawn and analyzed in the

laboratory. After this, a certificate is issued on the prescribed form and final labels and seals are also issued on the spot.

8. **Re-testing of seed lots:** To assess any deterioration during storage, a re-test sample is drawn from each lot at two months prior to its actual distribution/sale. Seed samples are analyzed for all the factors as mentioned above. Finally, the seed agencies are allowed to offer seed lots cleared by the FSC&RD.
9. **CHECKING OF SEED LOT DURING MARKETING AND IMPORT OR EXPORT:** To check the sale of deteriorated, inferior and low-quality seed, the Federal Seed Certification Department monitors the quality of seed during distribution and marketing. The department has established a system of seed testing under the Seed (Truth-in-Labeling) Rules, 1991 and in accordance with the guidance of import policy 1999. Seed samples are drawn from all the seed consignments and tested for their analytical purity and germination. The label placed on the containers is verified. If the seed lot does not match with the information given on the label, the consignment is not allowed to be sold as seed in Pakistan.

### **Variety Development and Release System in Pakistan**

**Plant breeders test their promising strains in micro varietal trials, breeding stations, sub-stations and the zonal varietal trials for a sufficient number of years.** When a breeder selects a variety after sufficient years of testing, he submits it to PARC for evaluation of its value for cultivation and use. Simultaneously, breeder submits a seed sample of that variety to FSC&RD for evaluation of distinctness, uniformity, and stability (DUS-statutory obligation for registration). A variety that meets the requirements of Value for Cultivation and Use (VCU) conducted by Variety Evaluation Committee and DUS is accepted for registration by the FSC&RD. The department submits its DUS report to FSRC. The committee evaluates the report regarding DUS and VCU and recommends its registration. The National Seed Council approves the registration and release of a variety.

## Annex-X Seed Requirement and Availability

Table A- X. Requirement and Availability of Improved Seed in Pakistan (FSC&RD)											
Year	Crop	Area (000 Ha)	Total Seed Requirement MT	Seed Availability (MT)				Seed Availability as %age of Total Requirement Percent			
				Public	Private	Imported	Local + Imp	Public	Private	Imported	Total
2015-16	Wheat	9,110	1,093,200	86,200	335,415	0	421,615	8	31		39
	Cotton	3,200	55,329	687	28,676	0	29,363	1	52		33
	Paddy	2,830	55,268	3,322	43,097	5,299	51,717	6	78	10	94
	Maize	1,109	33,261	656	17,078	16,145	33,878	2	51	49	102
	Oil Seed	830	10,790	3	529	99	631	0	5	1	6
	Pulses	1,337	48,132	747	2,435	0	3,182	2	5	0	7
	Vegetables	280	8,400	96	874	9,149	10,119	1	10	109	120
	Fodders	2,038	61,140	5	7	36,487	36,499	0	0	60	60
	Potato	149	372,725	0	0	6,837	6,837	0	0	2	2
	<b>All Crops</b>	<b>20,883</b>	<b>1,738,245</b>	<b>91,715</b>	<b>428,110</b>	<b>74,015</b>	<b>593,841</b>	<b>5.238</b>	<b>24.63</b>	<b>4.26</b>	<b>34.16</b>
2016-17	Wheat	9,110	1,093,200	63,442	375,876	0	439,318	6	34		40
	Cotton	3,200	55,329	1,246	42,830	0	44,076	2	77		80
	Paddy	2,830	55,268	3,268	48,311	8,050	59,629	6	87	15	108
	Maize	1,109	33,261	470	7,428	12,437	20,334	1	22	37	61
	Oil Seed	830	10,790	0	65	408	473	0	1	4	4
	Pulses	1,337	48,132	1,197	4,200	0	5,397	2	9	0	11
	Vegetables	280	8,400	62	321	11,261	11,644	1	4	134	139
	Fodders	2,038	61,140	0	5,904	34,931	40,835	0	10	57	67
	Potato	149	372,725	0	0	7,126	7,126	0	0	2	2
	<b>All Crops</b>	<b>20,883</b>	<b>1,738,245</b>	<b>69,684</b>	<b>484,935</b>	<b>74,212</b>	<b>628,832</b>	<b>4</b>	<b>28</b>	<b>4</b>	<b>36</b>
2017-18	Wheat	8,945	1,104,658	45,694	398,232	0	443,925	4	36	0	40
	Cotton	2,955	58,391	1,354	54,087	0	55,441	2	93	0	95
	Paddy	2,805	54,782	4,074	66,301	8,906	79,281	7	121	16	145
	Maize	1,170	35,079	220	6,537	16,653	23,409	1	19	47	67
	Oil Seed	830	10,790	7	357	147	511	0	3	1	5
	Pulses	1,185	42,674	902	2,392	0	3,293	2	6	0	8
	Vegetables	280	8,400	76	790	11,681	12,547	1	9	139	149
	Fodders	2,038	61,140	34	6,041	38,272	44,347	0	10	63	73
	Potato	166	415,000	0	0	7,126	7,126	0	0	2	2
	<b>All Crops</b>	<b>20,374</b>	<b>1,790,914</b>	<b>52,361</b>	<b>534,736</b>	<b>82,785</b>	<b>669,882</b>	<b>3</b>	<b>30</b>	<b>5</b>	<b>37</b>
2018-19	Wheat	8,833	1,090,925	58,874	424,478	0	483,352	5	39	0	44
	Cotton	2,955	58,391	1,569	64,323	0	65,893	3	110	0	113
	Paddy	2,879	42,393	5,217	67,707	9,947	82,871	12	160	23	195
	Maize	1,328	32,794	741	2,553	18,901	22,195	2	8	58	68
	Oil Seed	830	10,790	100	378	409	887	1	3	4	8
	Pulses	1,185	42,674	672	1,652	0	2,323	2	4	0	5
	Vegetables	280	8,400	109	5,296	5,681	11,085	1	63	68	132
	Fodders	2,038	61,140	43	27,534	50,506	78,083	0	45	83	128
	Potato	166	415,000	550	422	4,735	5,707	0	0	1	1
	<b>All Crops</b>	<b>20,495</b>	<b>1,762,507</b>	<b>67,874</b>	<b>594,342</b>	<b>90,179</b>	<b>752,395</b>	<b>4</b>	<b>34</b>	<b>5</b>	<b>43</b>
2019-20	Wheat	8,709	1,075,562	68,578	444,909	0	513,487	6	41	0	48
	Cotton	2,310	45,646	880	32,921	0	33,801	2	72	0	74
	Paddy	2,957	44,148	4,978	49,287	9,530	63,795	11	112	22	145
	Maize	1,339	33,071	212	2,289	13,114	15,615	1	7	40	47
	Oil Seed	830	10,790	356	429	893	1,678	3	4	8	16
	Pulses	1,185	42,674	504	2,329	0	2,833	1	5	0	7
	Vegetables	280	8,400	0	1,171	2,987	4,158	0	14	36	50
	Fodders	2,038	61,140	10	4,441	22,015	26,465	0	7	36	43
	Potato	166	415,000	10	0	5,996	6,006	0	0	1	1
	<b>All Crops</b>	<b>19,814</b>	<b>1,736,430</b>	<b>75,528</b>	<b>537,776</b>	<b>54,535</b>	<b>667,839</b>	<b>4</b>	<b>31</b>	<b>3</b>	<b>38</b>

## Annex-XI Availability of Certified Seed

Year	Wheat			Paddy			Maize		
	Requirement	Availability	%age	Requirement	Availability	%age	Requirement	Availability	%age
1995-96	1,005,180	78,929	8	30,265	1,848	6	18,774	1,854	10
1996-97	973,092	73,618	8	31,515	1,378	4	18,554	1,961	11
1997-98	1,002,552	78,544	8	32,442	2,047	6	18,652	1,498	8
1998-99	987,588	104,213	11	33,930	2,281	7	19,244	3,028	16
1999-00	1,015,560	106,379	10	35,216	3,845	11	19,234	2,564	13
2000-01	981,708	159,220	16	33,272	2,106	6	18,882	2,119	11
2001-02	966,900	134,954	14	29,599	3,541	12	18,832	2,636	14
2002-03	964,068	120,610	13	31,153	4,678	15	18,710	4,040	22
2003-04	985,944	135,499	14	34,448	7,547	22	18,942	5,321	28
2004-05	1,002,960	173,557	17	35,274	9,840	28	19,456	8,867	46
2005-06	1,013,748	166,627	16	36,700	12,157	33	20,840	9,063	43
2006-07	1,029,384	203,837	20	36,137	10,727	30	20,338	8,647	43
2007-08	1,025,976	188,879	18	35,216	11,474	33	21,034	9,951	47
2008-09	1,085,520	196,029	18	41,476	22,688	55	21,042	12,380	59
2009-10	1,095,792	284,344	26	40,363	22,253	57	18,702	9,785	33
2010-11	1,085,400	319,023	29	42,480	28,895	68	31,914	9,041	28
2011-12	1,085,400	259,904	24	42,480	34,528	81	31,914	12,550	39
2012-13	1,085,400	259,904	24	42,480	49,492	116	31,914	14,008	44
2015-16	1,093,200	421,615	39	55,268	51,717	94	33,261	33,878	102
2016-17	1,093,200	375,442	40	55,268	59,629	108	33,261	20,334	61
2017-18	1,104,658	443,925	40	54,782	79,281	145	35,079	23,409	67
2018-19	1,090,925	483,352	44	42,393	82,871	195	32,794	22,195	68
2019-20	1,075,562	444,909	48	44,148	63,795	145	33,071	15,615	47

## Annex-XII. Province-Wise and Crop-wise Varieties Registered and Released

Crop	Public Sector					Private	Pakistan
	Punjab	Sindh	KP	Balochistan	Islamabad		
Wheat	69	25	44	08	06	-	152
Barley	05	-	03	04	-	-	12
Maize	15	-	15	-	-	02	32
Rice	25	14	07	-	-	-	46
Cotton	105	30	02	-	-	28	165
Sugarcane	16	13	16	-	-	01	46
Pulses	49	04	21	01	05	-	80
Oilseeds	27	05	23	-	09	05	69
Fodders	31	-	07	01	-	02	41
Vegetables	51	01	13	08	-	-	73
Fruits	19	02	36	-	-	-	57
Flowers	03	-	-	-	-	-	03
<b>Total</b>	<b>415</b>	<b>94</b>	<b>187</b>	<b>22</b>	<b>20</b>	<b>38</b>	<b>776</b>

Source: FSC&RD Report 2018

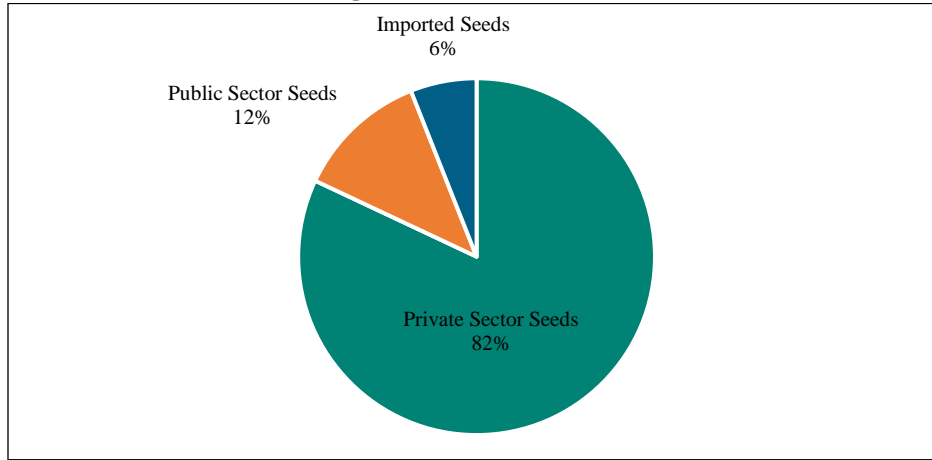
## Annex-XIII Sector wise share of Seed Availability

Year	Public Sector (MT)	% share of Public Sector	Private Sector (MT)	% share of Private Sector	Total (MT)
2013-14	81,796	21	304,071	79	385,867
2014-15	80,956	16	419,364	84	500,320
2015-16	79,043	14	485,549	86	564,592
2016-17	78,211	12	579,939	88	658,150
2017-18	69,868	12	476,610	82	582,113

Source: FSC&RD, Ministry of National Food Security & Research (MNFSR)

### Annex-XIV Seed market share in Pakistan

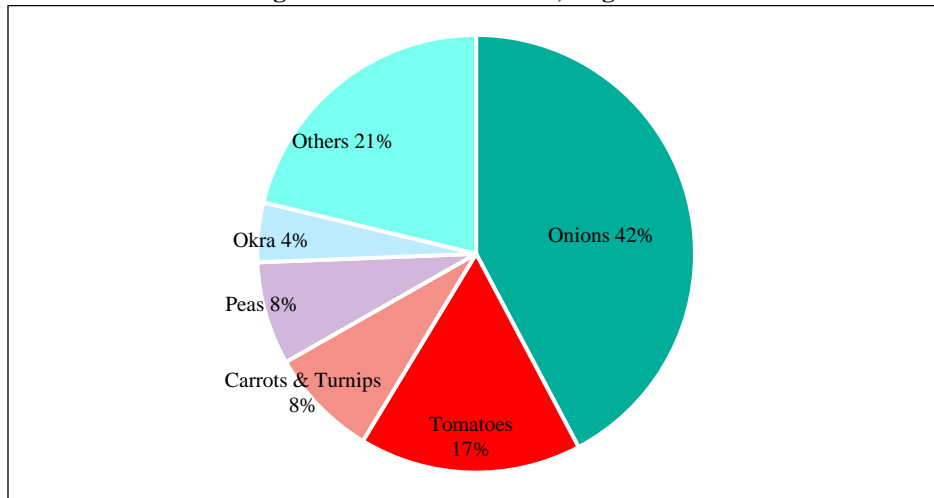
**Figure XIV Seed Market Share in Pakistan**



*Source: FSC&RD 2019-20, Ministry of National Food Security & Research (MNFSR)*

### Annex-XV Vegetable Seed Share

**Figure XV Seed Sale Share, Vegetables 2019**



*Source: Mordor Intelligence*

## Annex-XVI Organic Farming

**“Organic farming is an environmentally friendly ecosystem management in which, use of all kinds of synthetic inputs are eliminated”** (FAO, 1999). However, the General Assembly of IFOAM-Organics International in 2008 defined it as “Organic Agriculture is a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved”.<sup>106</sup> The principles of health, ecology, fairness, and care are the roots from which organic agriculture grows and develops.

**The area earmarked for “organic farming” forbids use of synthetic fertilizers, pesticides, veterinary drugs, hormones, Genetically Modified Seeds (GM seeds) and breeds, additives, preservatives etc.** Organic agriculture tends to minimize the use of synthetic inputs (fertilizers, pesticides, herbicides, and medical products), increases soil organic matter, and makes agriculture environmentally sustainable and economically viable. Organic agriculture capture and store more water than soils under conventional cultivation (Muller, 2009). Integrated organic approaches are also more demanding of labor inputs (Demiryurek and Ceyhan, 2008). Increased revenue because of premium sale price combined with low input costs may offer a feasible alternative to expanding farm size (Bolwig and Gibbon, 2009; Beuchelt and Zeller, 2011).<sup>107</sup> Nevertheless, despite recognizing the advantages of organic farming, productivity differential and financial viability relative to conventional methods remains a question (de Ponti et al., 2012). He argued that profitability may be lower because of low productivity or high costs because of more intensive use of labor. Meng Li et al., (2019)<sup>108</sup> suggested that investments in ecological intensification approaches could potentially contribute to long-term yield resilience. However, these approaches need to be tailored for individual crops and systems to maximize their benefits, rather than employing one-size-fits-all approaches.

**The organic agriculture (OA) began in 1996 Lok Sanjh**, a non-profit organization, started working with the farmers pursuing them to adopt ecological approaches for production.<sup>109</sup> It organized training of farmers and formation of Organic Farmers’ Association (OFA). OFA with the support of Lok Sanjh has established Farmer’s Guarantee System to ensure quality of organic produce. NARC and Pakistan Agriculture Research Council (PARC) are the leading supporters of organic food and also involved in production.<sup>110</sup> Many private farms located in the vicinity of Islamabad also produce organic food, particularly fresh fruits and vegetables for local markets, and get technical support from NARC (Husnain et al., 2017). A cost comparison of organic and conventional farming in Pakistan is in Table 7.

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<sup>106</sup> Available at <https://www.ifoam.bio/why-organic/organic-landmarks/definition-organic>

<sup>107</sup> Tina D. Beuchelt and Manfred Zeller (2011). Profits and poverty: certification's troubled link for Nicaragua's organic and fair trade coffee producers. *Ecological Economics* 70: 1316-1324.

<sup>108</sup> They developed a quantitative framework to assess yield resilience, emphasizing four aspects of yield dynamics: yield, yield stability, yield resistance (i.e., the ability of systems to avoid crop failure under stressful growing conditions), and maximum yield potential and compared the resilience of maize-tomato rotation systems after 24 years of irrigated organic, cover cropped, and conventional management in a Mediterranean climate, and identified crop-specific resilience responses of tomato and maize to three management systems.

<sup>109</sup> <http://loksanjh.org/project-3/index.html>

<sup>110</sup> [www.parc.gov.pk](http://www.parc.gov.pk) accessed on January 21, 2022

Table A-XVIa Cost Comparison of Organic and Conventional Farming in Pakistan (PKR) <sup>111</sup>						
Input Cost Per hectare	Wheat			Rice		
	Organic	Conventional	Difference	Organic	Conventional	Mean Difference
Water	10,438	10,885	-447	35,659	36,035	-376
Fertilizer	8,733	19,892	-11,159	6,867	13,566	-6,699
Pesticides	1,458	3,291	-1,833	2,819	3,761	-942
<b>Labor</b>	<b>11,458</b>	<b>10,951</b>	<b>+507</b>	<b>13,793</b>	<b>12,103</b>	<b>+1,690</b>
Casual	2,520	1,191	1,329	4,828	2,619	2,209
Family	4,584	5,214	630	4,552	5,061	509
Permanent	4,354	4,547	193	4,4134	4,423	10
Other Inputs	19,358	19,266	92	20,072	22,266	2,194
<b>Total</b>	<b>51,445</b>	<b>64,285</b>	<b>-12,840</b>	<b>79,210</b>	<b>87,731</b>	<b>-8,521</b>

Husnain et al. suggests that the cost -benefit ratio of both farming systems is 1.63 and 1.45 for organic and conventional wheat respectively while cost-benefit ratio for organic and conventional rice is 1.42 and 1.36 respectively, in Pakistan. These ratios indicate that growing organic wheat and rice the farmer can get higher profits by moving from conventional agriculture to organic wheat and rice is more profitable. It is evident from Table 8 below that yield of organic crops is lower than conventional farming, which is usually associated with “organic transition effect”. It implies that the yield is expected to decline during year 1 to 4 while transitioning from conventional to organic farming followed by an increase when soils have developed adequate biological activity (Martini et al., 2004). Despite lower yield in organic farming for wheat and rice per hectare relative to conventional farming, organic crops are profitable or at least as profitable as conventional farms. This profitability in organic farming can be higher in the niche markets. Second, if subsidies on fertilizer and pesticides for conventional agriculture are withdrawn or similar subsidy is provided for organic farming, the profitability in organic farming will increase further. Other economic benefits in organic farming include soil health, conservation of soil fertility and system stability.

Table A-XVIb Production and Profit Comparison of Organic and Conventional Farming in Pakistan (PKR) <sup>112</sup>								
Crop Name	Wheat				Rice			Monetary Profit (Revenue-Explicit Cost)
	Production (Kg)	Price Per Kg	Total Revenue	Monetary Profit (Revenue-Explicit Cost)	Production (Kg)	Price Per Kg	Total Revenue	
Organic	2,280	36.75	83,790	35,066	2,680	41.88	112,238	38,431
Conventional	4,040	23.08	93,243	33,430	4,240	28.10	120,268	38,051
Difference	1,760	13.67	9,453	1,636	1,560	13.78	7,930	380

Pakistan’s organic farms are certified by Control Union Certifications Zwolle, of the Netherlands for organic production methods according to regulation (EEC NO.2092/91, EC.No. 834/2007) and United States Department of Agriculture National Organic Program standards. Certified organic farming in Pakistan is only 0.1 percent of total organic farms in the world with expanding organic farming. Organic farming worldwide has increased three-fold since 2000, from 17 million hectares in 2000 to 51 million

<sup>111</sup> M. I. U. Husnain, M. Khan and H. Z. Mahmood, (2017). “An Assessment Of Public And Private Benefits Of Organic Farming In Pakistan”, The Journal of Animal & Plant Sciences, 27(3): 2017, Page: 996-1004

<sup>112</sup> Ibid.

hectares in 2015. Similarly, organic market size has expanded from US\$ 21 billion in 2000 to US\$ 82 billion in 2015<sup>113</sup> and continued to grow. The challenges in organic farming includes: (i) lands are low in organic matter because of overuse of fertilizers; (ii) weak skills, poor-organization, and under-developed markets; (iii) lack of investment, particularly the smallholder farmers; (iv) loss of biodiversity and soil organic matter; and (v) degradation of natural resource base because of inappropriate farming practices like monoculture and agrochemicals.

**Pakistan has the potential to develop organic farming in highly fertile and productive virgin lands** within the command areas of Akhori, Basha-Diamer, Kalabagh (subject to political consensus), Kuram Tungi, and Munda dams. It will not only provide large scale employment of unskilled and semi-skilled labor but may also the country to capture part of global market demand. The concerned authorities need to undertake soil survey to identify productive and fertile areas. It may also require training of the farmers and certification process. In addition, upgrading and strengthening the sanitary.

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<sup>113</sup> IFOAM



## Annex-XVII Number of Private Seed Registered Companies

Table A-XVII Number of Registered Seed Companies						
Year	Punjab	Sindh	Khyber Pakhtunkhwa	Balochistan	Gilgit Baltistan	Total
Before 1991	5	0	0	0	0	5
1991-1995	38	0	0	0	0	38
1996-2000	126	6	2	2	0	136
2001-2005	189	17	5	0	0	211
2006-2010	118	26	12	2	2	160
2011-2015	169	47	6	1	1	224
2016-2018	76	16	7	0	0	99
Private (Local)	<b>721</b>	<b>112</b>	<b>32</b>	<b>5</b>	<b>3</b>	<b>873</b>
Private (MNC)	4	1	0	0	0	5
Public sector	1	1	1	1	0	4
Total registered	726	114	33	6	3	882
Deregistered	150	17	5	3	0	175
<b>Total</b>	<b>876</b>	<b>131</b>	<b>38</b>	<b>9</b>	<b>3</b>	<b>1057</b>

## Annex-XVIII Steps Involved, Documents Required and Time Taken to Perform each Function

Table A-XVIII Steps Involved, Documents Required and Time Taken to Perform each Function			
S.No	Procedures	No of Steps Taken	Time Taken
1	Registration of Plant Varieties	7	2 years 6 months
2	Certification of Seeds	9	One Crop Season
3	Enlisting Plant Varieties or hybrids	4	4 months
4	Seed Quality Analysis of import seed consignments for issuance of release order	3-4	10 days
5	Registration of Fruit Plant Nurseries	4	2 months 20 days
6	Registration to do seed business	6	5 months 20 days
7	Registration of Seed Process Units	4	3 months 15 days

Source: Ministry of National Food Security and Research

## Annex-XIX Detail for performing each procedural step along with timeline

### ii) Registration of a Plant Variety

Documents required	Steps	Timeline	Remarks
i) Application for registration ii) Botanical description of variety iii) Seed sample of candidate line For Rabi crops upto 15 <sup>th</sup> Sep For Kharif crops upto 15 <sup>th</sup> March iv) In case of GM/Br. Crop variety, permission by National Biosafety committee to conduct commercial trials v) Submission of Fee @Rs. 10,000/Entry	<b>Step 1:</b> Examination of application	Within 3 working days of receipt of application	Application to be returned if; i) With deficiencies or not on format; ii) Seed sample not intact or sow-able; iii) Permission from NBC not sought.
	<b>Step 2:</b> coding of received seed samples/supply to DUS center of FSC&RD	Within 7 W/days of receipt of sample	In case seed does not germinate, or the seed sample got damaged during transit storage or transport, the applicant will be requested to redeem the seed sample
	<b>Step 3:</b> Conducting of DUS trials for two crop seasons by FSC&RD	Two crop seasons or two years	i) Applicant to be informed of variations noted in characters or application to be rejected of gross variations observed in DUS ii) Applicant to be informed of completion of DUS
In case of GM/Bt. Crop variety following documents shall be required; i) Undertaking that no gene or gene sequence involving terminator technology has been used ii) Certificate from NBC to the effect that the subject GM/Bt. trait has no adverse effects on environment, soil, human or animal and plant health and life; and Two years performance data from the concerned organization	<b>Step 4:</b> Registration of variety by the Federal seed registration committee	Within 3 months of completion of DUS trials	In case the variety is not registered by <b>FSRC</b> , the concerned applicant shall be informed of the decision immediately.
	<b>Step 5:</b> Notification of varieties in official gazette upon approval by <b>FRSC</b>	Within 30 W/days of the approval by <b>FRSC</b>	Copy of the gazette notification circulated to each applicant and concerned organizations
	<b>Step 6:</b> Issuance of Registration Certificate	Within 15 w/days of issuance of gazette notification of variety	Circulation of registration certificate to the applicant/breeder
	<b>Step 7:</b> Entry of a registered and notified plant variety into the National Register of Crop varieties	Within 10 W/days of gazette notification	

## ii) Seed Certification

Documents required	Steps	Timeline	Remarks
i) Request on form 01 for crop inspection ii) List of growers to be submitted as per following schedule; Punjab/KPK Rabi crops upto 28 <sup>th</sup> Feb Kharif crops upto 31 <sup>st</sup> July Sindh/Balochistan Rabi crops upto 15 <sup>th</sup> Feb Kharif crops upto 15 <sup>th</sup> July iii) Documents in favor of source verification	<b>Step 1:</b> i) Scrutiny of submitted list and details by the respective field stations of <b>FSC&amp;RD</b> ii) Crop inspection by <b>FSC&amp;RD</b>	i) Within 30 W/days  ii) Within 40-50 W/days of the application received	Rejection of crop/field in writing upon not meeting the requirements of certification standards, source verification etc.
	<b>Step 2 :</b> issuance of crop inspection report	Within 10 W/days of the crop inspection done	
i) Request on form 03 for seed sampling before processing ii) Documents and details of seed store/field, its location, No. of bags etc.	<b>Step 3:</b> i) Seed sampling ii) Issuance of lot number	Within 15 W/days of the request received	Rejection of sampling in case seed samplers is not satisfied with the lot homogeneity
	<b>Step 4:</b> Deliverance of seed sample to the seed Analyst and request for carrying out seed testing before processing	Within 2 W/days of the receipt of the sample	
	<b>Step 5:</b> Testing and issuance of provisional seed testing report by the concerned seed analyst/laboratory	Within 30 W/days of the receipt of the sample	If seed lot is rejected applicant is restrained from procuring the seed lot
Request on form 06 for seed sampling after processing along with details of store and details of quantity of seed lot	<b>Step 6:</b> Seed sampling for Laboratory analysis	Within 15 W/days of the receipt of the request for seed sampling	
	<b>Step 7:</b> Seed Analysis	Within 30 W/days of the receipt of the seed sample	
	<b>Step 8:</b> issuance of final seed testing report on form 04	Within 3 days of the completion of seed testing	In case the seed lot does not meet the seed testing standards as prescribed for the seed category requested, the seed lot will be rejected
Request for issuance of tags	<b>Step 9:</b> issuance of certification tags by the office in-charge of the laboratory concerned	Within 7 W/days of the final results of acceptance or issuance of seed analysis report	

### iii) Enlisting Plant Varieties

Documents required	Steps	Timeline	Remarks
<ul style="list-style-type: none"> <li>i) Application for enlisting</li> <li>ii) Authorization certificate by the principle exporting company/breeder</li> <li>iii) Essential characters of the variety to be enlisted</li> <li>iv) Catalogue or official document of the principal company for traceability</li> <li>v) Data of adaptability testing for two seasons in Pakistan</li> <li>vi) Recommendation of the VEC or VEC sub-Committee for enlistment.</li> <li>vii) Certified reference sample of the variety to be enlisted</li> <li>viii) Enlisting fee of Rs.10,000/entry</li> </ul>	<b>Step 1:</b> Examination of application before submitting to the enlisting committee	Within 7 W/days of the application received	In case of deficiencies the application shall be returned with observations
	<b>Step 2:</b> Approval for enlisting of a variety or hybrid by the VES or its Sub-Committee	Within 90 W/days of the receipt of application	
	<b>Step 3:</b> Entry of enlisted varieties in the National Register of enlisted varieties by FSC&RD	Within 7 W/days of the decision of enlistment	
	<b>Step 4:</b> Circulation of the list of enlisted varieties	Within 15 W/days of each meeting of the Committees for enlistment	

#### iv) Seed Quality of Imported Seed Consignment for Issuance of Release Order

Documents required	Steps	Timeline	Remarks
<ul style="list-style-type: none"> <li>i) Request for sampling the consignment</li> <li>ii) Submission of invoice, packing list, phytosanitary certificate, NON GMO certificate, authorization certificate in case of agent</li> <li>iii) Labeling details of the consignment</li> </ul>	<b>Step 1:</b> Taking seed sample by the seed inspector	Within 3 W/days of the request received	Sampling to be refused in case: <ul style="list-style-type: none"> <li>i) It does not meet labeling requirements as prescribed;</li> <li>ii) The variety is not enlisted by <b>FSC&amp;RD</b></li> </ul>
	<b>Step 2:</b> Release of consignment upon seed quality analysis	Within 7 W/days of the samples delivered to the laboratory	Consignment shall be released on the first count of germination test subject to provision of undertaking
	<b>Step 3:</b> Issuance of seed analysis report	Within 14 W/days of the completion of the seed analysis	<ul style="list-style-type: none"> <li>i) Release order to be issued in case it meets requirements of (Truth in Labeling) Rules, 1991;</li> <li>ii) The importers to be informed in writing not to distribute the rejected seed</li> <li>iii) All seed inspectors to be informed of the rejected seed lot by providing details</li> </ul>

#### v) Registration of Fruit Plant Nurseries

Documents required	Steps	Timeline	Remarks
Submission of application for registration along with information as required under Fruit Plant Certification Rules, 1998	<b>Step 1:</b> Examination of application	Within 7 W/days of receipt of application	Application to be returned in case of deficiencies
	<b>Step 2:</b> Verification and Recommendation by the Regional Fruit Plant Registration committee	Within 30 W/days of the referral to the committee	Nurseries not recommended to be informed; accordingly,
	<b>Step 3:</b> Registration of recommended nurseries by the Federal Committee	Within 30 W/days of the recommendation by the regional committee	Nurseries not granted registration to be informed accordingly
	<b>Step 4:</b> Issuance of Registration Certificate to Nursery	Within 15 W/days of the decision made regarding registration of the nursery	Circulation of certificate to all registered nurseries

## vi) Registration to do Seed Business

Documents required	Steps	Timeline	Remarks
Request to be submitted to <b>FSC&amp;RD</b> for availability of name and brand name	<b>Step 1: FSC&amp;RD</b> to convey in writing the status of availability of name/brand name	Within 7 W/days of the request received	No application shall be accepted without furnishing proof of availability of name and brand name as issued by <b>FSC&amp;RD</b>
<ul style="list-style-type: none"> <li>i) Application for registration of local seed producer, seed importer, seed exporter</li> <li>ii) Documents required for registration to do seed business</li> </ul>	<b>Step 2: FSC&amp;RD</b> Headquarter shall examine the application and refer the completed ones to the concerned Regional Director for Verification of Infrastructure; physical assets; Antecedents and other details provided by the applicant	Within 15 W/days of the application received	Application with deficiencies shall be returned
	<b>Step 3:</b> Supply of verification report by the Regional directorates to <b>FSC&amp;RD</b> Headquarter	Within 30 W/days of the referral by <b>FSC&amp;RD</b>	Cases not verified shall be returned with observation;
	<b>Step 4:</b> Approval by the working group of the Ministry for grant of permission to do seed business for a period of five years	Within 60 W/days after the verification is complete	Companies not granted registration shall be informed accordingly
Submission of fee at the following rate: Rs.75000 for seed importer Rs.50000 for local seed producer	<b>Step 5:</b> Issuance of certificate to do seed business by the Ministry	Within 30 W/days of the decision made by the WG of the Ministry	The companies failing to submit the prescribed fee shall not be issued any certificate
Renewal of the registration already granted by the working group subject to: <ul style="list-style-type: none"> <li>i) Application for the renewal to <b>DG FSC&amp;RD</b></li> <li>ii) Verification/progress report by the concerned Regional Directorate of <b>FSC&amp;RD</b></li> <li>iii) Renewal fee at the following rate; Rs. 40000 for seed importer Rs. 25000 for local seed producer</li> </ul>	<b>Step 6: FSC&amp;RD</b> to issue certificate for the renewal of permission to do seed business	Within 30 W/days of the receipt of application	The renewal shall not be made: <ul style="list-style-type: none"> <li>i) If the applicant does not fulfill the requirement as prescribed under section 22B of the seed Act. 1976 and seed (Business Regulation) Rules, 2016;</li> <li>ii) The applicant fails to submit the renewal fee</li> <li>iii) Case to be submitted in next meeting of the</li> </ul>

			working group for review by the WG
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### vii) Registration of Seed Processing Units

Documents required	Steps	Timeline	Remarks
Application for registration of seed Processing Units;	<b>Step 1:</b> Examination of the application	Within 15 W/days of the receipt of the application	The application shall be returned in case of deficiencies
	<b>Step 2:</b> Physical Verification by the Regional Directorates of <b>FSC&amp;RD</b>	Within 30 W/days of the referral	Cases not physically verified shall be rejected
	<b>Step 3:</b> Submission of completed and verified cases to the Ministry for permission to be registered	Within 30 W/days of the completion of the case	
Submission of fee of Rs. 10,000	<b>Step 4:</b> Issuance of Registration Certificate	Within 30 W/days of the approval of the case	

## Annex-XX Role of FSC&RD

- 1. Testing and registration of new varieties:** New varieties are assessed in two quite different ways, they should be:
  - Distinct, Uniform and Stable (DUS) – this brings some order to the market by linking the name of the variety to a reliable documented description, and that is essential if the variety is to be produced under a certification scheme.
  - In addition, varieties should have Value for Cultivation and Use (VCU) – meaning that they have some clear merit for producers, processors, or consumers – this is intended as a filter to keep unsatisfactory varieties out of the market, it is often presented as ‘protecting the farmers’. For various valid reasons, VCU testing is not normally applied to vegetable crops although this still seems to be done in Pakistan.
  - FSC&RD carries out both DUS and VCU tests and organizes the data for presentation to the National Seed Council (NSC), which then decides whether to add the variety to the National List. However, the **NSC does not meet regularly**, and it seems that FSC&RD manages the National List as an internal administrative activity. Once on the list, the variety is registered and is eligible for certification and marketing but decision to release a variety for production and marketing still rests with the seed councils in each province.
- 2. Operating the seed certification scheme:** Certification provides a comprehensive quality assurance package for seed by carrying out field inspections of the seed crop and laboratory tests on samples of seed lots before they are sold. This is managed from a total of 27 offices, 13 of which are in the main seed production areas of Punjab. Ideally, post-control plots (also called grow-out tests) should also be conducted on certified seed lots, but this is not always done because it uses a lot of resources. Collectively certification provides traceability throughout the production and marketing chain from breeder to farmer, but it is demanding in terms of resources and requires a good administrative system.
- 3. Seed Certification Cost:** Seed certification and control system has a cost which is either borne by government subsidies or by the seed buyer. Cost of multi-locational trial, crop inspection and testing of new varieties and travel does not appear as a separate budget item. This high cost combined with resource constraints creeps’ inefficiencies in variety control institutions which quite often biased them in favor of varieties which have a higher probability to meet the requirements of Variety Evaluation Committee and Variety Release Committee. This cost is generally borne by the plant breeders in Pakistan.



## Annex-XXI Status of Variety Testing Across Various Countries

Table XXI Status of Variety Testing Across Various Countries									
	Pakistan	India	Bangladesh	China	UK	France	Australia	Turkey	USA
<b>Variety Testing and Registration</b>									
Registration requires DUS testing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Performance testing (VCU) carried out	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minimum duration of VCU tests (years)	2 years	2 years	2 years	3 years	2-4 years	2-4 years	-	2 years	N/A
PVP Law exists	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Date	2016	2001	2019	1997	1964	1961	1994	-	1970
Country is a member of UPOV?	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
<b>Seed Testing / Quality Control</b>									
Seed Law exists? Date? Latest Edition	Yes 1976	Yes 1966	Yes 1977	Yes 2000	Yes 1964	Yes 1905	Yes 1982	Yes 2006	Yes 1939
Latest Edition	2015	2004	1997	2015	1964	1905	1982	2006	1983
National/Central Seed Testing Lab exists	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
National Seed Lab is a member of ISTA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
National Seed lab is accredited by ISTA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Number of Seed Lab is accredited by ISTA	1	5	0	2	3	6	5	1	1

Source: UPOV (2021). Accessed from <https://www.upov.int/portal/index.html.en>

ISTA (2021). Accessed from [seedtest.org/en/members-content---1--1002.html](http://seedtest.org/en/members-content---1--1002.html)

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## Annex-XXII International Treaties and Protocols

### Convention on Biodiversity

The Convention on Biodiversity (CBD) requires the contracting parties to take legislative, administrative, or policy measures to share results of research and development and the benefits arising from the commercial or other utilization of genetic resources with other contracting parties in a fair and equitable manner. Access to genetic resources is subject to prior informed consent (PIC) of the contracting party providing such resources (country of origin). Potential benefits to be shared include access to and transfer of technology using genetic resources, participation in biotechnological research activities based on the genetic resources, and priority access to the results and benefits arising from biotechnological use of the genetic resources.<sup>114</sup>

### Nagoya Protocol

The Nagoya Protocol is a supplementary agreement to the CBD and provides a legal framework for the effective implementation of the benefit-sharing. The protocol applies to genetic resources and to traditional knowledge associated with them and set out the provisions governing the access, appropriate technology transfer and funding and compliance.

### International Treaty on Plant Genetic Resources for Food and Agriculture

The treaty is based on the premise that states have sovereign rights over their genetic resources and that the authority to determine access to these resources lies with national governments. Under the Treaty, the Contracting Parties exercised their sovereign rights to establish the Multilateral System (MLS) to facilitate access and the sharing of monetary and non-monetary benefits arising from the use of PGRFA through standardized conditions as set out in the Standard Material Transfer Agreement (SMTA). While the Treaty applies to all PGRFA, its MLS applies only to PGRFA set out in Annex I to the Treaty that are under the management and control of the Contracting Parties and in the public domain.

### Cartagena Protocol

The objective of this protocol is to regulate and ensure the safe packaging, transportation, transfer, handling, and use of all Living Modified Organism (LMO) resulting from modern biotechnology that may have adverse effects on the biological diversity and assessment of risks to human health and their management. The exclusion includes pharmaceuticals for humans that are addressed by other international agreements or organizations.

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<sup>114</sup> **FAO.** 2019. *ABS Elements: Elements to facilitate domestic implementation of access and benefit-sharing for different subsectors of genetic resources for food and agriculture – with explanatory notes.* FAO, Rome. 84 pp Licence: CC BY-NC-SA 3.0 IGO.

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