SEED SECTOR OF BALOCHISTAN

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Government of Pakistan

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1 DESCRIPTION OF CLUSTER

1.1 Introduction, History & Background of Seeds Sector.

A seed is an embryonic plant enclosed in a protective outer covering, along with a food reserve. The formation of the seed is part of the process of reproduction in seed plants, the spermatophytes, including the gymnosperm and angiosperm plants. Seeds are the product of the ripened ovule, after the embryo sac is fertilized by sperm from pollen, forming a zygote. The embryo within a seed develops from the zygote, and grows within the mother plant to a certain size before growth is halted. The seed coat arises from the integuments of the ovule. Seeds have been an important development in the reproduction and success of vegetable gymnosperm and angiosperm plants, relative to more primitive plants such as ferns, mosses and liverworts, which do not have seeds and use water-dependent means to propagate themselves. Seed plants now dominate biological niches on land, from forests to grasslands both in hot and cold climates. The term "seed" also has a general meaning that antedates the above anything that can be sown, e.g. "seed" potatoes, "seeds" of corn or sunflower "seeds". In the case of sunflower and corn "seeds", what is sown is the seed enclosed in a shell or husk, whereas the potato is a tuber.

Agricultural sector of Pakistan is indispensable to the country's economic growth, food security, employment generation and poverty alleviation particularly. It contributes 19.2 percent to the GDP and provides employment to around 38.5 percent of the labor force. More than 65-70 percent of the population depends on agriculture for its livelihood. Agricultural growth rate has been constrained by shrinking arable land, climate change, water shortages, and large-scale population and labor shift from rural to urban areas. Increasing agricultural productivity, therefore, requires adoption of new approaches. With strong forward and backward linkages with the secondary (industrial) and tertiary (services) sectors, it can play a pivotal role to spur economic growth. However, this sector has remained prone to several challenges like climate change, variance in temperature, water shortage, and changes in pattern of precipitation along with increase in input prices.

The government is closely monitoring key crops and devising policies/planning interventions to ensure uninterrupted supply of basic food items at affordable prices in the country. The primary goal of the government is to enhance financial inclusion in the agriculture sector to boost productivity and exports, thereby enabling a rural development-driven economic growth.

Realizing the importance of agriculture, the government is also focusing on pro-agriculture set of policies to tap maximum benefits by introducing the Agri-input regime to increase yields of major Rabi and Kharif crops. The Prime Minister has approved "Agriculture Transformation Plan" with the objective to enhance national agricultural output and livelihood of farmers.

Seed is a basic input for agriculture sector and has a leading role in enhancing agricultural productivity. To improve the availability of quality seed to the farmers of Pakistan, there is a need to revitalize research and development and adopt international best practices in line with the requirements of the domestic and global markets.

History of seed sector in Pakistan.

From its post-colonial origins, under which Pakistan farmers relied on their own production, the Pakistan seed provision system has since expanded to encompass a wide range of activities. The history of the Pakistani seed industry can be divided into four broad phases.

- Phase 1 – Upon its independence in 1947, Pakistan inherited only one institute for agricultural research and education – the Punjab Agricultural College and Research Institute in Lyallpur, Punjab province (Sarwar 2007). The institute was home to a number of crop-specific stations and research and development projects, which bred new planting material for cultivation. Since there was no formal system of variety approval and registration, these seeds were handed over by breeders to the provincial agricultural department. While seed certification was not an entirely unknown concept, it could not formally be put into operation without the appropriate legal and institutional infrastructure. Overall, these public-sector stations played a small role in seed provision; most farmers produced their own.

- Phase 2 – Economic development in the 1950s necessitated the establishment of a more complex system for agricultural research and seed production. In 1961, the government launched two major initiatives. One was to divide the Lyallpur College and Institute into two parts: the Agricultural University at Lyallpur and the Ayub Agricultural Research Institute (AARI). The other was to establish the West Pakistan Agricultural Development Corporation (WPADC). These organizations grew quickly and emerged as dedicated institutional hubs for agricultural research and teaching, variety development, and seed production, respectively.

AARI and WPADC became an important conduit for transmitting technologies from overseas and can rightfully claim some credit for the transformation initiated by the Green Revolution. While the establishment of AARI and WPADC represented progress in an institutional sense, there remained major gaps in Pakistan's seed network. Procedures for variety approval still had not been developed, leaving a legal vacuum. Moreover, institutional reach was clearly limited and took several years to scale up operations. At the peak of their influence, these institutes were only able to serve a small proportion of Pakistani farmers concentrated in irrigated areas of Punjab and Sindh provinces. Capacity constraints, fore□most among them a shortage of skilled professionals, forced these organizations to devote research and development to a few major crops. Pakistan's first seed law, the West Pakistan Seeds and Fruit Plants Ordinance of 1965, was signed during this period. It established registration for producers of certified seeds. Registered growers could voluntarily apply for certification; in exchange, they would have to sell specified volumes of seed to the government.

- Phase 3– In 1973, the Pakistani government sought the help of the World Bank to review the seed provision system and to identify opportunities for reform (Salam 2012; Ahmad and Nagy 1999). This was the beginning of Pakistan's large-scale initiatives to address the seed sector, enacted through wide-ranging legal and institutional reforms. The Seed Act of 1976 was the most prominent piece of legislation signed during this period. It not only clarified procedures for variety registration and seed certification, but also created an extensive institutional framework to accompany them. It consisted of the National Seed Council, provincial seed councils, and two separate agencies under the federal Ministry of Agriculture, which in 1998 merged to form the current Federal Seed Certification and Registration Department (FSC&RD). The Seed Act was characteristic of an era that was defined by the active leadership of public sector organizations. This contrasted with the marginal role played by the private sector. Seed multiplication on private fields represented the extent to which the latter could claim participation. All functions in the seed development chain were reserved for the public sector, including variety development, production of breeder nucleus seeds, pre-basic and basic seeds, seed testing, and certification. Such an exclusive focus on

public institutions reflected the national economic policy of the 1970s, which pursued nationalization across a broad spectrum of activities.

- Phase 4 –The current period has its roots in the 1980s, when changes in macroeconomic policy led FSC&RD to proactively seek the private sector's participation in the seed business. The first seed company was formally registered in 1981, and eight others – all based in Punjab – opened for business shortly thereafter (Sarwar 2007). By 1994, the seed business was formally categorized as an industry (Ali and Ali 2004) and was granted associated privileges. Multinational corporations gained a foothold in Pakistan during the 1980s and 1990s. There were 291 private seed companies registered with FSC&RD in 2000 (Ali and Ali 2004), and the number jumped to 963 by 2012. Private seed companies represented a wider geographical reach than the Punjab- and Sindh-centered activity of earlier decades. From their modest beginnings as a host for the multiplication of basic seeds obtained from public corporations, private seed companies quickly established their competence in a range of functions. They have launched their own variety development programs and have introduced new crop varieties into the market in the last decade. As their operations grew, private seed companies began to outcompete and displace public sector corporations in the market. Gradually, they became the leading provider of several crops including cotton, vegetables, oilseeds, maize, and fodder. These developments signal the private sector's quiet assumption of leadership in Pakistan's seed sector.

1.2 Defining the Product

Seed is any material used for planning & propagation whether it is in the form of seed (grain) of food, fodder, fiber or vegetable crop or seedlings, tubers, bulbs, rhizomes, roots, cuttings, grafts or other vegetative propagated material. While we often avoid the seeds when we eat fleshy fruits, many common dry food-products are seeds. That includes most edible legumes peanuts, lentils, beans, and peas. A nut is technically a fruit, but we usually eat the seed and discard the fruit (or shell) when we eat our favorite nuts, such as cashews, walnuts, filberts, and pecans. Pine nuts, almonds, and Brazil nuts are also seeds even though none of these comes from a nut. Some spices are seeds, including nutmeg, mustard, and fenugreek. Two of our favorite non-legume "beans" coffee beans and cocoa beans are seeds. What about grains, such as rice, corn, and cereal

grains? Technically, grains are seeds that are fused to the ovary wall, so they are fruits, even though most of what we eat (and nearly all of the nutritional value) is the seed. Many common seeds of commerce are, in fact, seeds, including poppy, flax, and pumpkin seeds.

1.3 Geographical Locations

There's immense potential for growth given the persisting seed shortage in Pakistan. The market size and supply problem existed especially for high yielding varieties, of crops such as rice and wheat, which were self-pollinated. With self-pollinated seeds, even when new genetic materials are introduced, farmers can save seeds for several crop generations, without a major decline in yields. This made it difficult for seed companies to recover the full cost of seeds however hybrid varieties, by contrast, any seed retained from a crop performed much worse than its parents. Since development costs are more easily recovered, the private sectors tend to dominate both breeding and marketing in the hybrid seed segment all over Pakistan.

In Balochistan there is immense demand for Hybrid seed in areas like Nasirabad, Jafarabad, Jhal Maghsi, Quetta and areas adjacent to Quetta city. Mostly hybrid seed is used for rice cultivation and vegetables likewise cucumbers, tomatoes. Moreover hybrid seed is used for cultivating chick pea.

1.4 Core Cluster Actors

1.4.1 Size of Sector

The Pakistan Seed Market was Valued at USD 355.0 million in 2020 and it was projected to reach USD 458.6 million in 2026 registering a CAGR of 5.2% during the forecast period (2021-2026). Due to COVID-19, there was a significant impact on the delivery of seeds from distribution centers to the farmers due to disruption in supply chains all over the country. However, safety protocols and various measures undertaken by the Pakistani government over the last couple of months have enabled the timely availability of seeds to farmers and growers amid the pandemic crisis prevailing in the country. The demand for seeds, especially in developing countries such as Pakistan, is still untapped and provides multinational corporations various opportunities for expansion and a wide customer base. The country is shifting toward the adoption of high-quality seeds due to the export potential of vegetable seeds from the global

demographics. For instance, the adoption of high-yielding variants is on the rise in Pakistan due to the export potential. The rising investments in R&D of hybrid seeds are a key element to the success of the seed industry. 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 in the country.

The rice belt of Balochistan consisting of areas like Nasirabad, Jafarabad, and Jhal Maghsi produces majority of the crops likewise rice, wheat and chickpea. Moreover seed for wheat is stored from the produced crop however hybrid seed is used for rice and chickpea therefore there is demand for hybrid seed in this particular area of the province. The farmers in these areas are to 45 years to 12 years old respectively. Hence it can be concluded that farmers in rice have suitable level of experience.

In area like Sibbi and Bolan where there is sailaba irrigation system main crops in these areas are cotton and wheat and there is demand for seed of these crops in these areas.

Hybrid seed is mainly used by farmers in Quetta and areas adjacent to Quetta. Crops produced here are mainly vegetables which consists of cucumbers, tomatoes, moreover crops like wheat and fruits like grapes apples, apricot and almonds are produced.

There's is quiet some demand for hybrid seed in Quetta due to introduction of tunnel farming in the area. Farmers here prefer modern techniques and are quiet adoptive of new innovations. Thus it can be stated that due to water scarcity farmers here in Balochistan are adopting new techniques in farming moreover there is immense demand for hybrid seed in this region.

1.4.2 Current Cluster Scenario

The willingness and interest to grow hybrid crops are, to a large extent, governed by government legislation and policy. Pakistan is both a producer and importer of hybrid crops and products. Pakistan's seed sector is dependent on two key regulations, the Seed Amendment Act of 2015 and the Plant Breeders Rights Act 2018. In 2016, the Pakistan National Assembly adopted the Plant Breeders' Rights Act to encourage the development of new plant varieties and protect the rights of breeders of such varieties. The act provides protection for new plant varieties while at the same time respecting the right of farmers to save, use, exchange, and sell farm-saved seeds. In 2019, the Variety Evaluation Committee (VEC) of the Rice of Pakistan Agriculture Research

Council (PARC) recommended 12 new hybrids rice for commercial cultivation across the rice-growing areas of the country to promote the crop output. Hence, new technology is expected to increase the crop productivity of farmers in Pakistan and enable them to make the country self-sufficient in agriculture. Realizing the potential for immense growth, aided by favorable government policies, seed companies have shown keen interest in Pakistan. This is likely to enhance the growth of the seed sector in the country.

In Province, Balochistan agriculture research development center (BARDC) is amongst the most repudiated organizations contributing in seed development through its research work and other initiatives such as distribution of seed amongst the farmers. The organization has vastly contributed in olive sector and thus created awareness amongst the farmers about this potential sector. Moreover the organization also has installed olive processing plant. The organization also provides seeds of different plants such as Rosemary, Oregano, Chamomile, Thyme and Saffron.

Balochistan agriculture institute (ARI) is another institution contributing in research and development of agriculture sector of Balochistan. Some major projects of the institution are Agronomy of field crops, Evaluation and introduction of exotic vegetable varieties, Variety evaluation of oilseed, pulses and other cereals, IPM studies in field and horticultural crops,

Evaluation of different crop varieties for resistance to prevailing disease, Production of vegetable seeds and seed potato, Plant nutrient requirements of field and horticultural crops and assessing soil fertility status, Breeding/introduction of high yielding wheat varieties for irrigated and rain fed conditions.

2 ANALYSIS OF BUSINESS OPERATIONS

Business operations of a basic Seed processing Unit.

1. **Basic seed**

Approved certified seed is acquired from seed corporations or other bodies.

2. **Seed multiplication**

- Seed is distributed amongst selected growers or farmers
- Farmers will sow and grow this seed in controlled environment.
- Output produced by the grower/farmer is purchased by entrepreneur for processing.

3. **Seed processing**

- Drying; at the time of harvest, seed normally contains very high moisture content i.e., above 16% on average. In order to avoid any negative effects of high moisture, the seed has to be dried and the moisture content has to be reduced to 8-12%. If the seed is stored at high moisture content, it loses germination quickly and is infested with Pest and diseases.
- Cleaning; Impurities like weeds, immature seeds, infected seeds and other crop seeds have to be removed.
- Grading; Seed length and gravity separating.
- Treating; Suitable fungicide and color is used to protect the seed from fungus and various soil related diseases. The color also gives a suitable appearance to the seed proving that a check has been performed, confirming that all seeds have been uniformly treated.

4. **Packing**

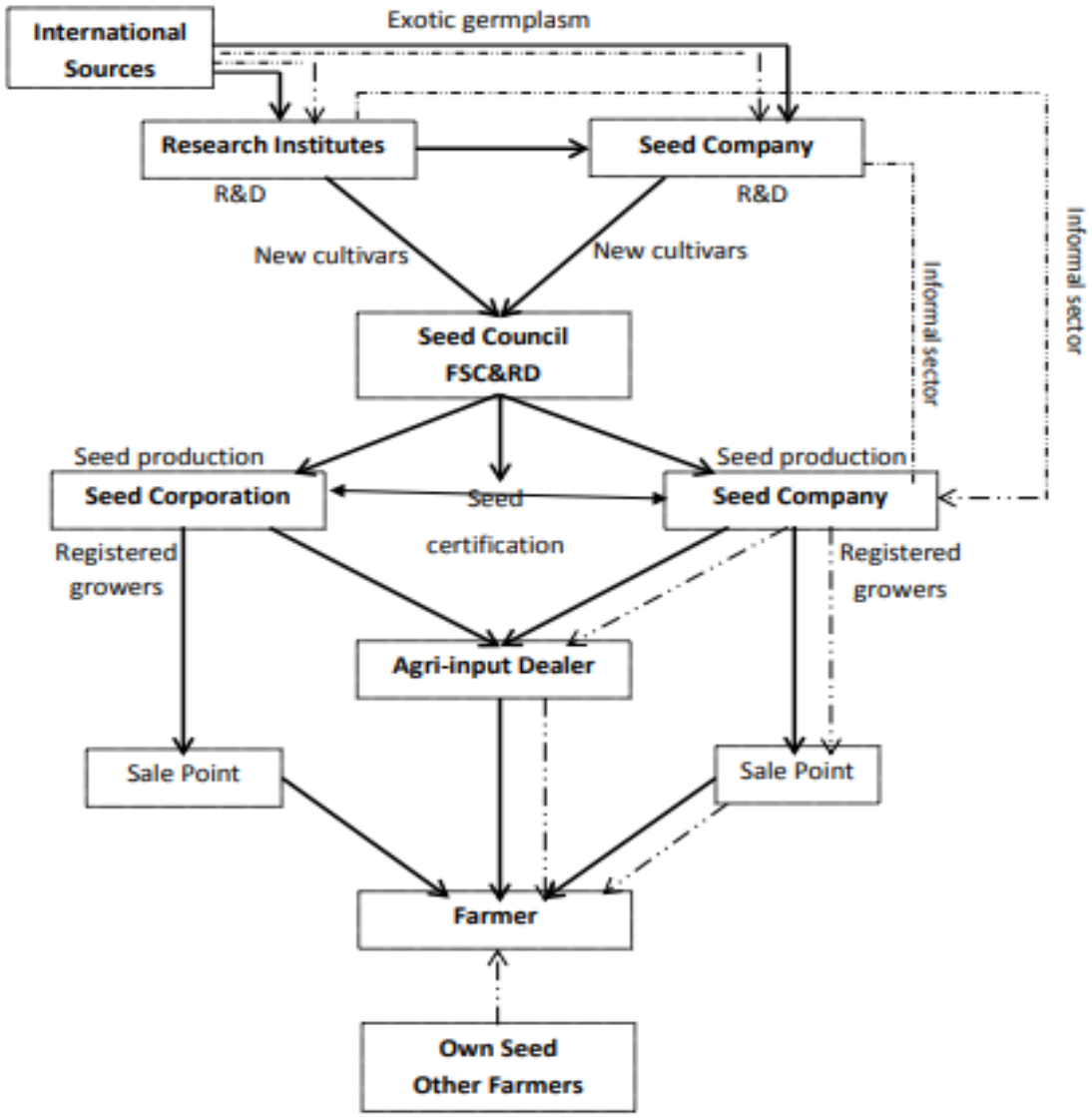
The processed seed is then packed in bags.

5. **Sales and distribution.**

Seed is directly sold to farmers and growers as well as seed distributors and retailers.

Business operations of multinational seed companies.

Figure 1: Flow diagram of seed provision in the formal and the informal sectors



2.1 Technological Analysis

Pakistan has an extensive agricultural research and variety development program carried out by 13 multidisciplinary and 14 mono-commodity research institutes and four agricultural

universities. The agricultural research institutes are located throughout the provinces with a large number of substations and satellite stations covering almost all economic crops and related disciplines. These research institutes have specific mandates to develop varieties suitable to their regions. At the national level, agricultural research is coordinated and funded by the Pakistan Agricultural Research Council (PARC) and Pakistan Central Cotton Committee (PCCC). PARC has seven major research establishments in Pakistan conducting research according to the agro-ecological needs of various regions. Please click on the links below for details of research work undertaken at these establishments: 1. National Agricultural Research Centre (NARC), Islamabad 2. Tropical Agricultural Research Centre (TARC), Karachi 3. Arid Zone Research Centre (AZRC), Quetta 4. National Tea Research Institute (NTRI), Mansehra 5. Sugarcane Research Institute (SRI), Thatta 6. Himalayan Agricultural Research Institute (HARI), Kaghan 7. Karakoram Agricultural Research Institute for Northern Areas, (KARINA), Gilgit.

Besides, PARC has Coastal Area Research Station, Karachi; Federal Pesticide Research Lab, Multan; and PARC-Integrated Pest Management Labortory, Multan, Agricultural Economics Research Units (AERUs) are functioning in all the provinces and Azad Jammu and Kashmir. PARC has its Liaison Offices in Lahore, Karachi, Peshawar and Quetta and its research units in Rice Research Institute, Kala Shah Kaku, Lahore and Dokri, Sindh. The agricultural research institutes maintain close collaboration with international agricultural research centers such as CIMMYT, CIAT, ICARDA, ICRISAT, IITA and IRRI to widen the genetic base of existing materials and to strengthen the national plant breeding programs.

Variety Development

Crop variety development remains the domain of the public sector. Provincial and federal research institutes developed a substantial number of crop varieties through conventional plant breeding. The Pakistan Atomic Energy Commission (PAEC) uses mutation breeding to develop grain legumes, rice and cotton varieties. Significant achievements have been made in plant breeding particularly, for crops such as wheat, rice and cotton. The privatization policy of the government encourages private sector plant breeding. Multinational seed companies have started introducing, testing and submitting their hybrid varieties of maize, sorghum, sunflower and sudax for registration and release.

Variety Evaluation

Breeding lines are tested in micro-variety trials at research station and sub-stations and then evaluated for adaptability in out-station zonal variety trials. Such trials are conducted at government farms and in collaboration with ëprogressiveí farmers in the proposed area of adaptation. When a breeder considers the variety has sufficient merit, he submits it to PARC (PCCC for cotton) and FSCRD for further testing. Variety registration and release require testing for Distinctness, Uniformity and Stability (DUS) and Value for Cultivation and Use (VCU) which are conducted simultaneously.

2.2 Market Mechanism

Pakistan's seed system similar to seed systems in most countries is comprised of a research system, regulatory agencies, and seed producers. They interact in a market that is difficult to estimate in terms of value or volume. Broadly, the Pakistani seed system comprises two segments; the formal seed system and the informal seed system. The former comprises breeding institutes, seed corporations, seed companies, regulatory organizations (i.e. the seed councils and FSC&RD; also NBC for GM crops), agricultural inputs dealer and farmers. The latter also comprises these actors and other farmers, implying thereby that the formal sector actors also operate as part of the informal sector to the extent of part of their seed business. A key component of this system is Pakistan's public agricultural research system, which is one of the larger agricultural research systems among developing countries with an estimated 3,513 full-time-equivalent researchers (Flaherty et al. 2012). The main research entities at the federal level include the Pakistan Agricultural Research Council (PARC), Pakistan Central Cotton Committee (PCCC), and agricultural research institutes of the Pakistan Atomic Energy Commission (PAEC). At the provincial level, the Punjab government's AARI stands out as a key research entity: AARI has led the system's most productive breeding program, accounting for 39 percent of the total varieties. In addition to these federal and provincial entities, five major agricultural universities in Pakistan carry out R&D activities, the largest of which is University of Agriculture, Faisalabad (UAF) with about 12,000 students and employing 593 faculty members of whom 49 percent hold a PhD degree (UAF 2013; Flaherty et al. 2012). The academic programs of these universities conduct research across a range of four important observations

about the research system's contribution to Pakistan's seed industry are worth noting here. First, the public sector accounts for 96 percent of all cultivars released to date.

The private sector has only recently started developing its own cultivars for commercial release that too for a small number of crops such as transgenic Bt cotton .Second, breeding activities are limited to a small set of crops. Even in these crops, cotton and wheat account for 40 percent of all cultivars. Such narrow R&D focus condemns farmers to rely on unimproved traditional cultivars for other crops. Third, Punjab-based institutes and companies have developed almost half of all cultivars. KPK-based institutes and companies have also developed a large number of cultivars. But the relatively small number of new cultivars developed in Sindh and Balochistan shows that farmers in these provinces have to rely on breeding programs in agro-ecologically different Punjab and KPK.

Beyond research and the release of new varieties, the task of seed multiplication, distribution and marketing falls to several actors in Pakistan's seed system. Among the public seed producers established in the 1970s, only the Punjab Seed Corporation remains as a significant seed producer. PSC has an impressive infrastructure for the production and distribution of seed across a wide range of crops. Its infrastructure includes seed farms on 7,303 acres, processing plants with a capacity of 72,000 metric tons, ginning capacity of 22.5 bales per hour, delimiting capacity of 13,500 metric tons, storage capacity of 6,700 metric tons, more than 1,200 registered growers, and a marketing network of 1,136 dealers and 19 sales points in Punjab and 70 dealers in other provinces (PSC 2008).

Alongside the PSC is a vibrant private sector, although exact numbers are difficult to come by. A total of 963 Pakistani seed companies have registered with FSC&RD since 1981, although 213 companies were deregistered over the years after they were found to be involved in irregularities. Several of these companies were started by contract growers of a provincial seed corporation with sufficient experience in producing seed for the public sector, or by successful farmers who had been providing seed in the neighborhood and wanted to formalize the arrangement. Other companies were established by members of the value chain (e.g., a ginning factory, an exporter, or an agrochemical company) seeking to diversify their business portfolio. Another five companies are Pakistani subsidiaries of leading multinational enterprises: (1) Monsanto Pakistan Agritech; (2) ICI Pakistan; (3) Pioneer Pakistan Seed; (4) Bayer Crop Sciences; and (5) Syngenta

Pakistan. Although none host significant R&D activities in Pakistan, they are popular suppliers of (mostly imported) hybrid seeds of maize, sunflower, fodder, canola, alfalfa, and sorghum.
Available data suggest several important trends. First, Pakistan's seed business is concentrated in Punjab, with 82 percent of companies having their registered offices there. Most of these companies are located in Southern Punjab, which enables them to also serve the markets in Sindh and Balochistan. Second, the total number of companies is large and growing, although there is little evidence indicating the emergence of strategic behavior mergers, acquisitions, joint ventures, and technical collaborations that often accompanies seed industry growth.

2.3 Human Resource

Human resource is locally available mostly university graduates' example students from agriculture universities', however training and development could be done to further enhance their capabilities and to produce specialized human resource.

3 INSTITUTIONAL SETUP

3.1 Associations

Seed Association of Pakistan

There are six seed trade associations in the country, Chamber of Private Seed Industry, Seed Companies Association of Pakistan (SCAP), All Sindh Private Seed Companies Organization (ASPSCO), Seed Associations of Pakistan (SAP), Association Seed Companies of Pakistan (ASCOP) and All Pakistan Seed Merchants and Seed Dealers Association (APSMTA APSMTA).
Seed association of Pakistan (SAP) was established in 2010 as the sole legal representative of Pakistani seed industry under the Trade Organizations Act. It is licensed by the Directorate General of Trade Organizations (DGTO) under the Ministry of Commerce, Government of Pakistan and also registered with the Securities and Exchange Commission of Pakistan (SECP). It coordinates with the Ministry of National Food Security & Research (MNFSR) which governs the seed laws and regulates the seed companies. SAP is also a permanent member of the National Seed Council (NSC) and Varietal Evaluation Committee (VEC) under the Seed Act. It has 200 member companies which own nearly 80% share of the Pakistani seed market, which is currently

valued at $300 million. The private seed companies produce more than 90% of the cotton and wheat and over 80% of rice seed in Pakistan and their share is rapidly increasing in local production of maize as well. The Association played a major role in the approval of the recently passed Seed (Amendment) Act 2015 and the Plant Breeders' Rights Act 2016, thus earning a formal legal recognition of the Private Seed Sector and a legal framework for the protection of plant varieties respectively. SAP is a member of the Federation of Pakistan Chambers of Commerce and Industry (FPCCI) and major international seed associations including International Seed Federation (ISF), the Asia and Pacific Seed Association (APSA) and ECOSA, which is the seed association of the Economic Cooperation Organization (ECO), a 10 member Asian political and economic intergovernmental organization, similar to the EU and ASEAN. It was founded by Pakistan and Turkey and includes countries of the Central Asia.

SAP currently has five technical committees: a) Cotton & Wheat Committee, b) Rice (Hybrid & OP) Committee, c) Hybrid Maize & Other Hybrids Committee, d) Vegetable Seeds Committee and e) Oilseeds & Other Crops Committee.

Main objectives of the Association include promoting the agricultural and socio-economic interests of its members, increase farmer awareness and create a sustainable and mutually beneficial public-private partnership. It also focuses on the promotion of seed quality and continuous development of seed varieties, strong scientific capabilities and breeding programs. It also provides a forum for exchange of information and advisory for its members. It strives to create a dynamic, innovative and internationally competitive research-based industry producing high performance, high quality seeds and encourages establishment of state-of-the-art labs, research and training facilities and investments in R&D. It also plays a vital role in deliberating on policy matters including negotiations with Government and its departments / institutions on issues concerning the seed sector and contributes towards the national goals of increasing food grain and commodity production.

Recent activities of SAP include participation in the Punjab Agri. Expo 2019, 5th CAC (China Agro Chemical) Pakistan Summit and an Innovation Agri. Program. It also organized consultative sessions with the Govt. of Pakistan on cotton and local seed production of potato, arranged a seminar on rice scope and opportunities as well as a traveling seminar during Maize National Uniform Yield Trials. The Association's Strategic Plan includes increase in local production of rice Hybrids for exports, local production and R&D on vegetable hybrids and OP

varieties and host international seed industry events in Pakistan. It aspires to hold at least one Technical Committee Meeting of APSA in 2020.

ASCOP is established by the private seed companies in Sahiwal, Okara and Pakpattan districts. The All Pakistan Seed Merchants and Seed Dealers Association (APSMTA) operate on national level and looks after the interest of vegetable seed dealers. Efforts are also under way to organize seed growers associations at various levels in different parts of the country. The Pakistan Society of Seed Technologists (PAKSSET) was established to provide a forum for professionals and all others involved in the seed sector in Pakistan. PAKSSET works for the development of seed technology and advancement of the profession in the country.

3.2 Government Support Institutions / Educational Institutions

Public-sector research organizations

Pakistan has one of the larger agricultural research systems among developing countries, with an estimated 3,513 full-time equivalent researchers (Flaherty et al. 2012). Most of these researchers are employed in public-sector research organizations, which play an important role in several seed sector activities, such as maintaining germplasm, importing exotic material from international research institutes for local adoption, developing varieties, and training workers for the seed industry. Three sets of institutes and universities are important: federal institutes, provincial government institutes, and agricultural universities.

FEDERAL INSTITUTIONS

The most prominent federal institutes are the Pakistan Agricultural Research Council (PARC), Pakistan Central Cotton Committee (PCCC), and agricultural research institutes of the Pakistan Atomic Energy Commission (PAEC). We briefly discuss each below.

Established in 1981, the Pakistan Agricultural Research Council (PARC) is the federal government's leading research outfit with a diverse portfolio. PARC carries out R&D for all crops, except cotton. It manages the National Agricultural Research Centre and nine area- and crop-specific research centers and institutes. Research is organized under four divisions: Plant Sciences Division, Animal Sciences Division, Natural Resources Division and Social Sciences Division. Scientific and technical staff members in these divisions conduct traditional breeding and agronomic research, as well as modern genomic and biotechnology research. PARC also

runs an institute for preservation of plant genetic resources, which holds in its gene bank more than 27,000 accessions of different crop species (PARC 2013).

Established in 1948, the Pakistan Central Cotton Committee (PCCC) is the federal government's dedicated organization for research on cotton, and has developed several popular cotton varieties. PCCC is funded by federal grants and a small cess on the textile industry under the Cotton Cess Act of 1923. Formerly administered by the Ministry of Textile Industry, in 2012, the PCCC's management control was transferred to the All Pakistan Textile Mills' Association, which has nominated one of its leading members as PCCC's Vice-president and Chief Executive Officer. The Central Cotton Research Institute (CCRI) is the leading Pakistani organization for cotton R&D, and falls under the control of the PCCC.

The Pakistan Atomic Energy Commission (PAEC) also runs several research institutes that carry out important seed sector activities. Most notable are the National Institute of Biotechnology and Genetic Engineering (NIBGE) and the Nuclear Institute of Agricultural Biology (both located in Faisalabad). These institutes use modern techniques and tools in agricultural biotechnology to support the breeding of new plant varieties. NIBGE has successfully developed GM varieties of cotton and is actively pursuing development of GM varieties of other crops (including drought-tolerant wheat).

PROVINCIAL GOVERNMENT INSTITUTIONS

The largest provincial government institute is the Punjab government's AARI in Faisalabad. AARI has several crop-specific research institutes and stations throughout the province, which develop new crop varieties, find novel and effective ways of countering pests and pathogens, and suggest appropriate farming practices to boost production and reduce costs. There is extensive overlap and duplication among the federal and provincial variety development programs. Perhaps the most obvious case is PCCC's CCRI, which is located in Multan, a large agricultural district in South Punjab. CCRI has elaborate plant-breeding facilities, and has developed several popular cotton varieties. Situated across the road from CCRI is AARI's premier Cotton Research Station, which pursues the same mandate and has similar facilities. Yet the two institutes exist as separate entities and rarely communicate.

AGRICULTURAL UNIVERSITIES

Five major agricultural universities in Pakistan carry out research leading to variety development: the University of Agriculture, Faisalabad (UAF); the University of Arid Agriculture, Rawalpindi; the Agriculture University, Peshawar; the Sindh Agriculture University, Tando Jam; and the Lasbella University of Agriculture, Water and Marine Sciences, Lasbella. Their academic programs—Bachelor of Science, Master of Science, Master of Philosophy, and Doctor of Philosophy (PhD) —provide a trained workforce for the seed industry and other agribusiness. Current total enrolment is estimated at 27,000 (Flaherty et al. 2012). UAF is the largest agricultural university and has a current enrolment of about 12,000 students (UAF 2013). It employs 593 faculty members, of whom 288 (49 percent) hold a PhD from a foreign or a local university. Since its founding, the UAF has conferred 916 PhDs (i.e., only 17 per year on average).

4 SWOT ANALYSIS

4.1. Strengths.

- Market gap between demand and supply
- Availability of skilled and qualified graduates from agriculture universities.
- Farmers being dependent on conventional method however this can be changed through introduction of new hybrid seeds which produce greater output.
- Vast availability of infrastructure for seed testing,
- Availability of finance through financial institutions.

4.2. Weaknesses

- 60% of seeds requirement in Pakistan met by informal sector.
- Archaic and bureaucratic legal and institutional structure causing delays in seed certifications and has failed to keep pace with structural changes in agriculture.
- Un-approved seed varieties being used hindering growth of formal sector.
- Research and development costing of new variety of seeds.

4.3. Opportunities

- Introduction of new technology and seeds may attract new farmers towards genetically modified seeds.
- Increasing market demand for seed.
- Increase in population and consumption therefore farmers preferring hybrid seed for maximum output.
- The government no longer controls seed prices in the market and various companies price seeds based upon their own specific production and procurement circumstances.

4.4. Threats

- Once a breeder wants to commercialize a new variety, he is required to submit its seeds for evaluation, which takes at least two years. Since the breeder is ready to enter the market, this is an unnecessary wait for him.
- In-acceptance of quality control mechanisms by informal sector.
- Unregistered seed importers and seed being used in informal sector.

5 INVESTMENT OPPORTUNITIES

The sector itself is very lucrative sector for investors around Pakistan since population and consumption needs have increased over the period of time therefore growers are looking for better seed variants e.g. hybrid seed/genetically modified seeds. Food is basic necessity for livelihood moreover agriculture sector being dependent on seed and demand on increase for seed therefore it can be stated that this sector would provide handsome return to the investor.

6 STRATEGIC RECOMMENDATIONS TO UPLIFT THE QUALITY & PRODUCTIVITY

The availability of quality seed plays an important role in enhancing the productivity of agriculture. The existing seed production and supply system is inadequate to meet the national requirements. Although, the seed program for major crops is progressing, in case of minor crops it is far behind. These recommendations may be taken into consideration to uplift quality and productivity.

- Provide incentives for the development of national seed sector.
- Reorganize or privatize public seed companies to increase efficiency.

- Encourage national private seed companies to establish Basic Seed Production Units.
- Encourage seed production of legumes, oilseeds, fodders and forages by public and private sector to substitute massive imports.
- Encourage seed potato production by public and private sector to reduce dependence on import.
- Encourage local vegetable seed production by private sector by providing incentives.
- Establish seed plants and encourage seed production of various crops in rain fed (barani) areas.
- Strengthen the FSCRD by establishing new laboratories and levying fees for variety registration and seed certification services.
- Amend Seeds Act 1976 to encourage the private sector and curb sale of unlabeled seed.
- Register all seed importers with FSCRD to ensure import of varieties that are locally tested.
- Organize the informal sector by forming seed growers association and provision of small cleaning units and storage facilities.
- Increase awareness about seed through demonstrations by the agriculture extension at union council level.