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Legal & Regulatory Framework for Plant Breeding Innovation in Pakistan

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Abstract:
Plant breeding innovation' is use to define the frequently evolving designs and practices which increase plant breeding field. The plant breeders when innovate the seed variety, it has to pass through different stages of variety testing like, "value for cultivation and use (VCU), distinctness, uniformity and stability (DUS)".This article deals with the legal and regulatory framework which has been established in Pakistan to achieve sustainable agriculture development. Agriculture sector is the backbone of Pakistan's economy and seed is basic component in agriculture production. It needs special attention on part of the policymakers. Currently, the important framework for the seed part exists in Pakistan at both the federal and provincial level. The Federal Seed Certification and Registration Department (FSC&RD), Provincial Seed Council (PSC) and Seed Organizations are controlling the seed's production and marketing of new varieties. Despite the availability of many natural genetic resources and seed varieties, Pakistan is not creating enough amounts of seed for the cultivating group, aside from cotton. The country is dependent mainly on imported seed and multinational seed companies; however, the government formative policies and strategy can increase the seed production in Pakistan which will increase the sustainability of agriculture sector.

Key Words: Plant breeding, Seed, Agriculture, Innovation, Varieties.

Introduction:

'Plant breeding innovation' is use to define the frequently evolving designs and practices which increase plant breeding field. Nowadays revolutions in plant breeding are developed through advanced scientific knowledge and expertise including cell biology, gene mapping and marker-assisted breeding. The core purpose of plant breeding program is to create new plant diversities for improving farm productivity and economy. Plant breeders have very successfully increased potential crop yields; however the negative impacts of crop breeding on health and environment is a significant issue.

The plant breeders when innovate the seed variety, it has to pass through different stages like variety testing, "value for cultivation and use (VCU) (ASSESSMENT OF VARIETY VALUE FOR CULTIVATION AND USE , 2016) distinctness, uniformity and stability (DUS)" (SASA, 2017).The plant breeders both private sector and public sector give preference to seek verity tested officially. It helps to improve and develop the system of official variety testing and release. Agriculture sector in Pakistan is considered as the leading component of all economic activities.
According to recent report, the sector added 19.8% in GDP and it remained the largest employer absorbing sector by employing 42.3% of the state's employment force (Investopedia,2016).The seed's varieties played pivotal role in boosting agriculture production of the country. International organizations, conventions and treaties are dealing with the ruling of seed. They give a global administrative system by control the interests of makers, reproducers, and customers (Agricultural Ministry of Pakistan, Agricultural report 2015-2016 of Seed).

The organizations contain the International Seed Testing Association (ISTA) internationally recognized procedures for seed sampling and testing, the Organization for Economic Co-operation and Development (OECD),its Seed arrangements are universally acknowledged for the affirmation of seed in global exchange (Wikipedia, International Seed Testing Association, 2016).'The International Union for the Protection of New Varieties of Plants (UPOV)' deals with new seed varieties and an intellectual property protection (Oecd.org, 2015). The International Seed Federation (ISF 2011, Seed Statistics) and (FAO, 2009) give the universal administrative system to related parts of seed exchange. It incorporates plant wellbeing and phytosanitary measures, get to and advantage exchange for plant genetic material and consumption of pest killing chemicals (OECD Seed Schemes, 2012).Regulatory mechanism exists in Pakistan for controlling and regulating the quality seed which generally include National Seed Council, Provincial Seed Council, Federal Seed Certification and Registration Department (FSC and RD).The Federal Minister for Food and Agriculture has full authority over policy making. The research institutions are supported by the concerned provincial government and some of the projects of these research institutions are funded and coordinated by (PARC) at the Federal level. The seed trade in Pakistan consisted of the official and informal sectors, the first in turn consist of the public and private sectors (Lahore University of Management Sciences, 2004). The formal seed structure comprises of nearby, national, worldwide public and private sector organizations. Business affiliations are included in preparing, showcasing and appropriation of seeds. Multinational companies are playing major role in seed sector of Pakistan.

Data Collection:

This paper utilizes information from the accompanying five sources: (1)the Federal Seed Certification and Registration Department(FSC&RD) Islamabad,(2) online Internet sources,(3) academic papers, books and reports,(4) meeting and interviews with concerned people like Pakistan Agriculture Research Council(PARC) Director, Plant Genetic Resources Institute(PGRI)Dr.Abdul Ghafoor and Nazar Iqbal Deputy Director Federal Seed Certification &Research Department.(5)The most of document were collected from Ministry of law and Ministry of National Food Security and Research, Civil Secretariat Islamabad.

Basic Concept of Plant Breeding:

Plant breeding is the method through which the modification in the characteristics of plants with the passage of time takes place to create variety for the production of improved crops and more nutritious food. In other words, breeding consists of choosing the best seed or plant and using this seed or plant to grow further generations. Through improvement scientists can produce better-quality varieties that withstand and possibly increase yields and are better adjusted to resist disease and the effects of weather change, like scarcity of water or floods, supporting sustainable agriculture and food safety. The procedure of plant rearing changes the hereditary capacity of the plants with section of time. Breeders in Pakistan have introduced many productive varieties of rice and wheat for improving the quality food production.

Main Requirement for Plant Breeding:

The main factor that is involved in plant breeding is genetic variation in the seed according to the most wanted feature (Bioscience in brief, 2015). For example, an agriculturist needs to choose a plant assortment with imperviousness to a bug will look for the plants which survive a creepy crawly assault. In many developing countries plant breeding is playing particular role to provide food, forage, fiber, medications, and shelter for humans. In addition, plants are used for artistic and other useful purposes in the scenery and in the houses for decorative purposes (History and role of plant breeding in society, 2016).

Clue of Biological Diversity:

Generally, diversity of life on land is called biological diversity. “It includes all species of plants, animals and ‘micro-organisms’, their genetic material and the ‘ecosystems’ where they live. The many different forms of life have taken millennia to develop through a process of natural selection and evolutionary change.” (Habibi, Biological Diversity in Pakistan, 2014).

Article 2 of the Convention on Biological Diversity (CBD) specify biological diversity resources

"*The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*".

The Importance of Quality Seed in Agriculture Sector:

Seed is:

"The unit of reproduction of a flowering plant, capable of developing into another such plant" (oxford dictionaries)

Seed is a material source which is used for regeneration or planting purposes. It is a source to shift the genetic potential of a variety to the next plant generation (Raza, MIT Technology Review Pakistan). "Subeejam Shushereto Jaayaty Sapadayaty" means:

"The good seed in a good field produce abundantly". (Raza, MIT Technology Review Pakistan).

Therefore, farmers should use healthy and pure seeds as per the minimum certification standards. "Adage is as per you sow as per you reap". The good quality seeds are those which have genetically pure, health standards, physical purity, and germination ability and moisture percentage. Hence, the farmers can increase more or less 20% production of crops while using the standard quality of seed. The seed is the chief arrangement among the other arrangements of the farmers. The low quality seed waste the labor and other expenses of the farmers. The farmers should keep in mind the following seed's characteristics at the time of sowing crops.

Characteristics of Quality Seed:

Generally, it suggests that if a seed meets the confirmation standard, it is great quality seed and if does not meet the accreditation gauges, it is unmistakably of a lower seed quality. The following distinctive necessary for a quality seed(India agro, 2015)

a) It must be genetically pure:
b) Breeder/nucleus seed: 100 percent(Lal, 2015)
c) Foundation seeds: 99.5percent
d) Certified seeds varieties: 98percent
e) Certified hybrid seeds: 95percent
f) Certified hybrid cotton: 90percent
g) Certified hybrid castor: 85percent
h) It should have required level of physical purity: All crops: 98percent, Carrot: 95percent, Ragi: 97percent (CSGA, 2017)

Quality Checking of Seed:

The purpose of quality checking is to provide accurate and clear information about seed. Furthermore, Seed testing provides necessary knowledge for determining the quality of a shipment of seed concerning parameters like 'germination, physical purity' and moisture content. Seed testing should be carried out in a national seed laboratory or ISTA accr edited laboratory (Seed and Seed Quality: Technical Information for FAO Emergency, 2014).

Plant Breeding in Pakistan:

Agriculture sector of Pakistan has a great significance. It is one of the dominant sectors for making its contribution to Pakistan's economy. For meeting the need of seed in agriculture, plant breeders are playing their extensive role in Pakistan. Agriculture's examine and variety development plan consist of 13 multidisciplinary, 14 mono-commodity research institutes and four agricultural universities (Akhlaq, and Bhutta, 2015).

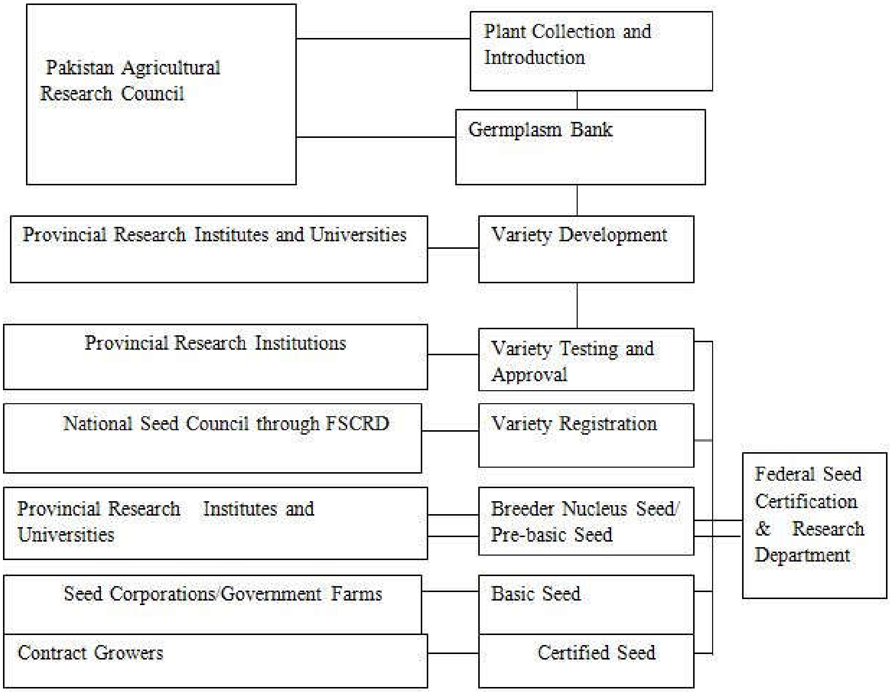
Out of the 13multi-disciplinary research institutes, four are established in Punjab, four in Khyber Pakhtunkhwa and three in Sindh and two in Balochistan. These colleges are covering every monetary yield and the related orders which are being instructed there had an expansive number of areas and sub-stations (Federal Seed Certification and Registration Department, 2016).

Punjab Agriculture College and Research Institute Lyallpur had been recognized in 1909.When Pakistan was established in 1947; it was the only one Agricultural education cum research institute; that was later separated and upgraded to university of Agriculture Faisalabad (UAF) and Aube Agriculture Research Institute (AARI), Faisalabad in 1961(Sarwar, , 2012).

The establishment of multi-disciplinary research institutes in province was due wide diversity of Agro-ecological reasons. These organizations have the order to grow better adjusted assortments for nearby agro biological prerequisites.

Larger part of research establishments are supported by the separate commonplace government. A couple of projects of these institutes are facilitated and partly financed by the Pakistan Agriculture Research Council (PARC) (National Agricultural Research Centre (NARC), 2013).

Fig 1: Organization of variety development, registration and release in Pakistan



*Data Sources: Federal Seed Certification and Registration Department, Islamabad.

The collection of germplasm, safeguarding, assessment and protection is approved by the Plant Genetic Resources association, ARC (for cotton by PCCC, 2015).These materials are made available to plant breeders. The variety's development, testing and evaluation are being undertaken by the Provincial Agricultural Research Institutes, Pakistan Agricultural Research Council, PCCC, Pakistan Atomic Energy Commission (PAEC) and Agricultural Universities. Since the plant breeding activities are dominantly oriented by the public sector. It played a major role in the development of agricultural and horticultural crop varieties. In the development of plant breeding with help of the research institutions Punjab has played prominent role.

Development of New Varieties:

Federal and provincial Agricultural Research Institutes are mainly developing new varieties through conventional Plant Breeding. Mainly, Atomic radiation is used for developing new varieties significantly of 'pulses', cotton and rice. Pakistan's denationalization support Policy has urged the appearance of multinational seed's companies like Syngenta (Pakistan) Ltd, Pioneer Pakistan Seeds Ltd, ICI (Pakistan) Ltd and Monsanto Pakistan Seed (Pvt.) Ltd. The mentioned companies have initiated breeding programs and submitting varieties for assessment and registration including hybrids of Maize, sunflower and 'Sorghum' (SORGHUM, 2015). For promoting and strengthening the national plant breeding programmers, the country had been contacted with International Agricultural Research Centers as ICARDA. IRRRI, CIMMTY, AVRDC, IITA and CIAT for getting germ plasm. The insurance of Plant Breeder's Rights might change the part of research's associations through more research toward improvement of germ plasm assets, new reproducing techniques and identifying the improved breeding lines (Section 2(n) Seed Act 1976 of Pakistan).

Selection of New Variety after Testing:

The breeders test and assess the new variety at research centers. Breeders organize proper assessment micro varietal trials and out-station zonal varietal trials. They judge the occurrence of change in the genotypic environmental interaction. The most zonal trials are led in the region of flexibility in collaboration with edified cultivators and on government ranches. They present the new seed assortment's specimen to the National Seed Registration Department to decide the Distinctness, Uniformity and strength with the end goal of setting up portrayal and enrollment. It is important to give an example to the Variety Evaluation Committees of Pakistan Agriculture Research Council (PARC) for products in the meantime as cotton's seed tests are submitted to Pakistan Central Cotton Committee. Another assortment that satisfies the necessities of significant worth for development and utilizes (VCU) and Distinctness, Uniformity and Stability is endorsed for discharge and registration. The Seed Act 1976, S.2 (n) provides

"A released variety means a registered variety having agricultural value for growing in a Province and approved by the Provincial Seed Council"(Section 2(n) Seed Act 1976 of Pakistan).

Requirement of Value for Cultivation and Use (VCU):

Value for cultivation and use (VCU) is the important standard for a profitable variety improvement. The provincial Agricultural Departments organize agronomic trials at their research farms, Seed Corporation and progressive growers' farms. The vital part of testing for VCU is the yield execution; in addition, there are some different elements which must be surveyed. Attributes of field may vary from one harvest to other product i.e. for wheat imperviousness to rusts and other cabin, bread quality and "pathogens" etc. It is also necessary the product of crop must be the real quality(Federal Seed Certification and Registration Department, 2014).

Basic Requirements for Estimating the Distinctness, Uniformity and Stability (DUS):

The following are the basic requirements for new and pure seed's verity production:

A) Distinctness:

The purpose is to check the candidate variety is different from the other commonly known varieties. A variety is considered distinct from another when the differentiations significant and consistent at least at one testing place. If two different varieties exhibit greater differences than the natural fluctuations of characteristic expression found within one variety, then they are distinct" (Julia, Hanna, and Waszak, 2003).A new seed's variety must be known and evidently distinct from all other present varieties by one or more morphological character (color, shape etc.), metric characteristics (height, leaf length etc.) and physiological (maturity, resistance etc.)

B) Uniformity (Homogeneity):

"The assessment of uniformity of parental lines and single hybrids is done on the basis of number of types in tested sample of plants. "Uniformity relates to the degree of variability within the new variety. The new assortment of seed ought to be sensibly uniform inside its stand singular plant could be recognized.

C) Stability:

It is fundamental necessities for immaculate seed generation that it must stay consistent with its depiction after rehashed multiplication. A steady cultivar is constantly advanced the reason is that it can be conveyed and expanded without numerous complaints. For the most part, it is extremely troublesome amid a period 2 to 3 years to perform solidness tests like the testing of homogeneity and uniqueness. Regularly, in two developing years, when a submitted test has appeared to be homogenous, it would be consider stable in light of the fact that the foundations or reproducers have the obligation to keep up the assortment and its dependability in coming era. The variety would be considered unfit for certified seed production as the failure in stability is detected in coming generation. Pre and post control trials are the source to further ascertain the stability of new variety (Julia, Hanna, and Waszak, 2003).

New Variety Testing Procedure:

The procedure and growing tests are nearly similar in many countries for establishing Distinctness, Uniformity and Stability as being practiced for Plant Breeder's Rights. In Pakistan,DUS function is approved by the Federal Seed Certification and Registration Department (FSC&RD).Breeders submit the seed sample along with the following documents to the FSC &RD:

a) Application in written form for registration of the new seed variety
b) Data regarding value for cultivation and use (VCU)
c) Actual specimens of plant variety and plant parts
d) Detailed about the botanical characteristics of the variety along with comparable variety closely resembling to the candidate variety - it may also include brief breeding history and parentage.

Requirement of Pre-Registration Trial:

The purpose of pre-registration trial is to determine the distinctness, uniformity and stability of new seed's variety. The trial is conducted under normal agronomic practices for two years with a minimum of two replications. The candidate varieties are compared with already registered varieties and among themselves. Closely resembling varieties are cultivated in one group for next year assessment. The distinctness of the candidate variety is known within one class during the second year. When the variety does not fulfill Distinctness, Uniformity and Stability the FSC& RD has right to set back for registration. The new variety meets its DUS and VCU characteristics, according the data issued by the Federal Seed Registration Committee (FSRC).After the approval of variety, it is sent to the National Seed Council (NSC) for confirmation of registration. Through the Federal Seed Certification Department the new registered varieties become entitled for quality control.

Features of Registration:

I) The registered variety secures the rights of Plant breeder.

II) The registration of new assortment gives the premise to genuine sort upkeep of raiser's Nucleus Stock of the assortment for the generation of pre fundamental seed.

III) The quality of new variety control easily through Federal Seed Certification Department.

Approval and Release of Crop Variety:

At the provincial stage, the provincial governments are answerable for distribution, processing and arranging production of quality seed of released variety. The registered variety is recommended and released for cultivation by the concerned Provincial Seed Council. The following are the steps for approval and release of variety.

The breeders and agricultural experts are the representative of Expert's subordinate committee. At the provincial level, committee receives the proposal of candidate variety. The committee assesses the data of breeders with the reports of FSC & RD. An expert sub-committee submits the report of the varieties for approval which are considered proper for cultivation to Provincial Seed Council.

Under section 9 of the Seed Act 1976, Provincial Seed council has been established. It works in same lines in its relevant province. It can approve the variety; a notification is issued by the Federal Government after registration. In every region, the Provincial Seed Council is spoken to by the seed makers, quality control offices, illuminated cultivators and reproducers. They talk about the proposition of the applicant assortment in the light of the remarks and suggestions of the Expert Sub-board of trustees support and discharge the new assortment.

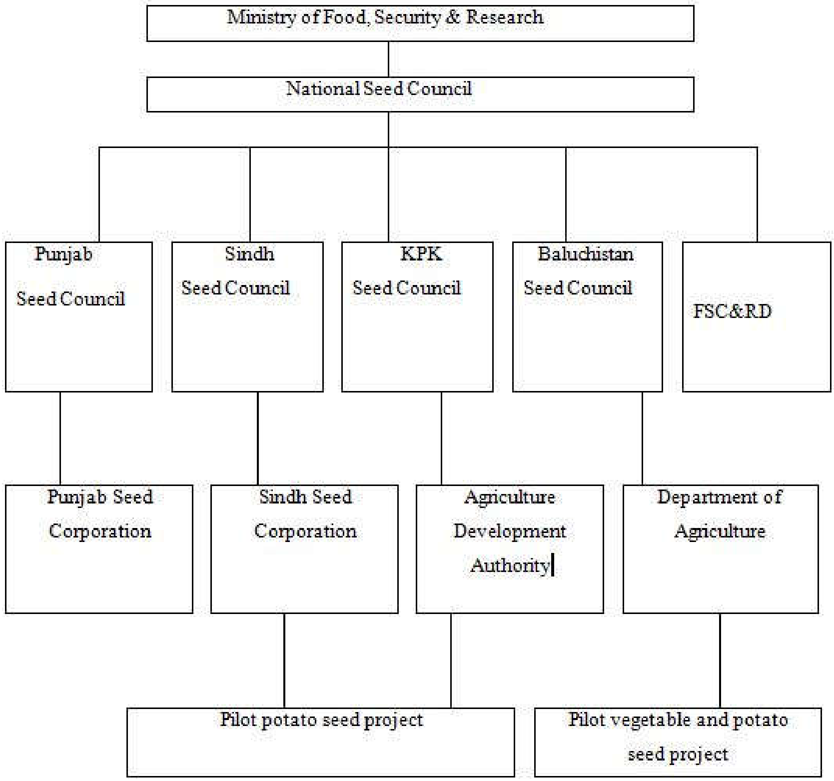
The issues are cited to the National Seed Council, while there is different opinion among the members of Provincial Seed Council. The Federal Seed Certification & Registration Department considers the report of the crop specialists and submits the cases for final decision to the National Seed Council. For the most part, the choice of the Provincial Seed Council with respect to endorsement and arrival of assortment is consistent. Moreover, the procedure of registration and release of vegetable varieties are almost the same except for their testing not on such a scale as that of cotton and cereals. The reason is that the most of the vegetable crops have limited localized preference and adaptability. Breeders provide the data on the basis for agronomic value regarding the performance of the varieties.

National Seed Policy:

A seed is a central source in agriculture production. It requires particular attention of the government for promotion and innovation of seed. The government is attached with agricultural research, seed promotion and variety development, distribution, extension and quality control; however, the measurements are not sufficient. There is massive need to promote the seed sector of Pakistan.

The Seed Act 1976 gives a lawful edge to assortment enrollment and seed quality control by setting up the 'institutional foundation. It included the Federal Seed Certification and Research Department (FSC&RD), National Seed council (NSC) and the Provincial Seed Councils (PSC). The basic seed's infrastructure based on the federal and provincial levels (Hussain and Bhutta, 2016)**.**

Fig 2: Organizational Structure of the Public Seed Sector in Pakistan.



Ministry of Food Security and Research is the incomparable body for planning national strategies and directing the seed segment of Pakistan. The National Seed Council (NSC) is regulated by the Ministry of Food Security and Research. It embraces approves on seed's quality and coordinates interprovincial advancements of seed. All establishments related to the progression of seed's industry in Pakistan are addressed by the National Seed Council. It has been resolved to endorse trim assortments for seed generation, make courses of action for seed duplication, handling and advertising in the applicable province.

The free market economic policies preferred by the government to encourage privatization and several companies have been granted permission to produce and market in the country. “The new policy defines the roles of agricultural research, private sector and NGOs and a legal framework to prevent adulteration of inputs. “The National Seed Council has accepted the ‘Rules for Certification of Fruit Plants’. This step may improve the quality of nursery stocks for fruit tree crops. This rule helps develop the production, distribution, disease free fruit and good quality plants. Ibid

According to the agro-ecological need of various regions, Pakistan Agriculture Research Council (PARC) has seven major research establishments in Pakistan:

1. National Agricultural Research Centre (NARC), Islamabad
2. Karachi Sugarcane Research Institute (SRI), Thatta
3. Karakoram Agricultural Research Institute for Northern Areas (KARINA),Gilgit
4. National Tea Research Institute (NTRI), Mansehra
5. Tropical Agricultural Research Center (TARC), Karachi
6. Himalayan Agricultural Research Institute (HARI),Kaghan
7. Arid Zone Research Centre (AZRC), Quetta

Pakistan Agriculture Research Council (PARC) has Federal Pesticide Research Lab, Multan; 'Beach front Area' Research Station, Karachi; and it incorporated Pest Management Laboratory, Multan, Agricultural Economics Research Units (AERUs) are working in every one of the areas and Azad Jammu and Kashmir. The PARC has its provincial workplaces in Lahore, Karachi, Peshawar and Quetta its examination units in Rice Research Institute Dokri Sindh and Kala Shah Kaku, Lahore. The agrarian research organizations support close cooperation with universal farming examination focuses like CIMMYT (2015) CIAT, ICARDA, ICRISAT, IITA and IRRI.

10. Variety Maintenance:

After the endorsement and arrival of new assortment, the concerned foundation has the obligation regarding upkeep and generation of Breeders Nucleus Seed (BNS), it duplicate to Pre-fundamental seed. Breeders work with the Federal Seed Certification and Registration Department (FSC&RD) to deliver the pre-fundamental seed by Public Sector Corporation. Under the new government approaches and laws, it appears that the private part will build its part in creating essential seeds (Hussain and Bhutta, 2016)**.**

Table 1: Number of Crop Varieties Released and Registered from 1947 to 2016 in Pakistan

Crops	**No. Of Registered and Released Varieties**						
	Punjab	**Sindh**	**KPK**	**Baluchistan**	**Islamabad**	**Private**	**Pakistan**
Wheat	61	24	44	08	04	---	141

Barley	03	---	03	04	---	---	10
Maize	14	---	12	---	---	02	28
Rice	20	14	07	----	---	---	41
Cotton	85	23	02	---	---	18	128
Sugarcane	15	10	16	---	---	01	42
Pulses	46	04	21	01	05	---	77
Oilseeds	22	05	23	---	08	05	63
Fodders	29	---	07	01	---	02	39
Vegetables	40	01	13	08	---	---	62
Fruits	10	---	36	---	---	---	46
Flowers	03	---	---	---	---	---	03
Total	**348**	**81**	**184**	**22**	**17**	**28**	**680**

*Sources from: Federal Seed Certification &Registration Department, Islamabad.

Pakistan's Seed Production:

Seed production of Pakistan is based on both public and private sectors. The official sector is probable to supply 100%, 33% and20%, in that order of seed necessity for cotton, maize and cereals.

In actual, more than 90 per cent of the cereal seed needs, and nearly the complete requirements of legumes, oilseeds and fodder crops, continued to be obtained from additional sources able to sufficiently provide the seed supplies for the farmers of Pakistan. Public sector organizations had established the production of quality seeds for the chief crops, and promoted farmer awareness for the use of certified seed. Yet, the public sector is not able to manage even the replacement rate of seed for the key cash crops as its accessibility is still fewer than 10% of demand (LUMS, 2015).

The seed processing focused on Sindh and Punjab. An open segment had three portable seed cleaning units and five seed handling plants. The four seed plants had a limit of 103,000 metric tons (mt) every year for harvests as rice, maize, wheat cotton. The seed stockpiling and handling limit of the formal division was not meeting the national seed prerequisite in correlation of the formal part.

The Seed Act 1976 provides the legal framework to the seed system in Pakistan. According to the requirement, a few alterations were received to give authorization to the private division to deliver the essential seed. General society segment essentially manages the high volume, minimal effort seed of real harvests, for example, rice, and cotton and wheat verities. In spite of the fact that, the mid 2000s, people in general division could supply seeds for under 35 percent of cotton, 3 percent rice, 5 per cent maize and 15 per cent of wheat. The real seed production and processing were managed at the provincial level. The Punjab and Sindh Seed Corporations were established with help of International donors, particularly the World Bank. Khyber Pakhtunkhwa and Balochistan have not established seed corporations. The Agricultural Development Authority was granted this mission in Khyber Pakhtunkhwa; however it ceases to role in 2001.Thus, the responsibility was taken by various components of the Department of Agriculture; same was the case in Balochistan.

The Punjab Seed Corporation (PSC) confronted misfortune, however later profit by more steady administration. There were two variables which change the PSC from a misfortune creator into an unassumingly beneficial open substance. The first was the quality control and second was the demonstration program. The PSC began furnishing agriculturists with free seed for a section of land of yield, under the condition that they will take after the suggestions. Nearly, 1,000 such plots were distributed and created in the Punjab. After this transformation method, the PSC succeeded over 20 per cent growth in seed sales in the late 1990s.However, the country should to pay attention to domestic seed’s production. There is positive requirement for straightforward, air and impartial checking to the market. Global agricultural framework is astounding with novel creation from the hybrid seed and the seed part in Pakistan is stuck pre-essential seed (Agri farming, 2015).

Fig 3: Seed Production and Supply in Pakistan.

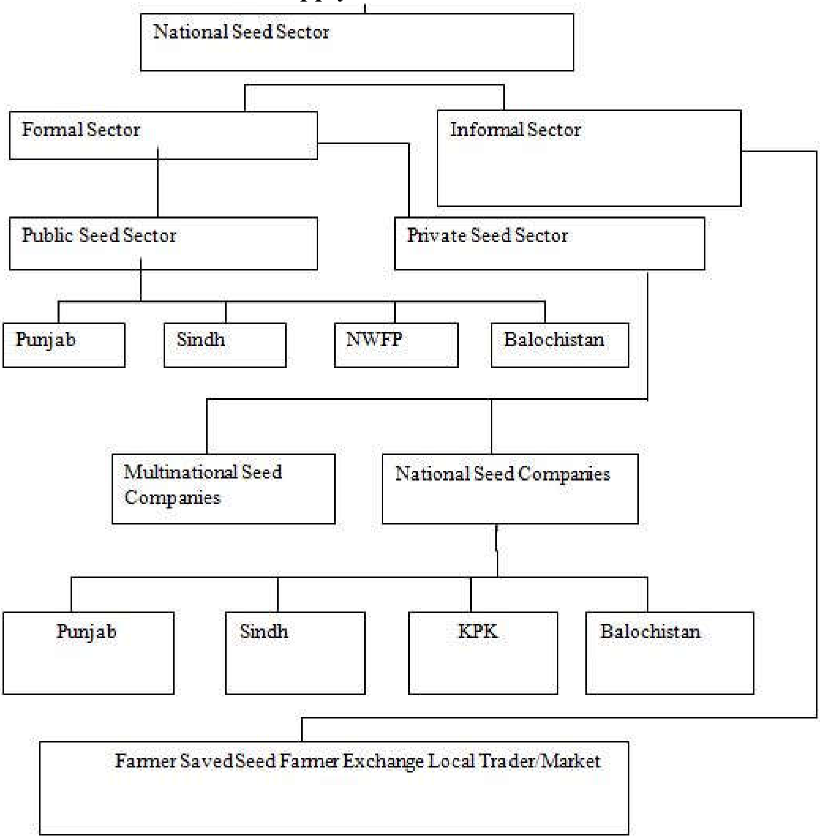


Table 2:Area, Seed Requirement and Seed Availability for Sowing Rabi 2015-16 and Kharif 2016in Pakistan

Crop	Area 000Ha	Total Seed Requirement	Targeted Seed Requirement MT	Seed Availability (MT)			
				Public	Private	Imported	Total (LOC+IMP)
Wheat	9,045	1,085,400	217,080	75, 45	239,55	0	315,020
			---	7%	22%	---	29%
Cotton	3,200	40,000	40,000	960	33,561	0	34,521
			---	2%	84%	---	86%
Paddy	2,847	46,660	12,744	4,269	43,962	8,470	56,701
			---	9%	94%	18%	122%
Maize	1,064	31,914	9,574	70	3,105	13,919	17,094
			---	0%	10%	44%	54%
Pulses	1,337	47,496	9,499	230	1,259	0	1,489
			---	0%	3%	0%	3%
Oilseeds	830	10,582	2,116	2	95	494	591
			---	0%	1%	5%	6%

Vegetable	254	5,570	5,070	21	106	7,300	7,427
			---	0%	2%	131%	133%
Fodders	1,942	40,138	40,138	---	27	37,307	37,334
			---	0%	0%	93%	93%
Potato	149	372,725	74,545	---	---	3,051	3,051
			---	0%	0%	1%	1%
Total	**20, 68**	**1,680,485**	**410,766**	**81, 07**	**321, 60**	**70,541**	**473,228**
			---	**5%**	**19%**	**4%**	**28%**

*Data Sources: Federal Seed Certification& Registration Department, Islamabad

Table 3: Summary of Imported Seed 2015-2016 in Pakistan

Crops	**Total Quantity (MT)**	**Total Value (Rs.Millions)**
Alfalfa	858.3400	333.8725
Berseem	16088.0000	2134.2696
Grass	32.7500	63.0016
Oat	0.0000	0.0000
Millet	1878.9250	106.1555

Sorghum	10970.2460	946.9298
Sesbina	0.0000	0.0000
Fodders	**29828.2610**	**3584.2289**
Canola	14.0000	11.0086
Sunflower	343.2860	209.3369
Jatropha	0.0000	0.0000
Oilseeds	**357.2860**	**220.3454**
Corn	8331.5418	3025.9163
Paddy	1943.5900	893.0700
Cereals	**10275.1318**	**3918.9863**
Potato	**3050.6750**	**200.4671**
All Crops	**43511.3538**	**7924.0278**
Vegetables		
Angled Gourd	0.0000	0.0000
Beans	109.7250	44.2997

Bittergourd	66.9970	141.3845
Bottle Gourd	36.1170	815.5860
Beet	0.4000	0.4650
Broccoli	0.0430	1.7986
Cabbage	7.0820	66.1987
Carrot	305.9430	147.5996
Cauliflower	19.0200	167.6624
Cucumber	31.0350	232.1231
Cucumber hyb	0.8180	196.8587
Corriander	114.7500	18.4462
Eggplant/Brinjal	5.4330	12.5101
Hot Pepper	11.6910	255.8802
Kohl Rabi	0.0000	0.0000
Lettuce	0.6150	1.3081
Leek	0.2000	0.5434

Long Melon/chichinda	8.0580	9.9006
Melon/Musk Melon	3.6520	36.5711
Moongra	2.7950	0.6465
Luffa	0.1190	0.9869
Okra	2450.6320	528.5030
Onion	220.8830	218.1269
Peas	1223.0780	177.9643
Pumpkin	0.1700	0.3897
Radish	108.4420	45.7780
Rape	0.0200	0.0010
Red Gourd	8.1700	7.1625
Ridgegourd	20.4930	13.1382
Round Gourd	297.6220	64.9910
Snak	0.7800	0.2226
Spinach	100.1320	22.0667

Spong Gourd	20.3180	44.0564
Squash	86.8140	362.1496
Sugar Beet	12.2860	29.0487
Sweet Pepper	1.7250	30.3030
Tinda	38.6210	414.6962
Tomato	162.9230	348.8600
Watermelon	31.1560	243.7935
Others/Veg.Marrow	3.6250	2.6374
Total (Veg)	**5568.8220**	**4847.7870**
Grand Total	**49080.1758**	**12771.8147**

* Data Source: Federal Seed Certification and Registration Department, Islamabad.

A) National and Multinational Seed Companies:

An extensive number of seed organizations were set up in 1991, providing diverse product seeds including vegetable and legumes. The government perceived the seed business as an industry in 1994.After affirmation of seed business as an industry, there was a consistent increment in the quantity of seed organizations. In one decade, no less than five multinational and more than 400 national seed organizations were enlisted. They were granted permission to produce and market seed. These companies were allowed to import and export seed.

Multinational seed companies operating in Pakistan included Bayer Crop Science Pakistan (Pvt.) Ltd. ,ICI Pakistan (Pvt.) Ltd.(Agro Chemical &Seed),Monsanto Pakistan Agri. Tech.(Pvt.) Ltd. Pioneer Pakistan Seed (Pvt.) Ltd and Syngenta Pak.Seeds Pvt. Ltd. These companies mostly imported and distributed seeds of sunflower, maize, canola, fodder and sorghum hybrids.

Monsanto Pakistan is headquartered in Lahore. It had extended network of 35 distribution and sale centers, selling several varieties of improved and traditional seeds. Monsanto acquired the Cargill hybrid seed business internationally in 1998. However, it later on acquired to grow and Dekalb Genetics businesses worldwide. It gives access to Pakistan to wide range of superior hybrids (LUMS, 2015).

It provides sunflower, corn, forage sorghum hybrid and marketed wheat, cotton and rice certified seed in Pakistan. Monsanto has large influence in research, production, processing quality assurance and development of a viable marketing infrastructure in

Table 4: Public and Private Seed Organizations in Pakistan Up to 2015 (Updated on 15-12-2015)

Type of Company	**Punjab**	**Sindh**	**KPK**	**Gilgit**	**Balochistan**	**Total**	**Status**
Public Sector Companies	1	1	1	---	1	**4**	Active
National Seed Companies	645	96	25	3	5	**774**	Active
Multinational Seed Companies	4	1	---	---	----	**5**	Active
Total Active	**650**	**98**	**26**	**3**	**6**	**783**	Active
Total Cancelled	217	43	5	---	3	**268**	Cancelled

Grand Total	867	141	31	3	9	**1051**	

*Data Source: Federal Seed Certification &Registration Department, Islamabad

Pakistan. Monsanto introduced herbicide for combating damaging weed, it has been claimed that it is very dangerous for environment and human health. World Health Organization (WHO) has issued warning that Monsanto developed weed killer Roundup –an active ingredient Glyphosate that is commonly used on Genetically Modified Organism(GMO) crops which causes cancer in human. Many countries have banned its usage or put limitation on its uses. Recently, Bermuda's Environment Minister Cole Simons is not ready to lift the ban on weed killers containing glyphosate (Science daily, 2016)

The Pakistani seed market pioneer had the second multinational company. It started its business in the country back in1989 with Pakistan's based partners. The Pioneer provided a wide variety of agronomic services in the country. In Pakistan, the Pioneer's main brands are maize, corn, pearl millet, sunflower, sorghum and fodder hybrid. Moreover, there are some other prominent companies are doing their business like ICI Pakistan(Pvt.)Ltd.(Agro Chemical &Seeds),Bayer Crop Science Pakistan(Pvt.) Ltd.

A) Informal Seed Sector's Production:

An informal seed sector is usually defined as the total of seed production activities of farmers, and small-scale farmers (Technology and Agrarian Development Wageningen University, 2000).

Other forms of the casual division incorporated the "bazaar" or unregistered part. The informal seed production was the main source of seed supplier; it had great potential in Pakistan. Generally, seeds originate from agriculturists or different sources like little retailers and gents. The informal seed division provided roughly 99 percent vegetables, 90 percent of wheat, maize and rice, 23 percent of vegetable seed, and 45 percent of cotton. According to a survey, 80 percent of seeds planted in developing countries were the farmer produced seeds.

"*Small-scale farming was estimated to contribute more than 50 per cent of the total food production in developing countries*."

Likewise, like other developing countries, Pakistan too has deep continuation of the informal sector of the seed provide for crops which is very important to food security, like wheat, rice and pulses.

The general view is that the informal seed systems are not able to meet the seed's requirement; they were outdated and should be substituted by the improved practices like western agricultural example, especially those chosen during the 'Green Revolution' [42] The current national regulatory seed system does not provide proper regulatory and legal framework to the informal seed sector. The informal producers of seeds in bordering areas had no such support and the national seed regulations were also centered on global standards. These regulations were mismatched with farmer's realities and the international slanderers often enforce limitations on free exchange and free marketing of alternative seed system. Pakistanshould change the international perception, in addition to local sponsorship on sustainable development in informal seed sector. Moreover, the informal seed sector itself distorted, that old age system would not be improved easily. In these circumstances, the national and local varieties were easily lost and supersede by relief seeds.

Conclusion:

Pakistan has extraordinary potential for creating a wide range of nourishment products. The country has rich and immense common assets, covering natural and climatic zones. Seed is basic component in agriculture production. It needs special attention on part of the policymakers. Currently, the important framework for the seed part exists in Pakistan at both the federal and provincial level. The Federal Seed Certification and Registration Department (FSC&RD), Provincial Seed Council (PSC) and Seed Organizations are controlling the seed's related activities. Despite the availability of many natural genetic resources and seed varieties,Pakistan is not creating enough amounts of seed for the cultivating group, aside from cotton. To sum-up, the country is relying mainly on imported seed and multinational seed companies; however, the government formulative policies and strategy can increase the seed production in Pakistan.

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Acronyms and Abbreviations

AARI	Aube Agriculture Research Institute
AERUs	Agricultural Economics Research Units
AZRC	Arid Zone Research Centre
CBD	Convention on Biological Diversity
CIMMYT	International Maize and Wheat Improvement Center
DUS	Distinctness, uniformity and stability
FAO	Food Agriculture Organization
FSC a& RD	Federal Seed Certification and Registration Department
GDP	Gross domestic product
GMOs	Genetically modified organisms
HARI	Himalayan Agricultural Research Institute
ISTA	International Seed Testing Association
ISF	International Seed Federation
ICARDA	International Center for Agricultural Research in the Dry Areas
IRRI	*International Rice Research Institute*
KARINA	Karakoram Agricultural Research Institute for Northern Areas
NARC	National Agricultural Research Centre
NSC	National Seed Council
NTRI	National Tea Research Institute
OECD	Organization for Economic Co-operation and Development
PAEC	Pakistan Atomic Energy Commission
PSC	Provincial Seed Councils
PGRI	Plant Genetic Resources Institute
PCCC	Pakistan Central Cotton Committee
PARC	Pakistan Agriculture Research Council

PSC	Punjab Seed Corporation
TARC	Tropical Agricultural Research Center
UAF	University of Agriculture Faisalabad
UPOV	Union for the Protection of New Varieties of Plants
VCU	Value for cultivation and Use
WHO	World Health Organization
WTO	World Trade Organization

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