

vegetables a major portion of which is being used only for hybrid seed production in case of vegetable crops. On the same pattern and pace like China, India is also required to replicate in all efforts to shift its vegetable seed production programs from conventional open fields to protected conditions looking to large number of problems in terms of several viruses, insects & pests and also due to several abiotic stresses encountered under open field conditions.

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## Role of Vegetable Seed Industry and impact of Plant Variety Protection (PVP) on seed industry in India

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### Abstract:

Seed is the prime important commodity for successful vegetable cultivation. After independence the policies of Govt. of India regarding the seed trade had been encouraged in India. Several private seed firms with multinational base are actively involved in vegetable seed production in India making the public sector much lagging behind. Expansions in areas, varied agro-climatic conditions, availability of huge and cheap human resource are creating ample scope for development of vegetable seed industry in India. Vegetable seed industry has positive influence on Indian economy in terms of income, employment generation and earning foreign exchange in International market. The role of the private sector in vegetable breeding has been increased with increase in hybrid share in the market. In recent years, however, the private seed industry has grown to be a sizeable presence in many crops. It is expected that the strengthening of intellectual property rights and the new technologies of genetic selection offered by biotechnology would make this sector even more attractive for private investment. These developments have affected the structure of the seed industry worldwide.

**Keywords:** CAGR, Global Index, Intellectual property rights, National Seed Corporation, Plant variety protection, Seeds industry, Vegetable

### Introduction:

Seed is the most important input component for productive agriculture. Every factor in agricultural production is of secondary importance, but it is quality of seeds which has a direct bearing on productivity in agriculture (Kapoor, 2006). About 20 to 30 per cent increase in productivity in various crops can be achieved with the use of quality seeds. Described as the embodiment of life's continuity and renewability, the seed has not only been stated to be the source of culture and history but also importantly, the ultimate symbol of food security (Shiva, 2001). Albeit there have been few private seed industries dealing with production of vegetable seeds, the growing of crops especially for seeds in an organized fashion to maintain quality in terms of genetic and physical purity is realized for first time during green revolution period with the establishment of National Seeds Corporation (NSC) in 1963. A major restructuring of the seed industry by Government of India through the National Seed Project Phase I (1977-78), Phase II (1978-79) and Phase III (1990-1991), was carried out, which strengthened the seed infrastructure that was most needed and relevant around those times. This could be termed as a first turning point in shaping of an organized seed industry. Introduction of New Seed Development Policy (1988-1989) was yet another significant mile stone in the Indian Seed Industry. The policy gave access to Indian farmers of the best of seed

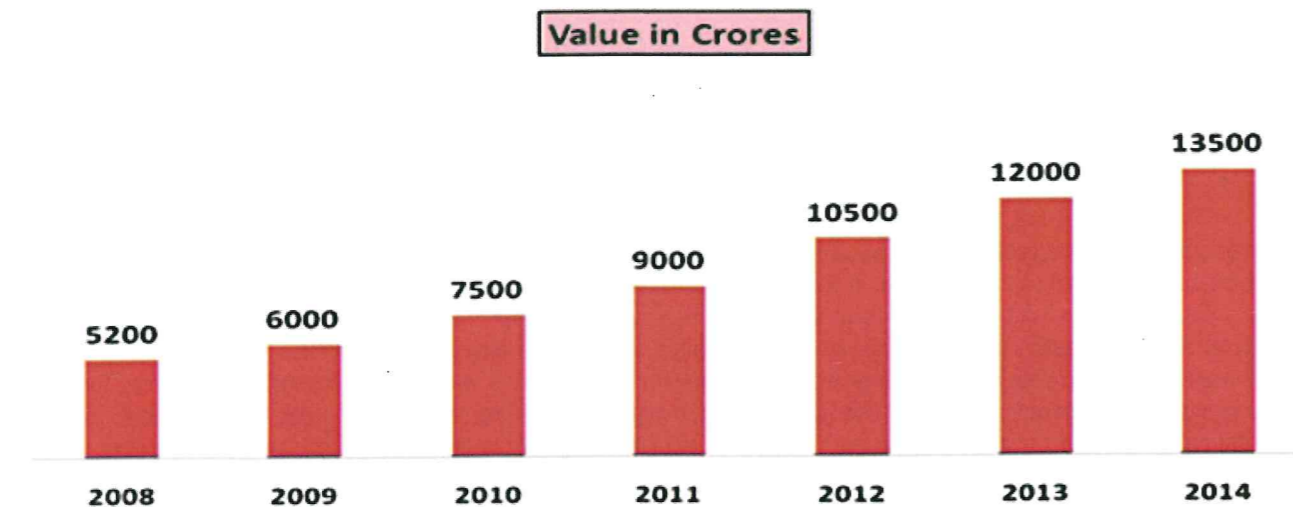
and planting material available anywhere on the world. The policy stimulated appreciable investments by private individuals, Indian Corporate and MNCs in the Indian seed sector with strong R&D base for product development in each of the seed companies with more emphasis on high value hybrids of cereals and vegetables and hi-tech products such as Bt Cotton. As a result, farmer has a wide product choice and seed industry today is set to work with a farmer centric approach and is market driven.

Intellectual property rights protection for new plant varieties, introduced in 2001, further boosted private crop breeding research. Currently there are about 850 seed companies (mostly seed producers) operating in India in 2014, of which about 50 have capacity in crop breeding research.

### Indian Seed Industry Current Status and future growth:

Indian seed Industry is currently occupying the 6th position. During the past 5 years the Indian Seed Industry has been growing at a CAGR of 12% compared to global growth of 6-7%. The volume growth has mainly come through increased Seed Replacement Rate in crops. Indian seed industry is undergoing wide ranging transformation including increased role of private seed companies, entry of MNCs, joint ventures of Indian companies with multinational seed companies and consolidations.

Figure 1 Increasing value (in crores) during past years in seed industries



### Global Index of Vegetable Seed Companies:

East-West Seed clearly outperforms its peers in the Global Index of Vegetable Seed Companies. Syngenta and Bayer rank second and third, respectively. Bayer is a steady top three performer but does not lead in specific areas. Syngenta scores highly in Governance & Strategy, due to the commitments articulated in its Good Growth Plan, and Capacity Building.

Figure 2: Global Index of Vegetable Seed Companies (Access to Seeds Index 2016)

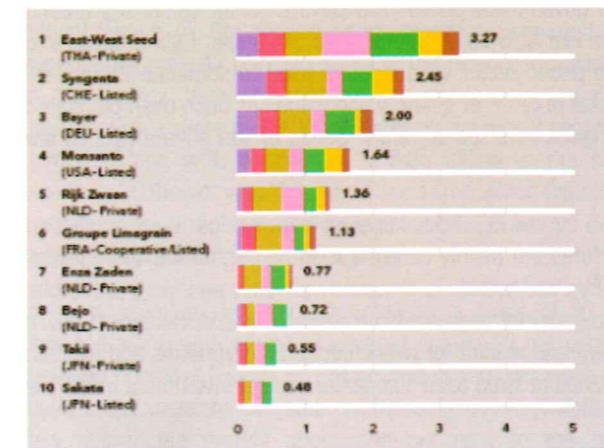
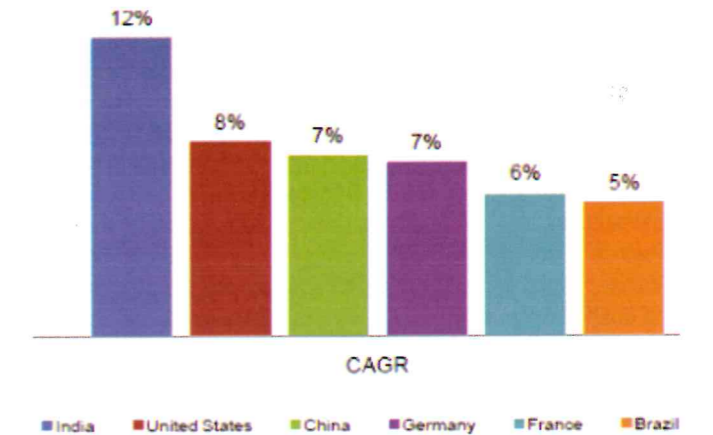


Figure 3: Fast growing countries in seed market (USD Bn), basis CAGR (2000 to 2010) – (Source ISF data 2013)



Keen Research on "India Seed Market Outlook to FY'2020 – Rapid Hybridization and Increased Government Support to Foster Future Growth" provides a comprehensive analysis of the seeds market in India. According to the research report, the India seeds market will grow at a considerable CAGR rate reaching INR 283.1 billion by FY 2020 due to improvement of seed replacement rate, production and distribution of quality seeds appropriate to agro climatic zone at affordable prices along with a determined effort to address region specific constraints.

Table 1: Future growth opportunities in major seed crops of India (Ken Research, 2016)

Crops	Hybrid Penetration FY-2020	Future growth opportunities	Key players
Cotton	95%	Increase in high density planting Acceptance of weed resistance GM gene-RR flex technology Increase in seed prices by the government	Nuziveedu, Kaveri, DCM Shriram, Mahyco, Ajeet, Ankur Seeds
Corn/maize	50%	Increase in area under acreages Increase in area under hybrid Improved product offerings under single cross	Monsanto, Dupont, Syngenta, Kaveri Seeds
Paddy	5%	Increase in area under hybrid	Bayer Crop, Kaveri, Nuziveedu, Meta-helix (Rallis)
vegetable	60-90%	New product launches	Syngenta, Pioneer, Nunhems (Bayer)

### Framework of Indian Public and Private industry:

Indian seed industry has been growing awfully in quantity and value over the past fifty years. The public sector component comprises National Seeds Corporation (NSC), State Farm Corporation of India (SFCI) and 15 State Seeds Corporations (SSCs), Indian Council of Agricultural Research (ICAR) institutions and State Agricultural Universities. ICAR launched an All India Coordinated Research Improvement project (AICRP) on seed production called National Seed Project in 1979 with 14 centres in different Agricultural Universities. AICRP on production of breeder seed in vegetable crops is started under National Seed Project in 1994. Twenty two State Seed Certification Agencies and 104 State Seed Testing Laboratories are involving in quality control and certification. The main task of the public sector today lies in meeting the national seed requirement for high volume, low value crops. These seeds are supplied at fixed rates (determined by the government), and the NSC and SSC have incurred major deficits, because fixed prices do not always reflect the actual costs of production, processing, and distribution.

Private seed firms slowly emerged throughout the 60's and the 70's, with a number of them benefitting from NSC's technical assistance. Many of these firms have developed their own breeding programmes and released inbred improved cultivars. Firms set their own prices for their own hybrid varieties of crops. These private hybrids represent an important share of the market for these crops. For public-bred varieties, private companies have to respect fixed government prices. The private sector comprises around 150 seed companies of national and foreign origin but only few companies like M/S Bejo Sheetal, Indo- American Hybrid Seeds and Namdhari Seeds are working exclusively on vegetable hybrids. The Indian public sector seed industry used to dominate the private sector in the very beginning. The order of type of seeds dominating the market in terms of quantity and value has been open-pollinated varieties followed by public hybrids and private hybrids. The situation is quite reversed currently. Seeds of the private hybrids are forming a significant portion of the total vegetable seed market.

In vegetables most of the public sector varieties and hybrids are replaced by private sector varieties and hybrids, seed production of which is solely done by the particular manufacturers. Corporate seed firms are mainly concentrating on vegetables like tomato, cabbage, brinjal, chilli, okra and cucurbits where the seed production of OPVs and hybrids is comparatively easy and more profitable. The doable explanation for moribund of public sector can be incapability to generate huge funds on research and development (R&D) when compared to private seed companies and lack of proper advertisement and market for public sector bred varieties and hybrids. Private seed corporations are spending 10-12% of their turnover in R&D. Medium sized seed companies annual investment in R&D is growing 20% annually.

**Table 2: Growth of private seed industry in India, 1970-71 to 2010-11**

Year of establishment	Private seed companies* (no.)	Multinational seed companies (no.)
1970-71	3	-
1975-76	15	5
1980-81	31	10
1985-86	59	15
1990-91	107	23
1995-96	142	44
2000-01	203	68
2005-06	253	90
2006-07	337	121
2007-08	421	153
2008-09	521	200
2009-10	534	245
2010-11	631	292
2011-12	662	309

Source: www.tradeindia.com

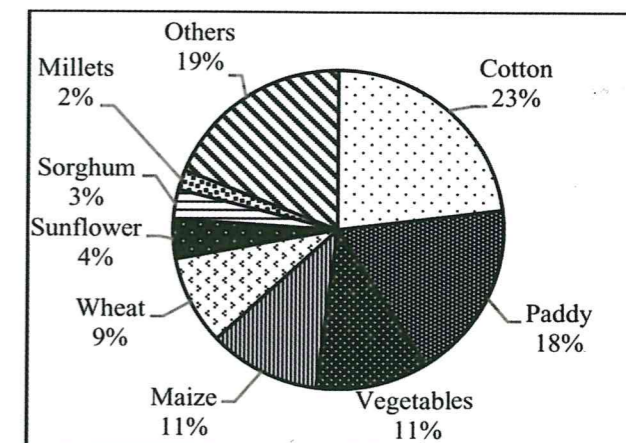
\* Indigenous seed companies

The private sector has started to play a significant role in the seed industry over the last few years. At present, the number of companies engaged in seed production or seed trade is of the order of 400 or 500. However, the main focus of private seed companies has been on the high value low volume seeds and market for low value high volume seeds. In the case of vegetable seeds and planting materials of horticultural crops, the private sector is the dominant player. Besides, significant quantities of seeds are also produced by the State Departments of Agriculture, where the State Seeds corporations are not in existence.

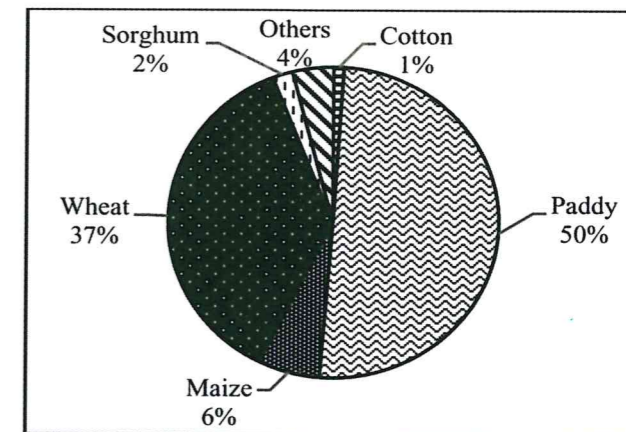
The value of seed business in India was around ₹ 65 billion in 2010. Across different crops, the highest share in this business was of cotton (₹ 14.95 billion), followed by paddy (₹ 11.7 billion) (Figure 4). Cotton and paddy together dominated the seed market with 41 per cent share in the total seed business in the country. Vegetables and maize jointly occupied third position with a share of ₹ 7.15 billion each and wheat occupied fourth position with a share of ₹ 5.85 billion in the seed business. Sunflower was the only oilseed crop which figured in seed business and its share was of about ₹ 2.6 billion. Seed business in pulse crops was negligible.

In terms of volume, paddy accounted for a share of 50 per cent and along with wheat, it covered around 90 per cent of the seed business (Figure 5). Cotton and vegetables were the major crops in terms of value, whereas in terms of volume, they contributed merely about one per cent to the total seed business. It was mainly because of the low seed rate requirement of these crops compared to those of cereals and pulses. Further, hybrids and high-yielding varieties of cotton and vegetables were sold at a very high price in the market and therefore, private seed companies have shown keen interest in high-value and low-volume seeds.

**Figure 4: Crop-wise percentage share in the value of seed business: 2010-11**



**Figure 5: Crop-wise percentage share in the volume of seed business: 2010-11**



### Factors enhancing vegetable seed industry in India

#### 1) Ever rising demand:

In the past two decades, the vegetable production in India has been increased from 58.5 mt in 1991-92 to 162.9 mt in 2015-16. Total cultivated area under vegetables has been increased from 5.59 mha in 1991-92 to 9.4 mha in 2015-16. Moreover, the yield of crops are higher when produced from and replaced seeds than own saved seeds. Seed replacement rates are high for vegetables like cabbage (100%), tomato (99.3%) compared to other cereals and oil seeds. Total quantity of vegetable seeds produced in the country is not sufficient to meet the country's ever increasing demand. Currently quality seeds are met to the extent of 20% only. Farmers themselves meet the 75% through own saved seeds. (Koundinya and Kumar, P. 2014)

#### 2) Diverse Agro Climatic Conditions:

India is blessed with 2nd largest arable land, 15 major agro-climatic zones in the world and 46 soil types out of total 60 types of soil in the world. This diversity gives opportunity to conduct breeding and evaluation research. Seed production of warm season vegetables is possible in Indian plains and Deccan Plateau and seed production of winter vegetables like cabbage, cauliflower, broccoli, beetroot, European carrot and radish is possible in hill stations of Himalayan range. Some winter vegetables like Onion, Asiatic Carrot, Asiatic Radish and tropical cauliflower produce seeds during winter season in North Indian Plains and Solanaceous vegetables, Cucurbits and Legumes set seeds throughout the year under South Indian conditions.

#### 3) Cheap availability of labour:

Vegetable seed production particularly hybrid seed production demands much labour. Mechanization reduces the human effort up to some extent. But, emasculation and pollination steps during hybrid seed production of vegetables solely depend on human labour. Smaller flower structure of some vegetables need more devotion of time and reduces human efficiency. These operations require

specially trained and skilled labour. India is ranked second in hand pollinated vegetable seed production in Asia next to China. India is having huge human resources availing at reasonably cheaper rates. This is attracting various corporate sectors of national and international origin to invest in seed business in India.

#### 4) Huge Domestic and International market

Due to high profits in vegetable cultivation, area under vegetable cultivation is expanding enormously year by year. This creates huge demand for vegetable seed in the market. Requirement of vegetable seed is increasing annually. Now a day hybrids are replacing the open pollinated varieties (OPV) largely due to higher yield, uniformity and their improved quality for instance. India is second largest user of hybrid tomato seed after USA.

### Importance of vegetable seed industry on economy

#### 1) Income generating

Seed production of vegetables is a highly remunerative business. Even from small land holdings very huge income can be generated.

When compared to OPVs hybrids fetch more price as the cost of hybrid seed production is more due to the involvement of more labour in crucial emasculation and pollination and also due to their higher yield than OPVs. Hybrid seed production of sweet pepper is highly remunerative generating an income of 136000 INR per 0.75 acre followed by hot pepper generating an income of 41500 INR per 0.25 acre. The hybrid seed production of tomato is having a benefit cost ratio of 2.77 whereas it is 2.02 for okra under Karnataka conditions (Koundinya and Kumar, P. 2014).

#### 2) Employment generating

On an average one million people are employed in vegetable seed production activity. Hybrid seed production of tropical vegetables is leading to an employment generation of 2.71 million man-days annually generating a net income of 373 million INR with the involvement of 10394 farm families. Hybrid seed production of Solanaceous vegetables contribute 56.46% towards employment generation, followed by cucurbits 28.08% and okra 15.46%. Approximately 0.17 million farmers are engaged in such contract seed production (Koundinya and Kumar, P. 2014).

#### 3) Foreign Exchange Earning

India is the ninth major exporter of fruit and vegetable seeds in the world there by earning good foreign exchange reserves. The major seed importing countries from India are Pakistan, Bangladesh, Saudi Arabia, Netherland and Korean Republic.

### Impact of plant variety protection on the Indian seed industry

India's Plant Varieties and Farmers' Rights (PPV&FR) Act of 2001, the establishment of the PPV&FR Authority in 2005, and the commencement of varietal protection application processing in 2007 have helped to some extent in providing the IPR environment needed to incentivize private investment in the seed sectors. There are also challenges in developing new transgenic traits for crops. The Indian government has not approved any genetically modified (GM) crops since the country's first forays into Bt cotton in 2002. And the 2010 moratorium on the commercial release of Bt eggplant effectively dampened private sector interest in furthering transgenic research.

The objective of this legislation was to provide an effective system for the protection of farmer's rights which would also stimulate investment for research and development both in public and private sector for the development of new plant varieties by ensuring appropriate returns on such investments.

### Participation of Private Seed Companies in PVP

The concentration of private seed companies on different crop groups in 2010 is depicted in Table 3.

**Table 3: Crop-wise focus of private companies in 2010**

Crop-group	No. of private seed companies
Cereals	363
Oilseeds	184
Vegetables	136
Pulses	23
Flowers	10

Source: National Seed Directory, (2011)

The private seed companies concentrated more on the cross-pollinated crops than self-pollinated crops. It could be correlated with the value of seed business, wherein self-pollinated crops have a lower share than of cross-pollinated crops, because hybrids require seed replacement every year. The crop-wise analysis showed that the number of seed companies working on cereals was highest, followed by oilseeds, and vegetables.

### PVP Pattern in private and public seed industries

The seeds of cereals, cotton, oilseeds and vegetables were being produced by all the companies across different size groups and pulses were the least preferred crops (Table 4). The most preferred crops across these companies were vegetables, followed by cereals, whereas oilseed crops received less attention. In general, the number of crops handled by a company increased with the size of company, but the large companies specialized in a lesser number of crops than the medium companies. The analysis has also highlighted that hybrids were the preferred products vis-a-vis open-pollinated varieties, as about 80 per cent of the products were hybrids. The number of products developed, especially hybrids, increased with the size of company.

**Table 4: PVP pattern in private seed companies in India**

Company Size	Average no. of crops handled							Open-pollinated varieties	Total	Varieties filed for PVP
	Cereals	Cotton	Pulses	Oilseeds	Vegetables	Total	Hybrids			
Large	4	1	0	2	11	18	893 (9)	83 (9)	976	644 (66)
Medium	5	1	2	2	13	23	440 (79)	114 (21)	554	381 (68)
Small	2	1	0	1	10	14	511 (75)	184 (25)	695	105 (15)
Total							1844 (83)	381 (17)	2225	1160 (52)

Note: Figures within the parentheses indicate percentage to total

## PVP in Public Sector

In total, about 1700 varieties developed by the ICAR were eligible for registration under PPVFRA, but only about 50 per cent of these varieties were protected. It is almost equal to the private sectors protection rate. In the public sector also, cotton was the crop which received the highest attention. Pulses, the most neglected crops by the private seed companies, occupied the second position in the public sector in terms of notified and protected varieties. The results confirmed the general notion that the public sector concentrates more on the low-value, high volume crops. Sugarcane was the least protected crop and the number of its notified varieties was also small in the public sector.

**Table 5: PVP application pattern in the public sector**

Crops	Notified varieties	Protected varieties	% of varieties protected
Cereals	881	561	64
Pulses	301	202	67
Oilseeds	262	25	10
Vegetables	106	23	22
Cotton	119	101	85
Sugarcane	54	7	13
Total	1723	919	53

## Conclusion:

It can be concluded that vegetable seed business will have wide scope for success and will play an important role in strengthening economy of countries like India where the occupation of majority people is agriculture. There is a greater need to make available quality seeds to the farmers in time and in sufficient quantity at reasonable prices. Seed laws are to be implemented strictly to ensure supply of quality seeds and to protect the farmers from spurious seeds. Government has to reduce precincts on import and export of quality seed and planting material. Policy making and implementations shall be free from political motivations. Strengthening of public sector in R&D is needed to compete with private seed companies so as to provide good quality seeds to the farmers at cheaper rates. The collaboration of both public and private sector may obviously help in quality vegetable seed production in India. There should be exchange of germplasm and other inputs between public and private sectors as per some pre made agreements.

In case of public sector, about 50 per cent of the eligible varieties have been protected under PPVFRA. The level of concentration of PVP applications by the private seed companies has gradually declined, and crop diversification in PVP has increased over time. It has also been observed that growth in the number of notified varieties in the recent decade (2001-2010) has increased for most of the crops. An increase has also been found in breeder seed production and distribution of quality seed in the country. The SRR has increased almost three-times for the major crops in most of the states. A discernible increase in public-private partnerships has been recorded after 2006. Therefore, the evidence suggests that initial response of the industry to PVP is optimistic. However, there is a need to monitor these trends in the seed industry, and as more data accumulate over the years, a better understanding of the impact of PVP on the seed industry can be established.

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