

## Vegetable Seed Production: A Remunerative Opportunity

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Seed is a key component amongst all inputs for sustainable crop production. It's the foremost important commodity for the superior vegetable production. As Indian population is increasing abruptly, to meet the demands of ever-increasing population we have to increase the production and productivity of vegetable crop which can be achieved by use of quality seed for vegetable production. The aim of this review is to find the present status of vegetable seed production with respect to different crops, to examine the role of private and public industry in seed production, focused on the prospects and challenges present in the vegetable seed industry in India.

By 2050, India's population is likely to reach 1.7 billion, nearly equal to that of China and the United States combined and it will have an addition of 430 million mouths to feed. To keep pace with the population, crop production must grow by at least 4.2% a year, more than twice the current rate. The growth of urbanization and industrialization ultimately put high pressure on the land so it's not possible to increase the area under vegetable cultivation but we can put our best efforts in the production of high quality vegetable seeds. High yielding varieties along with the resistance to biotic and abiotic factors is the need of the hour. Despite being the world's second-largest producer of vegetables, India lags far behind in their productivity in comparison to that in developed countries [1, 2]. Increased availability and adoption of improved varieties or hybrids have been recognized as a plausible solution for enhancing the productivity levels of vegetables. Commensurate with this view, there has been an increasing trend in the adoption of hybrid seed technology in vegetables like tomato (40%), cabbage (68.6%), brinjal (82%) and Okra (10%) during the past two decades. This technology, though capital- and labour-intensive, has increased the

profitability of farmers through enhanced productivity. But, the increased adoption also warrants increased availability of hybrid seeds to the farmers. Seed production in vegetables especially hybrids, though a specialized skilled activity was transformed into a commercial economic activity by the private seed companies. It is estimated that quality of seed accounts for 20-25% of productivity [3]. The importance of quality seed has been realized by mankind long ago. Saving of some portion of produce as seed for next cropping season or year in various structures is a very common and age-old practice of Indian farming community. 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 [4]. It is setup by aiming at promoting healthy development of seed industry in India. The principle responsibilities of NSC are establishing an adequate system of quality control inspection for scientific processing, storage and marketing of seeds.

### Present Scenario

India is an agrarian economy with over about 52% of the total workers is employed by the farm sector which makes more than half of the Indian residents dependent on agriculture for survival. Indian seed industry has shown a robust CAGR of 19% over the last four years, growing from USD 1 billion in 2010 to USD 2.2 billion in 2014. The overall Indian Seed Market is expected to grow annually at 11% while, the Indian Vegetable seed sector is expected to grow at 14.6% [5]. India seed industry is currently occupying the 5<sup>th</sup> position. Indian vegetable hybrid seed market has been increased 194% during

1998-2008. The estimated turnover (50000m INR) of Indian seed industry is 4% of the global seed turnover (1250000 m INR). At present, the vegetable seed business in India, with 9000 million INR accounting for 18% value wise share of various crops [6]. According to National Seed Association of India (NSAI), in upcoming years, the size of Indian seed market is probable to grow at a rate of 11% p.a. on account of favorable global grain supply-demand and productivity well under world's major grain producing regions. In the past two decades, the vegetable production in India has been increased 2.5 times from 58.5 mt in 1991-92 to 146.5 mt in 2010-11 [7]. In value terms, India's export of fruits and vegetable seeds in 2015-16 increased to 75.43 million USD from the previous year 2014-15 when it was 69.94 million USD and over 2013-14 when it was at 67.81 million USD [8].

The volume growth has come through the increased role of private seed companies, entry of MNCs, joint ventures of Indian companies with multinational seed companies and consolidations. The value of the global seed market in the year 2012 was USD 6.75 billion. Asian vegetable seed market is the largest where China and India have a major role to play. They both together occupy 48% of the global vegetable seed market share. Europe stands next at 26% [9].

### Role of Public and Private Sector in Seed Industry

Over the past few years, Indian seed industry has been growing at a slow rate. Seed production quality, quantity, and value have been growing unpleasantly. Various public and private sector organization are actively working for quality seed production of different crops, however, there is still a long way to go (Table 1). Initially, the public sector has more efforts in quality seed production than private sector while, private sector has more contribution than the public sector. 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 [4]. The public sector components like, National Seeds Corporation (NSC) now with State Farm Corporation of India (SFCI) merged, are responsible for providing quality seeds for centrally released varieties at the national level, the handling of multiplication and distribution of quality seeds of a large number of vegetables is a difficult task (Table 2). NSC also provides technical support to the seed growers for quality seed production and educates them through training, field demonstration, etc. It is believed that the yield of vegetable crops could be improved significantly, up to 30%, if quality seeds of improved varieties could be made available.

**Table 1.** Estimated vegetable seed requirement of the country

Crop	Area (ha)	Total Certified Seed Requirement	Seed Requirement		Total Breeder Production
			Foundation	Breeder	
Tomato	879630	439815	2199.08	11.00	173.20
Brinjal	722070	361035	1444.14	5.78	258.41
Chilli	794120	635296	3176.48	15.88	81.32
Okra	530790	6369480	106158.00	1769.30	2976.00
Onion	1051530	10515300	52576.50	262.88	1975.70
Garlic	247520	198016000	24752000.00	3094000.00	5933.00
Cauliflower	402200	160880	321.76	0.64	0.100
Cabbage	372360	111708	139.64	0.17	2.30
Pea	420900	42090000	5261250.00	657656.25	52413.00
Beans	123510	4940400	329360.00	21957.33	7371.70
Cowpea	102500	1537500	38437.50	960.94	911.00
Bottle gourd	113920	569600	5696.00	56.96	319.45
Bitter gourd	83220	416100	4161.00	41.61	292.50
Pumpkin	16170	80850	808.50	8.09	161.20
Cucumber	40900	122700	409.00	1.36	99.50
Watermelon	80590	322360	3223.60	32.24	80.00
Muskmelon	41820	250920	3345.60	44.61	5.50
Radish	170300	1703000	8515.00	42.58	705.50
Carrot	64270	642700	4284.67	28.56	80.25

**Table 2.** Overview of vegetable seeds handled by the National Seeds Corporation\*

Sr. No.	Year	Area (ha)	Production (q)
1	2009-10	765.20	15552.99
2	2010-11	935.68	8444.62
3	2011-12	1525.82	25743.64
4	2012-13	1133.75	19206.11
5	2013-14	2341.62	23621.90
6	2014-15	1653.25	23318.50
7	2015-16	2046.00	27541.28

\*Personal communication: Manager Production, NSC, New Delhi

Other components of public sector comprise of 15 State Seeds Corporations (SSC), ICAR institutions and State Agricultural Universities. Twenty-two State Seed Certification Agencies and 104 State Seed Testing Laboratories are involving in quality control and certification. ICAR launched an All India Coordinated Research Improvement project (AICRP) on seed production called National Seed Project in 1979 with 14 centers in different Agricultural Universities. The availability of vegetable seeds with NSC as on 17.07.2018 is 155928.58 kg which includes both varietal and hybrid seeds. All India status of sales of seeds of major vegetables given (Table 3) reveals that enormous potential in this sector still exists in our country.

Indian Council of Agricultural Research (ICAR) institutes, such as the Indian Agricultural Research Institute (IARI), Indian Institute of Vegetable Research (IIVR), Indian Institute of Horticultural Research (IIHR) etc. and State Agricultural Universities (SAUs) were responsible for crop breeding research in India, before seed sector liberalization in 1988. Recognized seed production was done by the National Seeds Corporation, State Seed Corporations, and a few private seed companies. Informal seed production by farmers, farmers associations, and local companies was the main source of seed supply of open-pollinated varieties. Seed sector reform allowed open import of vegetable seed and permitted foreign and large domestic companies to enter seed production [10]. The reorganization led to rapid expansion of private seed production for crops in which hybrid seed production was possible, such as cotton, pearl millet, sorghum, maize and many vegetables [11, 12]. Due to the arrival of private seed companies with the liberalization of seed trade in 1988, the public sector seed corporations have started declining and becoming inept. At present, the public sector is mostly confined to

**Table 3.** All India sales of seeds of major vegetables

Crop	Hybrid vegetable seed (tons)	Value in INR (Crores)
Okra	600	60
Eggplant	25	10
Tomato	40	100
Chilli	30	60
Sweet pepper	2	10
Cabbage	50	45
Cauliflower	15	25
Cucumber	5	10
Melons	5	30
Watermelon	50	20
Gourds	50	15
	Open-pollinated varieties seed (tons)	
Eggplant	300	10
Okra	4000	50
Onion	2500	60
Chilli	500	20
Sweet pepper	25	5
Tomato	300	10
Cauliflower	400	15
Cabbage	100	10
Knol-khol	80	2
French bean	2500	10
Cluster bean	1500	10
Dolichos bean	500	10
Peas	10000	50
Bottle gourd	500	10
Ridge gourd	500	10
Sponge gourd	600	10
Bitter gourd	400	20
Cucumber	1000	60
Watermelon	800	15
Muskmelon	400	20
Pumpkin	50	1
Radish	1000	10
Carrot	1000	50
Beetroot	50	5
Coriander	8000	60
Total	37877	918

certified seeds of high volume, low-value segment of high yielding varieties of cereals, pulses, and cotton [6].

For vegetables, the reform led to rapid growth in private sector research and development. Along with growth in private sector, the national and state seed corporations have parallel demise in the importance of vegetable seed production. Currently, there are about 850 seed companies operating in India in 2014, of which about 50 has capacity in crop breeding research [13]. The private sector comprises of a large number of seed companies of national and foreign origin but only a few companies like M/S Bejo Sheetal, Indo-American Hybrid Seeds, and

Namdhari Seeds are working exclusively on vegetable hybrids [6]. The private seed companies focused more on the cross-pollinated crops than self-pollinated crops (Table 4). It could be linked 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 (Table 5).

**Table 4.** Number of private companies and their crop-wise focus

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

Source: Seed Times Magazine [14]

The most preferred crops across the private companies were vegetables, followed by cereals, whereas oilseed crops received less attention.

Seed production of vegetables like tomato, cabbage, brinjal, chili, okra and cucurbits produced by corporate seed firms because seed production of OPVs and hybrids is comparatively easy and more profitable. The possible explanation for declining of the public sector can be incapability to generate huge funds on research and development (R&D) when related 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 [4, 15].

The World Vegetable Center is an international agricultural research center contains more than 8300 accessions each of tomato and pepper [3, 16]. Over 22 thousands seed samples of tomato and over 33 thousands seed samples of pepper were provided to institutions of 138 countries from 2001 to 2013. India

**Table 5.** Pattern of numbers of crops handled by private seed companies in India

Company size	Average no. of crops handled					Total	Hybrids	Open pollinated varieties	Total
	Cereals	Cotton	Pulses	Oilseeds	Vegetables				
Large	4	1	0	2	11	18	893	83	976
Medium	5	1	2	2	13	23	440	114	554
Small	2	1	0	1	10	14	511	184	695
Total	11	3	2	5	34	-	1844	381	2225

Source: Seed Times Magazine [14]

has been the key recipient, receiving 16% of all pepper samples circulated worldwide [17]. Private companies received 64% of the seed samples sent to India [18]. The World Vegetable Center's tomato and pepper breeding databases are located in Taiwan.

## Economic Benefits of Vegetable Seed Industry

### a) Profits

Hybrid seed production of sweet pepper is highly remunerative generating an income of 136000 INR per 0.75 acres 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 (Table 6 & 7). So, vegetable seed production is a highly remunerative business for small land holdings farmers as well as for large size farmers, result in huge income generation [19].

**Table 6.** Comparison of yields through own saved seeds and replaced quality seeds in various vegetable crops

Crop	SRR%	Yield (kg/ha)	
		Own saved seed	Replaced seed
Cabbage	100.0	-	370.26
Cauliflower	86.4	190.23	230.47
Chillies	83.7	68.21	85.73
Okra	92.4	140.55	230.87
Tomato	99.3	344.50	464.97

Source: Nandi et al. [20]

### b) Exchange earning

Fruit and vegetable seed exports consisted 3.37% of total horticultural exports from India in the year 2012-13 [21] while, India is the ninth major exporter of fruit and vegetable seeds in the world thereby earning good foreign exchange reserves. The major seed importing countries from India are Pakistan, Bangladesh, Saudi Arabia, Netherland and Korean Republic [4]. The foreign

**Table 7.** Cost and return per hectare from hybrid seed production of tomato and okra under Karnataka conditions

Particular	Tomato		Okra	
	Quantity	Value (INR)	Quantity	Value (INR)
Total cost		49775		38548
Yield	0.493 q	138118	5.66 q	77995
Benefit: Cost		2.77:1		2.02:1
Net income		88343		39447

Source: Poonia [22]

exchange generated through the import of fruit and vegetable seeds have increased from 675 m INR in 2001-02 to 3477.2 m INR in 2012-13 [21].

### c) Employment opportunities

Seed production is a labor intensive procedure, on an average one million people are employed in seed production activity [23]. 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. From an analysis based on Karnataka, it is apparent that emasculation and crossing have generated additional 313.60 and 276.89 working days (both male and female) in hybrid seed production of tomato and okra (Table 8), respectively [24]. Hybrid seed production of solanaceous vegetables contribute 56.46% towards employment generation, followed by cucurbits 28.08% and okra 15.46% [25]. Since, in recent past contract seed production is largely being taken place where seed production by private firms is done in farmers' fields. A huge number of farmers are showing interest in contract seed production. Approximately, 0.17 million farmers are engaged in such contract seed production [26].

### Constraints in Vegetable Seed Industry

Majority of the population in India lives in rural areas where poverty is widespread. Moreover, landless and

small farms are growing with the passage of time. These are becoming inefficient for growing vegetables as these require lot of funds, while small farmers are not capable to meet such fundamentals. There are a large number of other factors, such as the traditional farm management practices, non-availability of infrastructure, absence of marketing channels, pest and disease problems [27], lack of precise information on pesticides, high cost of irrigation, scarcity of labor, problems linked with contract farming [6], lack of access to institutional credit and loan, and the non-availability of inputs. Seed is a living unit and a biological product dissimilar fertilizers and chemicals manufactured in factories, it is subjected to death depending upon its genetic potentiality to remain viable and storage conditions [22]. Further, seeds are not the edible portions in the majority of vegetables. Lack of government support is also an important factor which results in failure of vegetable seed production activities in India [23, 28] so these are important factors which discourage seed production of vegetable crops in India and these constraints vary from region to region and province to province. There is a need to study these constraints in a regional context.

### Factors Promoting Vegetable Seed Industry in India

Easy and cheap labor availability: India is having huge human resources availing at reasonably cheaper rates. This is attracting various corporate sectors of national

**Table 8.** Employment generation through hybrid seed production in tomato and okra (M-Male, F-Female)

Operation	Tomato				Total	Okra				Total
	Own		Hired			Own		Hired		
	M	F	M	F		M	F	M	F	
All cultural	45.4	10.3	55.8	67.6	178.9	57.9	21.4	18.1	69.1	166.5
Emasculation & crossing	5.5	21.3	11.3	275.5	313.6	6.67	11.6	1.4	257.2	276.9
Processing & packaging	3.6	5.8	37.1	73.9	120.4	7.6	10.8	2.4	85.9	106.8
Total	54.4	37.7	104.2	416.9	613.3	72.2	43.8	21.9	412.2	550.2

Source: Poonia [22]

and international origin to invest in seed business in India. National and International market: High profits in vegetable cultivation create a huge demand for vegetable seed in the market. Vegetable seeds of either OPV or hybrids from India are having cosmic demand in foreign countries. Different Climatic Conditions: India is blessed with assorted agro-climatic conditions ranging from tropical to temperate which make possible the cultivation and seed production of all vegetables belonging to different temperature regimes. Good Income generation: Seed production of vegetables is a highly remunerative business. Hybrid seed production of sweet pepper is generating an income of 136000 INR per 0.75 acres followed by hot pepper generating an income of 41500 INR per 0.25 acre.

## CONCLUSION

A right blend of research activities of private and public enterprises is prevailing. Import of cabbage, cauliflower, chili and capsicum hybrids besides large volumes of open-pollinated varieties of carrot, beetroot and coriander exemplifies the successful functioning of international seed trade. Seed associations are ready to take up the cause of the industry, to support effective and efficient seed trade with other countries for imports. Success and continued growth in the private sector will depend on customer needs, development of need-based hybrids, development of efficient and appropriate technologies in frontier areas and germplasm enhancement. The Indian vegetable seed industry has the requisite technical skills and strength to provide the varietal needs of the future. India has a unique opportunity in terms of breeding a range of vegetable crops. Competent breeders capable of developing superior hybrids, backed by strong production capabilities can galvanize the industry towards development of hybrids not only for the Indian subcontinent but also for other Asian and middle-eastern countries. India has a vibrant vegetable seed industry and appears to be on the right track for a bright future. So, it can be concluded that vegetable seed business will ever have huge scope to success and will play an important role in the economy in countries like India where the occupation of the majority of the 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. The

government has to reduce limits on import and export of quality seeds and planting materials. Policymaking and implementations shall be free from political motivations. Strengthening of the 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.

## REFERENCES

1. SHARMA JK AND M PANDEY (2003). Marketing challenges and strategies for promoting Indian vegetable seed industry. *Indian Journal of Agricultural Marketing*, **17**(1): 129-153.
2. VANITHA SM, SNS CHAURASIA, PM SINGH AND PS NAIK (2013). Vegetable Statistics Technical Bulletin No. 51, IIVR, Varanasi. pp: 1-250.
3. EBERT AW AND YY CHOU (2015). The tomato collection maintained by AVRDC- The World Vegetable Center: composition, germplasm dissemination and use in breeding. *Acta Horticulturae*, **1101**:169-176.
4. GADWAL VR (2003). The Indian seed industry: Its history, current status, and future. *Current Science*, **84**(3): 399-406.
5. MANI E AND P BELGAMWAR (2016). Vegetable Market in India. *Seed Times*, **9** (3&4): 13-17.
6. MAZUMDAR B (2012). Vegetable hybrid seed industry in India. In Handbook of Vegetable Crops (eds. Peter and Hazra), Stadium Press LLC USA. pp: 101-114.
7. KUMAR B, NC MISTRY, BS CHANDER AND P GANDHI (2011). Indian Horticulture Production at a Glance. Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture, Government of India. pp: 1-296.
8. KUMAR SP AND S KUMAR (2016). Boosting Seed Trade Needs Policy Support and Interventions. *Seed Times*, **9** (3&4): 18-23.
9. SATHGURU (2015). Report on Enhancing Seed Export from India- A Knowledge. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi. pp: 1-22.
10. PRAY CE, B RAMASWAMI AND T KELLEY (2001). The impact of economic reform on R & D by the Indian seed industry. *Food Policy*, **26** (6):587-598.
11. KOLADY DE, DJ SPIELMAN AND A CAVALIERI (2012). The impact of seed policy reforms and intellectual property rights on crop productivity in India. *Journal of Agricultural Economics*, **63**(2): 361-384.
12. MORRIS ML, RP SINGH AND S PAL (1998). India's maize industry in transition: changing roles for the public and private sectors. *Food Policy*, **23** (1): 55-71.
13. REDDY MK, A SRIVASTAVA, S KUMAR, R KUMAR, N CHAWDA, AW EBERT AND M VISHWAKARMA (2014). Chilli (*Capsicum annum* L.) breeding in India: an overview. *SABRAO Journal of Breeding and Genetics*, **46**(2): 160-173.
14. SINGH DK, A PANCHBHAIYA AND SS SINGH (2016). Vegetable Seed Industry - India and World. *Seed Times*, **9** (3&4): 29-37.
15. ANONYMOUS (2013). Indian Agriculture: Performance and Challenges, State of Indian Agriculture.

16. SCHREINEMACHERS P, A EBERT AND MH WU (2014). Costing the ex situ conservation of plant genetic resources at AVRDC-The World Vegetable Center. *Genetic Resources and Crop Evolution*, **61**(4): 757-773.
17. REDDY MK, A SRIVASTAVA, SW LIN, R KUMAR, HC SHIEH, AW EBERT, N CHAWDA AND S KUMAR (2015). Exploitation of AVRDC's chili pepper (*Capsicum* spp.) germplasm in India. *Journal of the Taiwan Society for Horticultural Science*, **61**(1): 1-9.
18. LIN SW, YY CHOU, SC SHIEH, LH LIN, AW EBERT, S KUMAR, R MAVLYANOVA, A ROUAMBA, A TENKOUANO, SV AFARI AND P GNIFFKE (2013). Pepper (*Capsicum* spp.) germplasm dissemination by AVRDC- The World Vegetable Center: an overview and introspection. *Chronological Horticulture*, **53**(3): 21-27.
19. KOUNDINYA A AND PP KUMAR (2014). Indian vegetable seeds industry: Status and Challenges. *International Journal of Plant, Animal and Environmental Sciences*, **4**(4): 62-69.
20. NANDI AK, B DAS AND M SABLE (2013). Production and marketing strategy of seeds for developing countries. *Journal of Crop and Weeds*, **9**(1): 32-35.
21. APEDA (2013). Exports from India of Fruit and Vegetable Seeds. Retrieved from [http://agriexchange.apeda.gov.in/product\\_profile/exp\\_f\\_india.aspx?categorycode=0102](http://agriexchange.apeda.gov.in/product_profile/exp_f_india.aspx?categorycode=0102)
22. POONIA TC (2013). History of Seed Production and its Key Issues. *International Journal of Food, Agriculture and Veterinary Sciences*, **3**(1): 148-154.
23. SHARMA JP (2011). Indian vegetable seed Industry: Potential and problems. In Quality seed production of vegetable crops technological Interventions. pp: 60-78.
24. SUDHA M, TM GAJANANA AND DS MURTHY (2006). Economic Impact of Commercial Hybrid Seed Production in Vegetables on Farm Income and Farm Welfare – A Case of Tomato and Okra in Karnataka. *Agricultural Economics Research Review*, **19**: 251-268.
25. KALIA P (2009). Hybrid seeds making available at affordable price. In Recent initiatives in Horticulture (eds.Chadha *et al.*). Westville Publishing house, New Delhi. pp: 219-237.
26. HAZRA P, M SINGH AND S KUMAR (2005). Vegetable Hybrid Research and Development at Indian Public Sector. Souvenir, 23 annual group meeting, AICRP Vegetable Crops, BCKV, Mohanpur. pp: 97-106.
27. KOUNDINYA A, P SIDHYA AND MK PANDIT (2014). Impact of climate change on vegetable cultivation-A review. *International Journal of Agriculture, Environment & Biotechnology*, **7**(1): 145-155.
28. VERMA P (2008). Country Report. The Indian Seed Industry National Seed Association of India. pp: 1-40.