NEW ERA AGRICULTURE MAGAZINE

Value-Chain Perspectives on India's Vegetable Seed Industry

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Abstract: -

Seed is the most critical input for achieving successful vegetable production. The vegetable seed industry in India has been expanding rapidly each year. Since independence, government policies have progressively liberalized and promoted seed trade, creating a favorable environment for industry growth. As a result, several private seed companies, including those with multinational affiliations, are now actively engaged in vegetable seed production, while the public sector has comparatively fallen behind. The continuous expansion of vegetable-growing areas, diverse agro-climatic regions, and the availability of abundant and low-cost labor provide immense opportunities for the further development of the vegetable seed industry in India. This sector contributes significantly to the national economy by generating income and employment and by earning foreign exchange through participation in international markets. However, the industry also faces several challenges, including high production costs, technical limitations, and strict regulatory frameworks, which collectively constrain its growth and competitiveness.

Introduction:

Seed is a fundamental input for achieving sustainable crop production, and it is estimated that the use of high-quality seed alone contributes about 20–25% to overall crop productivity. The significance of quality seed has been recognized since ancient times. References in the Rigveda of ancient India highlight the importance of viable seed for human survival and prosperity. Similarly, the Manusmriti contains the well-known phrase

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"Subeejam Sukshetre Jayate Sampadyate", which translates to "a good seed sown in fertile soil will thrive and yield success." The practice of reserving a portion of the harvest as seed for subsequent seasons, using various traditional storage structures, has been a long-established custom among Indian farmers. Although some private enterprises were involved in vegetable seed production earlier, systematic and organized seed production aimed at maintaining genetic and physical purity gained prominence only during the Green Revolution period. This shift was marked by the establishment of the National Seeds Corporation (NSC) in 1963. NSC was created with the objective of fostering the planned and healthy growth of the seed industry in India. Its major responsibilities include developing an effective quality control and inspection system for scientific seed processing, storage, and marketing. In addition, the corporation is entrusted with the multiplication of seeds of pre-released varieties and the production of foundation seed of released varieties. Several landmark initiatives introduced by the Government of India in the form of seed policies are outlined below.

National Seeds Project

The National Seeds Projects were executed in three successive phases Phase I in 1975, Phase II in 1981, and Phase III in 1988 with financial assistance from the World Bank. Under these initiatives, nine State Seed Corporations were initially established; this number was later expanded to thirteen and has since increased to fifteen. In addition, State Seed Certification Agencies and State Seed Testing Laboratories were set up, and organized programmes such as the Breeder Seed Programme were implemented to strengthen the seed sector.

The Seeds Act, 1963

The Seeds Act was enacted in 1963 and became effective in 1966. Its key provisions specify that seeds must meet prescribed quality standards, including minimum levels of physical and genetic purity, required germination percentages, and limits on the allowable presence of off-types and weed seeds. The Act also mandates that seeds be marketed either with compulsory labeling or through voluntary certification. In addition, it establishes a framework for seed quality regulation through independent State Seed Certification Agencies operating under the authority of the respective state departments of agriculture.

New Seeds Policy, 1988

This policy brought about a major transformation in the Indian seed industry by easing restrictions on seed trade. It enabled Indian farmers to access high-quality seeds and planting materials from across the globe.

By permitting and promoting foreign direct investment, the policy facilitated the entry of several multinational seed companies into the Indian market, while also creating new opportunities for domestic private seed firms to participate in large-scale seed trade. Under this framework, seed production was designated as a "High Priority Industry". The policy also relaxed regulations on the import of improved crop varieties, breeding lines, and seeds of vegetables and ornamentals, and allowed the import of seeds of other crops under specified conditions through an open general license, while reducing tariff barriers. As a result, private seed companies began importing hybrid seeds of crops such as cabbage, cauliflower, and chilli, along with substantial quantities of carrot and beetroot seeds.

PPV & FRA, 2001

The Protection of Plant Varieties and Farmers' Rights Act, 2001 grants farmers the freedom to save, use, exchange, share, and sell the produce of protected varieties, except in the case of branded seed sales. The Act also safeguards farmers from unfair practices by seed companies that supply substandard or counterfeit seeds or planting material by requiring the declaration of a variety's expected performance. Under this legislation, breeders are obligated to inform farmers, at the time of sale, about the potential and performance characteristics of the variety being marketed. This provision enables individual farmers or farmer groups to seek compensation if the variety fails to perform as specified under the conditions defined by the breeder.

The Seeds Bill, 2004

The Seeds Bill, 2004 was introduced to address the shortcomings of the Seeds Act, 1966 and to strengthen the regulation of seed quality and planting material for all agricultural, horticultural, and plantation crops. Its primary objectives are to ensure the availability of genetically true and high-quality seeds to Indian farmers, prevent the marketing of adulterated and inferior seeds, promote greater private sector involvement in seed production, distribution, and testing, and facilitate the liberalization of seed and planting material imports.

Factors Driving the Growth of the Vegetable Seed Industry in India

1) **Rapidly Growing Demand:** Global vegetable production has doubled over the last 25 years, and the value of international vegetable trade has now surpassed that of cereals. India has emerged as the second-largest vegetable producer in the world, with an average productivity of 17.3 t/ha, following China (22.5 t/ha). Over the past two decades, vegetable production in India increased nearly 2.5 times, rising from 58.5

million tonnes in 1991–92 to 146.5 million tonnes in 2010–11. This growth is largely attributed to the expansion of cultivated area under high-yielding varieties and hybrids, which increased from 5.59 million hectares in 1991–92 to 8.49 million hectares in 2010–11. Consequently, the demand for quality vegetable seed has grown substantially. Yields are generally higher when crops are grown from certified or replaced seeds rather than farmer-saved seeds. Seed replacement rates are particularly high in vegetables such as cabbage (100%) and tomato (99.3%), compared with cereals and oilseeds. Despite this demand, domestic production of vegetable seed remains inadequate, meeting only about 20% of national requirements, while farmers rely on their own saved seed for nearly 75%. India continues to import vegetable seeds, primarily radish, followed by cabbage and pea. During 2007–08, the country imported 1,525.38 tonnes of vegetable seeds valued at ₹1,503.1 million.

2) **Diverse Agro-Climatic Conditions**: India's wide range of agro-climatic zones, extending from tropical to temperate regions, enables the cultivation and seed production of nearly all vegetable crops across different temperature requirements. Warm-season vegetable seed production is feasible in the plains and the Deccan Plateau, while seed production of cool-season vegetables such as cabbage, cauliflower, broccoli, beetroot, European carrot, and radish is well suited to the Himalayan hill regions. Certain winter vegetables, including onion, Asiatic carrot, Asiatic radish, and tropical cauliflower, can produce seeds during winter in the northern plains. In southern India, solanaceous crops, cucurbits, and legumes are capable of seed production throughout the year.

3) **Availability of Low-Cost Labor**: Vegetable seed production, particularly for hybrids, is highly labor-intensive and requires significant human involvement in various field operations. Although mechanization can reduce labor requirements to some extent, high fuel costs and energy constraints limit its widespread adoption. Critical operations such as emasculation and hand pollination in hybrid seed production are entirely dependent on manual labor. Additionally, the small flower size of certain vegetable crops demands careful handling, increased time, and skilled workers, further reducing labor efficiency. These tasks require specially trained personnel. India ranks second in Asia, after China, in hand-pollinated vegetable seed production. The

average labor requirement (man-days per acre) for hybrid seed production is approximately 480 for tomato, 1,800 for chilli, 180 for okra, 600 for brinjal, and 150–450 for cucurbits. The availability of abundant labor at comparatively lower wages makes India an attractive destination for both national and international seed companies to invest in vegetable seed production.

4) **Expanding Domestic and International Markets**: High profitability in vegetable cultivation has led to a continuous expansion of the area under vegetable crops, thereby increasing the demand for vegetable seeds each year. The requirement for open-pollinated vegetable seed increased from 30,550 tonnes in 2001–02 to 48,000 tonnes in 2005, while the demand for hybrid vegetable seed rose from 346.2 tonnes to 994 tonnes during the same period. This demand has likely grown further with the expansion of vegetable cultivation to 8.49 million hectares by 2010–11. Hybrids are increasingly replacing open-pollinated varieties due to their higher yields, uniformity, and superior quality. For instance, India is now the second-largest consumer of hybrid tomato seed after the United States. Vegetable seeds constitute nearly 70% of India's total seed exports. Both open-pollinated and hybrid vegetable seeds from India are in strong demand in international markets, particularly in countries such as Pakistan, Bangladesh, and Saudi Arabia. The volume of fruit and vegetable seed exports increased from 12,302 tonnes in 2001–02 to 17,174 tonnes in 2012–13.

Current scenario

The Indian seed industry has experienced remarkable growth in both volume and monetary value over the past five decades. At present, both public and private sector organizations are actively engaged in the production of quality seeds. The public sector includes institutions such as the National Seeds Corporation (NSC), State Farm Corporation of India (SFCI), 15 State Seed Corporations (SSCs), Indian Council of Agricultural Research (ICAR) institutes, and State Agricultural Universities. To strengthen seed production, ICAR initiated the All India Coordinated Research Project (AICRP) on Seed Production, also known as the National Seed Project, in 1979 with 14 centers located at various agricultural universities. Later, in 1994, breeder seed production of vegetable crops was incorporated under this project. In addition, 22 State Seed Certification Agencies and 104 State Seed Testing Laboratories are involved nationwide in seed quality regulation and certification. The private sector consists of

nearly 150 seed companies of both domestic and international origin; however, only a few, such as M/s Bejo Sheetal, Indo-American Hybrid Seeds, and Namdhari Seeds, focus exclusively on vegetable hybrid development. Initially, the public sector played a dominant role in the seed market. Earlier, open-pollinated varieties accounted for the largest market share, followed by public-sector hybrids and then private hybrids. This trend has now reversed, with private hybrid seeds constituting a substantial proportion of the vegetable seed market. For example, as of 30 September 2013, NSC held 133.43 tonnes of vegetable seeds, of which 131.68 tonnes were varietal seeds and only 1.75 tonnes were hybrid seeds. Following the liberalization of seed trade in 1988, the rapid expansion of private seed companies led to a gradual decline in the competitiveness of public-sector seed organizations. Currently, public-sector activities are largely confined to the production of certified seeds in the high-volume, low-value segment, mainly for cereals, pulses, and cotton, with limited participation in the high-value hybrid markets of cereals and cotton.

In the vegetable sector, most public-sector varieties and hybrids have been replaced by those developed by private companies, which exclusively manage their seed production. Corporate seed firms primarily focus on crops such as tomato, cabbage, brinjal, chilli, okra, and cucurbits, where seed production of both open-pollinated varieties and hybrids is relatively simpler and more profitable. The declining role of the public sector can be attributed to its limited capacity to invest heavily in research and development (R&D) compared to private companies, as well as inadequate marketing and promotion of publicly bred varieties and hybrids. In contrast, private seed companies typically invest about 10–12% of their annual turnover in R&D, and medium-sized firms are increasing their R&D expenditure by nearly 20% each year. Large multinational seed corporations also possess a significant advantage due to their ability to access and assemble germplasm from across the world, which is difficult for public-sector institutions to achieve with the same ease. Since germplasm is a critical resource for crop improvement, this access provides private companies with a substantial competitive edge. Moreover, multinational seed firms are able to recruit highly skilled technical personnel with attractive remuneration packages, a capability that public institutions generally lack. Currently, India ranks as the fifth-largest seed market globally, accounting for approximately 4.4% of the world seed market, following the United States, China, France, and Brazil. The Indian seed industry has been growing at an annual rate of about 12%, compared to a

global growth rate of nearly 5%. The vegetable seed segment, in particular, is expanding at a rate of 10–15% per year, with the vegetable hybrid seed market recording a growth of 194% between 1998 and 2008. The total estimated turnover of the Indian seed industry is around ₹50,000 million, representing nearly 4% of the global seed market valued at ₹1,250,000 million. At present, the vegetable seed sector in India is valued at approximately ₹9,000 million, contributing about 18% of the total value of the country's seed business. Looking ahead, projections by the National Seed Association of India (NSAI) indicate that the Indian seed market is expected to grow at an annual rate of around 11%, reaching nearly USD 3.2 billion by FY16, driven by favorable global supply–demand dynamics, relatively low domestic grain productivity compared with major producing regions, and sustained government efforts to enhance seed replacement rates.

Conclusion

In conclusion, the vegetable seed industry is poised for sustained growth and holds significant potential to contribute to the national economy, particularly in agrarian countries such as India where agriculture remains the primary livelihood for a large proportion of the population. Ensuring the timely availability of high-quality seeds to farmers, in adequate quantities and at affordable prices, is therefore essential. Strict enforcement of seed laws is necessary to guarantee quality standards and to safeguard farmers against counterfeit or substandard seeds. At the same time, regulatory barriers on the import and export of quality seeds and planting material should be rationalized to promote sectoral development. Policy formulation and implementation must remain transparent and free from political influence. To remain competitive with private seed companies and to supply affordable, high-quality seeds, there is a strong need to reinforce public-sector investment in research and development. Greater collaboration between public and private institutions can significantly enhance the production and distribution of quality vegetable seeds in India. Such partnerships should encourage the exchange of germplasm and other critical inputs under clearly defined agreements. While large multinational seed corporations may be less inclined toward such collaborations due to their well-established R&D infrastructure and skilled workforce, emerging and mid-sized seed enterprises with limited technical capacity could greatly benefit from these cooperative arrangements.

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