



Executive Summary

Mapping the Landscape, Challenges, and Opportunities for International Seed Trade in India - A Fact finding Study

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1. The Background

Agriculture has registered substantial growth during the last 50 years, transforming the food system in India. Quality seed of improved plant varieties played a key role in this transformation. Having attained self-sufficiency in food grains, the priority has shifted to make Indian agriculture more profitable and support nutrition security through diversification and promotion of horticulture. This has raised opportunities for the Indian seed sector to expand both in domestic and international markets.

SeedNL, a Public-Private organisation, was established in February 2020 by the Netherlands Ministry of Agriculture, Nature and Food Quality, the Netherlands Ministry of Foreign Affairs, and Plantum, to strengthen the seed sector in other countries, provide appropriate access to quality seeds for all farmers and increase productivity and farmers' income.

The present study was conducted from November 2023 to March 2024 to assess the potential of India's seed market, especially international seed trade, and to identify gaps, if any, that can be addressed through internal mechanisms or bilateral collaboration with the Netherlands, the global leaders in seed trade. The study is based on information collected from datasets, reports and other documents pertaining to the seed chain; regulations and related issues available in the public domain; interviews with the key officials in regulatory bodies, representatives of the industry, public research institutions, and industry associations; and presentations and interactions with experts during two seed conferences.

2. The National Agriculture Scenario

The growth of the agriculture sector during 1951-2021 has resulted in an 8.83 times increase in food production, while the population grew 3.81 times, thus raising the per capita food availability by 2.30 times (R. Chand & J. Singh, NITI Working Paper 02/2023). Having achieved sufficiency in food grains, meeting nutritional requirements in diet is the priority now. The cultivation and consumption of fruits and vegetables are therefore rising steadily. Also, Indian agriculture is moving towards commercialization, strengthening direct and indirect linkages between farm and non-farm sectors for better income and employment opportunities (NAAS Policy Paper 98, 2021).

3. The Indian Seed System

The national seed supply system in India gained a formal status during the '60s and '70s with close linkages between the public research institutions and seed production organisations: the enactment of the Seeds Act, 1966; and the establishment of the National Seed Corporation in 1963 and State Seed Corporations subsequently. The All India Coordinated Research Projects (AICRP) into different field crops, vegetables, and seed (NSP) played vital roles in developing improved varieties suitable for different agro climatic conditions, and bringing these into the seed chain. ICAR institutions and agricultural universities (SAUs and CAUs) produced breeder seed (BS) of notified varieties and made available to the public and private seed companies for further multiplication and marketing. The public research system has **released 5800 varieties through AICRP in field crops and over 500 in vegetables**, of which about ~10% are in the seed chain. Close collaboration with international organizations, particularly the Consultative Group on International Agriculture Research (CGIAR) institutes, contributed significantly to variety development programmes by providing access to the globally available germplasm, and by conducting collective evaluation. **The Indian seed industry today is a vibrant mix of the public sector, and > 500 private companies, including all major seed MNCs, and is valued at USD ~5.5 billion, with a potential to grow to USD >10 billion by 2027 @ CGAR 14%. Yet, India's share in export and import market of seed and planting material dwindles between 1-2% annually. In fact, the seed export has decreased from ~2% to ~1% over the past few years.**

The public sector comprising ICAR Institutes, Agricultural Universities (AUs), National Seeds Corporation Ltd (NSC), and State Seed Corporations **primarily deals in the production and marketing of Certified Seed of open pollinated varieties of major field crops, and distributes at least 50% of these through the government schemes and programmes.** However, there are regional disparities with regard to crop yields which is often because of farmers not planting the seeds of the varieties best suited to their agroclimatic conditions. At the same time there is also a high untapped potential for export of certified seeds of 259 varieties of 31 crops listed under OECD, particularly to the African, South and South East and Central Asian, and Middle Eastern countries.

India contributes 16.5% of global vegetable production, and hence vegetable seed is an important segment of the seed industry, estimated to be worth USD 700-750 million. It is dominated by private companies (>90%), especially the MNCs, both in terms of market share and variety spread with ~60% hybrids. Though hybrid seed production is taken up extensively in India, a significant proportion, especially of temperate vegetables, is also imported from other countries (notably the Netherlands and other EU states). The main exportable items are tomato, okra, hot pepper, cucurbits, roots & tuber crops. Asia Pacific is the largest export market (57%), followed by Europe (23%); North America (12%) & Africa (8%).

Overall there has been a rising trend in the use of quality seed as reflected in increasing Seed Replacement Rates and Variety Replacement Rates (ICAR-Indian Institute of Seed Science, 2023). **The formal sector is estimated to fulfil about 63% of the total seed requirement at present (Fig. 1) of which the share of the private sector in total seed production is growing steadily to over 65% (S. Kumar, National Seed Congress, 2023).** About 15% of the private seed companies engaged in variety research and technology development, and seed production make significant contributions. The private sector invests 5-10% of their annual turnover in R&D (A. Rana, Chairman, FSII, National Seed Congress, 2023). It releases most of the research

varieties based on their own multi-location trials (MLT), and some also through the All India Coordinated Research projects (AICRP). Nearly 80% of seed companies depend directly or indirectly, on the genetics developed by the public institutions, including international institutions. Earlier, the private sector was concentrating more on the hybrids that were of high value but usually of low volume, but lately it is also expanding its business into high volume field and horticultural crops, as well as in OP varieties. **However, provisions under BDA, 2002 restrict R&D activities of the seed companies having foreign holdings. It is desirable that ITPGRA and the genetic resources of the 64 crops identified by the ITPGRFA (Annex 1) are made available by DAC&FW to all R&D based seed companies following ABS norms.**

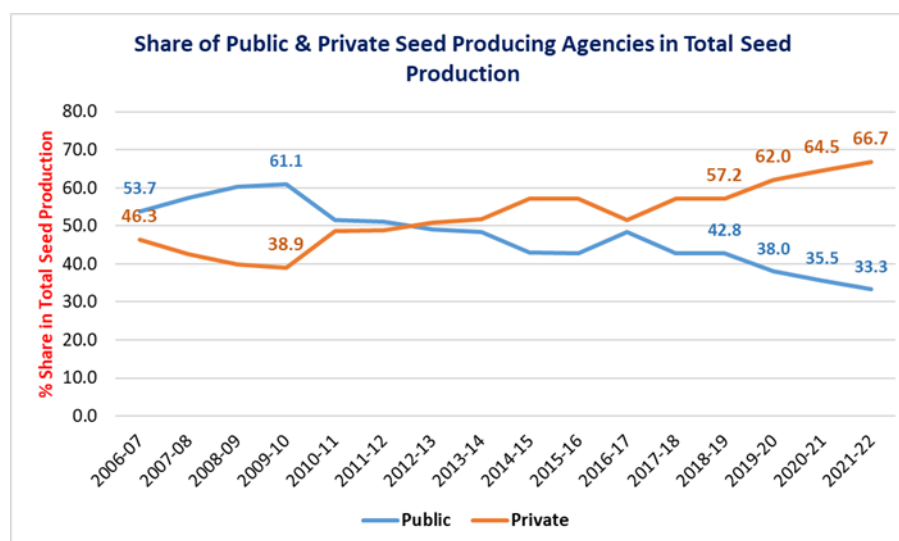


Fig. 1 (Source: S. Kumar, National Seed Congress, 2023)

Factors which contributed most to the enhanced demand and use of quality seeds are:

- Increased choice of varieties and availability of quality seeds of hybrids and OPVs.
- Government policy and incentives to promote newer varieties (<10 years old)
- Farmers' awareness about the advantages of using quality seeds of improved vars., which costs only 3-6% of the total cost but can give 15-20% boost in return. If quality seed is accessible, price is seldom a constraint.
- Wide-scale adoption of hybrids by farmers (seed replacement annually).
- High expansion in cultivation of vegetables due to increased market demands.
- Vigorous marketing efforts of private seed businesses, and the introduction of small packets (especially in vegetables).

4. Existing Regulatory Framework

The implementation of the Seeds Act, 1966, laid a strong foundation to build India's seed system. Since then several significant developments took place in agriculture, many of which directly influenced the seed scenario, necessitating the introduction of new laws, or amendment of the existing ones. Presently, the **Indian seed system is governed by at least 14 Acts and Orders (and subsequent amendments) regulating various components. Besides the Seeds Act of 1966, liberalised seed policies (New Policy on Seed Development, 1988 and National Seed Policy, 2002), and introduction of Protection of Plant Varieties & Farmers' Rights Act (PPVFRA, 2001), Biological Diversity Act (BDA, 2002) and Plant Quarantine Order (2003) contributed significantly in strengthening the seed sector** by increasing competitiveness, investment in seed sector, and improving the availability of the disease free seed and planting material of superior varieties and hybrids through research, production, import and export. Environment Protection Act (1986) and Biotechnology Regulatory Authority of India (BRAI) Bill, 2013 were introduced to support the introduction of GM & GE varieties. These not only created a favourable environment for rapid growth and development of the seed sector, but also supported the interests of smallholder farmers, and the protection of the environment, making it one of the most mature countries in the region (Access to Seed Index, 2019). To provide adequate scope to small and medium players, the provisions under the Seeds Act of 1966 are quite liberal. **Variety Registration (Notification for release) and seed Certification are not compulsory under the prevailing law. Seed Certification is applicable only to the notified varieties (Section 5, Seeds Act, 1966), but labelling (a form of self-certification) is compulsory for all seeds of notified kind/variety offered for sale (Section 7, Seeds Act, 1966) with same standards of physical purity, germination and moisture content as that of CS (variety purity and seed health standards are not included in seed labelling). It is estimated that only 30-40% of seeds of all major field crops are of certified class.** More than 90% of vegetable seeds, and >95% of cotton are of TL class (personal communications, NSAI, 2024; MSSCA, 2024), However, the TL seeds may be considered as equivalent to Quality Declared Seed (QDS) of FAO. The random market sampling shows that the quality of the TL seed is generally satisfactory, with only around 5% of TL seeds (under SCO sampling) found to be below the standards in different states (source: SSCA, Maharashtra & Telengana). As the variety registration is not a prerequisite to seed sale, there is no means to check the varietal purity and performance claim (unless registered with PPVFRA), nor is it required under the law. Under the prevailing law, one of the major concerns for the research-oriented private sector is **the absence of specific instruments for the control of counterfeit varieties sold in the market and lack of knowledge among seed inspectors.**

As agriculture in India is also governed by state legislations, there is a lack of uniformity and harmonisation of such regulations/procedures followed in different states. **Keeping this in view, the GOI has undertaken review and consultations to suitably amend the New Policy on Seed Development (NPSD, 1988) to a Seed Policy for 'Amrit Kaal', which will be based on the principle of "One Nation One Policy" and is expected to create an ecosystem that puts the Farmers First; promotes innovations and inclusiveness by including the start-ups and seed FPOs, and is universal in terms of using market intelligence and expanding the market reach globally. It is expected that harmonization of Rules will bring a parity of procedures in all states, improving the 'ease of doing business'** (P.K. Singh, National Seed Congress, 2023).

5. Adoption of New Improved Varieties/Hybrids

Climate change, shifts in consumers' preferences, and growing confidence of farmers in purchased seed over own-saved seed, has fuelled the demand for newer crops and varieties in the seed market. The public research programs made special efforts to release climate resilient and biofortified crop varieties. Nearly 83% of the 2380 varieties of field crops recommended for release in the last 10 years are climate resilient (D. K. Yadava, National Seed Congress, 2023). The GOI also adopted ways to increase the Seed Replacement and Variety Replacement Rates (SRR & VRR) by encouraging newer varieties and discouraging varieties that are more than 10 years old from being included under government programs and seed subsidies. Though a reliable assessment of VRR and SRR is difficult in vegetables, dominated by TL seed from the private sector, the market is growing. There is a need to create increased awareness among farmers about the advantages of switching over to superior performing crop varieties and assigning quality status to TL seeds.

The release of cotton hybrids in 1972, and its large-scale seed production by adopting emasculation and pollination techniques, as well as GMS and CMS systems, became a huge commercial success. Subsequently, the release of Bt cotton hybrids for commercial cultivation in 2002 was another landmark of the Indian seed system. ***During the period of 2002 to 2011-12 the cotton seed segment recorded an unprecedented rise in the use of Bt hybrids, at an annual GR of ~20%, with the market share rising to >85%, which reached ~95% of 12 million ha area in 2014 (ICAR-CICR, ISAAA, Yes Bank Analysis, 2015). However, presently the policy with reference to GM varieties is ambiguous and lacks clarity.***

The vegetable seed market is dominated by the private sector. The adoption of hybrids in vegetables has seen a phenomenal rise in the last two decades. More than 30% of vegetable varieties released from the AICRP (Vegetables) are hybrids, which has increased the annual production of vegetables from 88.62 million tonnes in 2002 to 178.17 million tonnes in 2018 (T. K. Behera, National Seed Congress, 2023). Currently, more than 80% of all vegetable seeds are hybrids (MOA&FW, Yes Bank Analysis, 2015; NSAI, pers. communication, 2023). Okra occupies the largest share in F1 vegetable seed market (13%) both by value and volume,

Presently hybrid seeds of cotton, vegetables and maize occupy the top 3 segments (by value) in the Indian seed market (Mordor Intelligence, 2023 & NSAI, personal communication, 2023). ***The Access to Seed Index (ASI), which measures and compares the availability of seeds from different companies to the smallholder farmers in different parts of the world recorded that the top 9 seed companies in India (4 were the Netherlands based) with high access to farmers hold ~37% of market share (WBB, 2019; ASI, 2021).*** European companies have a major advantage in temperate vegetables because of the wealth of genetic resources developed through a long history of breeding and favourable climate for seed production. Similarly, India has inherent strengths with regard to genetic diversity of tropical vegetables, knowledge, and skilled manpower, which need to be fully exploited for India to emerge as a leading country in hybrid vegetable seeds, both for the domestic and the export market (third country export). ***Thus, there is ample scope for further growth both horizontally and vertically.***

6. Vegetatively Propagated Planting Materials

Potato is one of the top food security crops in India which is vegetatively propagated. The second largest producer of potatoes in the world, India requires more than 5.4 million tons of potato seed tubers annually. With a seed multiplication ratio of only 1:6 and a lengthy process of multiplication, production of quality potato seed is a big challenge in India. It is estimated that certified seed potato fulfils < 10% of the requirement. Though farmers buy potato seed almost every year, there is practically no institutional mechanism to monitor the quality of seed potatoes (Strategy Paper #14 NAAS, 2021). The potato breeders in the Netherlands and elsewhere consider export of improved genetics to India risky, because of the farmers' rights accorded under PPVFRA to multiply, use, reuse, share, and sell the seeds (tubers) of a protected variety. The same is true for other vegetatively propagated spp. including fruit and plantation crops, ornamentals etc. **Reconsideration to classify vegetatively propagated planting materials separately from true seeds for Farmers' Rights to use, sow, share and sell the protected materials and strict implementation of the existing provisions against the violation of Plant Breeders' Rights deserves to be looked into by the PPVFR Authority.**

7. Phytosanitary Regulations and Plant Variety Protection

India has the potential to emerge as a global Seed Hub. While many Indian bred varieties find markets in other countries, the multiplication of seeds of foreign bred varieties/parental lines also offers a big business opportunity for India. Thus, both import and export of seed are crucial for the Indian seed industry. Plant Quarantine regulatory measures are intended to prevent the introduction of any insect, fungus or pest which could be destructive to crops. Import of agricultural commodities into India is regulated by Plant Quarantine (Regulation of Imports into India) Order 2003 notified under Section 3 (1) of DIPA. For seed imports Phytosanitary certification must provide necessary assurance of safety from regulated pests and vectors to India. PQ operations in India are carried out by the Directorate of Plant Protection, Quarantine and Storage (DPPQS), which functions under the aegis of the Ministry of Agriculture and Farmers' Welfare. **Though the PQ measures are followed for seed (planting material) import to India may seem somewhat lengthy and tedious at times (personal communications), considering that India has a diverse range of climate and is a biodiversity hot-spot, biosecurity is a complex issue requiring a more stringent mechanism than many western countries viz. the Netherlands with similar climate zone(s).** GOI is constantly evolving the system through on-line processing, 4 Regional Quarantine Stations, and 75 PQ examination centres. **Capacity building of analysts and technicians through exposure visits and training in advanced centres, and accreditation of independent laboratories will improve the PQ system in India. Periodic consultations with the National Plant Protection Organisations (NPPOs) could help address many issues. ISTA accredited labs or other labs having necessary competence and infrastructure, both in the public and private sectors, may be accredited by the DPPQS as Phytosanitary Service providers as per provisions specified in NSPM-23.** Multiplication of ornamental plant species and fruit crops could create enormous business for the Plant Tissue Culture Industry in India. However, the import procedure (Pest Risk Analysis) is often too lengthy. **Relaxation of the PRA procedures for import of in-vitro materials which are generated under aseptic (sterile) and climate-controlled conditions, and carry the required phytosanitary certificate from the exporting country, need to be adopted to expand the scope of the horticultural industry.**

NPSD, 1988 and PPVFRA, 2001 played catalytic roles in attracting investment in the seed sector. The Plant Variety Protection Act, the PPVFRA, 2001 is in place and has registered close to 6500 plant varieties. DUS Testing is performed at designated centres in ICAR institutes and agricultural universities. However, **for improving the accuracy and speeding up the process the PPVFRA could consider assigning the conduct of DUST to only qualified independent persons and special tests to be done at accredited and independent advanced laboratories, such as Naktuinbouw of the Netherlands. Registration of varieties imported under OGL for the purpose of multiplication and export to a third country needs to be kept out of compulsory registration, whereas the parental lines of hybrid varieties may be registered (independently) as varieties.**

8. Capacity Building to Strengthen the Seed Sector

Capacity building is needed for seed health testing, new technologies viz. use of molecular markers for variety identity and purity, verification of trait purity in case of GM varieties, presence of seeds with undesirable/unregulated genes/traits, special tests for variety distinctiveness etc. **Training in Seed Testing at an ISTA Accredited laboratory should be made mandatory for seed analysts.** Under the Indo-German Bilateral Project on Seed Sector Development (IGPSSD) a beginning has been made to build scientific capacity, especially in Seed Testing following ISTA procedures; Certification following OECD Seed Schemes, and DUS testing following UPOV. **More efforts are needed to build capacity in the emerging areas using molecular and imaging technologies for DUS, PRA, seed health testing, and new seed enhancement technologies. A G2B or B2B Collaboration with advanced centres of seed technology in the Netherlands could be considered.**

9. Constraints Identified

- Lack of verifiable dataset: Due to poor Centre-State coordination the flow of information between the federal and state agencies is not effective.
- Disparity in the regulatory system in different states.
- Low proficiency of many Notified STLs in the public sector and no recognition of ISTA labs.
- **Poor regulation w.r.t. the licensing of nurseries, production and marketing of seedlings, and other planting materials of horticultural crops, including potato.**
- Ambiguity and lack of clarity among seed analysts regarding the interpretation of many Rules under the seed laws. **Lack of Compulsory training and Refresher courses for the officials.**
- Vegetable seed imports are currently under the open general licensing (OGL) system, which supports the introduction of good genetics from across the world and also creates jobs. OGL is proposed to be withdrawn in the revised policy. This will be detrimental for the seed trade. Considering that imports of vegetable seeds under OGL play a vital role in making the use of vegetable seeds of improved varieties and hybrids accessible and affordable to Indian farmers, this channel should be continued and implementation of the revised policy on this point should be stopped where possible.
- Many new seed enhancement technologies (priming and hardening) are available for better performance. These offer sustainable solutions (e.g. the use of biostimulants),

and also reduce pesticide load (seed coating). However, their application is limited to only TL seed, in the absence of necessary testing guidelines. ***In the present scenario this needs to be promoted with the necessary guidelines for sustainable agriculture. G2G or B2B collaboration with the Netherlands pioneering such technologies is needed.***

- ***The traceability of TL seed is a big issue.*** The newly introduced SATHI (seednet.gov.in) portal is a welcome move, but it does not cover TL seeds - which dominate the chain. Registration of varieties is not compulsory, therefore it is difficult to check piracy.
- There is no designated Seed Export Hub/Park/Valley to facilitate seed export and import by providing all essential services efficiently under one roof or at one site.

10. Overall Recommendations

- ***India-Netherlands G2G collaboration is important for further strengthening the Indian seed sector – especially with relation to plant variety protection and phytosanitary regulations, bringing it on a par with those prevalent in the industrialised countries.***
- ***In particular, it is recommended to strengthen the systems of a) DUS testing for PVP; and b) PRA for phytosanitary control of pests and diseases, and c) to adopt environmentally friendly applied seed technologies for sustainable agriculture.***
- Truthfully Labelled seed, which is equivalent to self-certification, is recognized by the FAO as Quality Declared Seed (QDS). ***The importance of TL should be recognized by the Indian government and given due status in seed policies. The Netherlands can facilitate the traceability of TL seeds through the SATHI portal.***
- ***Wherever possible a systems approach between EU countries and India may be worked out under ISPM 38 (which does not require any additional declarations on the phytosanitary certificate between the two countries). Steps are also needed to work on adopting EU Equivalence in seed quality assurance by considering the necessary provisions.***
- A Round Table of the NPPOs of the major seed exporting/importing countries needs to be held to streamline many phytosanitary procedures. The ISF may facilitate the meeting.
- All ISTA member labs and NABL accredited ST Labs may be notified and included in the official system of Quality Assurance. Similarly, ISTA accredited labs may also be accredited by the DPPQS as Phytosanitary Service provider as per provisions specified in NSPM-23.
- Access to germplasm of all 64 crop spp. listed in ITPGRFA (annex 1 of the full report) may be made to all R&D based companies engaged in India.
- A Nodal Officer may be identified by the GOI to coordinate India-Netherlands cooperation in the seed sector.

