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Seed System in Bihar: An Overview

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ABSTRACT

Seeds are a vital input for good production and productivity. Poorly performing seeds can be devastating for the livelihood of farmers. Trust or quality assurance is a vital element in the functioning and resilience of any seed system. A seed system encompasses the processes and mechanisms through which farmers obtain seeds. Recently the importance of the seed system received significant attention. An effective seed system gives all farmers access to quality seed, reliable information, and up-to-date knowledge of improved varieties and seed practices. These systems are crucial for ensuring the availability of high-quality seeds, which are essential for food security and agricultural productivity. The agricultural seed system in Bihar encompasses a combination of traditional practices i.e. informal seed system and modern interventions i.e. formal seed system. Seed security can be sustained when the formal and informal seed systems can complement each other, particularly in Bihar where access to quality seed for resource-poor farmers is limited. The seed market in Bihar is robust and diverse, it faces challenges related to yield, adoption of new seed varieties, and efficient water use. Adoption of improved seed varieties is slow, which affects overall food production and productivity that ultimately lead to food insecurity. Efforts are being made to introduce better-quality seeds to increase yields and profitability. Addressing these issues can significantly enhance productivity and profitability for the state's farmers.

Keywords: Seed, seed system, seed security, formal, informal, hybrid

Introduction

Seed system refers to the network and infrastructure involved in the production, distribution, and marketing of seeds, particularly agricultural seeds. Bihar, being an agrarian state in India relies heavily on its seed system to ensure agricultural productivity and food security for its population. It is defined as the combined activities of actors, making use of planting materials and knowledge, that together are necessary for supplying seeds to farmers [5]. Seed systems can be broadly categorized into two types; informal and formal systems. Informal seed systems are more decentralized and include traditional practices where farmers save, exchange, and trade seeds. They often rely on local knowledge and indigenous varieties, whereas formal seed system involves regulated processes and professional management for the production, certification, and distribution of seeds. Governments or private companies typically manage formal seed systems to ensure seed quality and adherence to standards.

An ideal seed system aims to ensure seed security in the state. Seed security is defined as ready access by rural households, particularly farmers and farming communities, to adequate quantities of quality seed and planting materials of crop varieties, adapted to their agro-ecological conditions and socioeconomic needs, at planting time, under normal and abnormal weather conditions. National policies and local interventions do not often address constraints that affect smallholders' production and seed systems [11].

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Initiatives to improve seed security need to be based on a better understanding of them [6].

A sustainable seed system will ensure that high-quality seeds of a wide range of varieties and crops are produced and fully available in time and affordable to farmers and other stakeholders.

However, our farmers have not yet been able to take full benefit from the advantages of using quality seed due to a combination of factors, including inefficient seed production, distribution, and quality assurance systems, as well as bottlenecks caused by a lack of good seed policy on key issues such as access to credit for inputs.

Component of Seed System

An ideal seed system constitutes the following components:

1. Seed Production: This involves the cultivation of seeds by farmers or specialized seed producers. It includes the selection of appropriate varieties, land preparation, sowing, crop maintenance, and harvesting of seeds.

2. Seed Processing: Once harvested, seeds undergo processing to remove impurities, ensure uniformity, and enhance storage life. Processing may involve cleaning, drying, grading, and treatment with fungicides or pesticides.

3. Seed Testing and Certification: Quality control is crucial in the seed system. Seeds are tested for germination rate, purity, moisture content, and disease resistance. Certified seeds meet specified standards and carry certification tags indicating their quality.

4. Seed Distribution: After processing and certification, seeds are distributed to farmers through various channels. This includes government agencies, agricultural extension services, seed companies, cooperatives, and private retailers.

5. Research and Development: Continuous research and development efforts are essential for improving seed varieties, enhancing yield, and developing resistance to pests, diseases, and environmental stresses. Agricultural universities, research institutes, and private companies play a key role in this aspect.

6. Policy and Regulation: Government policies and regulations govern the seed sector to ensure fair practices, quality control, and accessibility. This includes seed laws, intellectual property rights (IPR) protection for breeders, subsidy schemes, and price regulations.

The efficient functioning of the seed system is critical for Bihar's agricultural development and farmers' livelihoods. Investments in infrastructure, technology, research, and policy support are necessary to strengthen the seed system and enhance agricultural productivity and resilience in the state.

Classification of Seed System

Traditionally seed has been traded as an informal system, but a new formal seed system is emerging rapidly. There are different kinds of seed systems in practice based on techniques of varietal development, seed production, quality control, marketing and distribution, etc. The system depends upon the level of awareness of farmers, production technology, farming practices, accessibility, and affordability of seeds of improved varieties. Farmers use a variety of seed systems for different crops, depending on their farming systems and markets. Broadly, the system has been classified as follows;

1. Informal Seed System

It is also called the farmer's seed system. The informal seed system is less structured and relies on traditional practices and farmer-to-farmer exchanges. Here, all the component of the seed system is managed by the farmers themselves [3]. Farmers' seed systems have existed since the dawn of agriculture and have been resilient, but they increasingly face vulnerabilities. Increasing challenges as a result of fast-changing farming systems due to climate change, soil degradation, and demographic trends on the one hand, and the technical and social innovations that can contribute to breeding and seed quality on the other, provide new opportunities to optimally future-proof farmers' seeds system. Examples include seeds saved from previous harvests, bartered, or purchased from local markets.

This system is based on intimate knowledge of farmers which is used for consumption and cultivation also. There is no difference between crop production and seed production. Here genotypic diversity and adaptability are higher which provides a greater level of resilience against developing disease and pest and adverse climatic conditions. One of the important advantages of this system is a good network of farmers for quick distribution of planting materials locally in case of contingency planning.

Despite the above advantage, the informal seed system is generally managed by resource-poor farmers, more vulnerable to environmental hazards for being operated on small landholdings mostly under rainfed conditions. Due to low levels of productivity, frequent and predictable food shortage occurs [7]. Seed security can be an issue here [1]. Farmers have good knowledge of seeds, but limited knowledge of seed-borne diseases sometimes it may lead to the spread of disease in larger areas.

2. Formal Seed System

This is a highly commercialized seed system. The formal seed system is well-structured and professionally managed. Specialized breeders, seed producers, seed conditioners, and marketers are jointly performing in this system. Here quality assurance mechanism exists under government law, policy, and guideline. The relative potential of production and distribution of seeds of improved varieties is higher than informal system. Here, the reliable label is on the seed packet based on standard seed testing procedure by a certification agency or by the producer itself that can be legally challenged under the Consumer Act, 1986, and Seed Act, 1966 also in case of any discrepancy. In this system, both public and private sector research institutions are involved in the development of new seed varieties through breeding programs. The quality assurance system of seeds is rigorous before being certified/packaged. Seed production is being conducted by professionals in a very scientific manner. The marketing network for the distribution of seed is being done through licensed seed dealers and retailers by both public and private seed producing companies.

Formal commercial seed systems can be quicker in their response to changes. However, they are only effective for particular crops and farmers. Formal seed systems may be slow in creating effective seed value chains beyond their original reach. Commercial seed systems are quite sustainable when appropriate policies are in place. These policies include appropriate investments in the public components such as breeding and seed research, and in many cases, aspects of quality controls. Creating a diversified, competitive seed sector in a country as well as stimulating seed entrepreneurship through fiscal and other incentives may be necessary to increase the resilience of the formal seed system. For successfully working on any seed system, maintenance of seed quality is essential. This is very well and professionally organized in a formal seed system.

Examples include seeds provided by government agencies, private companies, and international agricultural organizations. There is a significant difference in the distribution of tasks between the public and private sectors in formal seed chains in different geographies and crops.

3. Integrated Seed System

An integrated seed system combines elements of both formal and informal systems to leverage the strengths of each. Here a kind of collaboration/partnership between public institutions, private companies, and farmer organizations for organizing and managing the seed system. This system operates particularly in hybrid seed development and dissemination that combine traits from both formal breeding programs and local varieties. Local adaptation and innovation were encouraged while ensuring quality standards. This integrated system also ensures access to improved seeds and associated technologies for small and marginal farmers. This approach aims to provide high-quality seeds while maintaining local biodiversity and meeting the needs of diverse farming communities.

4. Community-Based Seed System

Community-based seed systems are grassroots initiatives focused on local seed sovereignty and agricultural resilience. The key features include the establishment of community seed banks and libraries to conserve and share seeds, a participatory breeding program to develop varieties suited to their specific conditions, emphasis on exchanging traditional knowledge and

practices related to seed saving and crop and management and enhancing the capacity of local communities to manage their seed resources sustainably. These systems often address specific local challenges and are driven by the needs and preferences of the community.

This system broadens the understanding of seed sharing and its diverse practices. In other words, we can say a community-based seed system promotes seed sovereignty and bio-cultural conservation. The community regularly hosts cultural seed festivals, establishes, and maintains a community seed bank, and facilitates intercommunity seed exchange.

Present Seed System of Bihar

Bihar has a significant agricultural base, and the success of farming largely depends on the quality of seeds available to farmers. The seed system in Bihar encompasses a combination of traditional practices and modern interventions aimed at enhancing productivity. Bihar's agriculture is diverse, with significant cultivation of rice, wheat, maize, and pulses. The state also stands out in horticulture, being a major producer of vegetables and fruits such as litchi, mango, and banana. Major suppliers of certified seeds of high volume and low-value crops in the public sector are Bihar Rajya Beej Nigam (BRBN) and National Seed Corporation (NSC) and to some extent by Bihar Agricultural University, Sabour (Bhagalpur) and Dr. Rajendra Prasad Agricultural University, Pusa (Samastipur). Whereas private sectors are mainly involved in high-value low volume seeds such as vegetable and hybrid seed. They mainly sell their seed as truthfully labeled class. The hybrid seed segment is mainly dominated by private firms. In Bihar, the demand for hybrid seeds is highest in Maize, paddy, and vegetable crops.

Continuous research and development efforts are necessary to develop new seed varieties that are resilient to local pests, diseases, and climatic conditions. Institutions like Bihar Agricultural University (BAU) played a crucial role in seed research and development in the state.

The Bihar State Seed and Organic Certification Agency (BSSOCA), established in 1972, is responsible for certifying the quality seeds in the state.

Farmers use different types of seed systems at a time for different crops [13] [2]. For example, the advanced seed system is predominant in maize and vegetable growing areas of Bihar where the informal system was there for the cultivation of minor millets traditional varieties of paddy, and many vegetatively propagated crops.

Seed availability and quality are critical components. The Bihar government, through its Agriculture Department and various initiatives, ensures the supply of certified seeds to farmers. Programs like the Seed Village Scheme promote the production of high-quality seeds locally, enhancing accessibility for farmers. Moreover, state-supported seed processing units help maintain seed quality standards.

To further support farmers, the Bihar State Seed Corporation provides subsidized seeds, and various extension services are available to educate farmers on best practices in seed treatment and crop management. This combination of traditional and modern seed systems aims to boost agricultural productivity and sustainability in the state.

Seed processing and storage infrastructure is a key component for the development of the seed sector in the state. To some extent, the absence of scientific storage facilities for storing seeds at the level of wholesalers and distributors results in damage to seeds.

Bihar, like many states in India, has been working on improving its seed storage infrastructure to support agriculture, which is a vital sector in the state's economy.

The seed market in Bihar involves major private firms like Advanta, DuPont, Kaveri Seeds, Syngenta, Bayer, Rallis India Limited etc. The competitive landscape is shaped by these companies offering a variety of seeds to meet the diverse needs of farmers.

The hybrid seed market in Bihar has been experiencing significant growth, particularly in crops like paddy and maize. The use of hybrid seeds has led to substantial increases in productivity and overall crop yields. The state has seen a "maize revolution" due to the adoption of hybrid seeds. Between 2008 and 2013, Bihar's maize production increased by 66 per cent, with productivity rising by 51 per cent to 4.11 tons per hectare, significantly above the national average of 2.5 tons per hectare [8]. The success of hybrid seeds in maize farming has attracted both national and multinational companies, enhancing the structural framework of the maize ecosystem in Bihar. The increased quality of maize produce has also been noted, and the state is becoming an important hub for maize production in India.

According to the Directorate of Maize Research, the quality of the maize produced has improved steadily over the last few years. "Increased participation of national players and a few multinationals has led to a structural change in the maize ecosystem in Bihar," it said in a report in 2012.

Likely the demand for hybrid paddy seeds in Bihar is rising, supported by government initiatives and the promise of higher yields. This trend is likely to continue as more farmers recognize the benefits of hybrid varieties in terms of productivity and profitability.

It was observed that private player has more flexibility in doing seed business. They sense the market quickly and respond to the market as per the desire of the farmer. For the popularization of the hybrid seed segment in the state is private sector played a significant role. The ICAR-IFPRI's survey shows that all maize growers in Bihar purchased seeds from private companies. The private sector has a deeper reach among farmers than the public sector and they market their product more aggressively [14]. Therefore, varietal turnover is faster for crops where private companies are involved in both hybrid seeds and open-pollinated varieties (OPVs). However, private companies are more interested in developing and selling hybrid seeds than improved varieties because farmers have to buy hybrid seeds every year [9].

One could think that private companies are more successful not because they are better at marketing, but because they target easier markets-crops with hybrid seeds or cash/high-value crops-where varietal turnover is faster anyway either due to technical reasons or higher commercial orientation of farmers [12]. Broadly considering the seed system in the state, we can have classified it into two categories: informal (Farmers) system and formal system. We have observed that even within a formal system, three -sub-systems prevailed first -sub-sub-system was dominated by varieties that were just introduced mainly by the public sector; second -sub-system was for varieties already become popular and widespread. So, in this sub-system, both the public and private sectors professionally managed all components of the seed system. The last sub-system is more advanced in nature. This advanced system is dominated by big private players mainly for the hybrid segment. They had their state of art research and development unit, highly mechanized

production and processing plant, and strong marketing network distribution of seed timely.

Although we had all kinds of seed systems in the state, the seed replacement rate (SRR) in Bihar varies significantly across different crops. For staple crops like paddy and wheat, the SRR is approximately 30-40 per cent. In contrast, pulses have a much lower SRR at around 20-25 per cent, while oilseeds have a higher SRR of about 40-45 per cent. These rates indicate the percentage of the cropped area sown using certified or quality seeds rather than farm-saved seeds. Smallholder farmers often have limited access to high-yielding and resilient crop varieties. Many of them still rely on traditional seed-saving practices or purchase seeds from local markets which may not be well-adapted to changing climatic conditions or may have lower yield potential [4]. There is a need to ensure seed security in the state. The key dimensions of seed security include availability, access, varietal suitability, seed quality, and the resilience of the seed system [6]. According to Remington *et al.*, seed availability means “having sufficient seed of desired crops within reasonable proximity and in time for sowing” [15]. It therefore refers to the farmer's supply of seed from all sources. These sources can include own-saved seed, social networks, local markets, the formal seed sector, and aid sources. Further, seed security has become a matter of urgent consideration in the perceived impact of climate change [10].

Key initiatives need to be undertaken to transform the Seed System in Bihar.

- Efforts need to be made to bring traditional varieties from informal to formal seed systems.
- A varietal improvement program needs to be initiated with the help of a traditional grower.
- Strengthening of seed processing and storage infrastructure in the state in both public and private sectors.
- Promote the investment in the seed value chain.
- Public-private partnership is required not only in seed production, but also in the distribution of seed to achieve a higher seed replacement rate.
- Better coordination among facilitators for licensing of seed/varieties, certification agencies, Research institutes, Production agencies, and farmers for strengthening the seed system in the state.
- Community-based seed production should be promoted particularly for the transformation of informer and stage I of the former seed system.
- The crop varieties have high cost and huge importance but poor adoption rate must be distributed at a subsidized rate initially.
- Seed treatment (like coating and Pelleting) becomes a specialized operation during -post-harvest for keeping the planting materials free from seed-born disease. So, it needs to be in the public sector also for high-value low-volume seed.
- To make our seed system responsive to climate change and healthy dietary needs.

Table: Classification of Seed System in Bihar

Technique		Informal Seed System	Formal Seed System		
		I	II (Introduction of Improved Varieties)	III (Widespread use of Improved Varieties)	IV (Advanced Seed System)
A	Seed Research & Development				
	a. Varietal Development	Small scale by farmer Mass selection of traditional landraces	Public sector	Public & Private sector	Predominantly by the Private sector
	b. Seed Production	No significant difference in crop and seed production	Breeder seed is produced by the public sector (SAUs) and commercial seed production by state seed Corporation, SAUs, & Pvt. growers	Shared role of Public & Pvt. Sector Pvt. firms increasingly involved in production of certified seed	On Private farm/farmers field with certain terms and conditions
	c. Seed Technique	On farm seed processing and storage	Seed of improved varieties processed and stored using new technique at a public facility	Processing & storage sophisticated Packaging and marketing by Pvt. company	Advanced technique in seed processing, storage, and treatment (Seed coating & pelleting)

Continued...

Technique		Informal System	Formal Seed System		
		I	II (Introduction of improved varieties)	II (Widespread use of Improved Varieties)	IV (Advanced Seed System)
B	Marketing & Distribution	Barter system (Exchange)/Gift Locally traded	By SAUs & State Seed Corporations (SSCs)	Both Public and Pvt. grower	Mainly by Pvt. Seed company through its wholesalers & distributors
C	Seed Certification System Bihar State Seed & Organic Certification Agency (BSSCOA)	No	Yes	Mixed Both as certified seed & truthfully labelled seed	No (self-declaration by the producer) Truthfully labelled seed
D	Seed Pricing	Very less	Close to grain price	Pvt. varieties having a high price	Very high

E	Promotional Activities	Contact basis	State department/ Extension agency of Govt.	Govt. advertisement Private advertisement	Its own or by outsourcing by Pvt. company
E	Performance Indicators				
	a. Seed Productivity	Low (but having special trait value)	Medium	High	Very high
	b. Adoption Rate	Low	Medium	High	Very high
	Example of System	Traditional varieties of rice, wheat, millet	Pulses, millets, oil seed	Rice, Wheat	Hybrid (Rice. Maize Vegetable crops)

Conclusion

Understanding the different types of seed systems is crucial for developing strategies to improve seed security and agricultural productivity. Different seed systems have their unique advantages and challenges, and often, a combination of systems is employed to meet the diverse needs of farmers and ensure sustainable agricultural development. The type of crop and its cultivar have been an integral aspect of any seed system, including its genetic variability, propagation methods, production requirements, storage, distribution networks, and regulatory framework. Understanding this aspect is essential for designing effective seed systems for different crops. The transformation of the seed system in Bihar has needed a multifaceted effort to modernize the seed sector through investment in research and development, and infrastructure development in the seed value chain. While formulating policy for seed sector development, our approach should be pluralistic in nature, so that we can strengthen multiple seed systems and have the potential to combine objectives targeting food security, agricultural development, promoting entrepreneurship, and contributing to biodiversity management. Continued investment, innovation, and collaboration will be essential for sustaining these efforts and ensuring long-term agricultural growth and seed security in the state. Thus, it may result in increasing accessibility, availability, and affordability of quality seed in the state.

Future scope of study

To increase the crop production and productivity, kind of seed, its availability and accessibility play a significant role. Despite the availability of good quality seed, we cannot achieve higher yield due to poor seed distribution system. Therefore, there is need to look after improving seed system before making any plan to increase food production and productivity of crops.

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References

- Adiyoga, W. (2021). Seed systems in the four shallot producing Areas of Java: A focus group discussion. E3S-Web Conf., 232, 01003.
- Almekinders, C.J.M.; Louwaars, N.P. (1999). Farmers' Seed Production: New Approaches and Practices; Intermediate Technology Publications: London, UK; 291p.
- Almekinders, C.J.M.; Louwaars, N.P.; de Bruijn, G.H. (1994). Local seed systems and their importance for improved seed supply in developing countries. *Euphytica*, 78: 207–216.
- Balwinder-Singh, McDonald, A. J., Kumar, V., Poonia, S. P., Srivastava, A. K., and Malik, R. K. (2019). Taking the climate risk out of transplanted and direct seeded rice: Insights from dynamic simulation in Eastern India. *Field Crops research*, 239: 92-103.
- Cromwell, E.; Wiggins, S.; Wentzel, S. (1993). Sowing beyond the State: NGOs and Seed Supply in Developing Countries; ODI: London, UK, 143p
- FAO (2015b). Seed security assessment. A practitioner's guide. Building capacity for seed security assessments. Version 1. FAO, Rome: Food and Agriculture Organization and European Commission Humanitarian Aid.
- FAO; IFAD; WFP. The State of Food Insecurity in the World. Strengthening the Enabling Environment for Food Security and Nutrition; FAO: Rome, Italy, 2014.
- <https://www.businesstoday.in/industry/agriculture/story/bihar-sees-maize-revolution-with-use-of-hybrid-seeds-46617-2014-05-06>
- <https://www.downtoearth.org.in/news/agriculture/hybrid-seeds-are-becoming-increasingly-popular-in-india-but-that-is-not-good-news-here-is-why-91584>
- Kumar, M., Kumari, H., Kumar, N. and Kumar, R. (2017). Urgent consideration for sustainable seed security in perceived impact of climate change. *Progressive Research*, 12 (Special-I) :1278-1281
- Louwaars, N. P., De Boef, W. S., and Edeme, J. (2013). Integrated seed sector development in Africa: a basis for seed policy and law. *Journal Crop Improvement*. 27:186–214.
- Malope, P. (2006) Prospects and challenges of seed sector privatization. *J. Dev. Agric. Econ.* 3: 504–513.
- McGuire, S. and Sperling, L. (2016). Seed systems smallholder farmers use. *Food Secur.* 8: 179–195.
- Pal, S. and Tripp, R. (2002). India's Seed Industry Reforms: Prospects and Issues. *Ind. Agric. Economics*, 57: 443–458.
- Remington, T., Maroko, J., Walsh, S., Omanga, P., and Charles, E. (2002). Getting off the seed and tools treadmill with CRS seed vouchers and fairs. *Journal of Disaster Stud. Policy Management*. 26:302–315