

Sticky Seeds: Why Old Seeds Continue to Dominate the Rice-Wheat Agriculture in Eastern India

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April 2020

Introduction

Preliminary findings of a joint ICAR-IFPRI survey covering more than 2,000 farmers from 40 districts of Bihar, eastern Uttar Pradesh and Odisha show that the adoption of improved varieties of rice and wheat seeds is slow in the region. The average age of wheat varieties grown in Bihar and eastern Uttar Pradesh is 25-30 years. A 2016 study of varietal adoption of wheat by CIMMYT and the Michigan State University (MSU) in Bihar also reports similar findings (Ray and Maredia, 2016). The average age of non-hybrid rice varieties grown in the region is around the same. The situation is even worse for pulses where landraces of unknown origins dominate the cropped area. More than 90% of pulse growers in our sample in Bihar and Odisha could not recall the names of the seed varieties they had sown. The two state governments are implementing programs with subsidies, extension and participatory seed production programs to popularize rice and wheat varieties that are less than 10 years old and pulse varieties that are less than 15 years old. The IFPRI-ICAR survey shows that these programs have had limited impact.

Rice and wheat together cover more than two-thirds of the gross cropped area (GCA) in Bihar and eastern Uttar Pradesh and rice alone accounts for 46% of GCA in Odisha. Why is the adoption of improved seeds so slow for the main crops in these states?

Different Seed Adoption Rates in Wheat and Maize

It is often argued that farmers in eastern India are slow to adopt new technologies because they have smaller and fragmented landholdings, small capital endowments, and poorer access to complementary factors like credit, extension, and markets. All these disadvantages notwithstanding smallholders in Bihar have rapidly adopted single-cross hybrid seeds of maize within a few years even when a kilo of maize seed is 4-5 times more expensive than the wheat seeds and farmers must spend on new seeds every year. In Bihar, it is not uncommon to come across farmers who grow single-cross hybrid maize and Lok-1—a 30-year-old wheat variety—in adjacent plots in the same season.

Why were farmers so quick to adopt hybrid maize, but do not show the same alacrity to adopt improved seeds of wheat or rice? This note presents some possible reasons using preliminary data and other secondary resources. Several questions still remain to be answered, but in this note, we have tried to address some of the most pressing questions with regards varietal adoption.



The Cereal Systems Initiative for South Asia (CSISA) is a regional initiative to sustainably increase the productivity of cereal-based cropping systems, thus improving food security and farmers' livelihoods in Bangladesh, India and Nepal. CSISA works with public and private partners to support the widespread adoption of resource-conserving and climate-resilient farming technologies and practices. The initiative is led by the International Maize and Wheat Improvement Center (CIMMYT), implemented jointly with the International Food Policy Research Institute (IFPRI) and the International Rice Research Institute (IRRI), and is funded by the US Agency for International Development (USAID) and the Bill & Melinda Gates Foundation.

Seeds of change: Some stylized facts

1. Seed adoption is faster when private companies are involved

Private seed companies played a big role in popularizing hybrid maize in the state. The ICAR-IFPRI 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 extension system and they market their product more aggressively. Therefore, varietal turnover is faster for crops where private companies are involved both for hybrids seeds and open-pollinated varieties (OPVs). However, private companies are more interested in developing and selling hybrid seeds than improved varieties because farmers buy hybrid seeds every year while they save and reuse varieties from year to year, sometimes for several years. Nonetheless, varieties still dominate the cropped area of rice and wheat does not have hybrid seeds.

One could think that private companies are more successful not because they are better at marketing, but 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. Bihar today has an estimated 25-lakh packet *rabi* hybrid maize seed market, worth Rs 250 crore (33 million USD) at an average Rs 1,000 per packet of 4 kg. A major share of this is with MNCs: DuPont Pioneer (36 percent), Monsanto (30 percent), Limagrain (10 percent), and Syngenta (5 percent). The balance is accounted for by domestic players like Nuziveedu and Kaveri Seeds¹.

However, recent partnerships between the Indian Agricultural Research Institute (IARI) and private companies shows that the profit-oriented private sector can help accelerate the adoption of new seeds—even for staples and varieties, not just hybrids. IARI has signed Memorandum of Understanding (MoU) with a number of small and medium-sized seed companies to market new varieties it has launched like PUSA 1121 Basmati rice, and HD 2967 and HD3086 varieties of wheat developed for Haryana and Punjab. These public-private partnerships have been highly successful in accelerating the adoption of these varieties not only in the two states but also in many other parts of India where rice and wheat are grown.

PKI's partnership with private seed companies has three major advantages.

- i. **Greater market penetration:** The new mechanism has reduced barriers to entry for smaller and newer companies in the seed system. With multiple new companies, seed markets have become competitive. Compared to the state seed corporations and public extension agencies, private seed companies have much greater field presence and stronger incentives to aggressively promote new seeds. With private participation, newly developed seeds can now reach from the laboratory to the fields of thousands of farmers in the same season. For example, the incubator helped sell 140 quintals of PUSA-3226 variety of wheat in the first year itself through a partnership with 70 seed companies. Achieving a similar scale takes 3-5 years or even longer when a new seed is disseminated only by the public sector organizations and the government extension system.

¹ <http://www.udyogmitrabihar.in/bihar-an-unlikely-corn-revolution/>

The PUSA Krishi Incubator

Nearly 10 years ago, ICAR-IARI established the PUSA Krishi Incubator (PKI) as an innovation hub and agri-business incubation center. The incubator supports entrepreneurs and startups in the agribusiness sector and helps innovators with intellectual property (IP) management. It also works with 366 industry partners to commercialize 211 different agricultural technologies developed by IARI and 13 other ICAR institutions in Northern India. Of the many technologies, the incubator has been the most successful in commercializing new varieties of basmati and non-basmati rice and wheat seeds through 212 seed companies, including 57 startups.

For each seed variety, the incubator enters into a non-exclusive licensing arrangement with private seed companies for a one-time licensing fee and royalties on the sale of seeds. Both the licensing fee and the royalty vary according to the crop type. High-value crops have higher fees and royalties than the staples. For a given product, fees and royalties are the same for all firms irrespective of their size and vintage. This approach has given a boost to micro, small, and medium enterprises, and the startup seed companies. A standard template has been created for contracts with private partners and the whole process has been streamlined to ensure that a new firm can sign a memorandum of understanding (MoU) within 2 days of expressing interest. Entrepreneurs can get all the necessary information needed to sign the MoU on the phone without having to visit the PKI in New Delhi repeatedly.

ii. Increased capacity for seed multiplication:

If a new variety becomes popular, more private companies show interest in partnership with the PKI and they can rapidly increase the production of the certified seeds. The public sector institutions have limited resources and flexibility to quickly respond to the market signals and the older popular varieties also compete for these limited resources.

iii. Reduction in the irregularities in the seed chain:

The PKI has instituted a more transparent system where each private partner files an indent for a fixed quantity of certified seeds. This information is shared with the seed certification companies. The new system helps curb the widely prevalent practice of illegal sales of breeder or foundation seeds straight to farmers without multiplying them into certified seeds.

This strategy offers some lessons that can be adapted in Eastern India to encourage the intensification of newer seed varieties for cereal crops. Instead of charging the private sector a royalty for every quintal of seed they sell, the government can pay them a fixed rate

of commission as a reward for popularizing better seeds among farmers. This commission can be set in a way that offers higher rewards for exceptional performance. Private companies frequently use such commissions or incentives to motivate their sales force.

2. Low and unstable returns from rice and wheat in eastern India discourages input intensification

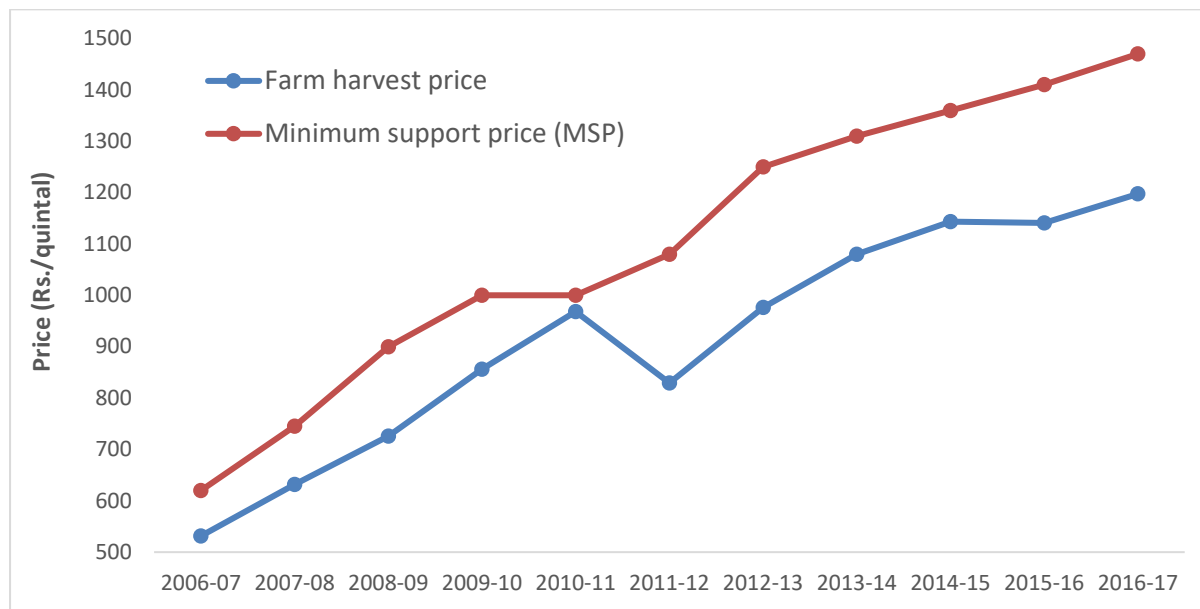
Rice: high risk-low returns

Rice growers in the region faces high production risks due to frequent droughts and floods and realize low farm harvest prices (FHP) for their produce (Figure 1) because of low volumes of public procurement.

High risk and low returns from rice lower farmers' incentives to spend on better inputs, including better seeds—even when this expenditure can potentially have high returns in good years. In a study

of assessment of rice-yield and variability in Bihar, it was found that late transplanting with old seedlings under farmer practice of transplanting long-duration cultivars under rainfed conditions, can lead to low rice yields due to high drought risk (Balwinder-Singh et.al., 2019).

Figure 1. Farm-harvest price (FHP) and minimum support price (MSP) of rice in Rs/quintal in Bihar (2006-07 to 2016-17)

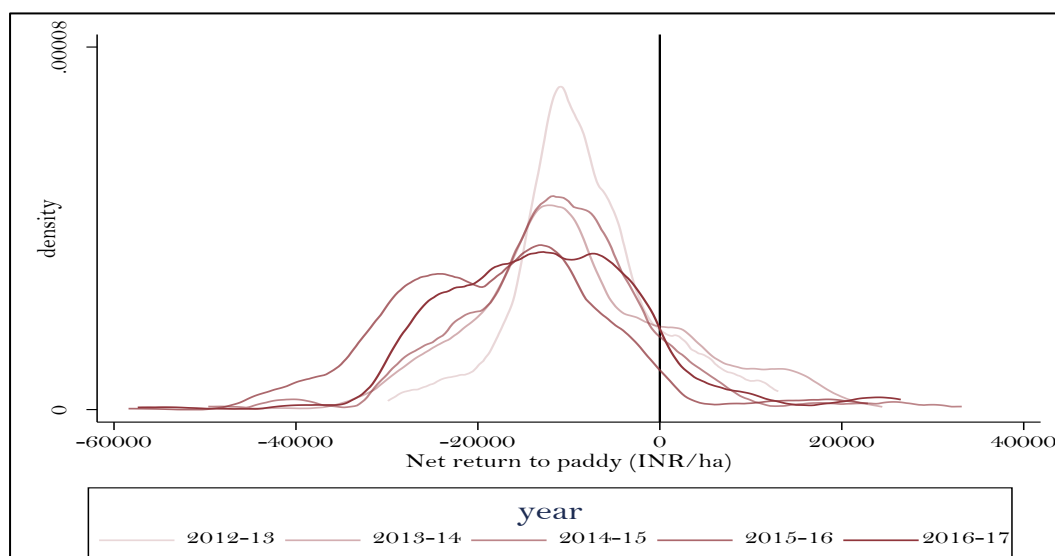


Source: Authors' calculation using the cost of cultivation data from CACP and MSP data from the Food Corporation of India (FCI).

Wheat: Low risk, low returns due to terminal heat

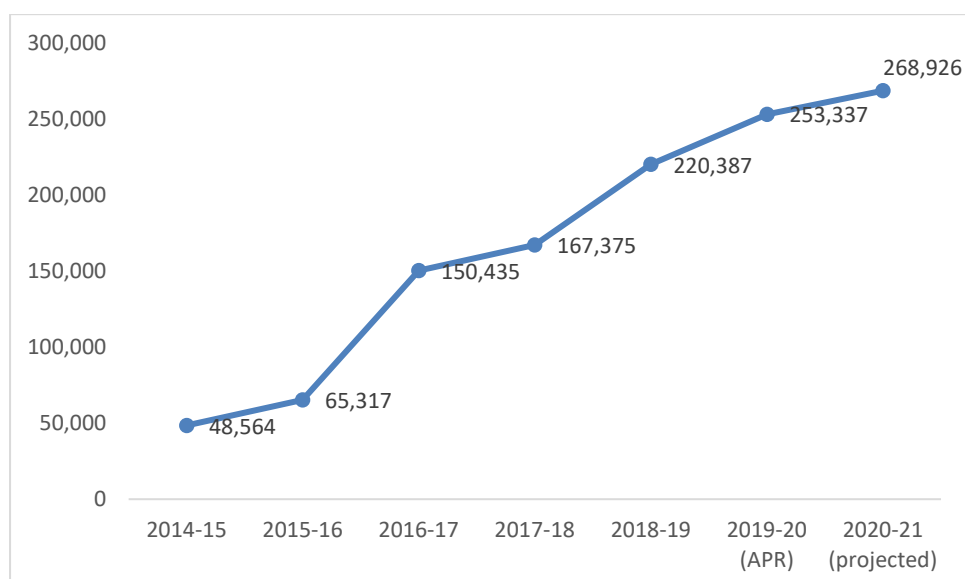
Wheat yields are not as uncertain as rice yields are, but the wheat economy of Bihar and eastern Uttar Pradesh also appears to be stuck in a low-input, low-output equilibrium. CSISA team's analysis of the Production-Practice Surveys (CSISA-PPS) in Bihar and Eastern Uttar Pradesh shows that wheat crop is often sown late in the region exposing the crop to high temperatures during the grain filling stage. The CSISA-PPS also shows that the late sown wheat responds poorly to input intensification: improved seeds (also irrigation and fertilizers) have low marginal returns if wheat is sown late. Delays in rice harvesting lead to delays in the subsequent winter (*rabi*) crop due to delayed sowing (Cornish et.al., 2015).

The whole rice-wheat cropping system in eastern India is in a 'cost-covering mode' where producers spend just enough on inputs to recover their cash costs. Most farmers earn near-zero profits from rice-wheat cultivation. Cultivating rice is a loss-making enterprise in most years for most farmers in Bihar (Figure 2). Given the low and uncertain returns from rice-wheat cultivation, farmers minimize cash expenditure on essential inputs like improved seeds and irrigation, which in turn leads to persistent low returns.

Figure 2. Per hectare net returns from rice in Bihar over the years

Source: Authors' calculation using the cost of cultivation data from CACP.

Access to affordable irrigation can help de-risk paddy production and advance the crop calendar for the whole rice-wheat system in eastern India. After decades of lag, electricity is coming to farmers in Bihar and eastern Uttar Pradesh. The number of electric pumps in Bihar has increased from 48,564 in 2014-15 to 253,337 in 2019-20-- a more than five times increase in 5 years (Figure 3). The government of Bihar is creating a new parallel grid for irrigation pumps to ensure a high-quality power supply to farmers. Electrification of pumps will lead to more affordable access to irrigation in the state which in turn will encourage farmers to sow rice and wheat on time and adopt newer varieties that respond more strongly to input intensification.

Figure 3. Number of electric pumps in Bihar (2014-15 to 2020-21)

Source: Data compiled from the Annual Revenue Requirement (ARR) reports filed by the North Bihar and South Bihar Utility Companies

Maize is different from both rice and wheat

Unlike rice, winter maize is not prone to droughts and unlike wheat, this crop is not affected by terminal heat. Improved seeds of maize return high yields when farmers apply 4-5 irrigations and high doses of fertilizers. Winter maize is a cash crop that has fetched decent prices to farmers because of its rising demand for animal feed in India and the rest of the world. Additionally, because of factors such as early harvesting against the American corn as well as reduced shipping time to southeast Asian nations, Bihar's annual exports of maize saw a tremendous increase. By 2012-13, Bihar's annual maize exports had crossed 10 Lt – 6.5 Lt to South-East Asia and 3.5 Lt to Bangladesh and Nepal. That was also the year when world corn prices peaked, with landed costs at Indonesia's Cigading or Malaysia's Klang ports averaging \$ 310-315 a tonne².

Potential Policy Implications for the Rice-Wheat System in Eastern India

Though we need more evidence to find out the best possible strategies to accelerate the adoption of newer and better varieties of rice and wheat seeds in EIGP, we recommend some policy strategies that have worked well in other parts of India and have the potential to transform the rice-wheat cropping system in the eastern region also.

1. Experiment with public-private partnerships for faster diffusion of improved seeds. Private companies have better reach among farmers but focus more on the market for hybrid seeds. Eastern states should experiment with the IARI model to involve and incentivize private seed companies in selling improved varieties of rice and wheat seeds.
2. Provide access to affordable irrigation to farmers to encourage them to transplant rice on time and advance the whole rice-wheat crop cycle by 4-6 weeks. Affordable irrigation will accelerate the varietal replacement rate in eastern India. However, highly subsidized flat tariffs for electricity, offered to farmers in Bihar may prove to be environmentally and fiscally unsustainable. Government of Bihar should learn from the mistakes of other states of India that followed similar policies with disastrous effects on groundwater aquifers and the exchequer.
3. Ensure that farmers receive remunerative prices for rice and wheat. This will require a significant increase in public procurement of grains in Bihar and eastern Uttar Pradesh. High and assured prices will create incentives for investment in high-quality inputs, including improved seeds.

While these measures may result in some positive outcomes for the rice-wheat seed systems in Eastern India, there remains the need to address certain key questions that will help in creating a more beneficial policy process:

- i. How can we adopt the IARI model of public-private partnership in rapidly popularizing improved seed varieties in the less developed eastern region where seed replacement rates are lower than in Punjab and Haryana?

² <http://www.udyogmitrabihar.in/bihar-an-unlikely-corn-revolution/>

- ii. Bihar, Odisha and Uttar Pradesh have implemented direct cash transfer of seed subsidies to farmers. How can this reform be used to incentivize private seed firms to enter the varieties market?
- iii. What are the different ways to ensure that farmers in Bihar and Eastern Uttar Pradesh get remunerative prices for rice and wheat?

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