

Transitions in Rice Seed Provisioning System in Odisha: Key Features, Constraints and Reform Agenda

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Introduction

There is no need to overemphasize the fact that a seed sector that provides timely access to adequate quantities of good quality seeds with desirable genetic traits to all farmers in an efficient and equitable manner is critically important for sustained agricultural productivity growth. The two key functions of the seed sector are the promotion of new varieties and the supply of high quality seeds of existing varieties to farmers.

In India, there has been a heavy involvement of public sector not only in agricultural research and development (R&D) but also in the production and marketing of seeds of food grains. New varieties of rice and wheat developed through public R&D are provided to farmers through subsidized public sector seed production and marketing programs together with the subsidized provision of irrigation and fertilizers. Such public sector involvement was critical for the spread of green revolution which was successful in raising the productivity growth in agriculture and generating substantial impact on food security and income growth (Hazell 2010).

While recognizing the critical role of the public sector in agricultural R&D, questions are being asked in recent years regarding the rationale of continuing the direct involvement of public sector in seed production/marketing programs (Tripp and Pal 2001, Gadwal 2003, Tripp et al. 2010). The importance of private sector investment in R&D and in the provision of seeds is now increasing. This is especially true for proprietary technologies (e.g., Bt cotton, hybrid sorghum and hybrid maize). Even for self-pollinated crops such as rice and wheat, private sector is now increasingly involved in seed production and marketing throughout India. This is happening in response to several economic and institutional factors. Economic factors include increased commercialization of agriculture and rising farm incomes. These have encouraged farmers to purchase good quality certified seeds from the market instead of following the traditional practice of using the farm-kept seeds. The institutional factors include enactment of various seed laws and provision of intellectual property rights protection (IPR) on plant varieties that have provided incentives for private sector to be involved in agricultural R&D and in seed business.

The transition in seed provisioning from public to private sector is taking place differentially across crops and states in India. In the case of rice – the focus of this study, the transition is far ahead in the agriculturally more advanced states such as Andhra Pradesh, Haryana and Punjab where rice is grown mainly under irrigated conditions. In the rainfed region such as in various states of eastern India, the transition has been much slower and the public sector is still a major provider of rice seeds.

The determinants and the process of transition from public to private sector seed provisioning are generally poorly understood, especially in the context rainfed rice systems of eastern India. Through a case study of Odisha, an important rice growing state in rainfed environments of eastern India, this paper aims to highlight the nature of transition taking place in rice seed provisioning, its likely future evolution and institutional/policy reforms needed to facilitate the transition.

The paper is organized as follows. The next section provides a descriptive analysis of the rice production system, trends in productivity growth and varietal adoption in Odisha. This is followed by a brief historical description of institutional set-up for seed production and marketing in India. The third section provides a detailed analysis of the rice seed system of Odisha and identifies key factors constraining the process of transition. The strategy for the future is discussed in the following section and a policy reform agenda is presented subsequently. Some concluding remarks are included in the final section.

The paper is focused on issues related to inbred rice varieties only and excludes the considerations related to hybrids in which the private sector is expanding its activities in India. This is not to imply that hybrid rice will remain unimportant in the future although the current area under hybrid rice in India is small (less than 10%). As it is a proprietary technology, there are different sets regulatory and IPR issues that will affect hybrid rice seed marketing and these have been analyzed elsewhere (Spielman et al. 2011, Kolady et al. 2012).

Characteristics of rice production system in Odisha

Odisha is the 5th largest rice-producing state in India accounting for roughly 7% of the national rice output. The current rice area in the state is 4.1 million ha, with the average rice yield being 2.3 t/ha¹.

Rice is cultivated mainly under rainfed conditions in the state, with the irrigated area being around 23%. The state is prone to drought and submergence that result in a low and highly unstable yield (Figure 1). Salinity is an important constraint in the coastal belt which also suffers from periodic cyclones.

Adoption of improved rice varieties in Odisha has increased over time (Figure 2). Although rice yield has also increased with the increased adoption of improved varieties (Figure 3), the overall average yield has remained below the all India average.

An important feature of the rice production system in Odisha is its spatial variability. Yield performance varies substantially across districts with some irrigated inland districts having higher average yields relative to the largely rainfed coastal districts.

Institutional set-up for rice seed production/marketing in India

The existing institutional set-up for rice seed production/marketing in India is largely based on the public sector, with expanding but still a fairly minor role of the private sector. This basically reflects the nature of seed systems established during the green revolution period of 1960s and 1970s. During this period,

¹ All production and yield data are expressed in this paper in terms of rough rice not milled rice.

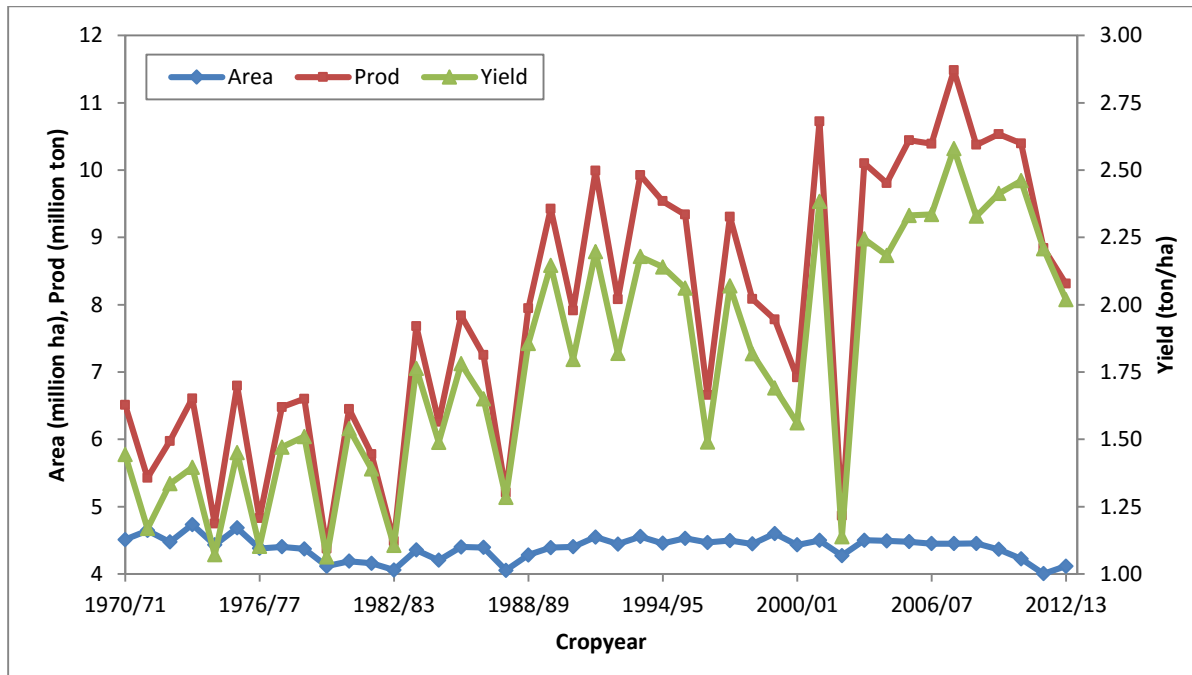


Figure 1. Trends in area, production and yield of rough rice in Odisha.

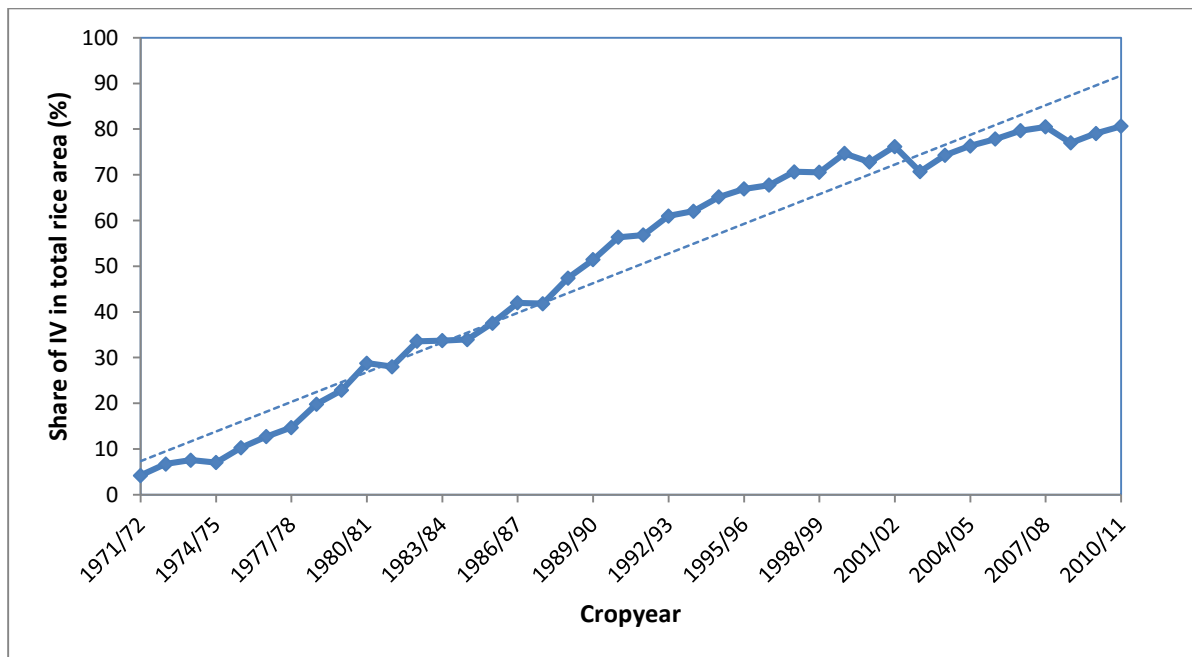


Figure 2. Trend in adoption of improved varieties (IV) in Odisha.

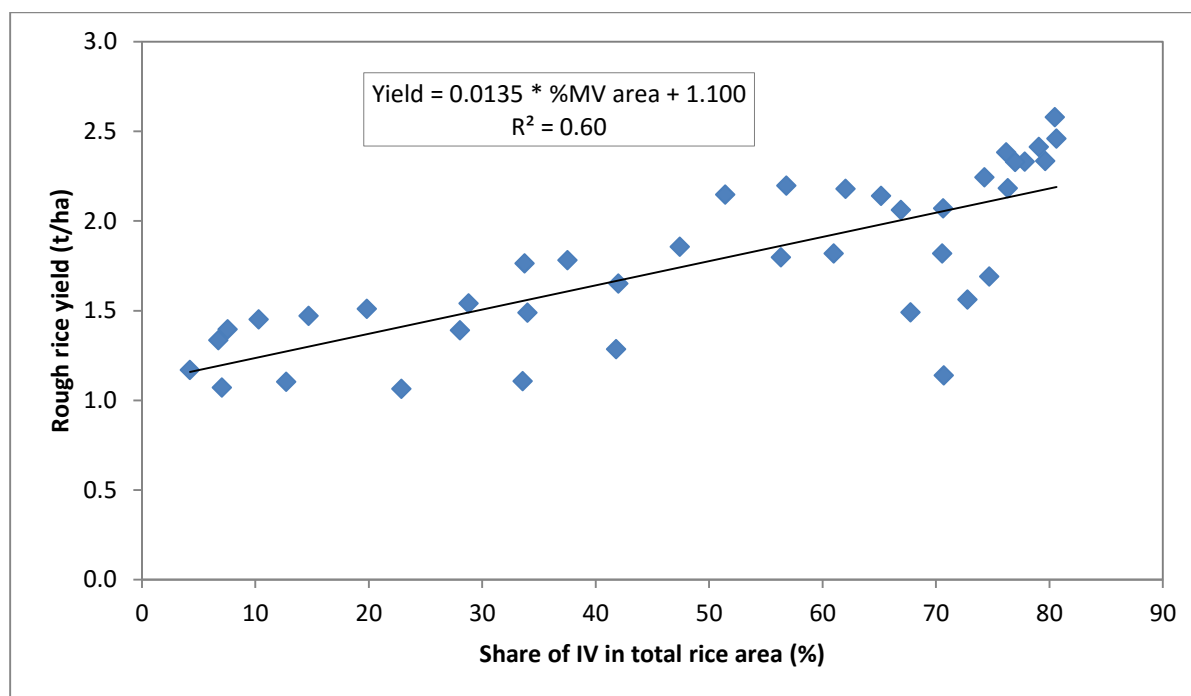


Figure 3. Relationship between rice yield and percentage area under improved varieties (IV) in Odisha, 1970/71 to 2010/11.

public sector was the main driver not only of the development of improved varieties of rice through publicly-funded R&D but also of production and marketing of seeds of such varieties.

The public sector involvement in seed production of food grains in India was formalized through the establishment of the National Seed Corporation in 1963 and the subsequent establishment of 15 state-level seed corporations (Gadwal 2003, Singh et al. 2008). The State Farm Corporation of India (SFCI) is an additional central level entity involved in the seed sector since early 1970s.

The national and state seed corporations source the breeder seeds from public sector research institutes (ICAR and State Agricultural Universities) and produce foundation seeds and certified seeds². The certified seeds are sold to farmers through public-sector retail outlets. As with the subsidized provision of agricultural inputs such as irrigation and fertilizers, the production and marketing of seeds is also subsidized. The public sector largely drives the seed production and marketing systems for rice despite an increasing involvement of the private sector in recent years, especially in agriculturally more advanced states such as Andhra Pradesh, Haryana, Punjab and Tamil Nadu.

The enactment of the Seeds Act in 1966 paved the way for the private sector involvement in seed production and growth of the private seed industry in India. The Seeds Act provided a system for seed quality control through independent state-level seed certification agencies. Growth in the private sector

² The Indian seed system for food grains recognizes three phases of seed production: breeder seeds, foundation seeds and certified seeds.

involvement in seed production in India took place in the backdrop of enactment of legislation for Protection of Plant Varieties and Farmers' Rights in 2001 and the formulation of National Seeds Policy in 2002. The legislation provides for proprietary or intellectual property rights on plant varieties through patents or plant variety protection or a combination of both. The expansion of private sector in seed production is largely concentrated on proprietary varieties such as Bt cotton, corn hybrids and hybrid vegetables. For self-pollinated crops such as rice and wheat, no such proprietary rights can be established – hence, the private sector involvement is limited. The development of proprietary hybrid rice technology has attracted the private sector involvement, however, hybrid rice currently accounts for a small proportion (less than 10%) of area under rice in India.

Broadly, the rice seed system of India consists of formal and informal components. The formal component is dominated by public sector production/marketing of seeds, although private sector involvement is increasing. The informal component consists of farmer-based systems in which farmers select, process, store, exchange and use the seeds as they have been doing traditionally. This informal component is dominant as the formal component accounts for only around 20% of the total seed use at the national level.

Analysis of rice seed system in Odisha

Institutional set-up and seed chain

Odisha State Seed Corporation (OSSC) is the main public agency responsible for production and marketing of rice seeds in the state. A second public agency, Odisha State Agro-Industries Corporation (OAIC) has been entrusted recently to provide an additional public-sector marketing channel for seeds. Both these agencies are under the administrative control of the Directorate of Agriculture and Food Production (DAFP) of the state government of Odisha. In addition to these two apex corporations, other public sources of rice seeds are DAFP farms, Central Rice Research Institute (CRRRI), and the Orissa University of Agriculture and Technology (OUAT). The Odisha State Seed & Organic Products Certification Agency (OSSOPCA), a government agency, has the mandate for certification of seeds produced in the State.

In addition to these state-based public sector organizations, some seeds are also supplied from outside the state by the government of India through National Seed Corporation (NSC) directly or through programs such as the National Food Security Mission (NFSM) and Bringing Green Revolution to Eastern India (BGREI).

There are two primary players in the private sector. The first types are private commercial producers who operate as full-fledged private entities for producing and marketing of seeds³. Some of these commercial producers have a research wing that conducts adaptive research to identify rice varieties adapted to specific production environment and the seeds are sold as “research seed”. These private sector entities, which are mostly located outside Odisha, directly purchase breeder seed/foundation

³ These include large companies that are involved in hybrid rice development and seed production but also produce seeds of inbred rice.

seeds mostly from the public sector and produce seeds that are either certified or sold as truthfully-labelled (TL) seeds⁴.

The second type of the private sector entities is called the Memorandum of Understanding farms (or simply as MOU farms). They basically have a somewhat loosely-defined contract (or MOU) with OSSC/OAIC for production of foundation seeds from breeder seeds and/or production of certified seeds from foundation seeds. The source seeds (breeder or foundation seeds) are mostly supplied by OSSC/OAIC although they also have the freedom to source their own supply. These farms mostly supply their seeds to OSSC/OAIC as per the contract but also sell a small proportion to the market directly. These farms may be considered as parastatals due to this tight linkage with OSSC/OAIC on both ends of the seed chain (source seed as input and certified seed as output).

The essential features of the seed chain are broadly captured in Figure 4. The breeder seeds are sourced mainly by OSSC from research organizations within and outside the state. Foundation seeds are produced from these breeder seeds through two channels. The first involves the MOU farms who receive the breeder seeds mainly from OSSC/OAIC but also on their own. The second channel involves the production of foundation seeds directly by OSSC on its own farms. The foundation seeds are subsequently multiplied to certified seeds by MOU farms themselves, by contract seed growers of MOU farmers, or by registered seed growers of OSSC (5000 growers). The seeds produced, after proper certification by OSSOPCA, are ultimately sold to farmers through retail outlets managed by the Primary Agricultural Cooperative Society (PACS), OSSC/OAIC designated seed dealers and private input dealers. Overall, OSSC is the key agency involved in different stages of the seed chain including the acquisition/supply of breeder seeds, the production/supply of foundation seeds, and production/supply of certified seeds. The dominant seed flows are indicated in the diagram by bold lines/boxes. There are several cross-linkages across various agencies in the seed chain. These cross-linkages while providing some degree of flexibility also add to the complexity and confusion which are bound to result in loss in efficiency.

In addition to the main agencies mentioned above, several other agencies are also involved in seed production and marketing although they together account for a relatively small share (<20%) of the total quantities of rice seeds produced. These include research organizations such as OUAT, CRRI, and DAFP farms and several projects involved in seed distribution such as Seed Village Schemes, Self-Help Groups and National Food Security Mission. Seeds supplied through these agencies and projects also include “truthfully-labelled” seeds as not all of the seeds supplied go through the official certification process. At the retail end, seeds are sold to farmers through PACS (878 in number), OSSC dealers (3225 in number), OAIC dealers (644 in number) and private retail outlets.

⁴ These are seeds that have not been certified by an official certification agency but are guaranteed by the seed company as being of superior quality.

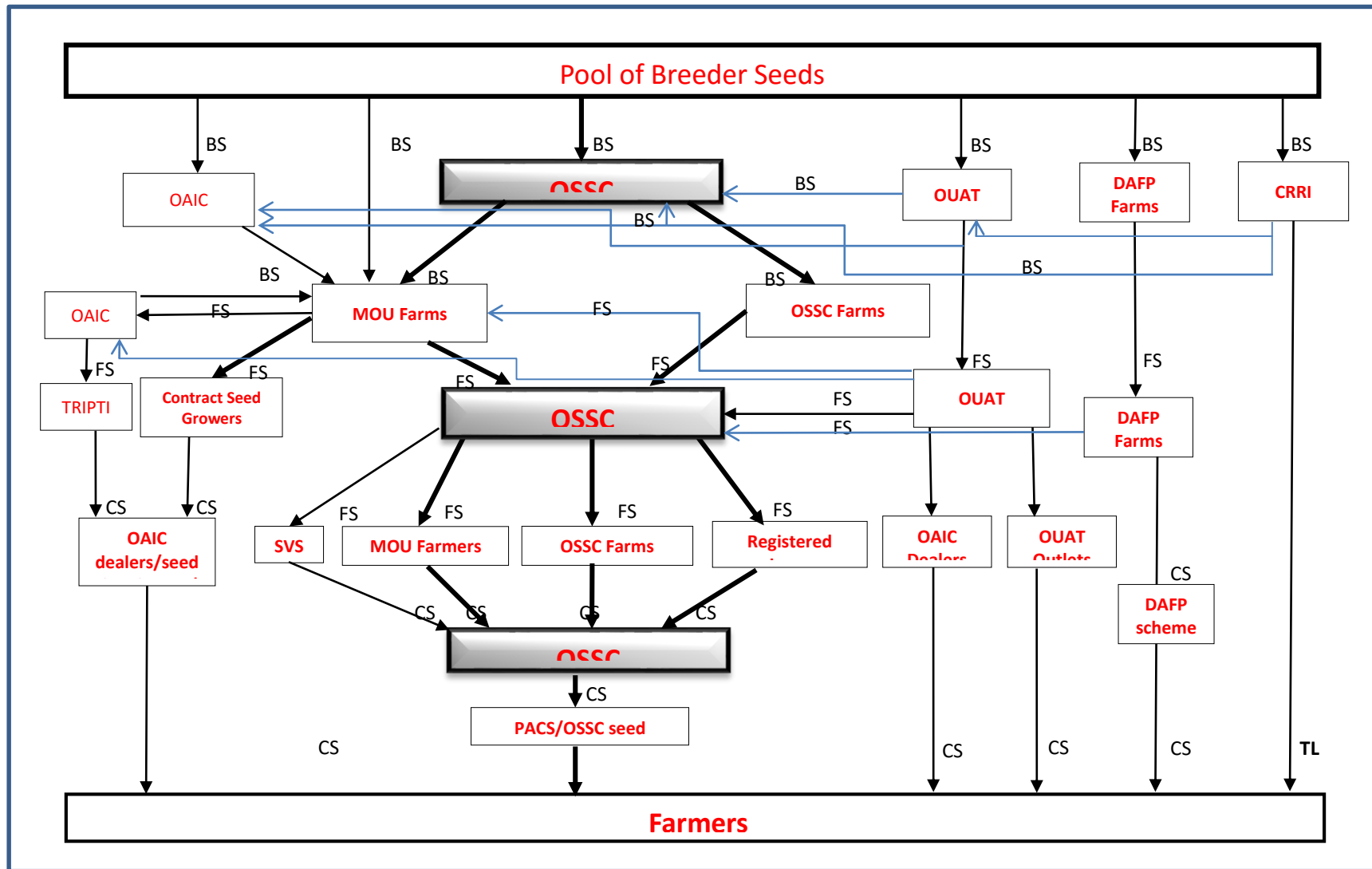


Figure 4. Rice seed chain in Odisha.

Seed production trends

The production of certified rice seeds has increased over time (Figure 5) due to an increased emphasis of the government to raise the seed replacement ratio (SRR)⁵. The production of certified rice seeds in the formal sector was 20,000t in 2000/01 but it almost tripled to 62,000t in 2011/12. Seed production has had a strong positive trend despite some years of slight dips.

The production of certified seeds is dependent on four variables, viz, the quantity of foundation seeds produced, the quantity of foundation seeds actually used for the production of certified seeds, the seed multiplication ratio (SMR) and any seed loss due to rejection during the certification process. The data indicate that the quantity of foundation seeds produced has increased steadily over time. There are no authentic data available on the extent of utilization of foundation seeds for further seed production but key informant interviews indicated that only a fraction of the foundation seeds produced is actually used for seed production, with the remaining used directly as seeds for rice production or even consumed as grains. The extent of this loss from the seed chain cannot be directly estimated due to lack of data. An attempt is made here to estimate this loss indirectly.

Under reasonable assumptions about the seeding rate of foundation seeds and the actual seed grain output, the government estimate of SMR is 80:1. This means that 1 kg of foundation seed normally produces 80 kg of certified seeds⁶. So, the quantity of seeds produced can be obtained by multiplying the quantity of foundation seeds by a factor of 80. However, not all seeds produced meet the certification criteria and the rejected quantity needs to be accounted for.

The fourth variable, hence, is the quantity rejected due to failure to meet the certification criteria. Certification is a two-step process: the first step involves the certification of area where seeds are produced. This is done by monitoring the extent to which the production practices on seed farms follow the recommended practices for seed production. The second step involves checking of the quality of seeds produced from the area certified during the first step. The analysis of monitoring data for 2001-2009 indicates that, every year, around 5% of the area and around 10% of the production is rejected.

The certification process thus results in a loss of about 15% production. This implies that the effective SMR is around 68 (calculated as $0.85 * 2400/30$). If all the foundation seeds produced were used for the production of certified seeds, one would thus expect one kg of foundation seeds to produce 68 kg of certified seeds. But the actual ratio of CS:FS during 2001-2011 varied between 5-21, a value lower than the expected value of 68 by several orders of magnitude, supporting the key informant observation that only a proportion of the foundation seeds is actually utilized for the production of certified seeds. If true, this represents a substantial economic loss. A positive development, however, is that the CS:FS ratio is

⁵ Seed replacement ratio is the proportion of crop area planted with certified or good quality seeds obtained from outside the farm. Typically such seeds are purchased from the market.

⁶ The government estimate of SMR is based on the assumption that the seeding rate of foundation seeds is 30kg per ha while the seed yield is 2.4t/ha.

increasing over time (as indicated by the increasing vertical distance between the two curves in Figure 5, indicating that such losses, although likely substantial, are decreasing.

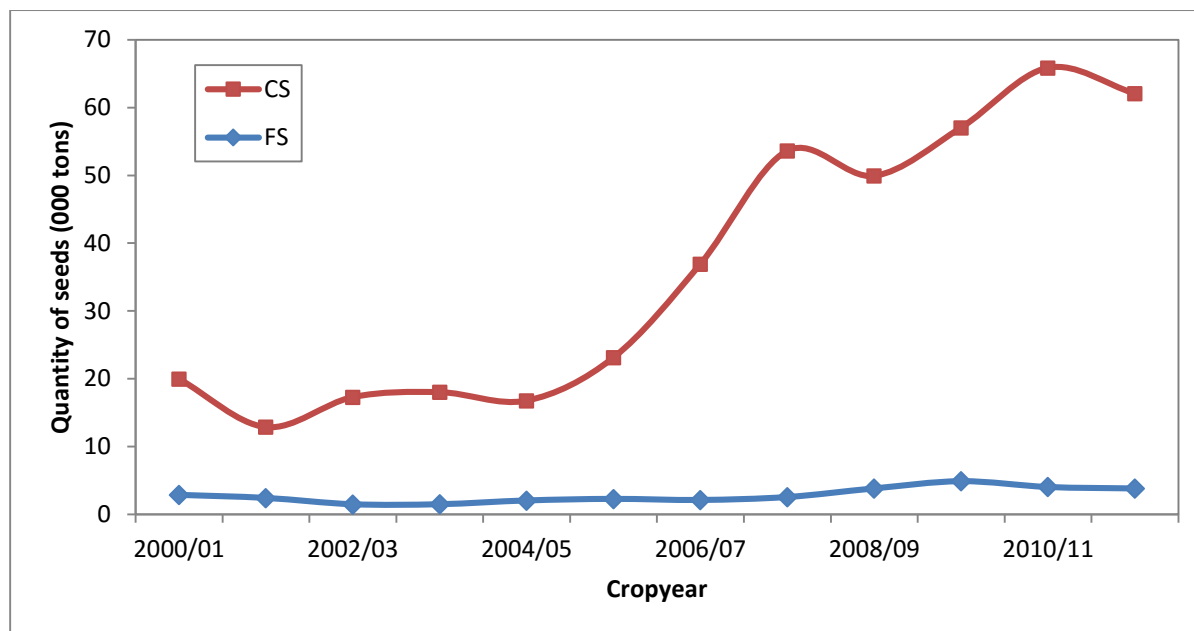


Figure 5: Trends in foundation (FS) and certified (CS) seed production in Odisha.

(The data on CS is lagged by one year as CS in the current year is produced by using FS from the previous year).

Varietal composition of seeds produced

The public sector seed supply is concentrated on top 10 varieties which account for almost 95% of the total seeds produced (Table 1). Of these, the top 3 varieties account for nearly 70% of the total seeds produced. All top five varieties were released prior to 2000, with Swarna being the oldest one released in 1979. Clearly, seed production is concentrated on older successful varieties that have been widely grown and have an established demand⁷. This seed production pattern, while sensible, limits the choice of improved varieties available to farmers despite the fact that farmers indeed grow a much wider range of improved varieties.

⁷ This pattern is observed in previous 3-4 years also, indicating some stability in this varietal composition of seed production.

Table 1. Composition of rice seeds supplied by the public sector in Kharif season 2014, Odisha.

Variety	Variety release year	Seeds supplied (tons)	% Share in total seeds
Swarna (MTU 7029)	1979	13689	26.1
Pooja	1999	11943	22.8
Vijeta (MTU 1001)	1995	10865	20.7
Cottondora Sannalu (MTU 1010)	1995	4517	8.6
Lalat	1988	2692	5.1
Ranidhan		1809	3.5
Sarala	2000	1429	2.7
Khandagiri	1992	942	1.8
Sahabhagi		825	1.6
Pratikshya	2005	758	1.4
Others		2920	5.6
Total		52390	100.0

Data source: Agricultural Statistics, Government of Odisha

A comparison of the proportion of seeds of specific varieties produced/supplied with the estimated adoption levels of respective varieties is quite revealing (Table 2). Swarna accounts for 31% of the area under improved varieties but it accounts for only 20% of the total production of seeds⁸. This indicates a mis-match between adoption level and the public supply of seeds, with seeds of Swarna being under supplied. In the case of Vijeta and Cottondora Sannalu, there appears to be an oversupply as the proportion of certified seeds produced is much higher than the adoption levels. Similarly, improved varieties grouped under “other” category account for 33% of the area but only 22% of seed production. This mismatch could be the result of several factors including the difficulties with the “indent” method of demand estimation (see the section “mechanisms for seed demand estimation and supply management”).

Table 2. Production of certified seeds of major varieties and adoption levels.

Variety	Proportion of certified seeds produced, 2012/13	Percentage area adopted, 2010/11 ^a
Swarna (MTU 7029)	20	31
Pooja	14	14
Vijeta (MTU 1001)	26	10
Cottondora Sannalu (MTU 1010)	13	4
Lalat	5	8
Others	22	33
Total	100	100

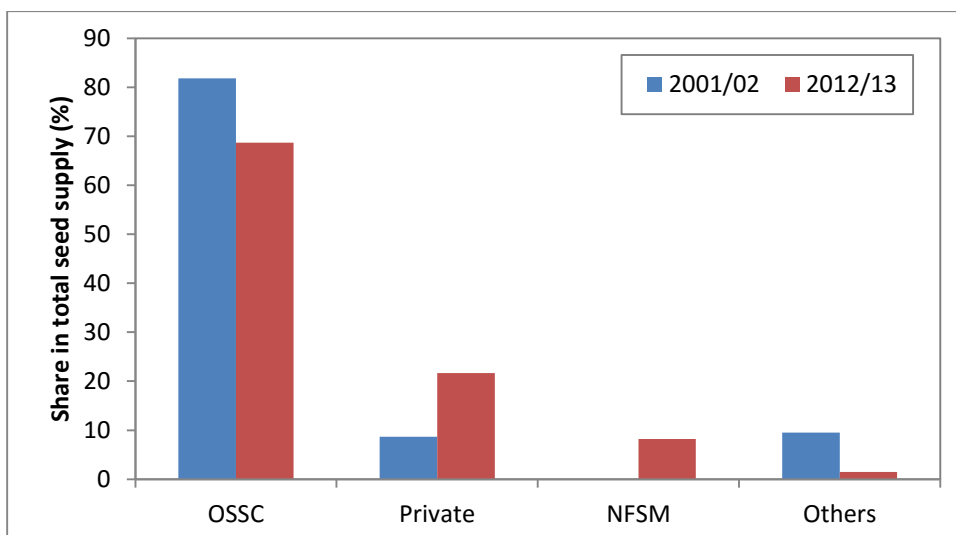
^aSource: Pandey et al. (forthcoming).

⁸ The two data series are not strictly comparable as they are one-year apart, however, they indicate the broader trend.

Increasing role of the private sector:

The OSSC/OAIC set-up currently accounts for close to 70% of the rice seeds (certified plus truthfully-labelled) produced in the state. However, its relative contribution in the total seed supply has decreased from over 80% in 2001/02 as a result of the increased private sector activities (Figure 6). The private sector (which mainly includes the MOU farms⁹) now accounts for over 20% of the seeds produced, although they supply most of their seed output to OSSC/OAIC¹⁰. The share of other state agencies has also decreased between 2001/02 to 2012/13 and close to 10% of the supply is provided through various national/state schemes that procure seeds within and outside the state. Overall, the share of the public sector (both within and outside the state) is around 80%.

The total number of MOU farms registered with OSSC/OAIC in 2013 was 52. The number of these private seed farms increased rapidly from 15 in 2005 to 32 in 2010, with a further increase to 52 in 2013. These private entities are involved in the production of seeds of a number of crops including rice. Most of these companies are located in the western inland belt which has good irrigation facilities and more stable environmental conditions for seed production. In addition to supplying certified seeds to OSSC/OAIC, these companies also sell directly in the local and interstate markets as certified and TL seeds as well as foundation seeds.



⁹ MOU farms are considered as private sector as these farms essentially run as independent private sector entities with only a broad MOU for the supply of seeds to the public sector. Most of them have their own processing units and are free to sell directly in the market. On the other hand, contract seed growers who supply to OSSC/OAIC are bound by a tight contract with OSSC/OAIC and are largely dependent on these organizations for the supply of source seeds and the purchase of certified seeds produced.

¹⁰ This is likely to be a lower bound estimate of the private sector share as only those that are certified are captured in the official statistics. Private sector sale as TL seeds is not included in these official statistics. Anecdotal evidence indicates that the size of this market is at least 5000 tons (or about half of the amount recorded in official statistics as produced by private companies).

Figure 6. Certified seeds produced by different sources (2001/02 and 2012/13).

Changes in Seed Replacement Rate

Seed replacement ratio is an indicator of the effectiveness of seed systems in supplying high quality seeds to farmers¹¹. For rice, farmers traditionally keep their own seeds (or exchange from neighbors) and purchased seeds (of high quality) typically account for less than 10% of the total cropped area. For encouraging farmers to use high quality seeds, various programs of central and state government are now increasingly emphasizing the production and supply of certified/quality seeds. Accordingly, the SRR for rice in India and various states of India has increased in recent years.

In the case of Odisha, the SRR for rice increased from a low of 5.4 in 2002/03 to 21.6 in 2011/12 (Figure 7). The ratio¹² has thus increased by about 1.8 percentage points per year on average and represents seed replacement of once in about five years only. At this rate, it can take at least another 5 to 7 years to achieve the state target replacement rate of 33%.

The ratio for the state as a whole, however, hides considerable spatial variability across districts (Figure 8). The ratio is considerably higher for inland districts with relatively favorable rice growing environments such as Ganjam, Gajapati, Kalahandi, Nuapada, Koraput and Sambalpur. On the other hand, the coastal districts, with less favorable environment with limited irrigation, still continue to have low SRR. The predominant practice in this region is to sow early using direct seeding of long-duration varieties. New seeds produced through OSSC are mostly unavailable in seed stores early in the season resulting in a low SRR. In addition, the incidence of tenancy in these districts is higher and tenant farmers are somewhat reluctant to use monetized seed input because of resource constraints. Thus, it is important to have a more targeted approach for raising SRR that prioritizes the districts with currently low SRR.

While an increasing trend in SRR indicates a desirable development, the actual values of SRR are likely to be considerably lower than indicated above as these estimates are based on production/supply of seeds, not on use by farmers. The derivation of SRR based on seed production/supply is based on the assumption that all seeds produced/supplied are actually sown. Field visits and key informant surveys indicate several reasons why this assumption may not be valid. These include instances such as delayed supply of seeds after the planting window is closed; poor quality even though the seeds may have the 'certified' label; a mismatch between farmer-preferred varieties and the varieties of seeds supplied; a diversion of subsidized seeds for consumption; and export of seeds outside the state borders. Results of field-level studies indicate that farmers in Odisha still rely mainly on farm-kept seeds (Pandey et al. 2015

¹¹ For inbred crops such as rice, farmers typically keep a portion of harvested grain for use as seeds in the next growing season. Such seeds tend to deteriorate in quality after many cycles of use and it is important to replace them with high quality new seeds frequently. In the case of rice, replacement of old seeds with new high quality seeds every 3-4 years is considered desirable. This is equivalent to SRR of 33-25%. For hybrids, the SRR is 100%, with new seeds planted every year as farm-kept seeds lose the hybrid vigor.

¹² SRR is typically estimated assuming the seeding rate of 60kg/ha.

(forthcoming), Behura et al. 2013, Pandey et al. 2013 and Behura et al. 2012). These results are indicative of a low SRR.

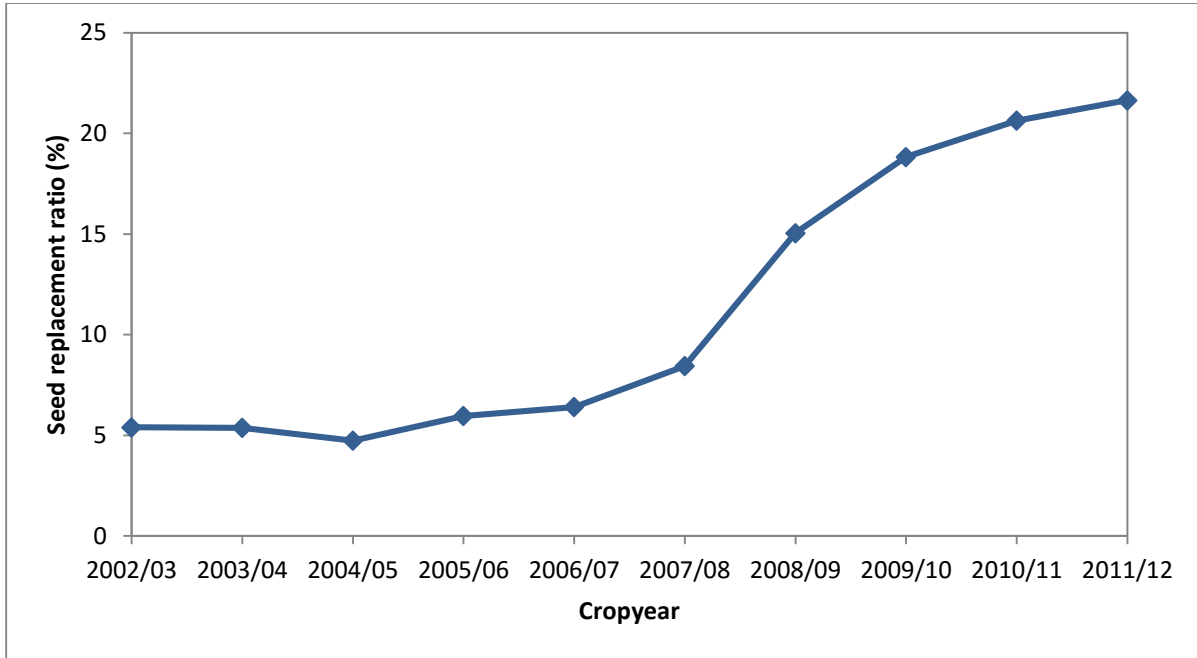


Figure 7. Trend of seed replacement ratio of rice in Odisha.

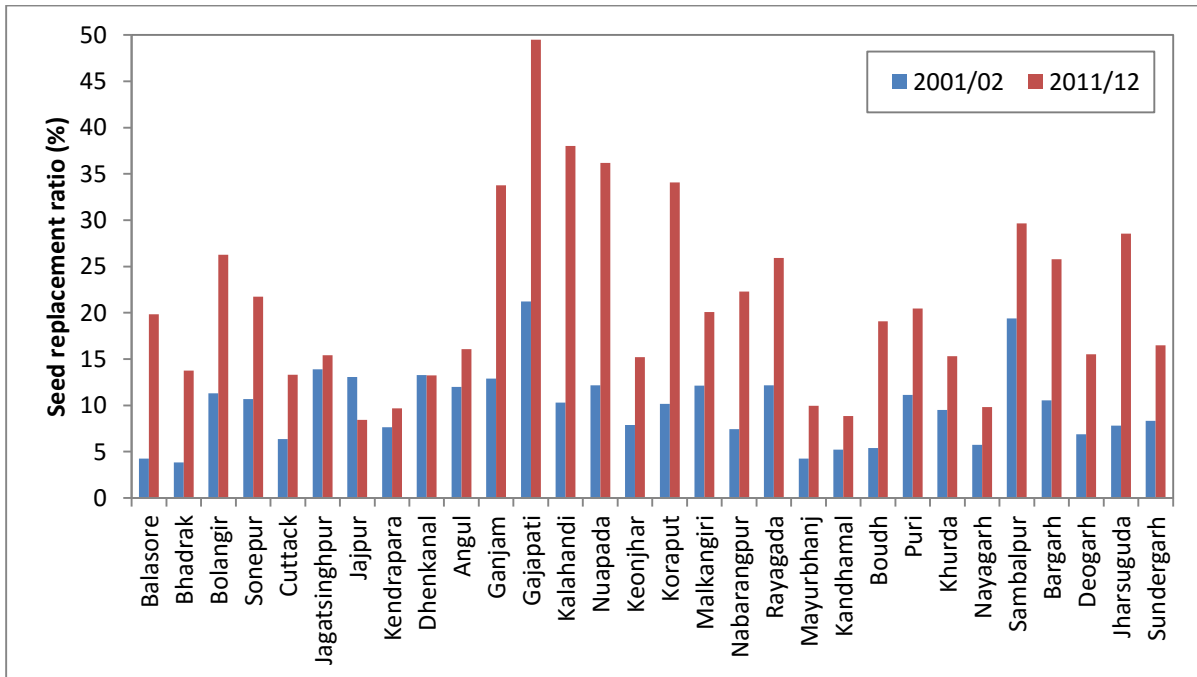


Figure 8. District level variation in seed replacement ratio in Odisha.

Seed subsidies

Certified seeds are sold to farmers through public outlets at a subsidized price. It is not possible to estimate the total subsidy cost directly as the subsidy is covered through budgets allocated to various central and state schemes on a shared basis, typically on a 50-50 basis.

An indirect way of estimating the cost of the subsidy is to compare the price in public outlets (such as primary agricultural cooperatives, designated seed dealers and government retail outlets) with the general market price. Both types of price vary to some extent depending on the variety, the time of sale and the local supply conditions. Hence, a range of prices are used to estimate the cost of subsidy.

The subsidized price of seeds for 2013 is estimated to be in the range Rs13,500-15,000/t with the market price being in the range of Rs22000-23000/t. This is close to the cost of seed production based on the price fixed by the government for the MOU farms (Table 3). The subsidy cost (based on market price and cost of production) is in the range of Rs7000-9500/t.

With the total quantity of seeds supplied through government channels for the kharif season of 2014 being 52000t, the total subsidy cost is estimated to be Rs 360-500 million. The subsidy cost is, hence, estimated to be in the range of Rs 97-133/ha as the total rice area under kharif crop is around 3.7 million ha. Using the same rate, the total cost for the Rabi season (0.25 million ha) will be in the range Rs 24-33 million. Thus, the total annual cost of seed subsidy is estimated to be in the range Rs 380-530 million.

How does this level of subsidy compare with the annual state budget for agriculture? The estimated budget for agriculture for 2014/15 is Rs17340 million. Thus the subsidy on rice seed alone accounts for around 2.2-3.1% of the state annual budget on agriculture. The subsidy is 0.3-0.4% of the gross value of rice production of the state – slightly less than the ratio of government expenditure on agricultural research to agricultural GDP in India (estimated at 0.7% for the 11th Plan period).

The cost of seed subsidy is substantial given the dubious nature of the benefit resulting from publicly-sponsored seed production/marketing programs. In addition, inefficiency costs associated with such programs are obvious in terms of the concerns expressed by farmers such as poor quality of seeds, lack of timely supply, and unavailability of seeds of preferred varieties.

In addition to the above costs, a major impact of such subsidies is to discourage the entry of private sector in seed production/marketing. It is difficult for the private sector to compete in the market when subsidized seeds are available from the public sector. In fact, the presence of subsidy is one of the major constraints for expanding their business as cited by private sector seed growers during key informant surveys.

Table 3. Cost of production of rice seeds by MOU farms (2013).

Particulars	Cost (Rs/t)
Minimum support price (MSP)	13600
Regulated Market Committee fee (2% MSP)	260
Processing fee (6% of MSP)	800
Allowance for moisture loss (4%)	540
Transport, loading and unloading	700
Other costs (roguing/certification etc)	1500
Profit margin	1000
Total cost for seed growers	18400
Seed processing, treatment, packaging and transport	4100
Total cost	2250

Source: Statistical bulletin (OSSC).

Mechanisms for seed demand estimation and supply management

Production and marketing of seeds of basic food grains in Odisha (and in most states of India) are based on an “indent” system which is a fairly elaborate non-market mechanism for estimating the “demand” for seeds and using the estimated demand as the basis for public sector production and marketing of seeds. The state governments make this estimation based on the area under different crops, area covered by hybrids/self-pollinated varieties and the seed replacement ratio. The starting point for the estimation process is a cluster of villages (or a “block”) and the information is aggregated to arrive at the state level demand.

In Odisha, the Village Agricultural Worker/Agricultural Overseer makes an estimate of the seed requirement of different rice varieties based on the current area and the likely changes in area at the block level. This block level information is aggregated to the district level and the “demand’ from all districts is aggregated by the DAFP in Odisha. The total demand for the state by varieties is jointly analyzed by OSSC, OAIC, State Department of Agriculture, OUAT and CRRI taking into consideration the seed replacement ratio. The total estimate of demand derived through this process is translated into the amount of foundation seeds and breeder seeds required using the standard seed multiplication ratio. This information is finally forwarded to the Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, government of India.

The demand information is aggregated for the whole country by DAC and sent to ICAR as it has the mandate for the production of breeder seeds through different crop research institutes and state agricultural universities. Available breeder seeds are allocated to various states, with any deficits distributed among all indenters in an equitable manner. The breeder seeds allocated to each state are acquired by the respective departments of agriculture for production of foundation seeds. There is a time lag of at least 3 years for the conversion of breeder seeds to foundation seeds and, foundation seeds to certified seeds for rice. Hence, the production of certified seeds of rice for any particular year is based on the “indent” developed at least 3 years ago. The certified rice seeds finally produced are

allocated to different districts based on the original indent, taking into account any shortfall/surpluses in production, for marketing through public outlets.

This administrative non-market mechanism of estimating the demand and matching the supply with demand suffers from a number of problems including a mismatch between the demand and supply of specific varieties referred to earlier, the long time lag involved and the likely high cost of administrative procedures. In addition, the process may not adequately reflect the demand for improved varieties that may be suitable to specific locations. Similarly, the system seems to ignore the newly-released improved varieties that may have superior performance relative to well-established older releases but are not yet widely grown.

Factors determining transitions in seed systems

Although the agricultural seed system in Odisha is undergoing a transition from public to private sector, the transition has been very slow in the case of rice. The public provisioning of rice seeds remains the dominant mechanism, with the private sector having some increased role but mainly as a parastatal entity. This is largely an outcome of the institutional set-up for seed supply in which the public sector has always had the dominant role and the policies that have supported the continuation of this role.

Despite the current situation, there are long-term factors that are likely to result in a transition towards market-based provision by the private sector. Some of these factors are discussed here.

A factor constraining the evolution of commercial private sector for providing rice seeds is the traditional practice of using farm-kept seeds of rice. Traditionally, farmers use their own farm-kept seeds of rice or use new seeds acquired through exchange with other farmers. There was very little market demand for rice seeds except for those supplied directly by the public sector to promote adoption of new varieties through highly subsidized technology packages.

Recent economic and social changes in rural areas have, however, substantially eroded the viability of this traditional practice and have encouraged the use of purchased seeds. The economic factors include increased income of farmers and increased cash availability due to commercialization of agriculture, increased rural non-farm employment and implementation of publicly-funded employment guarantee schemes. Thus, lack of cash income to purchase seeds is not a major constraint for most farm households. In addition, rice seeds account for a very small proportion (less than 5%) of the total cost of purchased inputs, hence, the cost of rice seed is not a major consideration.

Simultaneously, the household structure in rural areas is changing increasingly from large joint families to small nuclear families living in smaller separate houses that do not have adequate suitable space for storing seeds in the traditional manner. The smaller family size, the limited seed management skills of younger household heads in nuclear families, and the rising opportunity cost of family labor are also making the practice of seed-saving on the farm less viable. It is making more economic sense for farmers to buy certified seeds that normally produce higher yields than to rely on self-provisioning of seeds.

Experience from other states of India indicates that the incremental return from the use of high quality rice seed (with or without certification) is mostly greater than the additional cost of such seeds. For example, a study in Andhra Pradesh found that a 15% increase in rice yield resulting from the use of quality seeds increased the overall returns although farmers paid more for the seeds (Tripp and Pal 2001). This profitability advantage has led rice farmers in Andhra Pradesh to increasingly rely on the market which is mainly supplied by private sector seed industry. A simple back-of-the-envelope calculation indicates that if quality seeds result in an increase in rice yield by 10%, the additional farm-level returns to investments in quality seeds will exceed 300% even if the cost of such seeds is twice that of the regular seeds (assuming the Odisha average seeding rate 60kg/ha and average grain yield of 2.5t/ha)¹³. The returns increase to over 500% if the incremental grain yield is 15%, *ceteris paribus*.

The above indicates that, under the Odisha conditions, the key parameter is the additional grain yield resulting from the use of certified seeds not so much the additional cost of seeds that drives the incremental returns. This implies that the traditional argument that the use of higher cost quality seeds supplied by the private sector is uneconomic is no longer valid. This raises an important question regarding the rationale for the provision of seed subsidy and the direct involvement of the public sector in seed production/marketing.

The capacity of private sector seed enterprises is also increasing over time in Odisha. Some of them are connected with larger seed companies and have made substantial investments in seed processing and storage capacity. To benefit from the economy of scope, these seed enterprises produce seeds of many crops including that of rice. These companies are not only linked with OSSC/OAIC but also independently produce and market rice seeds within and outside Odisha, although the quantity sold directly in the market in Odisha by these companies is relatively small currently.

The nature of transition will, however, depend on the changes in the policy on seed subsidy. The presence of a major seed program subsidized by the government is an important policy constraint for the expansion of private sector. The high and rising cost of subsidy will put into question the wisdom of continuing the production/marketing of rice seeds by the public sector.

Rice seed provisioning strategy for the future

The picture that emerges from the analysis presented above is that of a seed provisioning system which while successful in promoting the diffusion of improved varieties in the state during the past three decades or so is increasingly beset with the usual problems associated with direct involvement of the public sector in a business that is better managed by the private sector. The usual justification for public sector involvement in seed production/marketing is based mainly on the grounds that (a) private sector is not well-developed (b) private sector has no incentives in the production of seeds of a low value self-pollinated crops and (c) seed costs will be high and unaffordable to poor farmers if produced by the private sector which operates on profit motives. These justifications had validity up until 1990s but they

¹³ See Appendix 1 for details.

have weakened considerably over time and are likely to weaken further due to a number of economic and institutional changes.

First, the private sector has established itself well in seed production/marketing of not only proprietary varieties (such as hybrids), but also of self-pollinated varieties. In agriculturally more advanced states such as Andhra Pradesh, Haryana and Punjab, most of the seed requirement for food grains such as rice and wheat is met by the private sector. Seed companies enjoy tremendous benefits from economies of scope as a firm which is set up mainly to produce proprietary variety seeds or seeds with very high market demand can also use a large part of the infrastructure for producing seeds of a number of other crops. This economy of scope arises due to a limited infrastructural specificity in seed production. This was the reason why many private seed firms in Andhra Pradesh established initially for producing hybrid vegetables seeds expanded the operation later to include rice and several other crops. In Odisha also, most private seed companies are producing seeds of multiple crops, not just of rice. Various institutional changes such as enactment of legislations for Protection of Plant Variety and the Seed Act contributed to the expansion of seed production by private sector.

Second, private sector clearly has economic incentives to engage in the production of seeds of self-pollinated crops as evidenced by an increase in the number of firms and their output. The number of private seed firms will likely increase in the future with the expansion of the market as farmers increasingly substitute farm-kept seeds by purchased seeds.

Third, the analysis above clearly indicates that net returns to farmers from using high quality seeds (certified or truthfully labelled) are higher relative to the use of farm-kept seeds even if the cost incurred in purchasing quality seeds is more. The critical variable here is the amount of incremental gain in yield as the seed cost accounts for a very small proportion of the total cost of purchased inputs.

The above points together with the high cost and low efficiency mentioned earlier in the public sector-based seed production and marketing clearly indicate the desirability of a move from public to private provisioning of rice seeds. Thus a key strategy for the future is to facilitate such a transition through suitable policy/institutional reforms.

The second element of strategy is strengthening the informal farmer-based seed system. The informal system in which farmers and communities select, process, store and exchange seeds will continue to remain important in self-pollinated crops such as rice especially in remote fragile areas where penetration of the formal systems may be slow and somewhat limited. Capacity building of farmers and communities to carry out these traditional tasks in a more scientific and efficient way through the use of better knowledge and techniques will certainly enhance the system's effectiveness and efficiency (Tripp et al. 2010). Even in cases in which farmers meet their seed requirements largely from formal systems, there may be some niche varieties for which seeds are better managed at the farmer/community level.

The third element of the strategy is re-imagining the regulatory system for assuring high quality of seeds in a market-oriented system with multiple suppliers. In such systems, it is up to the farmers to decide the most suitable varieties and seed sources that match their preferences and the agro-ecosystems. The key role of the public sector in such systems is to create an enabling environment by establishing the

standards of quality, enacting the required legislation and developing a compliance mechanism. Seed certification in such systems does not need to be compulsory as truthful labelling may be adequate for ensuring quality. Seed certification, where deemed necessary, could be carried out by a duly accredited agency, not necessarily by the public sector.

Ensuring an effective and strong linkage between the public R&D and the private seed sectors is the fourth element of the strategy. Agricultural research in India, especially for rice, has remained largely in the public domain and will continue to remain so for the foreseeable future despite some involvement of private sector in proprietary technologies such as hybrid rice. There must be a new mechanism for the private seed sector to access breeder seeds of current and new varieties developed by the public sector R&D. The existing administrative “indent” system needs to be replaced by a market-oriented system in which seed companies access breeder seeds from R&D institutions through other mechanisms such as licensing or royalty payment. These market-oriented systems will also have implications on the way R&D is funded and breeding systems are incentivized.

Policy Reform Agenda

The strategic elements discussed above point towards some key policy reform agenda. These are outlined below.

Removal of seed subsidy: As described in the analytical part of the paper, the current seed subsidy has not only restricted the development of private sector seed business in Odisha but has also diverted public resources that could have been better utilized elsewhere (for example agricultural R&D). Small savings farmers make from subsidized seeds are less important relative to the yield gains they can obtain by being able to access adequate amount of good quality seeds of desired variety in a timely manner. Removal of subsidies will be an important step in facilitating the transition from public to private provision of seeds.

Restructuring the state seed corporations: The state seed corporation is a key agency, which together with another state agency (OAIC), accounts for over 80% of rice seeds provided by the formal sector in Odisha. These corporations have performed important functions historically in increasing farmers’ access to quality seeds. However, justifications for the direct involvement of the state are now much weaker with the expansion of private sector seed industry and there is a need to restructure them to increase the overall efficiency of the seed system. A potential mechanism for restructuring would involve delineating the target domain of the state corporation to those areas where private sector currently has little capacity or incentive to be involved. Such areas are more likely to be poor, marginal and remote areas which often happen to be inhabited by minorities and socially disadvantaged groups. There is a clear equity-based justification for the state involvement in such cases. In other areas where private sector has already established itself or has the potential to do so, the involvement of public sector merely results in crowding out the private sector.

Development of new business models for R&D system to make it demand-responsive: The current business model of agricultural R&D system of India has been successful in generating a tremendous impact by providing the technological underpinnings of green revolution. Despite the past successes, it

is now time to re-orient the public R&D system of India through the development of new business models to support a more market-oriented agriculture of the future. In this regard, market demand as reflected through the seed sector could be used as an additional important signal to guide public R&D. Incentive structures for breeders could be similarly aligned with the market signal as reflected in the seed demand and the extent of adoption. Such business models will not only increase the efficiency of resource allocation in public R&D but will also help increase the impact by strengthening the seed system. Such major restructuring of R&D system will obviously have far-reaching implications on the way public agricultural research is conducted in India and the nature of public-private partnership.

Deregulation of seed industry to promote private sector participation: In addition to removal of subsidies, removal of regulatory barriers is needed to improve the efficiency of seed markets. For example, replacement of certification requirement by truthful-labelling will help avoid delays and save resources as farmers make their own judgment on seed quality irrespective of the presence or absence of the certification tag. The requirements for registration of seed companies could be similarly relaxed to enable easier entry into the industry. Deregulation, however, does not mean no regulation at all – public sector still has a critically important role in setting standards and establishing compliance mechanisms.

Increased support to strengthen informal systems: As mentioned earlier, informal seed systems managed by farmers/communities will continue to play an important role, especially in remote and fragile areas. These systems are being managed by farmers based on their traditional knowledge. Public support through farmer training and provision of better scientific methods and equipment for seed selection, drying, and storage is needed to improve these informal systems.

Concluding Remarks

There is clearly a need for reforming the rice seed sector in which the public sector is currently heavily involved. This role of the public sector was critical in spreading the green revolution in Odisha and in other states of India. The future growth in productivity of the evolving modern market-oriented rice sector, however, demands a paradigm shift in both R&D and the seed systems away from the past approach of heavy direct involvement of the public sector and towards a greater involvement of the private sector, cooperatives and NGOs. The case of Odisha demonstrates some of the problems associated with the current paradigm of public sector-based formal seed systems. Clearly, a pluralistic approach is needed for the future. The challenge is to identify an optimum mix which itself must adjust dynamically to the changing farming, economic and institutional contexts.

Appendix 1 . Economics of seed quality improvements

Let the profit associated with farmers' own farm-kept seeds be given as:

$$\Pi^0 = PY^0 - P_s^0 Q_s - F$$

where:

P = price of output

Y^0 = yield using farmers' seeds

P_s^0 = price of farmer's seeds

Q_s = quantity of seeds used

F = other fixed and variable cost.

If better quality seeds (or certified seeds) at a higher price are used,

$$\Pi' = PY' - P'_s Q_s - F$$

where:

Y' = yield using "better" seeds

P'_s = price of "better" seeds

The primes indicate the respective variables for a better quality seed. Q_s and F are assumed to be invariant across seed types.

The incremental profit:

$$\Pi' - \Pi^0 = P(Y' - Y^0) - Q_s(P'_s - P_s^0)$$

Let $P_s^0 = P$ (i.e. price of farmers' seed is the same as the price of output) and;

$P'_s = \alpha P$ (i.e. price of "better" seed is α times the price of output).

Let β represent the % increase in yield due to better quality seeds. The incremental rate of return net of the additional cost of seeds can be obtained after some algebraic manipulation as:

$$\% \text{ Rate of return} = \left[\left(\frac{Y^0}{Q_s} \right) \left(\frac{\beta}{\alpha - 1} \right) - 1 \right] \times 100$$

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