



# **Changing Structure and Composition of Rice Seed Sector: Insights from Seed Villages in Telangana State, India**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The purpose of the study was to understand the recent developments in the seed industry as well as farm-level information from seed villages on the structure and composition of the of the rice seed system in the Telangana state. A focussed group discussion approach was adopted to collect the primary data needed for the study with 8 to 10 progressive and experienced seed farmers in 30 selected seed villages of two predominant seed producing districts of the state in two points of periods 2014 and 2021. The results indicated that the sizeable portion of seed business has been shifted to other neighbouring states specially to Chhattisgarh in case hybrid paddy due to special incentive is being given to seed growers. Similarly, cotton seed production area is being shifted to Karnataka due to less cost of production compared to Telangana. As a result, the relative share of Telangana in India's seed business has declined from about 30 per cent to 18 per cent between 2014 and 2020. The commission paid to intermediators (organisers) by companies has increased by 40 per cent while the procurement price paid to seed growers increased merely 14 per cent in

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the case of inbred paddy seed and less than 1 per cent in the case of hybrid paddy seed. The MNCs' participation in both inbred and hybrid rice seed production has decreased substantially. The average yield of hybrid rice seed has decreased, and there is no improvement in its procurement price offered by companies between 2014 and 2021. The per cent of farmers who entered into a contract without specifying a price has been increased in last seven years. The companies reduced their services like insurance to farmers, supply of critical inputs like GA3 for free and prolonged payment period after procurement, and limited compensation in the event of crop loss, which influenced the farmers to convert from hybrid rice seed production to other crops.

*Keywords: Seed system; rice seed sector; hybrid rice; seed production; inbred rice; seed firms; contractual arrangements.*

## 1. INTRODUCTION

Seed is only a biological input among all key farm inputs which increases the productivity of other inputs, there by crop yields significantly. The quality of seed and its timely availability in desired quantity at right time at appropriate price is an important determinant to increase crop yield [1,2]. In Vietnam 60 per cent of rice farmers change their seeds for every season [3]. It was reported that use of cleaned farm saved seed can improve the paddy yield by 8 to 10 per cent [4]. It has been reported that regular replacement of quality seed alone increases crop yield by 12 to 17 per cent in India [5]. The average paddy yields are high in the regions where the seed replacement rates are high [1].

The seed system has been grown in the country over the past half century with the active participation of public and private sectors, NGO's (Non – Governmental Organizations), Cooperatives and State Departments of Agriculture. The size of seed business in India has grown by six times since 2010 and it has reached to ₹22980 crores during 2020 which was 6 per cent of global seed business and nearly providing employment opportunities to millions of rural youths in the country (www.oecd-ilibrary.org). Rice being widely grown crop in India, about 45 million hectares under diverse eco system was considered by private sector as a big opportunity for engaging in seed business. After rice hybrids were developed in 1990's, private sector has started playing an important role in view of expected huge size of business and considering high profit margin. Public sector is largely confined to inbred seed development of rice due to less participation of private sector in view of its bulkiness in nature and low profit margin.

The erstwhile Andhra Pradesh was India's leading rice producing state and most of it was

produced under irrigated conditions. The seed requirement of rice seed farmers in the state was served by two public seed agencies that are Andhra Pradesh State Seed Development Corporation (APSSDC) and National Seed Corporation (NSC). The important factors in rice seed system like varietal development, breeder seed production and its multiplication until certified seed, quality control and variety promotion were initially in public domain. However, the scenario is rapidly changing with aggressive participation of private sector. Approximately 40 per cent of rice seed was produced in Northern Telangana region of erstwhile Andhra Pradesh where climatic conditions for rice seed multiplication are favourable [5]. It was observed that there was a significant participation of private companies in Andhra Pradesh in production and sale of public varieties in case of rice in late 1990s [6]. It was reported that about 440 (small, medium and large) companies were operating in the state and most of them are located at in and around of Hyderabad. The state was accounts for 59 per cent of the total production of hybrid seed of cotton, 86 per cent of hybrid maize seed, 93 per cent of hybrid sorghum seed, 63 per cent of pearl millet seed and 80 per cent of hybrid rice seed of India during the year 2002 [7]. It was estimated that about 80 per cent of hybrid rice seed requirement of the country was produced in Telangana region of united Andhra Pradesh alone due to favourable production environment and presence of many private companies with strong R&D system [3]. It can be noted that Telangana region was considered as major seed hub in united Andhra Pradesh, which was created as a separate state in 2014. Therefore, Telangana state was a major seed hub in the country until mid-2010s.

Keeping this in view, the importance of seed industry in Telangana State, the government has emphasized special focus to strengthen the seed

industry soon after the formation of state in 2014. However, it has been reported that sizeable portion of seed sector has been shifted from Telangana to other neighbouring states in recent years due to most favourable policies being adopted in these states.

Despite, the recent changes in the structure of seed industry in India, Telangana state continues to be the seed giant of Indian seed sector and plays an important role in the agriculture development not only in state but also in the country. In particular, Telangana state is the leading hub for rice seed industry for both inbred and hybrid seed production. Large quantity of rice seed (inbred and hybrid) produced in the state is supplied to rest of the country especially to eastern and northern states. With this above background the present study was undertaken with the objectives to understand the recent trends in seed industry growth, especially rice seed sector after formation of Telangana and to document the farm level insights from seed villages with respect to structure and composition of rice seed (hybrid and inbred) production system in the state.

## 2. DATA AND METHODS

The present study was conducted in two major rice seed producing districts of Telangana state namely Hanamkonda and Karimnagar based on consultation with seed industry experts and other stakeholders in seed production. As a result, a purposive sampling method was adopted to select the districts stated above. It was noted that there are 150 villages where rice seed is predominantly produced for various public and private sector agencies. For present study 30 seed villages were selected among rice seed producing villages (15 villages from each of two districts). About 80 to 85 per cent farmer in the selected villages are primarily rice seed growers for various public and private agencies (Telangana State Seed Development Corporation). The focussed group discussion approach was adopted to collect the data, that represents overall seed producing farmers with respect to their own and their relation with other seed entities (seed organisers and seed companies). Accordingly, 30 focussed group discussions with 8 to 10 experienced and knowledgeable rice seed producers (one focussed group discussion in each village) were conducted by the researcher and outcome of

discussions are summarised related to changes in the following indicators between 2014 and 2020. They are a) socio economic profile, b) cropping pattern b) agro and biophysical features c) seed production practices, d) nature of contract and e) marketing channels etc. The summary of outcome of all focussed group discussions in 30 villages were compiled and analysed the same with simple arithmetic ratio and tabular analysis. The changes in seed villages experienced between 2014 and 2020 are statistically tested with paired t test. Paired t test was purposively selected to test the significance difference between two points of periods (2014 and 2020) under the same agro-ecological and socio-economic conditions in the same villages. The secondary data regarding monetary value of India's domestic seed market and its growth have been compiled from various reports of Directorate of Economics & Statistics, Ministry of Agriculture, Government of India, NBARD (National Bank for Agricultural and Rural Development), TSSOCA (Telangana State Seed & Organic Certification Agency), TSSDC (Telangana State Seed Development Corporation) and State Department of Agriculture, Telangana. Further, seed industry expert's consultation was also conducted to collect data on the performance of seed industry in the state.

## 3. RESULTS AND DISCUSSION

### A) Current trends

India is the fifth largest seed market in the world after the U.S. (27%), China (20%), France (8%) and Brazil (6%). The size of global seed market by and large was stagnant at about \$ 52 billion between 2014 and 2020. However, the share of India's seed business in global seed market has increased from 4 per cent to 6 per cent between 2014 and 2020 (Fig. 1).

The Indian seed market has witnessed major changes in its growth structure in the recent years primarily due to large scale participation of private sector and in view of growing domestic demand for quality seed of major crops. The share of the public sector in seed production in the country reduced from about 42 per cent in 2017-18 to 35 per cent in 2020-21, while the share of the private sector grew from about 57 per cent to 64 per cent during the same period (The Hindu, July 2<sup>nd</sup> 2021).

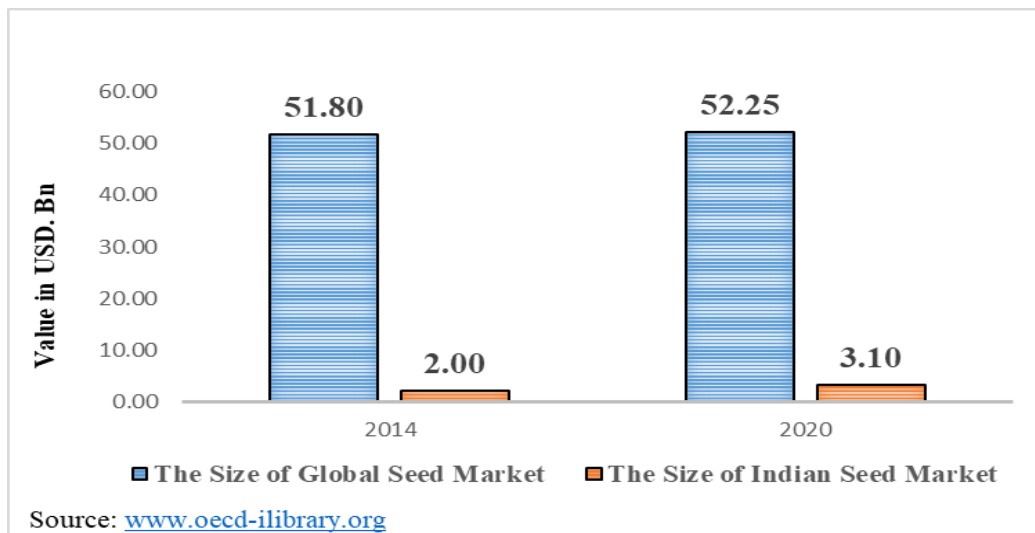


Fig. 1. The size of global and Indian Seed Market

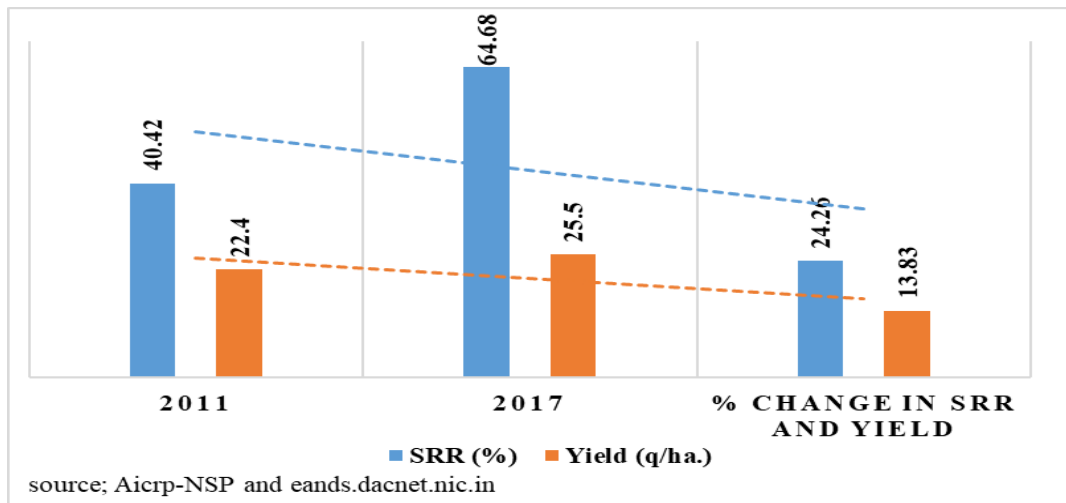


Fig. 2. Seed replacement rate and yield of varietal paddy in India in 2011 and 2017

It was reported that the seed business in India was almost doubled during the past decade due to increase in seed replacement rates (use of quality seeds) for open pollinated crops, wide usage of hybrid varieties for field crops along with vegetables and transgenic crops like Bt. Cotton [8]. For instance, the average seed replacement rate of rice has been increased from about 40 per cent in 2011 to 64 per cent 2017 in India. This increase in seed replacement rate resulted in increase of average seed yield of paddy and in India (Fig. 2). The other key elements for this growth are commercialization of agriculture sector, growing number of public-private collaborations, and development of hybrid product variants.

Telangana state is considered as seed capital of India, with the presence of about 400 seed

companies including major multi-national companies, strong processing capacity (850 tonnes/hour), storage facilities, presence various public and private research organisations, skilled labour and seed farmers engaged in seed production for different seed agencies. Out of India's total paddy seed requirement, 70 per cent of hybrid and 35 per cent of inbred paddy seed is being supplied by Telangana alone [9]. However, a sizeable portion of seed business has been shifted to other neighbouring states specially to Chhattisgarh in case paddy due to special incentive ₹ 500/quintal is being given to seed growers registered with seed corporation of Chhattisgarh (Source: Report on centrally and state sponsored schemes, Government of Chhattisgarh).

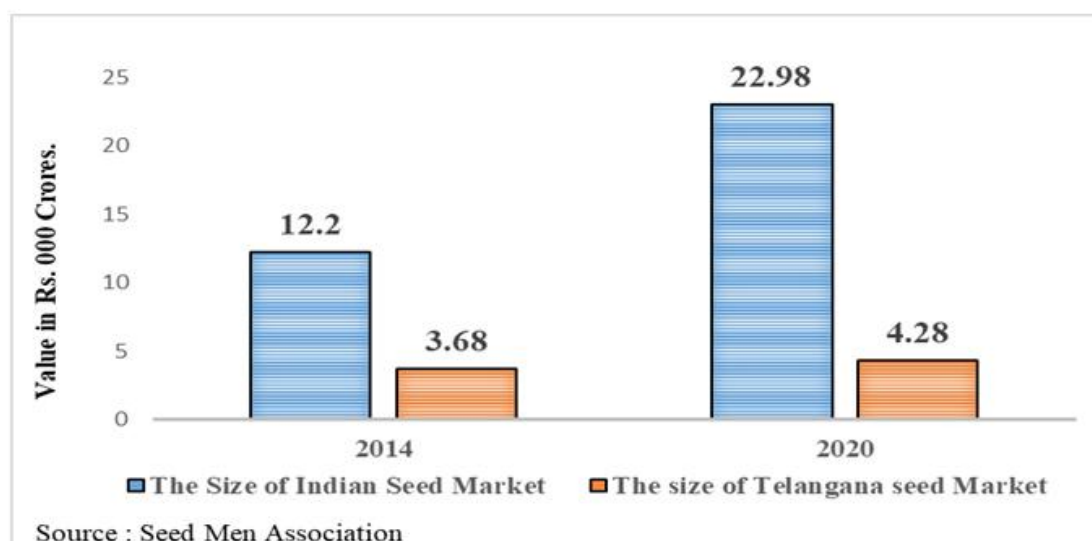
**Table 1. Changes in the structure and composition of seed system in Telangana**

Particulars	2014	2020	Difference (%)
Total area under seed production in Telangana (acres)	472400	599400	26.88
Total number of registered seed companies in Telangana	400	450	12.50
Total number of seed growers in Telangana.	300000	320000	10.34
Area under hybrid rice seed production in Telangana (acres)	110000	80000	-27.27
Quantity of hybrid rice seed produced in Telangana (tonnes)	51750	37160	-28.19
Number Hybrid rice seed growers in Telangana	66865	51428	-23.08
Area under inbred rice seed production in Telangana (acres)	190000	350000	55.00
Quantity of inbred rice seed produced in Telangana (tonnes)	386000	700000	81.35
Number inbred rice seed growers	86300	159000	84.24
Area under cotton seed production (acres)	38000	28500	-25.00
Quantity of cotton seed produced (tonnes)	10450	7500	-28.22
Number of cotton seed growers	58000	40600	-30.00

Source: Seed Men Association

Similarly, cotton seed production area is being shifted to Karnataka due to less cost of production and more climate suitability compared to Telangana. Therefore, the share of Telangana in India's seed business has declined from about 30 per cent to 18 per cent between 2014 and 2020 (Fig. 3). Similarly, area under hybrid rice seed production and cotton seed production has declined by about 27 per cent and 25 per cent between 2014 and 2021. On contrary, the area under seed production, number of seed companies and seed growers increased in the state between 2014 to 2020. The important contributor to this growth is demand for inbred rice seed is more in the market in recent years. The key factor for this rise in demand is due to the cultivated area under rice increased from about 34.97 lakh acres in 2014-15 to 104 lakh

acres 2020-21 (Source: Telangana Socio Economic Outlook, 2022). In addition to this, rice cultivars in the state regularly replacing the crop with quality seeds as a result the seed replacement rate in the state has also increased from about 73 per cent in 2011 to 90 per cent in 2021 which is higher than national average in both periods (Source: Seed rolling plan, Telangana State). As discussed earlier, though the market for inbred rice seed production increased, the relative share of Telangana in India's seed business has declined. This is mainly due to decline in seed production of high value hybrids like bt cotton and hybrid paddy. Similarly, seed production of inbred rice contributes very less to total seed business in the state as it has less value compared to seed production of hybrid rice and bt cotton.

**Fig. 3. The size of Indian and Telangana Seed Market**

## B) Insights from seed villages

### (i) Socio-economic and agro-biological features:

The basic profile of selected villages where focussed group discussions conducted are summarised in Table 2. There is no significant difference in population, number of farm households, number of small farmers, net cultivated area and area under irrigation in between 2014 and 2021. The share of small and marginal farmers accounts for about 88.22 per cent and 93.29 per cent in both periods respectively. However, the share of marginal farmers increased by 14.9 per cent in total farm households due to fragmentation of land during this period (2014 and 2021). The average farm size by and large is stagnant in last 7 years which is same as about 2.5 acres during this period (2014 and 2021) and more than 75 per cent of it was under irrigation. Similar study was conducted by international rice research institute during the year 2009 in northern Telangana region, the socio-economic and agro-biological features of sample seed growers of paddy were reported by and large same as present study [3]. The gross cultivated area was significantly increased about 6.75 per cent in 2021 against 2014. The increase in gross cultivated area is due to raise in acreage under second crop (rabi) in the same year. As a result, cropping intensity has also increased by 1.83 per cent in 2021 against 2014.

The small farm holdings with assured irrigation and favourable climatic condition for seed production in the study area was attracted private seed companies to purposively engage them in seed production. It is interested to note that the area under hybrid rice seed production as well as

number of hybrid rice seed growers in selected villages have significantly declined between 2014 and 2021 (Table 3). As discussed earlier (Table 1) the sizeable part of hybrid rice seed industry has been moved from Telangana to Chhattisgarh state during this period, which is the primary factor for shrinking of hybrid rice area in selected villages over the past 7 years. Further, some of hybrid rice seed growers shifted to inbred paddy seed production due to the prolonged management practices, high input consumption, more labour and capital requirement, low yield, germination problems in parental lines and weather-related problems associated with hybrid rice seed production. On contrary, the area under inbred seed production substantially increased over last 7 years. Similarly, number of inbred rice seed growers had also increased about 14 per cent during this period (Table 3). The primary reason is that area under varietal paddy has been doubled in last 7 years in the state and it was coupled with increased seed replacement rate from about 67 per cent in 2011 to 90 per cent in 2021. As a result, demand for inbred rice seed production has drastically increased. Among all seed growers, nearly 3/4<sup>th</sup> of them belonging to weaker sections (SC, ST and OBCs) and most of them are marginal and small farmers.

Organiser is an important entity in seed system. He organises contractual arrangements between seed growers and seed companies and facilitates for smooth functioning of these arrangements during crop season. The seed companies identify a progressive and educated farmer who has substantial experience in seed production as an organiser in the village. There will about 3 to 5 such seed organisers representing different seed companies in each village.

**Table 2. Changes in the basic socio-economic profile of selected villages in Warangal and Karimnagar Districts**

Particulars	2014 #	2021 ##	Difference (%)	t-statistic
Population (no's)	3344	3468	3.71	0.147
Farm households (no's)	671	716	6.71	0.070
Marginal farmers (no's)	416	478	14.90	0.00***
Small farmers (no's)	176	190	7.95	0.277
Gross cultivated area (acres)	3185.00	3400.26	6.75	0.030**
Net cultivated area (acres)	1748.30	1847.90	5.69	0.060
Cropping intensity (%)	182.17	184.00	1.83	-
Area under irrigation (%)	74.43	82.60	5.16	0.260
Average farm size (acres)	2.60	2.58	(-) 0.94	-

Note: #Survey data of International Rice Research Institute (IRRI) (2014),

Note: ##Authors own survey data (2021)

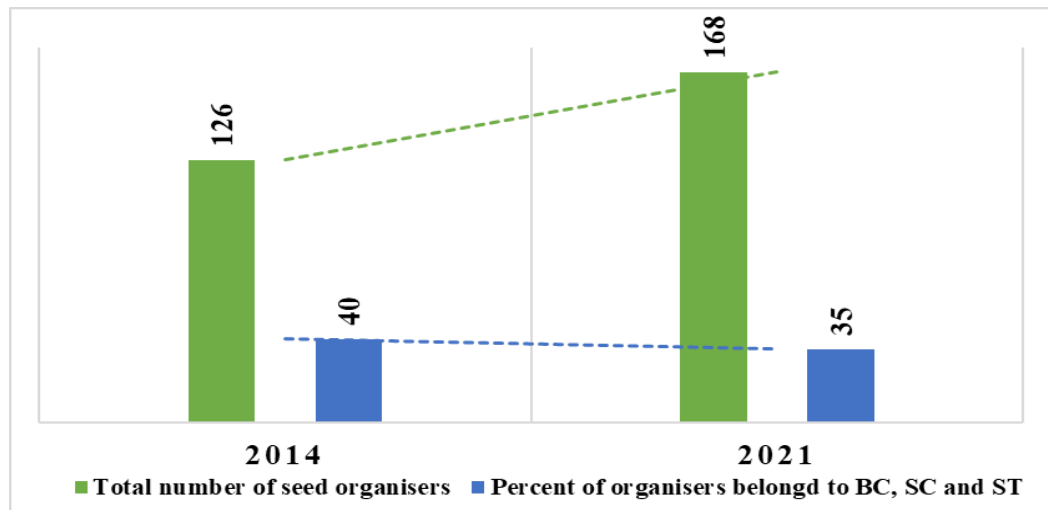
Note: \*\*\* significant at 1 per cent level, \*\* significant at 5 per cent level

**Table 3. Changes in rice seed production system in the selected villages during 2014 and 2021**

Particulars	2014 #	2021##	Difference (%)	t-statistic
Area under rice seed production (acres)	1068	1259	17.88	0.119
Area under hybrid rice seed production (%)	46.05	33.51	-14.25	0.011**
Area under inbred rice seed production (%)	53.95	66.49	12.54	0.004**
Number of rice Seed Growers (no's)	365	409	12.05	0.03**
Hybrid rice seed growers (%)	46.70	32.42	-14.28	0.011**
Inbred rice seed growers (%)	53.20	67.58	14.38	0.000***
Seed growers belongs to BC, SC and ST (%)	75.37	74.44	-0.93	-

Note: #Survey data of IRRI (2014), ##Authors own survey data (2021)

Note: \*\*\* significant at 1 per cent level, \*\* significant at 5 per cent level

**Fig. 4. Composition of seed organisers by social status**

As depicted in Fig. 4, number of seed organisers (both inbred and hybrid) has substantially increased by 33 per cent over the last 7 years, while the share of organisers belonging to weaker sections (SC, ST and OBCs) has marginally declined due to unbearable costs involved in arrangement of services between seed growers and companies. Most of the small and medium farmers especially those belongs to weaker sections could not able to meet the capital requirements for seed production particularly hybrid rice seed production. As a result, most of the seed farmers are under financial pressure to meet the cash requirements of farm inputs. Taking this scenario as an advantage, some of the seed organisers are lending required capital to seed growers at high rate of interests (22 to 26% per year).

#### (ii) Participating seed companies

The seed firms operate as full-fledged private sector entities for the production and marketing of seeds. These include large (multi-national companies) and small companies (domestic) that

are involved in hybrid and inbred rice seed production.

It was reported that the share of companies engaged in hybrid seed production and Multi-National Companies (MNCs) participation in hybrid and inbred rice seed production had significantly declined between 2014 and 2021 (Table 4). The reasons for this shift in hybrid rice seed production are that the companies are shifting the production points to Chhattisgarh as it is near to many northern states where hybrid rice is extensively cultivated, thus adding the logistic advantage for companies; another one is that companies deliberately reduced their production due to less demand for hybrid rice seed and excess previous stocks of rice at the above-mentioned places during this period (2014 and 2021). Generally, in hybrid rice seed production, the female (cytoplasmic male sterile line/A line) and male (restoral line/R line) parental lines are crossed, and most of its production was undertaken by MNC's in the study area. The R line is an inbred paddy seed used as a male parental line in hybrid rice seed

**Table 4. Change in the composition of different agencies involved in hybrid and inbred rice seed production**

Type of Company	2014#	2021##	Difference (%)
Total number of seed companies engaged in rice seed production	7	14	50
Companies engaged hybrid rice seed production (%)	71.24	42.85	- 28.57
Companies engaged in inbred rice seed production (%)	71.42	57.14	14.28
MNCs engaged in hybrid rice seed production (%)	60	50	-10.00
Domestic companies in hybrid rice seed production (%)	40	50	10
MNCs engaged in inbred rice seed production (%)	40	25	-15.00
Domestic companies in inbred rice seed production (%)	60	75	15

Note: #Survey data of IRRI (2014), ##Authors own survey data (2021)

production, and its production is similar to inbred seed production. Since the MNCs reduced their hybrid rice seed production in the study area, the requirements of the R line also declined. Consequently, MNCs participation in inbred rice seed production has reduced due to shrink in requirement of R line. On the contrary, the share of total companies engaged in inbred rice seed production and domestic companies participating in inbred and hybrid seed production both significantly increased between 2014 and 2021. This could be due to simple management practices, lower capital requirements, and demand in the domestic seed market for inbred rice seed both in the state as well as in India, attracting many small and local seed companies into inbred rice seed production.

### (iii) Yield and price of rice seed

The average seed yield of rice (both inbred and hybrid), the average procurement price offered by firms, and the average sale price of seed are presented in Table 5.

From the survey, it was found that the hybrid rice seeds varieties that yield high, their prices are low, and those that yield low, their prices are high. Two methods of payment have been observed in the surveyed villages. The first method is that the seed companies pay an amount directly to the hybrid rice seed growers while procuring the seed. In this case, the price could be revealed at the time the contract was made and the same could be mentioned in the contract agreement. In the second method, payment could be made through an organiser to the hybrid rice seed farmers for procuring the seed. In this case, primarily companies, inform the organisers about procurement prices. Later, the organisers will have negotiations with hybrid rice seed growers. In the latter case, the actual procurement price offered by the company was not revealed to the seed grower, and it was not mentioned in the agreement that concealed the actual price offered by the firm. The average procurement price for inbred rice seed was increased by 14.62 per cent in 2021 compared

**Table 5. changes in average seed yield and price in study villages**

Particulars (Quintal/ acre)	2014 #	2021 ##	Difference (%)	t-statistic
Average seed yield of hybrid rice seed (Quintal/ acre)	10.03	9.26	- 11.12	0.000***
Average yield of inbred rice seed (Quintal/ acre)	25.45	26.83	5.42	0.002***
Average procurement price for hybrid rice seed (₹ /kg)	75.00	75.50	0.66	0.908
Average procurement price for inbred rice seed (₹/kg)	16.75	19.20	14.62	0.023**
Average selling price of hybrid seed by the seed companies (₹/kg)	22	26	9.09	-
Average selling price of inbred seed by the seed companies (₹ /kg)	22.00	28.00	27.27	-

Note: #Survey data of IRRI (2014), ##Authors own survey data (2021), Note: \*\*\* significant at 1per cent level, \*\* significant at 5per cent level



with 2014. The average selling price of inbred rice seed in the commercial seed market by various seed companies was increased by 27.27 per cent during 2021 over 2014. The rate of increase in average selling price of both inbred and hybrid rice seed by various firms in commercial seed market was higher than the increase in procurement price paid to seed growers by firms in the study area.

#### (iv) Contractual arrangements

The organisers were provided an allowance by the company for rendering their services to contracted farmers and seed firms. This allowance is provided on the basis of the quantity of seed harvested and sold by the farmer to the company. In the case of hybrid rice seed production, the average amount charged for the services of organisers was ₹5/kg in 2014 and ₹7/kg in 2021 (Table 6). In the case of inbred rice seed production, the average amount charged for the services of the organiser was ₹0.70/kg (70 paise) in 2014 and the same was ₹1.20 in 2021. The charges paid to organisers increased in both inbred (₹0.50/kg) and hybrid rice (₹2/kg) seed production. The allowance paid to a hybrid seed organiser is higher than an inbred seed organiser as he bears more financial risk in terms of expenditure for paying salaries to

field supervisors and inputs needed for seed production. As discussed earlier, all the seed growers have contracts with seed companies. In 2014, 73.33 per cent of hybrid seed farmers had a written contract with the company, with 30 per cent entering without mentioning price in the contract. The per cent of hybrid seed farmers having a written contract with the company was 86.66 per cent, in which 23.33 per cent of farmers entered without mentioning price in the written contract during 2021. Though the number of hybrid rice seed growers entering into written contracts has been increased by 13.33 per cent, the percent of farmers entering into contracts without price specifications has also increased by 6.67 per cent during 2021 compared to 2014. This was mainly due to the second method of payment, where the organiser hides the procurement price offered by the company, as discussed above. The seed growers in the study area opined that most inbred rice seed growers do not enter into contract agreements with seed companies and the organiser has a limited role in the inbred rice production system. The companies specify compensation in the contract in the event of crop loss due to poor germination of the parental line and low yield. Farmers may claim this compensation only if there is a loss of more than 70% in a specific variety among various seed growers in the area. Merely 40 per

**Table 6. Change in roles of different entities in seed system**

Particulars	2014	2021	Changeover 2014
Charges to the service of organisers by the companies for hybrid seed (₹/ quintal)	5	7	2
Charges to the service of organisers by the companies for OPV Seed (₹ / quintal)	0.70	1.20	0.50
Per cent of hybrid seed farmers having written contract with company	73.33	86.66	13.33
Per cent of hybrid rice seed growers having written contract without mentioning price.	30.00	23.33	6.67
Per cent of farmers received compensation in event of crop loss	40.00	33.33	-6.67
Per cent hybrid seed farmers insured for their seed production	25.83	13.66	-12.17
Per cent of growers received parental lines for free of cost	6.66	20.00	13.34
Per cent hybrid seed grower received GA3 for free of cost	50.00	33.33	-16.67
Average amount deducted by seed company for supply of parental seed (₹ /acre)	500	1000	500
Average time taken to receive payment from seed company (in days)	46	54	8
Average wastage (kg) deducted from total	10	10	Nil

Note: #Survey data of IRRI (2016), ##Authors own survey data (2020)

cent of seed growers expressed that the companies pay compensation in the event of crop loss during 2014, and the same was recorded as 33.33 per cent in 2021. The percent of hybrid rice seed growers claiming compensation seems to be very small and gradually decreasing. This was primarily due to compensation covered only for new varieties and varieties planted in the kharif season. The percent of hybrid rice seed growers insured was 25.83 per cent during 2014 and the same was 13.66 per cent in 2021.

This insurance coverage was given to seed growers and labour engaged in hybrid rice seed production by a few MNCs in the study area. Three major inputs that are supplied by seed firms are seed of parental lines (female (A) and male (R) lines), GA3, and labour expenses for rouging. Only one of these three inputs is supplied free of charge by firms; the remaining two are charged. The percentage of hybrid rice seed growers receiving GA3 for free has decreased by 16.67 per cent in 2021 over 2014. Since the GA3 price is very high (ranging between ₹50000 to ₹100000/kg) compared to parental line seed, its supply for free was reduced. The percent of hybrid rice seed growers received parental line for free of cost is increased by 13.34 per cent during 2021 over 2014. The seed firms take some time to make payments to seed growers. The average time taken by firms to make payments was 47 days during 2014 and the same was 54 days during 2021. On an average 10 kg per quintal hybrid rice seed was deducted from final weighed output of farmer as a processing wastage in both periods. This processing wastage quantity was very high in hybrid rice seed compared to inbred rice seed, where 3 to 5 kg/quintal was deducted as processing wastage.

#### 4. CONCLUSION

From the study, it can be concluded that there is a slight improvement in area under irrigation, gross cultivated area, and cropping intensity in the villages of rural Telangana. The average farm size in sample villages did not differ significantly between the two time periods (2014 and 2021) and the majority of seed growers are small and marginal farmer. The area under hybrid rice and cotton seed production has been decreasing over the last 7 years in Telangana as part of the seed industry is being shifted to neighbouring states. However, the area under inbred rice seed

production is increasing in the state due to cultivated area under varietal paddy and seed replacement rates are increasing over a period. The commission paid to organisers by companies has increased by 40 per cent while the increment in procurement price paid to hybrid rice seed growers was very negligible. This indicates the increased role of middlemen (organisers) in the rice seed system. As a result, the number of organisers was increased due to incentives received by existing organisers, who attracted others to enter into seed production. The MNCs participation in both inbred and hybrid rice seed production has decreased substantially. On the contrary, the number of companies engaged in rice seed production was doubled due to the entry of many small and medium seed companies into the industry, as inbred rice seed area was increased greatly. The average yield of hybrid rice seed has decreased and there is no improvement in its procurement price offered by companies over the last 7 years. A progressive improvement was found in inbred rice seed yield and in its procurement price, which attracted the hybrid rice seed growers. As a result, they converted to inbred rice seed production due to simple management practices, low capital and labour requirement. Though the inbred rice seed procurement price paid to farmers by companies is increasing, this rate is less compared to the rate of increase in its selling price by companies in commercial seed market [10,11]. The organiser has a limited role in the inbred rice seed production system. The per cent of farmers who entered into a contract without specifying a price has been increased. Because the actual procurement price offered by the company cannot be disclosed to the farmer, these hidden benefits will be enjoyed by intermediaries (organiser) between the farmer and the company. The companies reduced their services like insurance to farmers, supply of critical inputs like GA3 for free and prolonged payment period after procurement, and limited compensation in the event of crop loss, which influenced the farmers to convert from hybrid rice seed production to other crops. In a nutshell, the share of Telangana state in India's seed business declined substantially due to reallocation of part of seed industry specially hybrid rice and bt cotton to the other neighbouring states [12,13]. However, the area under inbred rice seed production increased due to expansion of paddy cultivation in the state. The seed organisers were benefitted more than the rice seed growers after 2014.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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