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A study on adoption of hybrid rice varieties at the farm level in Tamil Nadu

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Abstract
For any nation, food production plays a vital role in its economic and human development. In spite of some success stories in addressing food production shortfalls, India continues to have the largest number of people suffering from poverty and malnutrition. The technological innovation in agricultural production plays crucial role in ensuring food security in the world. Hybrid rice is one of the outcome of such technological advancement and it was an important step towards food security and agriculture development in the World and India. However, India hasn't performed well in this area. Hence the study explores the extent of adoption and the level of participation by the different categories of farmers in the cultivation of hybrid rice in Tamil Nadu. The study make a primary survey on the farm level acceptance or rejection of hybrid rice and reasons for the same in the state. The results shows interesting facts, including that there is no major increase in cultivable area of the state.

Keywords: hybrid rice, Tamil Nadu, technology, farmer, agriculture

Introduction
In India, the farmers were very much interested to adopt the hybrid rice cultivation during the first couple of years after 1994. Until 1996, the area under cultivation of hybrid rice was more than what was actually projected. However, after that, many farmers started dropping out from the hybrid rice cultivation. In many States, the hybrid rice cultivation dispersed horizontally than vertically due to private sector moving from one state to another. These hybrids were not grown continually in the same State. In South India, these technologies were not suited to the littoral districts, whereas there is intensive cultivation of rice-wheat in northern India (DRR 1997, Rao *et al*. 1998) [5, 25]. Particularly, in Odisha, the poor performance of hybrid rice technology during 1997-98 had caused irrevocable loss to the farmers due to cyclone. The aggregate level of adoption of hybrid rice is at meager level (>0.3 percent) even one decade after the release of hybrid rice in India. This trend has been continuing and the percentage increased to 4.54 percent in 2012.
It is clear that the impact of hybrid rice technology on production has had a limited impact on the total rice production in India. Over the past two decades, the spread of hybrid rice technology has not been successful as most of States in India and districts of Tamil Nadu particularly have not enjoyed the benefits of hybrid rice technology due to structural problems like lack of government support, poor grain quality and reluctance of the farmers. The hybrid rice cultivation techniques are not known to farmers of Ariyalur, Tiruvallur, Karur, Dindugal, Kanniyakumari and Udagamandalam districts of Tamil Nadu.

Objectives of the study
To indicate the extent of adoption and the level of participation by the different categories of farmers in the cultivation of hybrid rice.

Data and Methodology
The data for the study has been collected from primary and secondary sources in Tamil Nadu. Primary data has been collected from two districts namely Nagapattinam and Tiruvarur of Tamil Nadu. The two districts are having relatively higher concentration of hybrid rice cultivation (National Food Security Mission). In each of the districts of Nagapattinam and Tiruvarur, two representative blocks namely Kuttalam, Mayladuthurai, Needamangalam and Valangaiman are taken respectively and within each block two villages are selected. In each village, a complete list of cultivating households including SC, ST and women farmers growing hybrid rice and HYV has been prepared and stratified according to four land size groups such as marginal (less than 1 hectare), small (1 to 2 hectares), medium (2 to 4 hectares) and large (more than 4 hectares). In each district, 40 hybrid rice growers from the list of hybrid rice growing cultivators are drawn at random from household farmers with different land sizes on the basis of their proportion in the universe. In addition to the above sample, conventional 10 HYV rice growers but non-adopters of hybrid rice are selected randomly from households with different land sizes amongst HYV rice growing cultivators following the same method. Thus, altogether, 50 rice growing cultivators are selected from each district (Tiruvarur and Nagapattinam). In all, 100 rice growing cultivators among two districts form the selected sample size in the study.

Review of Literature
In India, rice production has experienced remarkable progress

over the past four decades due to the technological advancement in the agriculture. Yield improvement has been a major thrust area in India. Several studies have indicated the need for rice research in India (Evenson and Mckinsey, 1991, Evenson 1993, Kumar and Rosegrant 1994, Pingali *et al*. 1997, Janaiah and Hossain 2004) [7, 8, 28, 24, 20]. Yield improvements in rice were major sources of a strong output growth, largely because of the widespread adoption of modern rice varieties in favourable irrigated environment (Barker and Herdt 1985, David and Otsuka 1994, Hussain 1997, Pingali *et al*. 1997) [1, 4, 10, 24]. The development and promotion of hybrid rice is a strategy being pursued by the Government to attain self-sufficiency in rice supplies and improve farmer's welfare. The farm level experiences have shown significant yield advantage of hybrid rice over the best HYV rice varieties. The adoption of hybrid rice is still at a low level (Cherll Casiwan *et al*. 2003).

The farmers faced a number of problems during cultivation of hybrid rice in India as well as in Tamil Nadu. Non-availability of seeds, low market price for the yield, higher seed cost and lack of consumer demand are some of the major problems faced by the farmers. A survey conducted among the rice growing farmers in Tamil Nadu by Ramasamy *et al*. (2003) revealed that the average yield of hybrid rice was 5.27 tonnes/ha., while that of HYV rice was 5.33 tonnes/ha. The study has also shown that there was no significant yield gain from hybrid rice in Tamil Nadu.

Farmers in India reported that there was no consumer demand for hybrid rice grown due to poor grain quality. This is in conformity with the earlier studies based on farmers' perception during farm verification of hybrid rice during 1992-93 and 1993-94 that poor grain quality of the tested hybrid rice would constrain large scale adoption of this technology in India (Janaiah *et al*. 1993) [12]. In addition to that, the adoption of hybrid rice in Tamil Nadu had very low impact on productivity of rice before 2003. The study highlighted why hybrid rice has not made a dent on the rice production in Tamil Nadu. The results show that there was not much improvement in rice production in the past decade (Ramasamy, Janaiah and Selvaraj *et al*. 2003).

The Discussion

The Farmers' Details

Table 1: Distribution of Sample Farmers in Nagapattinam and Thiruvarur Districts of Tamil Nadu

Size of Operational Holdings	Hybrid Adopters		Non-adopters	
	No. of Farmers	Percent	No. of Farmers	Percent
Marginal Farm (< 1 Hectare)	7	8.75	6	30.00
Small Farm (1 to 2 Hectare)	27	33.75	8	40.00
Medium Farm(2 to 4 Hectare)	20	25.00	3	15.00
Large Farm (> 4 Hectare)	26	32.50	3	15.00
Overall Farm	80	100.00	20	100.00

***Source*:** Field Survey Data

The sample farmers and their distribution according to their farm size are presented in Table 1. About 80 sample farmers are selected for hybrid rice adopters and the remaining 20 sample farmers are non-adopters. Hybrid rice seeds for adopters are supplied free of cost since it is a part of National Food Security Mission by the Department of Agriculture, Government of Tamil Nadu. Among the hybrid adopters, the small (33.75 percent) and large landholders (32.50 percent) are very much interested to adopt hybrid rice cultivation techniques. Both types of farmers have occupied two-thirds of hybrid rice cultivation area. On the contrary, the marginal farmers represent only 9.0 percent. It is observed that small and large farmers are adopting hybrid rice technology as their land size is quite enough to implement the technology. Further, the small and large farmers are able to cope with new technology, which involves high cost of operation, whereas, significant proportion of marginal farmers are unable to emulate the technology because of high cost and small landholdings. In the case of non-adopters, they prefer to adopt HYV rice cultivation as it requires low cost of cultivation. Further, they are continuously cultivating with the same traditional technology given their knowhow in the HYV cultivation technique.

Table 2: Economic Characteristics of Sample Farm Households

Characters		Hybrid Adopters		Non-adopters		Total
		Actual	Percent	Actual	Percent	Actual
Occupational Status	Self-Employed	68	85.0	17	85.0	85
	Business	6	7.50	1	5.0	7
	Salaried Person	6	7.50	2	10.0	8
	Agricultural Labour	-	-	-	-	-
	Non-agri. Labour	-	-	-	-	-
	Household Work	-	-	-	-	-
	Others	-	-	-	-	-
	Total	80	100	20	100	100
Average Size of Holdings (Ha.)	Ownership Holdings	7.02	-	4.20	-	11.23
	Operational Holdings	7.23	-	4.33	-	11.56

Seasonal-wise Average Size of Irrigated Land (Ha.)	Kharif Season	6.02	40.51	5.97	40.42	11.99
	Rabi Season	6.03	40.58	6.00	40.62	12.03
	Summer Season	2.83	19.04	2.81	19.03	5.64
	All Seasons	14.86	100.0	14.77	100.0	29.63

***Source*:** Field Survey Data.

The table 2 provides an overview of economic profile of the respondents. In both the hybrid adopter and no-adopter categories, majority of the respondents, that is 85 percent, are self employed in agricultural sector. Average size of the land holding by a hybrid adopter is 7 hectors whereas a non-adopter possess 4.5 hectors on an average. However the irrigated area is higher in case of non-adopters, compared to hybrid adopters, on an average, on looking for different seasons separately.

The cropping pattern

Table 3: Cropping Pattern (Area in Ha.)

Seasons/Crop	Hybrid Adopters				Non-adopters			
	2009-10		2010-11		2009-10		2010-11	
	Area	Percent	Area	Percent	Area	Percent	Area	Percent
Kharfi Season	282.65	40.45	255.96	41.98	39.43	51.58	38.41	48.72
Hybrid Rice	16.98	2.43	21.84	3.58	-	-	-	-
HYV Rice	265.26	37.96	225.64	37.01	39.43	51.58	38.41	48.72
Pulses	0.81	0.12	8.09	1.33	-	-	-	-
Others	0.40	0.06	0.00	0.00	-	-	-	-
Rabi Season	266.68	38.16	259.20	42.51	47.72	62.43	48.93	62.05
Hybrid Rice	12.13	1.74	23.05	3.78	-	-	-	-
HYV Rice	248.69	35.59	235.34	38.60	47.72	62.43	48.93	62.05
Pulses	4.65	0.67	0.40	0.07	-	-	-	-
Others	-	-	-	-	-	-	-	-
Summer Season	149.51	21.39	94.52	15.50	21.43	28.04	20.62	26.15
Hybrid Rice	-	-	-	-	-	-	-	-
HYV Rice	34.88	4.99	30.02	4.92	2.02	2.65	4.04	5.13
Pulses	114.23	16.35	67.33	11.04	18.20	23.81	15.77	20.00
Others	-	-	-	-	1.21	1.59	1.21	1.54
GCA	698.85	100.00	609.68	100.00	76.43	100.0	78.85	100.00

***Source*:** Field Survey Data.

The pattern of cropping is varied as farmers choose different patterns depending on the climatic conditions. The fixed supply of land, increased demand for food and burgeoning population and urbanization give pressure to farmers to choose different cropping patterns and crop diversification. The able 3 describes cropping pattern for the years 2009-10 and 2010-11. During the three seasons, the cropping patterns varied from each other. Generally, majority of the sample farmers in those districts were cultivating paddy, black gram, green gram, and vegetables. Table 3 shows that, among hybrid rice adopters, the total gross cropped area declined from 698.85 ha. in 2009-10 to 609.68 ha. in 2010-11, and for the non-adopters it has increased from 76.43 ha. to 78.85 ha. in the same period. During the kharif season, the share of hybrid rice cultivation in the gross cropped area has increased from 2.43 percent in 2009-10 to 3.58 percent in 2010-11, whereas the cultivated area has increased from 1.74 percent to 3.78 percent during rabi season. During rabi season, the share of HYV rice in the gross cropped area increased from 35.59 percent to 38.60 percent. On the other hand, the share of cultivation almost remained same for the kharif as well as summer seasons.

It has been noticed that the share of cultivated area of HYV rice declined due to excessive utilization of land. It indicates that hybrid rice was mainly cultivated in the study area during kharif and rabi seasons alone and not during the summer season due to lack of availability of seeds and diversification of cropping pattern from paddy to pulses in the study area. The highest share of pulses in gross cropped area declined to 11.04 percent in 2010-11 from 16.35 percent in 2009-10 during summer season.

Among non-adopters, the percentage share of HYV rice increased from 2.65 percent in 2009-10 to 5.13 percent in 2010-11 during summer season, while the share of area declined from 51.58 percent to 48.78 percent during kharif season and 62.43 percent to 62.05 percent during rabi season. The percentage share of pulses in cropped area has declined from 23.81 percent to 20.0 percent in the same period. A majority of the sample farmers were cultivating the HYV rice instead of hybrid rice varieties due to unawareness of the scheme and high intensive technology needed. It indicates that the majority of the sample farmers cultivated hybrid rice varieties within a variation ranging from 2 percent to 4 percent during reference period of study. The government officials have provided the seeds at the rate of 4 kg per acre to the selected farmers on a limited basis and not to all farmers in a village. Therefore, there was a lack of hybrid seed availability in the sample districts.

Area coverage of adoption of hybrid rice by the farm households

Table 4: Area Coverage of Adoption of Hybrid Rice Technology (Area in hectare)

Farm Size	2009-10						2010-11					
	Average Farm Size	Average Rice Area	Average Rice Area under		Percent Rice Area under		Average Farm Size	Average Rice Area	Average Rice Area under		Percent Rice Area under	
			HYV	Hybrid	HYV	Hybrid			HYVs	Hybrid	HYV	Hybrid
Marginal	0.67	0.67	0.27	0.40	40.30	59.70	0.67	0.67	0.30	0.37	44.78	55.22
Small	1.79	1.75	1.50	0.24	85.72	14.28	1.79	1.70	1.30	0.40	76.47	23.53
Medium	3.32	3.12	2.82	0.30	90.38	9.61	3.32	3.06	2.70	0.38	88.24	11.76
Large	8.06	7.22	6.80	0.42	94.18	5.82	8.06	6.09	5.54	0.52	90.97	9.03
All Sizes	3.46	3.19	2.85	0.34	89.34	10.66	3.46	2.88	2.46	0.42	85.42	14.58

***Source*:** Field Survey Data

According to the table 4, the average farm size of the sample household is 3.46 ha. Out of this, the average area for paddy cultivation has declined marginally from 3.19 ha. in 2009-10 to 2.88 ha. in 2010-11. Similarly, the HYV rice cultivation area has also declined from 89.34 percent (2.85 ha.) in 2009-10 to 85.42 percent (2.46 ha.) in 2010-11. On the contrary, the area under hybrid rice cultivation has increased from 10.66 percent (0.34 ha.) to 14.58 percent (0.42 ha.) between the two reference periods. The hybrid rice cultivation area had increased marginally (4 percent). The area under hybrid rice has ranged from 0.24 ha. to 0.42 ha. across the different sizes of the farm holdings during 2009-10 and the same has ranged between 0.37 ha. and 0.52 ha. during 2010-11 marking a slight increase. There was a small improvement in the hybrid rice cultivation in the study area during the reference period.

Between 2009-10 and 2010-11, the area under hybrid rice cultivation by the sample households has increased from 10.66 percent to 14.58 percent. A closer examination of the Table 3.4 reveals that there is a considerable change observed among the small, medium and large farmers with respect to the area under cultivation. The shift is sharp in the case of small farmers recording an increase from 14.28 percent to 23.53 percent of the area. It is also found in the study that proportion of HYV rice cultivators has declined by 4 percent and the ratio of hybrid rice cultivators increased by 4 percent. It may be noted from the study that the farmers are ready to diversify farm lands for the cultivation of HYV rice than hybrid rice varieties. It is found in the study that majority of the farmers cultivate HYV rice varieties. The reason behind this is easy availability of seeds, well known technology and conventional farming technique. But, the hybrid rice cultivation involves high cost of operation, inadequate seed supply and one-time seed usage and unknown technology.

The share of rice area in the farm size declined from 3.19 ha. in 2009-10 to 2.88 ha. in 2010-11. Out of that, the share of HYV rice also declined from 2.85 ha. to 2.46 ha. On the contrary, the area under hybrid rice improved from 0.34 ha. to 0.42 ha. during the same period. The highest share of area under hybrid rice cultivation was occupied by large size of farmers, which increased from 5.82 percent (0.42 ha.) to 9.03 percent (0.52 ha.).

The medium size farmers adopting the hybrid rice technology improved from 0.30 ha. to 0.38 ha. But, among the small size of the sample farmers, the area planted had declined from 0.40 ha. to 0.37 ha. It is found that the large and medium size sample farmers were keenly interested in cultivating the hybrid rice than marginal farmers. It may be noted that the marginal farmers have been left out of the paddy scheme due to small size of operating land (an average 0.40 ha.), no storage room and lack of awareness about the scheme.

Access to hybrid rice technology

The adoption of hybrid rice has been a challenging task to the government ever since it has been developed and released for commercial farming in India. Thus the Table 5 gives classification of the farmers based on the various sources of accessing information. The important sources of information are training programme organized by the government, frontline demonstration programme, Krishi Vigyan Kendra, extension workers of state government department of agriculture, television, radio, input dealer, progressive farmer, private agency, output buyers and credit agencies.

Table 5: Farmers Accessing Sources of Information on Hybrid Rice Technology (For Hybrid Adopters only)

Source of Information	Number of Farmers Reporting	Percent of Farmers Reporting
Frontline Demonstration Programme conducted by Government	69.00	86.25
Participation in Training Programme organized by Government	66.00	82.50
Krishi Vigyan Kendra	31.00	38.75
Extension Worker of State Department of Agriculture	62.00	77.50
Television	1.00	1.25
Radio	21.00	26.25
Newspaper	32.00	40.00
Input Dealer	-	-
Progressive Farmer	-	-
Private Agency/ NGO	-	-
Output Buyer/ Food Processor	-	-
Credit Agency	-	-
Others	-	-

***Source*:** Field Survey Data

Majority of the farmers (86.25 percent) reported that they have participated in the frontline demonstration programme conducted by the government. About 82.50 percent farmers reported that they have participated in training programme organized by the government; 77.50 percent farmers came to know about hybrid rice technology through extension workers. An important finding from the classification is that apart from participating in programs, the farmers are informed about the technology by the agricultural department officers who visited the villages. The agriculture officer could not solve the problems relating to distribution of hybrid rice seeds due to limited material available (Table 5).

Table 6: Sources of Seed for Hybrid Rice Cultivation

Source of Seed	2009-10		2010-11	
	No. of Farmers Reporting	Percent of Farmers Reporting	No. of Farmers Reporting	Percent of Farmers Reporting
Government on Full Subsidy	56.00	100.0	72.00	98.63
Government on Partial Subsidy	-	-	1.00	1.37
Private Agency	-	-	-	-

***Source*:** Field Survey Data

How the farmers are accessing information relating to collection of seeds for hybrid rice cultivation remains a question. The table 6 addresses this question. It is found from the study that a majority of the sample households have collected the hybrid seeds from government alone with full or partial subsidy basis. The majority of hybrid rice growers have reported that they have received hybrid seeds from government source (Department of Agriculture, Government of Tamil Nadu) on full subsidy basis. The number of beneficiaries of hybrid rice seeds received from the government has declined from 100 percent in 2009-10 to 98.63 percent in 2010-11 on full subsidy basis. About 1.37 percent of the hybrid seed farmers reported that they have obtained seeds from government sources on partial subsidy basis. Regarding hybrid rice seed sales, government has the monopoly in the study area. The government officials provide hybrid seeds to selected farmers based on their socio-economic status and land holding status.

Summary and Conclusions

Tamil Nadu is one of the leading states in terms of the socio-political, economic and human development (6th place) in India. The area under rice cultivation expanded marginally from 16.96 lakh ha (74.91 percent) to 17.55 lakh ha (76.12 percent) during pre-hybrid rice period for winter season. It has declined to 14.44 lakh ha during second post- hybrid period. It is observed that urbanization, rapid development of real estate and increasing non-cultivable area in Tamil Nadu are some of the reasons for these trends. During autumn season, it has increased from 2.86 lakh ha (12.67 percent) to 3.35 lakh ha (17.63 percent). However, the cultivable area expanded by only 0.49 lakh ha (5 percent) during the last three decades.

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