

Hybrid Rice in Andhra Pradesh

Findings of a Survey

Andhra Pradesh was the first state in India to develop and release two rice hybrids during the 1993-94 dry seasons. Hybrid rice technology was projected as the harbinger of another rice revolution in the state, as the yield potential of existing varieties was declining. However, the initial experiences of farmers who grew hybrid rice in the state indicated that it was not profitable relative to existing modern varieties. Recently, scientists have claimed that the initial experiences of hybrid rice cultivators are no longer relevant as many new rice hybrids of better quality were developed and marketed by the late 1990s. The current study tests the widely propagated hypothesis that these new rice hybrids have been accepted by farmers in Andhra Pradesh.

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I Introduction

Andhra Pradesh is a surplus rice growing state, which produces about 13 per cent of India's rice output with 9 per cent of total rice area. Rice is the dominant staple food for about 70 million people in the state and a major source of livelihood to nearly 70 per cent of rural households. Rice production and yields have nearly doubled with only a marginal expansion of cropped area since the introduction of modern rice varieties (MVs) in the late 1960s (Table 1). Most of the additional output has come from yield enhancement. Research-induced modern rice varieties, improved crop management practices, and development of assured irrigation infrastructure were the key contributing factors in the spectacular growth of rice production. About 95 per cent rice area in Andhra Pradesh under MVs and fortified with irrigation sources.

However, there has been a visible deceleration in rice yield growth in the 1990s (Table 2). Yields increased at a compound growth rate of 2.62 per cent per year during the 1970s, which slowed down to 1.6 per cent per year during the 1990s. The principal reason for the slowdown is that yields have almost plateaued at about 5-6 tonnes/ha with existing modern varieties under intensive rice systems [Pingali et al 1997; Janaiah et al 2000]. Moreover, biotic (insects and diseases) and abiotic (soil and water-related problems) stresses have increased on rice crop through intensive cultivation in the 1990s that caused a yield loss of about 560 kg of paddy/ha/year between 1990 and 1999 (Figure 1).

Rice scientists and policy-makers are consistently making efforts to find solutions to various production problems through technology development and refinement process. Andhra Pradesh made a pioneering effort in research and development in India. There are 12 research stations in the state under the state agricultural university with about 100 scientists working for rice improvement technologies alone. About 12 per cent of state resources for agricultural research are allocated for rice research (1998-99). Over the past 35 years, the state has released about 70 MVs for various agroclimatic zones, covering about 24 per cent of India's rice area (10.5 million ha) in 11 states of the country [Janaiah et al 2002].

The research managers considered hybrid rice technology as a readily available option in the late 1980s to shift the yield frontier

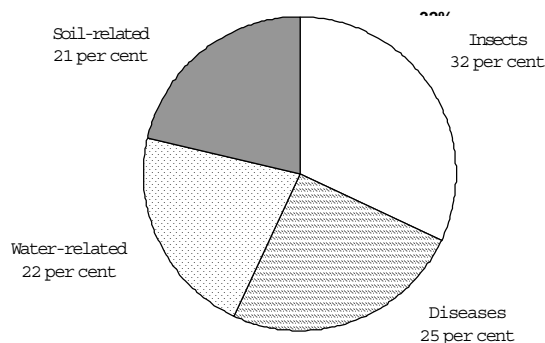
upward in intensive irrigated systems where rice yields have stagnated in the 1990s. Andhra Pradesh is the first state in India to develop and release two rice hybrids during the 1993 and 1994 dry seasons [DRR 1996, 1999]. A large number of private seed companies have participated actively in hybrid rice seed production, and a few big companies also initiated R and D on hybrid rice in the early 1990s. It was projected that hybrid rice technology would bring about another rice revolution in the state as the yield potential of existing varieties was declining. However, the initial experiences of farmers who grew hybrid rice during 1994-95 in the state indicated that hybrid rice was not profitable relative to the cultivation of existing modern varieties due to lower market price for hybrid rice produce because of poor grain quality and higher production costs especially for hybrid seed. It was reported that farmers were not readily accepting hybrid rice [Janaiah 2000]. The extent of adoption of hybrid rice in the state was too meagre to make an impact until 1998. Further, many seed agencies, both in public and private sectors have slowed down their participation in hybrid rice seed production, and also in R and D. It is quite often argued that the initial experiences of the hybrid rice cultivators are no longer relevant now as many new rice hybrids of better quality were developed and marketed by both the public and private sectors during the late 1990s. This paper aims to test the widely propagated hypothesis that new rice hybrids – developed and marketed in the late 1990s – have made a significant impact at farm level, and examine the trend in the seed industry participation in hybrid rice R and D over the past decade in Andhra Pradesh. The paper is organised into the following sections. Section II provides data source and methodology followed for the study. Section III summarises findings from the survey data conducted in 2000-01 crop year. The seed industry roles in hybrid rice R and D in Andhra Pradesh are explained in Section IV. The last section concludes with implications of the study results.

I Data Source and Methodology

Farm-level data from sample adopters (who grew hybrid rice in 2000-01) and dropouts (who grew hybrid rice previously and dropped out in 2000-01) were collected through surveys in the selected study sites. Even 10 years after the release of rice hybrids

Figure: Extent of Rice Yield Losses Due to Biotic and Abiotic Stresses (1990-99)

(Total yield loss: 563 kg of paddy/ha/year)



Source: Janaiah, et al (2000).

in the state, their acceptance by farmers is limited, and scattered and thin in terms of area coverage under hybrid rice. Thus, a systematic sampling technique has not been followed to select sample farmers for surveys. However, surveys covered 13 villages scattered over two districts; thus selected sample farmers may be considered as fairly representative.

Thirteen villages were purposively selected due to the thin and scattered spread of hybrid rice, from Karimnagar and Nizamabad districts, which were targeted areas for hybrid rice cultivation as well as seed production. One hundred sample farmers in the selected villages who grew hybrid rice during 2000-01 crop year (adopters), and 50 farmers who grew hybrid rice previously but discontinued in 2000-01 (dropouts) were interviewed for generating farm-level data. Data on input-output details and farmers perceptions, were collected from sample farmers through personal interviews with help of a structured questionnaire.

II Major Findings from Surveys, 2000-01

Nature of adoption of hybrid rice: About 76 per cent of the sample adopters were first-time growers of hybrid rice in 2000-01 while the remaining 26 per cent were second-time adopters. Only 16 per cent of the rice area of the adopters was planted under hybrid rice, and conventional inbred varieties were grown in the remaining 84 per cent area. Most adopters were provided with hybrid rice seeds for free of cost as part of hybrid rice promotion programmes by both department of agriculture and by some seed companies for on-farm experimentation. This confirms earlier findings that most of the hybrid rice adopters discontinued hybrid rice cultivation after one or two seasons of experience. Therefore, many private seed companies moved at the initial stages from one location/region to another exploring market for hybrid rice seed [Janaiah 2002].

Yield advantages: Hybrid rice had a 15-20 per cent yield advantage over existing best-inbred rice varieties at research stations in Andhra Pradesh [DRR 1996, 1999]. Table 3 summarises the yield performance of hybrid rice in farmers' fields over the period. Only 10 per cent yield gain was reported for hybrid rice in on-farm trials conducted during 1993-95 crop years in farmers' fields under the direct supervision of scientists (Table 3). In a detailed study based on actual cultivation of hybrid rice during 1997-98, about 22 per cent of yield gain for hybrid rice over inbred rice varieties was reported. For this study, sample was

the big farmer with about 6 ha of average farm size that used a high level of inputs for both hybrid and inbred rice varieties. Average higher yields reported from this study are shown in Table 3. Despite a 22 per cent yield gain recorded during 1997-98, about 85 per cent of sample farmers have expressed their willingness to discontinue hybrid rice cultivation due to lower profitability [Janaiah 2002].

Results from the surveys in 13 sample villages for the present study shows that hybrid rice had only 4 per cent yield gain over the best inbred rice varieties during 2000-01 (Table 3). For drop-outs of hybrid rice cultivation, there was a negative yield gain of about 5 per cent for hybrid rice compared with HYVs/inbreds. Farm-level performance of hybrid rice over the period indicates that hybrid rice technology has not yet clearly demonstrated its

Table 1: Trends in Area, Production and Yield of Rice Paddy in Andhra Pradesh

Year (Triennium Average)	Area (mn hectare)	Production (mn tonnes)	Yield (tonnes/hectare)	Per Cent Contribution to All India	
				Area	Production
1969-71	3.29	7.10	2.12	8.70	11.30
1979-81	3.63	10.60	2.91	9.10	14.20
1989-91	4.05	14.52	3.60	9.50	13.50
1998-2000	4.12	17.30	4.20	9.20	13.20

Note: 1969 means 1969-70 and likewise.

Table 2: Compound Annual Rate of Increase (Per Cent) in Rice Yield

Period ^a (TE)	Andhra Pradesh	India
1970-80	2.62	1.42
1980-90	2.10	3.20
1990-2000	1.63	1.10
1970-2000	2.10	2.30

Note: ^a Triennium ending.

Table 3: Yield Advantages of Hybrid Rice Over Inbred Rice in Farmers' Fields (Kg/Ha)

Crop Year	Hybrid Rice	Inbred Rice	Yield Advantage (Per Cent)
1993-95 ^a	6080	5520	10.1
1997-98 ^b	8800	7200	22.2
2000-01 (present study)			
Adopters ^c	6900	6620	4.2
Drop-outs ^d	6140	6460	-5.0

Sources: a - Janaiah (2000); b - Janaiah (2002); c - Survey data for adopters; d - Survey data for farmers who grew hybrid rice earlier but dropped out in 2000-01

Table 4: Input Cost of Cultivation of Hybrid Rice Over Inbred Rice Varieties in the Farmers' Fields of Andhra Pradesh (for Adopters, 2000-01) (Rs/Ha)

Input Cost	Hybrid Rice	Inbred Rice	Per Cent Difference
Seed	2200	680	235.3***
Manures and Fertilisers	6740	6130	10.0
Labour (human and Animal)	4055	3670	10.5**
Rental value of machinery	3460	2880	20.1**
Pesticides	1180	760	55.3***
Total	17635	14120	24.9**

Notes: a - Although many sample adopters received 50-1005 subsidy on hybrid rice seeds, we assured seed price of Rs 100 per kg to calculate imputed seed cost.

***, ** and * are significant at 1 per cent, 5 per cent and 10 per cent probability levels, respectively.

higher yield potential under normal production environments in Andhra Pradesh. This explains why farmers who grew hybrid rice previously, dropped out during subsequent seasons.

Economic returns: Yield gain, additional input costs (if any) and market price for output are the key determinants of the relative profitability of any new innovation. Table 4 presents comparative input costs for the cultivation of hybrid and inbred rice varieties for adopters during 2000-01 crop year. Hybrid rice cultivation incurred about 25 per cent additional production costs compared with existing inbred rice varieties. The adopters of hybrid rice during 2000-01 have used more inputs such as manures, fertilisers, labour and pesticides expecting significantly higher yields than existing varieties. However, there was only a 4 per cent yield gain for hybrid rice with 25 per cent additional production costs.

The hybrid rice after harvesting fetched about 9 per cent less in the market (Table 5). This further confirms earlier studies [Janaiah et al 1993, Janaiah 2000] that hybrid rice grain has poor cooking and keeping qualities leading to lower market price. This implies that there was no improvement of grain quality of new rice hybrids that were made available to the farmers until 2001. When yield gains, production costs and market price for output were translated into net profitability, hybrid rice cultivation was about 18 per cent less profitable than the inbred rice cultivation (Table 5).

Farmers' perceptions: When we asked dropouts of hybrid rice cultivation about their experiences, 50 per cent of sample dropouts indicated that hybrid rice had lower yield than inbred rice varieties (Table 6). Lack of consumer acceptance of hybrid rice grain due to poor cooking, eating and keeping qualities leading to lower market price, lower head-rice recovery, more broken rice after milling, higher costs especially for hybrid rice seed, and formation of sterile grains in the productive tillers were other serious constraints that led to discontinuance of hybrid rice cultivation in Andhra Pradesh.

Among adopters, about 70 per cent were not in favour of continuing the same rice hybrids for the next year, due to lower profitability. Many adopters also expressed similar constraints

Table 5: Profitability in Hybrid Rice Cultivation for (Adopters)
(per ha)

Cost/Return	Hybrid Rice	HYVs	Per Cent Difference
Grain yield (tonnes)	6.90	6.62	4.3
Grain price (Rs)	5969	6580	-9.3*
Gross return (Rs)	42394	44321	-4.3
Total cost (Rs)	17635	14120	24.9*
Net Profit (Rs)	24759	30201	-18.2**

Note: ***, ** and * are significant at 1 per cent, 5 per cent and 10 per cent probability levels, respectively.

Table 6: Perception of Hybrid Rice Cultivation in Andhra Pradesh (Reasons for Dropping out)

Perception	Per cent of Sample Dropout Reported (N=50)
Less yield gain	28
No yield gain	22
Lower yield	50
Higher production cost	88
Lower market price	92
Poor cooking and keeping quality	84
Lack of consumer acceptance	74
Low head-rice recovery	68
Chaffy/sterile grain	64
More susceptible to pest and diseases	66

for hybrid rice as reported by the dropouts. Among the constraints reported by both adopters and dropouts is poor quality of hybrid rice grain that led to lower consumer demand, lower market price and lower profitability. Consumers in Andhra Pradesh are highly-oriented towards long slender grains and taste varieties such as BPT 5204 (Samba Masuri), a popular rice variety preferred by consumers. This variety was developed and released in Andhra Pradesh in 1986, and it was grown in 10 Indian states covering 3.3 per cent of the total rice area during 2000-01 crop year. This variety fetches 30-35 per cent higher price in the market due to its super-fine quality and consumer demand. Farmers in Andhra Pradesh compare any new variety/hybrid with this type of super-fine quality rice variety. Hybrid rice varieties developed till now are inferior to many currently available fine quality rice varieties such as BPT 5204, Vijetha, and Masuri. Although the yield of these fine varieties may be marginally lower than the best hybrid rice varieties, the market price of fine rice varieties is substantially higher than hybrid rice grain resulting in higher profitability for fine rice varieties than for hybrid rice. Thus, farmers prefer to grow high premium varieties rather than hybrid rice varieties.

IV

Seed Industry Participation

Andhra Pradesh is home to the Indian seed industry. About 500 seed companies including small-scale companies, are located in the state, of which 135 are in the rice seed business. Nearly 40 per cent of India's seed requirement for rice is produced in Andhra Pradesh. Some large seed companies in the private sector initiated hybrid rice R and D in the late 1980s and early 1990s. Around 15 seed companies participated actively in hybrid rice seed production during 1994-95, expecting a huge market. However, farmers will have to purchase hybrid seed every crop season unlike inbred high-yielding varieties in which they can use their harvest as seed for the next season. A few big companies produced hybrid rice seed in the state and marketed it in other states. Despite active participation by the private sector, hybrid rice use has not spread among farmers as much as it was expected.

Since farmers are dropping out of hybrid rice cultivation after one or two years, private seed companies have moved from one region/state to other to explore the market for hybrid rice seed. In spite of the efforts of the seed companies to move hybrid rice from one state to another, area expansion has remained much below the projected level. In many regions, hybrid rice was noted to spread horizontally rather than vertically because of the private sector moving hybrid seed from one region to another to explore the market, as the adoption rate fails to pick up in the region where the technology is introduced. For instance, about 3 tonnes of hybrid rice seed of one private hybrid seed company was sold in Nizamabad district (Andhra Pradesh) during 1994-95 (the year of introduction). The seed sale of this hybrid dropped to 1.5 tonnes in 1996 and was less than 1 tonne in 1997 in the district. A large quantity of seed of the same rice hybrid was marketed in West Bengal during 1995-96, but sales dropped in subsequent years. Then the same rice hybrid was introduced on a large scale in Orissa state in 1997-98 with subsidy provided by the state government. But heavy crop losses due to poor performance of this hybrid disappointed farmers and policy-makers. This has become a political issue in the state legislative assembly because of the heavy crop losses incurred as a result of indiscriminate introduction of rice hybrids in the rainfed lowland

ecosystems of the state by the private sector with government's support.

Thus, it seems that the private seed sector intended to get their investments and profits as quickly as possible by moving from one region to another without having acceptable hybrid rice technology for farmers. However, some private seed companies that initiated hybrid rice research and seed production in the early 1990s partially withdraw from the hybrid rice seed business by the late 1990s due to lack of demand from farmers. Public sector seed agencies such as the Andhra Pradesh State Seed Development Agency and National Seeds Corporation have also reduced their exposure to hybrid rice seed production through the 1990s.

V Conclusion

Although considerable progress has been made in the development and release of new hybrids in the late 1990s, farmers were not convinced on the economic superiority of rice hybrids that were made available until 2001. The yield gain of hybrid rice was only 4 per cent during 2000-01 with 25 per cent of additional costs. Thus, hybrid rice cultivation was 18 per cent less profitable than inbred rice cultivation. Lack of consumer demand due to poor grain quality, higher production costs and less yield gains among others remain unresolved constraints in hybrid rice adoption even 10 years after the initiation of focused R and D on hybrid rice in the state.

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To conclude, the overall results of the study reconfirmed that

there was no significant improvement made in hybrid rice R and D until 2001, in terms of proving farmer-consumer acceptable rice hybrids in Andhra Pradesh. Thus, future R and D in hybrid rice ought to primarily focus on improvement of high-value hybrids through quality enhancement, instead of pushing unacceptable rice hybrids through promotion efforts. [27]

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