

Profitability of Hybrid Rice Cultivation

Evidence from Karnataka

Hybrid rice cultivation has not increased significantly in Karnataka since the introduction of hybrids in the state in the mid-1990s. This study focuses on the profitability aspects of hybrid rice cultivation based on farmers' experiences during the 2000-01 crop year. Hybrid rice was found to be higher yielding but less profitable than existing high-yielding varieties. The paper provides reasons for lower profitability and explains the constraints in hybrid rice expansion based on farm-level data.

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I Background

Rice is the staple food of the people of Karnataka. There has been a steady increase in area and production of rice in the state, from 8,78,000 hectares (ha) area in 1955-56 to 1.42 million ha in 1998-99 and from 1.18 million tonnes production to 3.60 million tonnes (Table 1). The growth rates of area under rice were appreciably higher during the 1950s and decreased considerably thereafter (Table 2). This indicates limited opportunity for expanding area under the crop. The state has maintained a secular growth trend (1967-68 to 1998-99) of 1.98 per cent per annum in rice production, almost matching the population growth rate. However, the state recorded a negative growth rate (-0.15 per cent) during the 1980s in rice production.

The rice yield in Karnataka almost doubled from 1.398 tonnes/ha in 1955-56 to 2.663 tonnes in 1998-99. However, the secular growth trend (1967-68 to 1998-99) for rice yield in the state was low at 1.36 per cent per annum. In fact, the growth rate in yield was negative during the 1950s and 1990s. Thus, the growth in yield of rice was not impressive and at the same time instability in yield growth was seen with fluctuating growth levels in different periods. With the increase in population and shift in consumption from inferior to superior grains such as rice it is expected that the demand for rice is on the increase in the state. At the present growth rate in yield of 1.36 per cent per annum with the existing high-yielding varieties, it would be difficult to meet the expanding demand for rice.

Scientists and policy-makers realised that the recent breakthrough in hybrid rice technology provides an alternative option to increase rice production. However, the adoption of hybrid technology depends much on its profitability in relation to existing technology.

Hybrid rice was first commercially cultivated in China in 1976 and its planting area had expanded to more than 13 million ha by 1990. Hybrid rice with a higher yield advantage over inbred varieties has helped China produce more than 300 million tonnes of paddy. Hybrid rice not only has a distinct yield advantage over inbred varieties but also is more responsive to fertiliser and can adapt to varying environments [Jumin et al 2000]. Contrary to these advantages of hybrid rice cultivation, certain disadvantages

have also been reported in China and other growing regions such as Bangladesh [Muazzam Husain et al 2001] and India [Janaiah and Hossain 2001]. It has been reported that hybrid rice in China had a 15 per cent yield gain over the inbreds, but that it got lower prices in the market because of poor grain quality compared with conventional HYVs [He Guiting and Flinn 1987]. It was pointed out that China being a centrally planned economy promoted certain technologies without considering the relative probability and other economic reasons [Lin 1991]. Further, government agencies produced and supplied hybrid rice seeds free of cost to farmers, supported with subsidies on fertilisers and plant protection chemicals. Hybrid rice research was primarily aimed at reversing the current yield trend in the intensively rice growing regions. There are evidences to show that farmers cultivating hybrid rice realised higher yield gains at 16 per cent over current inbred varieties in similar agro-climatic zones of Karnataka and Andhra Pradesh [Janaiah 2001]. However, in Orissa and Tamil Nadu, hybrids gave lower yields due to pests and disease attack compared with inbred varieties. The exhaustive survey undertaken by Janaiah (2001) covering 254 farmers spread over five major rice-growing states of India indicated that the pace of hybrid rice adoption is too slow due to many socio-economic factors, thereby affecting its profitability. This study revealed that there are additional costs and risks involved in the cultivation of hybrid rice varieties vis-a-vis inbred varieties. In fact, farmers growing hybrid rice realised a lower net return (of 51 per cent) due to higher cost/tonne of production (21 per cent) and lower market realisation (price) due to its inferior quality perception among consumers and traders. It has been concluded that the higher costs incurred in hybrid rice cultivation are not commensurate with higher yield gains.

In Karnataka, systematic research on hybrid rice was initiated in the 1980s by the University of Agricultural Sciences (UAS) Bangalore. The research efforts of UAS have resulted in the release of two hybrid varieties, namely, KRH1 and KRH2. Later on, due to the liberalisation of seed policy, some private companies have ventured into the production of new hybrid varieties. Now, two hybrid varieties, Pro Agro 6210 and Pro Agro 6615, released by a private seed company are under cultivation in the state. A few more varieties have been released by private sector companies but are not popular. However, rice hybrids have not been well accepted by the farmers. There have been

serious concerns on profitability of hybrid rice cultivation in the state in view of slower and limited acceptance of hybrid rice by farmers.

The present study aims to assess the profitability of hybrid rice cultivation compared with inbred/HYVs in Karnataka. It also analyses factors affecting adoption of hybrid rice by farmers.

I Data and Methodology

For the present study, Mandya and Mysore were purposively chosen since the spread of hybrid varieties is relatively higher in these districts. A purposive sampling procedure was adopted to select the farmer respondents since the total number (population) of hybrid rice adopters is too low in Karnataka and they are highly scattered. Data was obtained from a total of 146 sample farmers, drawn from two different categories. The first comprised farmers who cultivated hybrid rice during 2000-01 for the first time (adopters). The second category comprised farmers who had cultivated hybrid rice previously but discontinued it thereafter (dropouts).

There were 98 sample adopters and the remaining 48 samples were dropouts. Data relating to farm size, extent of area under different crops, varieties of rice cultivated, costs incurred on hybrid and inbred rice varieties (separately), price received on sale of paddy, perception of farmers on hybrid rice cultivation and problems faced by the farmers in production and marketing were obtained by administering a structured questionnaire. A simple tabular analysis was followed to analyse the data obtained.

II Findings from the Study

Small-scale adoption of hybrid rice and source of seed: The average size of the farm of the sample household was 4.59 acres. Of this, 0.82 acres (17.86 per cent) was under hybrid rice cultivation. The area under hybrid rice ranged from 0.2 acres to 3.52 acres across the farm holdings. Since hybrid rice is still at an introductory stage, farmers devoted more area to inbred varieties and normally cultivated two to three inbred varieties. Most farmers said that they planted hybrid variety on a trial basis. Only 16.32 per cent of the farmers said they had previous experience in hybrid rice cultivation. Of the 98 farmers in first category, 65 obtained seeds from a public source on full/partial subsidy and the remaining 33 from private source on payment.

Yield performance: The results of the study indicated that the average yield of hybrid rice was 8.41 tonnes per hectare while that of inbred rice was 7.42 t/ha. Thus, it emerges that the yield realised by hybrid rice growers was higher by 13.34 per cent compared with inbred (HYV) rice growers in Karnataka (Table 3). Janaiyah and Hossain (2001) reported a yield gain of 16 per cent in hybrid rice production in India based on a survey conducted by them in four major rice-growing states. In China, hybrid rice has shown a yield advantage of 15-20 per cent over conventional inbred varieties in farmers' fields [Lin and Pingali 1994, Lin 1994]. So, there is a convincing case that the yield realised in hybrid rice cultivation is higher than that in inbred varieties.

Profitability of hybrid rice cultivation: The average cost of

production of hybrid rice worked out to Rs 17,889.80 per hectare while for inbred rice it was Rs 15,387.76 per hectare (Table 3). Among the components of total cost, expenditure on labour formed the single largest item and accounted for 43.11 per cent and 40.84 per cent of the total cost for hybrid and inbred varieties respectively. The cost incurred on fertiliser was the next most important item, at about 13-15 per cent of the total cost. The farmers growing hybrid rice realised a gross return of Rs 47,736.26 per hectare while the gross return realised in inbred varieties was Rs 45,619.89. Thus, the gross return 4.64 per cent higher in hybrid rice cultivation. However, the profit (net return) realised in hybrid rice production was lower by Rs 385.67 (1.28 per cent) per hectare. Consequently, the benefit-cost ratio was also lower in hybrid rice cultivation.

Table 1: Trend in Area, Production and Productivity of Rice in Karnataka

Year	Area ('000 ha)	Production ('000 tonnes)	Yield (kg/ha)
1955-56	878	1184	1398
1967-68	1116	1251	1181
1979-80	1146	2323	2133
1989-90	1183	2373	2111
1998-99	1425	3605	2663

Source: Directorate of Economics and Statistics, Govt of Karnataka, Bangalore.

Table 2: Rice in Karnataka - Compound Growth Rates (Per cent)

Year	Area	Production	Yield
1955-56 to 67-68	2.22***	2.07**	-0.20
1967-68 to 79-80	-0.40*	1.85	2.13*
1979-80 to 89-90	0.20	-0.15	-0.36
1989-90 to 98-99	1.69***	3.76***	2.08***
1967-68 to 98-99	0.64***	1.98***	1.36***

Notes: Growth rates were obtained using Log-linear regression model.

*** - Significant at 1 per cent level; ** - Significant at 5 per cent level;

* - Significant at 10 per cent level.

Table 3: Comparison of Costs and Returns for Hybrid and Inbred Rice (Rs/ha)

Particulars	Hybrid		Inbred		Difference	
	Cost	Per Cent	Cost	Per Cent	Amount/ Quantity	Per Cent
Costs						
1 Seed	1715.98	9.59	1153.30	7.50	562.68	48.79
2 Farm yard manure	1205.20	6.74	1310.52	8.51	105.32	-8.04
3 Fertilisers	2396.98	13.40	2310.13	15.01	86.85	3.76
4 Irrigation	1949.91	10.90	1874.03	12.18	75.88	4.05
5 Plant protection	630.68	3.52	436.75	2.84	193.93	4.44
6 Human labour	7711.53	43.11	6283.85	40.84	1427.68	22.72
7 Machine labour	1623.42	9.07	1474.43	9.58	148.99	10.10
8 Miscellaneous	656.10	3.67	544.75	3.54	111.35	20.44
Total cost	17889.80	100	15387.76	100	2502.04	16.26
Unit cost of production (Rs per kg)						
	2.12		2.07			
Returns						
1 Yield-paddy (tonnes/ha)	8.41		7.42		0.99 13.34	
2 Market price/tonne	5421.90		5718.40		296.50 -5.19	
3 Value of paddy	45598.18		42430.53		3167.47 7.47	
4 Straw value	2138.08		3189.36		1051.28 -3.30	
5 Gross return	47736.26		45619.89		2116.39 4.64	
6 Net return (profit)	29846.46		30232.13		385.67 -1.28	
7 Benefit: cost ratio	1.67:1		1.96:1			

Reasons for lower profitability: The lower profit in hybrid rice cultivation is a matter of concern since the adoption of a new enterprise or technology depends much on its profitability. As seen from Table 3, hybrid rice growers incurred additional costs for most of the inputs. In fact, the quantity of seed required for hybrid rice cultivation is comparatively lower than inbred varieties. However, the price per kg of hybrid rice (Rs 80) is much higher than that of inbred varieties (Rs 10 per kg). Hybrid rice growers incurred an additional expenditure of Rs 562.68 per hectare on seed alone. Besides, they need to purchase seed for each and every cropping season unlike inbred farmers, who quite often use their own seeds. This result reinforces the findings of Janaiah and Hossain (2001), who observed the seed cost for hybrid rice cultivation to be three to four times higher than that of conventional varieties. Similarly, hybrid rice growers incurred a higher expenditure on labour (Rs1,427.68) for performing various cultural operations. Enquiry with farmers revealed that they had to incur higher labour for hybrids mainly for transplanting the seedlings of paddy since it involved a cumbersome method of planting single seedlings per hill unlike multiple seedlings per hill in inbred varieties. In addition, more labour was used for spraying plant protection chemicals and for irrigation. More expenditure on plant protection chemicals also contributed to pushing up the cost of production of hybrid rice. Coupled with higher production cost was low market price realisation for hybrid paddy. On average, the hybrid rice farmers realised a sale price that was Rs 296.50 (5.19 per cent) lesser per tonne of paddy sold in the market compared with inbred paddy. This is attributed to the fact that the farmer consumers felt hybrid rice to be of inferior quality in terms of taste and cooking. Discussions with rice millers indicated that the output in processing hybrid paddy was lower especially due to a lower quantum of head rice.

Thus, the higher costs of production (of 16.26 per cent) and lower market realisation (of 5.19 per cent) have contributed to lower profitability of hybrid rice cultivation in Karnataka even though the yield 13.34 per cent higher. This calls for improvement of technology to reduce costs of cultivation and enhancing the quality attributes of hybrid rice.

Yield response function for hybrid and inbred rice: Log linear models were fitted to identify the factors affecting the yield of rice. The fitted model explained 68 per cent of the variation in yield in case of hybrid rice (Table 4) and 74 per cent (Table 5) of the variation in inbred rice. The estimated coefficients indicated that seed, fertiliser and human labour influenced the yield levels to a great extent in both hybrid and inbred rice. The coefficients for seed and fertilisers were of higher magnitude in case of hybrid rice, indicating that the marginal efficiency of these two inputs was higher for hybrid rice. This clearly shows that yields of hybrid rice respond more to these inputs. Janaiah (2000) quantified a similar response for hybrid rice in India based on farm experimental data. The availability of these two inputs at a reasonable price will help in pushing up the yield levels and consequently the production of hybrid rice so as to achieve sustainable food security. The positive and significant coefficient for labour indicates that there is still scope to expand the use of labour in both hybrid and inbred rice cultivation.

Farmers' perception: The response of farmers who have grown hybrid rice for the last two consecutive seasons and those who discontinued after growing for one season were elicited. The

availability of subsidy on seed and to a limited extent on fertilisers and provision of knowledge on the higher yield potential of hybrids acted as motivational factors for farmers to undertake the cultivation of hybrid rice (Table 6). Besides, the farmers were of the opinion that the hybrid adapts well to varying situations and have resistance to pests and disease attacks, prompting them to go for hybrid cultivation. Further, it is interesting to note that a good number of small farmers took up hybrid rice cultivation since they felt that its higher yield potential would help them get more rice for their own consumption. The non-availability of seed during planting time, high cost of seed, lower market price and low consumer preference acted as factors in the discontinuance of cultivation of hybrid rice by farmers (Table 7).

Table 4: Yield Response Function for Hybrid Rice – Log Linear Estimates

Variable	Regression Coefficient b	S E of b	t-Ratio
Seed	0.1446**	0.0456	3.17
Manure	0.0006	0.0612	0.009
Fertiliser	0.5682**	0.1278	4.45
Irrigation	0.0031	0.042	0.74
Human labour	0.0376**	0.0061	6.16
Machinery labour	-0.0122	0.0214	-0.57
Plant protection	-0.0041	0.084	-0.05
Constant	2.46**	0.6213	3.96
R ² = 0.68			

Note: ** Significant at 1 per cent level of probability.

Table 5: Yield Response Function for Inbred Rice – Log Linear Estimates

Variable	Regression Coefficient b	S E of b	t-Ratio
Seed	0.0286**	0.0041	6.98
Manure	0.0042	0.061	0.69
Fertiliser	0.4165*	0.2041	2.04
Irrigation	0.0002	0.046	0.004
Human labour	0.0489**	0.0028	17.49
Machinery labour	-0.0141	0.2631	-0.05
Plant protection	-0.0081	0.4312	-0.19
Constant	2.46**	0.8102	3.04
R ² = 0.74			

Notes: ** Significant at 1 per cent level of probability.

* Significant at 5 per cent level of probability.

Table 6: Reasons for Farmers Continuing with Hybrid Rice Cultivation
(n = 98)

Reasons	Number	Per Cent
Availability of subsidy	66	67.35
Extension support	53	54.08
Better resistance to pests and disease	46	46.94
Better adaptability	32	32.65
High yield	22	22.45

Table 7: Reasons for Discontinuing Hybrid Rice Cultivation
(n = 48)

Reasons	Number	Per Cent
Nonavailability of seed	45	93.75
High cost of seed	43	89.58
Low market price	43	89.58
Low consumer preference	42	87.50
Problems in transplantation	35	72.92
Matures early and causes problems of bird damage	28	58.33

They expressed their willingness to grow hybrid rice again if corrective measures are taken on this front.

IV Conclusions

The comparison of profitability of hybrid and inbred varieties of rice has shown that the former have a distinct yield advantage over the inbred varieties now being cultivated in Karnataka. However, higher costs of production due to higher seed cost, higher level of fertiliser and labour use coupled with lower market prices have completely offset the yield gain recorded for hybrid rice. Overall, the profitability of hybrid rice was a little lower than inbred varieties. This calls for refinement of hybrid rice technology to reduce cost of cultivation and improving the quality of rice to create a demand pull suiting the tastes and preferences of consumers. [27]

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