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HYBRID RICE:
SPREAD OF NEW VARIETIES AND THEIR IMPACT ON THE OVERALL PRODUCTION AND PRODUCTIVITY IN ANDHRA PRADESH

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PREFACE

Rice being the principal food crop for millions of Indians, any short fall in production due to unfavorable monsoon will drastically affect the lives of the poor. Once the recently passed Food security bill comes into effect, the responsibility of maintaining buffer stocks will assume greater importance for the government. Past few decades have witnessed efforts to protecting rice yields that prompted the researchers and administration to focus on modern technologies like hybrid varieties. Though many concerted efforts were made to develop and popularize these varieties, these results were not up to expectation. A variety of reasons were put forward to explain the slow adoption of these hybrids. Though the yields were encouraging the acceptance by the cultivators was slow due to the grain quality of the available hybrids in terms of milling ratio and cooking quality. In this back drop the Ministry of Agriculture, Government of India asked the Agro-Economic Research Centre, Visakhapatnam to conduct a study to investigate the extent of hybrid varieties and its impact on the overall production of rice crop in Andhra Pradesh.

The study found that the spread of hybrid rice was very low though it was introduced more than a decade ago. Ironically Andhra Pradesh is one of the top hybrid seed producing states. Developing hybrid rice varieties that are suitable to the existing market environment would catalyze their acceptance and expansion in the state.

I appreciate the research team of the Centre in putting efforts in finding areas of hybrid rice cultivation that are sparse and dispersed. I am pleased to place on record the good work of my colleagues, Sri N. Ramgopal, Research Officer and Dr. K.V. Giri Babu, Research Associate for drafting the report and Dr. P. Ramu, Research Associate, Sri B. Krishna, Research Fellow in tabulation and analysis. I acknowledge the help of officials of NFSM Cell in Directorate of Agriculture, Andhra Pradesh in selecting the sample and in conducting the study.

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CHAPTER – I

INTRODUCTION:

A) Rice crop in India:

Rice is a staple food crop for major population in India. Expanding population invariably puts pressure on its production. Food security, heralded by Green Revolution slowly petered out with population growth. Changes in life style seeped through all sections of society including the farmer community forcing them to look for higher incomes from the farm. More yield is the motto. This syncs with the pressure the policy makers and scientists are undergoing to raise the yields to meet the supply gap. As the scope of expanding the cultivable area being limited higher focus is put on productivity. In addition to intensification, developing seeds of high yield potential was a challenge for the scientists. Research in to Hybrid rice was given a fillip in the early nineties.

Rice productivity had witnessed deceleration during 1990s. The productivity potential of modern varieties had hit a plateau. Increase in population and shift in consumption from inferior to superior grains has driven the demand for rice to shoot up in the last few years. According to one estimate India would require 118 million tonnes of rice by 2020 to fulfill the requirement of its rising population. The consumption growth in rice is likely to outpace production increase, which might hurt exports, In case of pronounced slowdown, it will inevitably leads to food insecurity and deficiency. A report, prepared by ASSOCHAM says "If we presume less severe conditions for next decade and expect population growth to decline to 1.6 per cent and assume per capita consumption of rice to remain steady at the current 78.5 kg per year, the country will require about 109 million tonnes of rice in 2020. If the acreage remains stagnant in the next decade and the country manages to keep the average yield growth of 1.2 per cent of the last decade in the forthcoming years, the production is likely to grow to about 108 million tonnes". Whatever be the estimates the yield levels of rice remain to be poor when compared to other countries.

Praduman Kumar and Mark W. Rosegrant (1994) observed that the area under rice had increased only slightly during the 1980's. The gains in rice production have essentially from improved utilization of the available infrastructure and from the resulting increase in yield per

unit of land. Public policies such as investment in irrigation, infrastructure development and investment in research and pricing policies have lowered unit cost of production.

Countries such as China have taken a big leap in rice production by going in for hybrid rice cultivation in a big way. Hybrid rice was first commercially cultivated in China in 1976. Area under hybrid rice expanded to more than 13 million hectares by 1990. Hybrid rice not only has a distinct yield advantage over inbred variation but also is more response to fertilizers and can adopt to varying environments. (Jumin et all 2000). Researchers reported 15 percent yield gain for hybrid rice over inbreds, but got lower prices in the market because of poor grain quality compared with conventional HYVs.

India is the World's second largest rice producer. However, by productivity it ranked as low as 16. Close to 40 per cent of the total area under food grains is covered by rice. Out of this 57% of area is rainfed. This underlines the fact that hybridization needs to focus on disease resistant, shorter duration, hardier varieties in addition to increased yields.

Efforts to develop and use hybrid technology in India, through initiated in 1970's have been systematized and intensified since December, 1989, with launching of mission oriented project. National Net work project was started involving 12 centres. The technical support was received from the International Rice Research Institute (IRRI). Philippines, Food and Agricultural Organization (FAO) Rome and financial support from United Nation Development Programme (UNDP), Mahyco Research Foundation, World Bank funded National Agricultural Technology Project (NATP) and IRRI/ADB projects on Hybrid rice. Within a short span of seven years, half a dozen hybrids each from public and private sectors were made available for commercial cultivation.

Hybrid seed production technology has been developed and demonstrated by producing on average seed yield of 1.0 to 1.5 tonne per hectare. During the kharif season of 1996 more than 60,000 hectares were planted with hybrid rice in India. Present area under hybrid rice (2009) is 1.32 million hectares out of total rice area of 44 million hectares (3 per cent).

As the demand for rice is expected to increase, the present rate of yield growth with available High Yielding Varieties (HYVs; also known as inbred varieties) would not meet the future demand. Initial experiences of Hybrid Rice adoption by the farmers during 1994 and 1997in Tamilnadu showed that yields of both conventional HYVs and hybrid varieties were nearly the same but with increased production costs for hybrid rice cultivation. (Janaiah 2000, Janaiah and Hossain 2001).

Based on research farm data it was reported that average yield of some hybrid rice varieties was 6 to 6.5 tonnes per hectare which was about 15 to 20 per cent higher than the yield of the popular conventional HYV/inbred varieties (DRR 1996, 1999).

Though hybrid rice varieties have distinct yield advantage, due to higher seed cost and relative higher fertilizer cost coupled with lower market prices have completely offset the yield gain resulting in lower profitability of hybrid rice over inbred varieties (Chengappa P.G. 2003).

Rice in Andhra Pradesh:

Rice is the Principal crop extensively cultivated in all the districts of Andhra Pradesh both in kharif and rabi seasons. It accounted for 32.74 per cent of the total cropped area, 70.99 per cent of the total food grain production during 2010-11. The area under rice during 2010-11 was 47.51 lakh hectares as against 34.41 lakh hectares in 2009-10, recording an increase of 38.07 per cent. The area under rice increased due to favourable seasonal conditions during the south west monsoon period. The productivity of rice is 3035 kgs/hectares in 2010-11 as against 3150 kgs/hectare in 2009-10.

Andhra Pradesh leads other states in production with 14.42 million tonnes in 2010-11. In terms of area it is next only to Uttar Pradesh (5.66) with 4.75 million hectares. But yield wise it is far superior with 3036 kg/ha against 2118 for Uttar Pradesh. Overall it comes next to Punjab, where the yield is 3830 kg/ha in 2010-11. The productivity of rice at all India level increased from 1984 kg per hectare in 2004-05 to 2372 kg per hectare in 2011-12.

First two hybrids of India were developed and released in Andhra Pradesh in 1993-94. As the existing yield potential was declining many hopes were pinned on these new hybrid rice varieties. Initial euphoria died down as farmers felt that the hybrid varieties were not profitable when compared with modern varieties. This was mainly due to lower market prices because of poor grain quality and higher production costs especially the hybrid seed which was to be bought every year in the market. Until 1998 the area under hybrid rice was very limited to make any impact. "even 10 years after the release of rice hybrids in the state, their acceptance by the farmers is limited, scattered and thin in terms of area coverage under hybrid rice"(Janaiah A, 2003).

Rice Hybrids released in Andhra Pradesh:

Table 1.1 Telangana, Rayalaseema and Uplands of Coastal Andhra

Hybrid	Parentage	Duration (Days)	Yield Hybrid (Tons/ha)	Yield Check Tons/ha	% increase over check
APHR -1	IR 58025 A/Vajram	130 – 135	7.14	5.27 (Chaitanya)	35.4
APHR – 2	IR 62829 A/MTU – 9992	120 – 125	7.52	5.21 (Chaitanya)	44.2
KRH – 1	IR 58025 A/IR9761	120 – 125	6.02	4.58 (Mangala)	31.4
DRRH - 1	IR 58025 A/IR 40750	125 - 130	7.30	5.50 (Tellahamsa)	32.72

Source: Directorate of Rice Research, Hyderabad

Bayer is the major company selling Hybrid rice in Andhra Pradesh. It sold 750 kgs of seed in 2011 kharif and it increased to 11000 kgs in 2012 kharif. These seeds are comparable

with MTU-1001 in kharif and MTU-1010 in rabi in grain quality. It sells under ARIZE-444 GOLD brand. It launched ARIZE DHANI in 2008. According to the company it offers a holistic solution to BLB, a dreaded rice disease causing considerable loss(20-60 percent) to production. The company is optimistic in increasing its sales in the coming years.

Table-1.2 District wise Distribution of Hybrid Rice Seed/Area covered in A.P. 2006-07 to 2011-12

(Qty in Qtls)
(Area in ha.)

S.No.	District	2006-07		2007-08		2008-09		2009-10		2010-11		2011-12 (Plan)	
		Total Qty distributed (Qtls)	Total Area covered (Area in ha)	Total Qty distributed (Qtls)	Total Area covered (Area in ha)	Total Qty distributed (Qtls)	Total Area covered (Area in ha)	Total Qty distributed (Qtls)	Total Area covered (Area in ha)	Total Qty distributed (Qtls)	Total Area covered (Area in ha)	Total Qty distributed (Qtls)	Total Area covered (Area in ha)
1	Vizianagaram	0	0	0	0	0	0	2	10.13	0	0	10.00	66.7
2	Visakhapatnam	0	0	0	0	0	0	2	12.75	0	0	0	0
3	Guntur	0	0	0	0	1	6.00	0	0	0	0	0	0
4	Kurnool	0	0	8	53.00	10	66.00	10	66.00	1.44	9.00	10.00	66.00
5	Ranga Reddy	15.0	99.9	115	765.9	19	126.54	19	124.28	14.87	99.06	26.50	176.59
6	Nizamabad	15.0	99.9	236	1569.266	145	966.54	852	221.84	68.9	459.26	127.00	846.32
7	Medak	15.0	99.9	213	1418.9	143	951.95	119	789.72	43.99	292.66	76.50	509.29
8	Nalgonda	18.4	122.3	0	0.792	0	0.00	0	0.00	0	0.00	0.00	0.00
9	Mahabubnagar	15.0	99.9	127	845.9	31	202.95	28	184.66	28.43	189.10	71.50	476.39
10	Warangal	0.3	1.8	170	1133.486	65	435.36	71	472.85	26.96	179.85	92.00	612.62
11	Khammam	20.4	135.8	20	133.00	26	176.60	20	133.00	2.12	14.00	10.00	66.00
12	Karimnagar	2.6	17.2	238	1585.868	194	1289.86	571	324.88	171.13	1140.99	136.50	909.79
13	Adilabad	7.8	51.8	57	375.966	68	455.63	402	95.00	30.75	204.62	70.00	466.40
14	Hyderabad	0.0	0.0	41	267.83	55	369.20	62	389.25	38.43	256.33	40.00	266.80
	Total	**109.39**	**728.40**	**1224**	**8149.91**	**757**	**5046.63**	**2158**	**2824.37**	**427.02**	**2844.86**	**670.00**	**4462.90**

Source: estimates: Department of Agriculture, Andhra Pradesh

Need for the study:

Lot of impetus has been given to research in Rice production and many programmes were launched to break the yield plateau that has been experienced in rice crop in the past. A number of steps are being taken by the government to popularize new hybrid rice varieties through frontline demonstration, minikit supply, organizing training programmes for farmers, farm women, seed growers, seed production personnel of public and private seed agencies, extension functionaries of state departments of agriculture, researchers of state agricultural universities and NGOs. But there is no clear data to estimate the results of the concerted efforts put in by the government. Therefore, it has become necessary to conduct a study to assess the actual spread of newly developed varieties in terms of area with simultaneous reduction in area under conventional HYVs of rice and the increase in the average yield per hectare. It is hoped that the results of the study would enable the government to formulate the necessary changes in shaping the programmes like "Bringing Green Revolution to Eastern India (BGREI)".

Objectives of the study:

The study aims to:

- indicate the extent of adoption and the level of participation by different categories of farmers in the cultivation of hybrid rice.
- Assess the overall impact on rice production and productivity of hybrid rice Cultivation
- Study the Economics of Cultivation of hybrid rice varieties vis-à-vis inbred varieties.
- Identify factors determining the adoption of hybrid rice varieties.
- Address various constraints and outline the prospects for increasing hybrid rice cultivation
- Suggest policy measures for expansion of hybrid rice cultivation.

Database and research methodology:

The study is based on both primary and secondary data. The data is sourced from Directorate of Economics and Statistics Publications to arrive at the trends in area, production and productivity of rice. The performance of rice in the pre-introduction period of hybrid rice with that in post-introduction period is analyzed. As first hybrids were developed and released for commercial cultivation in India in 1994, the study period was divided into three sub periods viz., 1984-85 to 1993-94, 1994-95 to 2003-04 and 2004-05 to 2009-10. The period 1 viz., 1984-85 to 1993-94 refers to the pre-introduction period at hybrid rice while other two periods viz., period – 2 and 3 correspond to post-introduction periods.

The log-linear growth rates for area, production and productivity of HYV paddy are estimated to find out the variations among the sub-periods and also the different seasons of the crop. To observe the variations among the time series data of area, production and productivity of paddy over a period of 26 years, the coefficients of variation are estimated for all the sub-periods and also for total period. Further, a logit function based on the primary data is estimated to identify the impact of the determinants over the yields. A log-linear regression (based on the primary data) is computed to observe the impact of explanatory variables over the yields.

For primary survey, NFSM cell in the state department of Agriculture was consulted and two districts where higher concentration of hybrid rice cultivation was practiced were chosen. No proper records were found regarding hybrid rice cultivation either with Department of Agriculture or with Directorate of Economics and Statistics as its cultivation is very sparse and widely distributed. Farmers who cultivate hybrid rice in successive years are even rare. Nizamabad district in Telangana and Srikakulam from North Coastal Andhra area were selected on the advice of state Agricultural Department where higher concentration of hybrid farmers were found. In fact, Nizamabad is known for hybrid rice seed production. In each district, 40 hybrid rice growers from the list of hybrid rice growing cultivators from different size groups, marginal (less than 1 hectare), small (1 to 2 ha), medium (2 to 4 hectares) and large (more than 4 hectares) including SC, ST and Women farmers were selected on the basis of their proportion in the Universe. In addition to this sample, 10 inbred variety (traditional HYVs) rice

growers but non-adopters of hybrid rice were selected randomly from the same land size groups following the same procedure. Thus, 50 rice growing cultivators were selected from each district.

For the primary survey, the reference years are 2009-10 and 2010-11. Accordingly, 2 kharif and 2 rabi seasons for the rice crop were covered in the study. A structured schedule/questionnaire was used to obtain information from the sample cultivators.

Organization of the study:

In the introductory chapter, the back drop of the study, ie., the stagnancy in area and yields of rice crop and efforts to develop and introduce the hybrid rice is discussed. Objectives, research methodology are also covered in this chapter. Second chapter mainly deals with secondary data covering trends and composition of rice in the state and growth and instability of rice production. Socio-economic characteristics of sample farmers, their distribution according to farm size, cropping pattern, their access and extent of adoption of hybrid rice at the farm level and determinants of participation are analyzed in the third chapter. Fourth chapter concentrates on relative yield performance of hybrids and HYVs, yield gain from hybrid rice over HYVs and factors contributing to yield. Economics of hybrid and inbred rice cultivation is analyzed in chapter five by going through input use pattern, operation-wise labour absorption and relative incomes. Chapter six deals with the volume of marketing by season and the grain quality traits of hybrid and HYV rice. Farmers awareness, problems faced in hybrid rice cultivation and their overall perception, non-adoption of hybrid rice by other cultivators are discussed in chapter seven. The seventh chapter summarizes the report and highlights the findings and focuses on policy recommendations.

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Note: There is no proper record of area under hybrid rice crop either with Department of Agriculture or the Bureau of Economics and Statistics. Selection of sample is based on estimates of seed sales by private companies supplied by the Department of Agriculture, Andhra Pradesh.

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CHAPTER – II

Rice crop in the state

Introduction:

The present chapter deals with the trends in Area, Production and Yields of total paddy in the state for the periods (1) 1984-85 to 1993-94, (2) 1994-95 to 2003-04, (3) 2004-05 to 2009-10 and (4) 1984-85 to 2009-10. The season wise Compound growth rates and co-efficient of variations are also estimated for the area, production and productivity of paddy crop for the same above mentioned periods.

2.1 Trends in Area, Production and Productivity of paddy (Rice) in the State.

The details of Area, production and productivity of paddy are presented in the Table 2.1. Wide fluctuations are observed in the area and production under paddy over a period of 26 years. The year to year variations of area and production of paddy showed a declining trend. The reason for the decline may be attributed to the erratic conditions of rain fall and inadequacy of irrigation facilities. The per hectare yield varied form 1951 kgs in 1986-87 to 3345 kgs during 2007-08. As in case of area and production, the decrease is also observed in year to year variations of yield.

Looking at the sub-periods, production variations in relation to the changes in the area are observed during first sub-period (1984-85 to 1993-94). Accordingly, the fluctuating trend is also observed the case of yields during that period. The yield rate is ranged between 1951 kgs in 1986-87 and 2759 kgs in 1993-94. On the other hand, the yield rate of paddy varied from 2471 kgs in 1997-98 to 2978 kgs in 2001-02 in the second sub-period. Moreover highest rate of yield is recorded during 2007-08 i.e., during the sub-period.

Glancing over the seasonal variations, the Rabi yield showed an increasing trend from year to year over a period of 26 years compared to the Kharif yields. This increasing trend is mostly observed in the second and third sub-periods inspite of the area allocation is

Table -2.1
Trend and Composition of Total Paddy (Rice) in the State

(Area in 000'ha, Production in 000' tones, Yield in kgs/ha)

Years	Kharif			Rabi			Total		
	A	P	Y	A	P	Y	A	P	Y
1984-85	2592 (74.10)	4858 (70.31)	1916	905 (25.87)	2051 (29.69)	2328	3498 (100)	6909 (100)	2021
1985-86	2609 (75.58)	5585 (73.36)	2045	843 (24.42)	2028 (26.64)	2483	3452 (100)	7613 (100)	2264
1986--87	2625 (75.89)	4587 (69.59)	1786	834 (24.11)	2004 (30.41)	2473	3459 (100)	6591 (100)	1951
1987-88	2234 (69.66)	4669 (65.88)	2132	973 (30.34)	2418 (34.12)	2551	3207 (100)	7087 (100)	2258
1988-89	3061 (72.57)	7443 (70.08)	2483	1157 (27.43)	3178 (29.92)	2309	4218 (100)	10621 (100)	2572
1989-90	3134 (74.51)	7115 (71.44)	2316	1072 (25.49)	2844 (28.56)	2715	4206 (100)	9959 (100)	2403
1990-91	3047 (75.50)	6985 (72.35)	2340	989 (24.50)	2669 (27.65)	2758	4036 (100)	9654 (100)	2442
1991-92	3029 (76.96)	6748 (72.96)	2273	907 (23.04)	2501 (27.04)	2828	3936 (100)	9249 (100)	2400
1992-93	2705 (75.05)	6365 (72.40)	2405	899 (24.94)	2427 (27.60)	2768	3604 (100)	8792 (100)	2495
1993-94	2475 (69.78)	6346 (66.37)	2623	1072 (30.22)	3216 (33.63)	3088	3547 (100)	9562 (100)	2759
1994-95	2511 (69.04)	5989 (64.56)	2438	1127 (30.99)	3288 (35.44)	2994	3637 (100)	9277 (100)	2609
1995-96	2590 (70.15)	5998 (66.54)	2369	1102 (29.85)	3016 (33.46)	2807	3692 (100)	9014 (100)	2498
1996-97	2808 (68.32)	6745 (63.12)	2450	1301 (31.65)	3941 (36.88)	3096	4110 (100)	10686 (100)	2654
1997-98	2383 (68.09)	5218 (61.32)	2213	1117 (31.91)	3292 (38.68)	2915	3500 (100)	8510 (100)	2471
1998-99	2812 (65.14)	7006 (58.98)	2544	1504 (34.84)	4872 (41.02)	3313	4317 (100)	11878 (100)	2812
1999-00	2849 (70.98)	7056 (66.33)	2529	1156 (28.80)	3582 (33.67)	3154	4014 (100)	10638 (100)	2710
2000-01	3004 (70.80)	8234 (66.09)	2741	1239 (29.20)	4224 (33.91)	3409	4243 (100)	12458 (100)	2936
2001-02	2426 (63.42)	6501 (57.08)	2679	1399 (36.58)	4889 (42.92)	3496	3825 (100)	11390 (100)	2978
2002-03	2109 (74.73)	5054 (68.98)	2397	713 (25.27)	2273 (31.02)	3189	2822 (100)	7327 (100)	2597
2003-04	2109 (53.06)	5842 (65.25)	2772	866 (21.79)	3111 (34.75)	3594	3975 (100)	8953 (100)	3011
2004-05	2215 (71.78)	6393 (66.59)	2886	871 (28.22)	3208 (33.41)	3683	3086 (100)	9601 (100)	3111
2005-06	2526 (63.44)	6377 (54.49)	2524	1456 (36.56)	5327 (45.51)	3659	3982 (100)	11704 (100)	2939
2006-07	2641 (66.39)	6949 (58.53)	2631	1337 (33.61)	4923 (41.47)	3681	3978 (100)	11872 (100)	2984
2007-08	2578 (64.71)	8191 (61.48)	3178	1406 (35.29)	5133 (38.52)	3650	3984 (100)	13324 (100)	3345
2008-09	2803 (63.89)	8380 (58.84)	2989	1584 (36.11)	5861 (41.16)	3700	4387 (100)	14241 (100)	3246
2009-10	2063 (59.95)	5956 (54.95)	2887	1378 (40.05)	4882 (45.05)	3543	3441 (100)	10838 (100)	3150

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh, Hyderabad.

lesser in Rabi than the area under Kharif. On the other hand in first subs-period there was a marginal increase or decrease has been observed in Kharif yields. This inference that owing to vagaries of monsoon and inadequate irrigation facilities during Kharif, the expected yields could not be achieved.

2 2: Growth and Instability of Rice Production in the State

2.2.1:- Compound Growth Rate of area, Production and Productivity of Total Paddy (Rice) in the State.

The changes that have been observed among the area, Production and Productivity of paddy over a period of 26 years are presented in the form of growth rates in Table 2.2. On the whole the growth rates of production and yield of paddy are found to be statistically significant, though there is no significant increase in area. Across the sub-periods, the yield of paddy showed a significant growth in the first and second sub-periods. While in the third sub period no significance is observed. The growth rates of Area in all the sub periods are found to be not significant but showed a negative growth in the second sub-period.

Observing the seasonal growth rates of yields across the sub-periods, positive significance of yields is observed in the two seasons of 1st sub period. While the yield rate in Rabi of second sub-period is only is reported as significant. No significant growth is reported in any case of both seasons during third-sub-period. As a whole it can be concluded that the reason for showing significance of yield rates may be due to the quality seed but not due to the changes in any of other variables.

Table-2.2
Compound Growth Rates of Area, Production and Productivity of total Paddy (Rice) in the State

Years	Kharif			Rabi			Total		
	A	P	Y	A	P	Y	A	P	Y
1984-85 to 1993-94	9.1373 (0.72)	3.8869** (2.36)	3.258* (4.10)	1.4342 (1.22)	3.9991** (2.70)	2.6484* (4.96)	1.0664 (1.02)	3.9331** (2.71)	2.8389* (3.97)
1994-95 to 2003-04	-1.8373 (-1.42)	-.1400 (-0.08)	9.7794 (0.56)	-3.0349 (-1.29)	-0.5816 (-0.21)	2.1606* (3.97)	-0.5671 (-0.39)	-0.2535 (-0.13)	1.5867** (2.54)
2004-05 to 2009-10	-0.1926 (-0.06)	1.7996 (0.49)	1.9940 (0.98)	7.4195 (1.75)	6.9368 (1.58)	-0.4822 (-1.41)	2.3900 (0.75)	3.7426 (1.14)	1.3558 (1.20)
1984-85 to 2009-10	-0.5.949*** (-1.98)	0.9389** (2.34)	1.3132 (0.52)	1.5160* (3.14)	3.4453* (6.67)	1.8964* (15.13)	0.1802 (0.62)	1.8211* (4.59)	1.6490* (10.83)

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh, Hyderabad.

Note: Parentheses refer to 't' values.

* 1% level of Significance, ** 5% Level of Significance, *** 10 % level of significance

Table2.3
Coefficient of Variation (CV) in Area, Production and Productivity of total Paddy (Rice) in the State

Years	Kharif			Rabi			Total		
	A	P	Y	A	P	Y	A	P	Y
1984-85 to 1993-94	10.94	17.63	11.66	11.13	17.60	9.30	9.52	16.70	10.34
1994-95 to 2003-04	12.11	14.93	35.34	20.32	22.92	8.01	11.46	16.42	7.22
2004-05 to 2009-10	11.24	14.43	8.36	18.26	18.35	1.55	12.21	14.00	4.91
1984-85 to 2009-10	11.64	15.95	23.72	20.90	32.25	14.60	10.37	19.64	13.27

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh, Hyderabad.

2.2.2: Coefficient of Variation (C.V) in area, Production and Productivity of Total Paddy (rice) in the State.

Observing the variations among area, production and productivity of Total period (1984-85 to 2009-10), wide range of co-efficient is observed in the case of yields across the sub-periods than the co-efficient of area and production. Comparing the seasons, lesser variations are observed in the yields of Rabi season than in the Kharif season across the periods.

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CHAPTER – III

Adoption of Hybrid rice among the sample households

Introduction:

This chapter deals with socio-economic profile of selected farmers of hybrid rice adopters and non-adopters. Their farm size distribution, cropping pattern, access to hybrid rice technology and level of adoption at farm level are discussed here. Determinants of participation in hybrid rice cultivation are analyzed at the end.

3.1. Socio-economic characteristics of the sample farmers:

The sample comprises of 80 hybrid rice adopters and 20 non-adopters spread over 2 districts and different farm size groups. The average size of household for hybrid adopters is 4.6 and it is 4.2 for non-adopters, on the aggregate it is 4.5. For the males it is 2.4 in hybrid adopters and 2.1 in the non-adopters. The average worker size in hybrid rice farmers is 2.76 while it is 1.47 in non-adopter group. About 76.36 per cent of hybrid adopters are in the age group of 18-60. The same age group accounts for 78.57 per cent in non-adopters.

It is well known that education is the key in accepting new-technologies. In the same vein it is significant to note that 2.44 per cent of people in hybrid adopter group persued education beyond graduate level while it is nil in non-adopters. In hybrid adopter group 14.63 per cent of people are graduates while it is 10 per cent in non-adopters. Of the remaining educated in the hybrid farmer group 26.83 per cent had primary education and 45.12 per cent had secondary education. In the non-adopters the corresponding figures are 45 and 25 per cent. Illiterates are higher in non-adopters while it is only half in hybrid rice adopters. These observations indicate that technology acceptance has a positive link with level of education.

The sample does not have any ST farmers. While the non-adopters have a SC population of 30 per cent, it is only 7.5 per cent in hybrid adopters. OBC's dominate in both groups. While it is 76.25 per cent in hybrid adopter group; the other group has only 50 per cent.

All the heads of household in the sample, both in hybrid adopters and non-adopters, reported self-employment farming as main occupation.

For hybrid farmer sample the average size of land in owned category is 5.08 ha and in operational land it is 5.10 ha. The corresponding figures are 4.21 ha and 4.21 ha in non-adopter group.

There is no summer crop in the sample area. The average irrigated land in hybrid adopters group is 4.07 ha and forms 60 per cent of the total irrigated land in the year. The remaining 40 per cent land (2,68) is irrigated in the rabi season. In the non-adopter group it is slightly lower at 2.88 ha (58 per cent) in kharif and 2.12 ha (42 per cent) in rabi season.

Table-3.1: Socio-economic characteristics of sample farm households

Characteristics		Hybrid adopters	Non-adopters	Aggregate
Household size	Male	194	43	237
	%	52.72	51.19	52.43
	Female	174	41	215
	%	47.28	48.81	47.57
	Total	368	84	452
Size of worker	Male	118	31	149
	%	53.39	52.54	53.21
	Female	103	28	131
	%	46.61	47.46	46.79
	Total	221	59	280
Age group	< 18	87	18	105
	%	23.64	21.43	23.23
	18 - 60	281	66	347
	%	76.36	78.57	76.77
	> 60	0	0	0
	%	0	0	0
Educational status	Illiterate	9	4	13
	%	10.98	20	12.75
	Up to Primary	22	9	31
	%	26.83	45	30.39
	Up to secondary	37	5	42
	%	45.12	25	41.18
	Up to Graduate	12	2	14
	%	14.63	10	13.73
	Above Graduate	2	0	2
	%	2.44	0	1.96
Caste	SC	6	6	12
	%	7.5	30	12
	ST	0	0	0
	%	0	0	0
	OBC	61	10	71
	%	76.25	50	71
	General	13	4	17
	%	16.25	20	17
Main occupation of the head	Self-employed Farming	80	20	100
	%	100	100	100
	Self-employed Non-farming/ Business	0	0	0
	%	0	0	0
	Salaried Person	0	0	0
	%	0	0	0
	Agriculture Labour	0	0	0
	%	0	0	0
	Non-agricultural Labour	0	0	0
	%	0	0	0
	Pensioner,	0	0	0
	%	0	0	0
	Household Work	0	0	0
	%	0	0	0
	Student	0	0	0
	%	0	0	0
	Others (specify)			
	%			
Average size of holding (ha)	Ownership holdings	5.08	4.21	4.91
	Operational holdings	5.10	4.21	4.93
Average size of irrig.d land (ha)	Kharif	4.07	2.88	3.88
	%	60.00	58.00	60.00
	Rabi	2.68	2.12	2.60
	%	40.00	42,00	40.00
	Summer	-		
	%	-		
	Total	6.75	5.00	6.47

Source: Field survey data

3.2. Distribution of sample farmers:

Based on the operational holding the sample farmers represent 4 farm size groups. About 40 per cent have below 1 ha land, 30 per cent have 1-2 ha land 20 per cent have 2 – 4 ha. Only 10 per cent of farmers posses land above 4 ha. This categorization is applied to both hybrid adopters and non-adopters. Details are presented in Table 3.2.

Table – 3.2: Distribution of sample farmers according to farm size

Size classes of operational holdings (ha)	Hybrid adopters		Non-adopters	
	No of farms	Percent of farms	No of farms	Percent of farms
Below 1ha	32	40.00	8	40.00
1 – 2	24	30.00	6	30.00
2 – 4	16	20.00	4	20.00
4 – 10	8	10.00	2	10.00
Total	80	100	20	100

Source: Field survey data

3.3. Cropping Pattern:

Area under different crops for the sample farmers is given in Table 3.3. Predominant crops in kharif are hybrid paddy, HYV paddy, Groundnut and Turmeric. In rabi season again paddy, both hybrid and HYV are grown along with Blackgram, Sesamum, Groundnut, Turmeric are grown. Maize and Greengram are also raised in small areas.

Hybrid adopters have brought larger area under hybrid paddy in 2010-11 when compared to 2009-10. It increased from 29.38 per cent to 39.35 per cent. Understandably area under HYVs recorded a decrease from 54.30 per cent to 44.60 per cent in this group for the same period. For non-adopters the area under HYV paddy remained the same. Groundnut is the next leading crop with 6.39 per cent. It has shown no change in the two year period. In Nizamabad district turmeric is widely grown as a commercial crop. It occupies 5.25 per cent of cropped area in 2009-10 and 5.16 per cent in 2010-11 for hybrid adopters. For non adopters, after HYV pady turmeric is the major crop with 20.40 of the cropped area. It is static in the two year period.

Table 3.3: Cropping pattern for the years 2009-10 and 2010-11

Season/Crops	Hybrid adopters				Non-adopters			
	2009-10		2010-11		2009-10		2010-11	
	Area (Ha)	Percent	Area (Ha)	Percent	Area (Ha)	Percent	Area (Ha)	Percent
Kharif								
Hybrid Paddy	41.89	29.38	57.06	39.35				
HYV Paddy	77.42	54.30	64.67	44.60	24.08	79.60	24.08	79.60
groundnut	9.11	6.39	9.11	6.28				
Turmeric	7.49	5.25	7.49	5.16	6.17	20.40	6.17	20.40
Soya been	2.23	1.56	2.23	1.54				
Maize	2.02	1.42	2.02	1.40				
Sugarcane	2.43	1.70	2.43	1.67				
Total	142.57	100.00	145.00	100.00	30.25	100.00	30.25	100.00
Rabi								
Hybrid Paddy	35.81	37.90	36.62	41.32				
Hyv Paddy	10.12	10.71	5.67	6.39	12.95	72.32	12.95	72.32
black gram	8.70	9.21	8.30	9.36	0.81	4.52	0.81	4.52
Seasmum	9.51	10.06	8.90	10.05	0.40	2.26	0.40	2.26
Groundnut	21.85	23.13	21.65	24.43	3.24	18.08	3.24	18.08
G.GRAM	1.82	1.93	1.82	2.05				
Turmeric	4.05	4.28	4.05	4.57	0.51	2.82	0.51	2.82
Maize	2.63	2.78	1.62	1.83				
Total	94.49	100.00	88.63	100.00	17.91	100.00	17.91	100.00

Source: Field survey data

In Rabi season groundnut occupies the second place by replacing turmeric's position. Hybrid adopters have increased area under hybrid rice from 37.90 per cent in 2009-10 to 41.32 per cent in 2010-11. However, in the same period HYV paddy has shown a decrease in area from 10.71 per cent to 6.39 per cent. But, in non adopter category HYV paddy did not show any change. In the hybrid adopter group crops like blackgram and sesamum have shown no change in area. The area under groundnut indicated marginal increase of 1.30 per cent in the said period. Green gram and Turmeric remained static while maize has shown slight dip in area from 2.78 per cent to 1.83 per cent in 2009-11. In the same period the non-adopters have shown no change in area under different crops. This might be an indication of their un-willingness to embrace hybrid rice.

Table 3.4: The extent of adoption of hybrid rice technology by farm size

(For hybrid adopters only)

Farm Size Classes (ha)	2009-10						2010-11					
	Average Farm Size (ha)	Average Rice Area (ha)	Average rice area (ha) under		Percent of rice area under		Average Farm Size (ha)	Average Rice Area (ha)	Average rice area (ha) under		Percent of rice area under	
			HYVs	Hybrid	HYVs	Hybrid			HYVs	Hybrid	HYVs	Hybrid
Below 1 ha	1.35	1.15	0.37	0.78	7.12	17.61	1.36	1.15	0.26	0.90	5.99	17.34
1-2	2.92	2.19	1.22	0.97	23.46	21.90	2.92	2.19	1.03	1.16	23.73	22.35
2-4	5.23	3.18	2.31	0.88	44.42	19.86	5.15	3.13	1.66	1.47	38.25	28.32
Above 4	5.04	3.10	1.30	1.80	25.00	40.63	4.77	3.06	1.39	1.66	32.03	31.98
All Sizes	3.64	2.41	1.30	1.11	100.00	100.00	3.55	2.38	1.09	1.30	100.00	100.00

Source: Field survey data

3.4. Extent of adoption of Hybrid rice technology at farm level:

An attempt is made to gauge the extent of hybrid rice penetration in sample rice growing households. Area under rice crop gradually increased as the size of the land holding increased. It was 1.15 ha in below 1 ha group and went up to 3.18 ha in 2 to 4 ha size group. On an average the rice area is 2.41 ha in the hybrid adopters group. Out of this hybrid rice crop occupies 1.11 ha (46%). Once again the large farmer group (above 4 ha) holds the highest average of 1.80 ha of hybrid rice area in 2009-10. But this figure fell marginally to 1.66 ha by 2010-11. The largest chunk of area under HYVs (44.42%) is under 2 to 4 ha group. But in hybrid rice growers it is the above 4 ha category that holds highest acreage (41 per cent) of hybrid rice in 2009-10. Even though there is slight increase in average area under hybrid rice from 1.11 ha to 1.30 ha the same type of holding pattern continued in 2010-11 also. The details are presented in Table 3.4.

3.5. Exposure to Hybrid rice Technology:

Hybrid rice cultivation is relatively new to Srikakulam district whereas Nizamabad district has some pockets where hybrid rice seed production is popular. The channels of information is analysed in Table 3.5. Seventy farmers (87.50 per cent) were exposed to this technology through frontline demonstration programme conducted by government followed by 64 (20 per cent) who got the knowledge from private seed companies, Government extension workers are also seem to be active as 63 (78.75) per cent reported having gained this knowledge from them. About 44 per cent got the information through television whereas news papers was the medium of knowledge for 40 per cent. Progressive farmers have also played a key role in dispersing this knowledge as 31 per cent of farmers got benefitted by them.

Table – 3.5: Farmers accessing source of information on hybrid rice technology

(For Hybrid adopters only)

Source	Number of farmers reporting	Percent of farmers reporting
Frontline demonstration programme conducted by government	70	87.50
Participation in training programme organized by the government	30	37.50
Krishi vigyan Kendra		
Extension worker of state department of agriculture	63	78.75
Television	35	43.75
Radio	14	17.50
Newspaper	32	40.00
Input dealer	40	50.00
Progressive farmer	25	31.25
Private agency/ NGO	64	80.00
Output buyers/food processor	20	25.00
Credit agency	5	6.25
Others	0	0.00

Source: Field survey data

3.6.: Quality of information received

Respondents were asked to rate the information they have received from different sources. Their responses were presented in Table 3.6. Training programmes conducted by the government were poor according 43 per cent of respondents. But nearly that number (40%) of people said that they were satisfied. Only 5 per cent were convinced that the programme were good. Demonstration programmes received good feed back as a majority (57 per cent) expressed satisfaction. Only 29 per cent rated these as poor. Similarly a good number (56 per cent) have expressed satisfaction regarding the information they received from Agricultural department extension workers about hybrid rice. Significant number (21 per cent) has rated the same information as 'good'. However, a little more than that number (24 per cent) has derided the information from extension worker as 'poor'.

Table–3.6: Farmers reporting quality of information received among those accessing the source

(For hybrid adopters only)

Source	Hybrid adopters reporting quality of information received		
	Good	Satisfactory	Poor
Participation in training programme conducted by the government	5 (16.67)	12 (40.00)	13 (43.33)
Participation in demonstration Programme organized by the government	10 (14.29)	40 (57.14).	20 (28.57)
Extension worker of state department of agriculture	13 (20.63)	35 (55.56)	15 (23.81)
Krishi vigyan Kendra			

Note: Figures in brackets indicate percentages Source: Field survey data

3.7. Adoption of recommended practices:

Receiving information about the new technology of hybrid rice is only first step. Better results would follow only when the recommended practices are translated at the field level. As expected farmers who cultivate inbred or HYVs are better equipped technology wise. Hence, all of them are practicing recommended packages. In hybrid rice technology demonstration programme 88 per cent of farmers have participated. About 79 per cent of them are also practicing the recommendations of the extension workers of state department of agriculture. Training programmes conducted by the government did not show much impact as only 38 per cent of hybrid farmers are practicing their suggestions.

Table–3.7: Farmers reporting adopted recommended package of practices in rice cultivation

(Percent of farmers reporting)

Source of information	Hybrid Adopters		Non-Adopters
	Hybrid Rice	HYV Rice	HYV Rice
Participation in training programme conducted by the government	37.50	80.00	75.00
Participation in demonstration Programme organized by the government	87.50	60.00	60.00
Extension worker of state department of agriculture	78.75	50.00	50.00
Krishi vigyan Kendra	-	-	-

Source: Field survey data

3.8. Sources of Hybrid rice seed:

State agricultural departments are supplying hybrid rice seed on partial subsidy under NFSM programme. Half of the sample farmers said they have received seed under this programme. Rest of the half depended on private seed companies (Table 3.8).

Table:3.8 Farmers accessing sources of seed for Hybrid rice cultivation

(For hybrid adopters only)

Sources of seed	2009-10		2010-11	
	Number of farmers reporting	Percent of farmers reporting	Number of farmers reporting	Percent of farmers reporting
Public on full subsidy	-	-	-	-
Public on partial subsidy	30	38	40	50
Private	50	62	40	50

Source: Field survey data

3.9: Determinants of participation in Hybrid Rice cultivation:

This section deals with the analysis of the determinants of participation of the selected households of selected districts in Hybrid rice. To analyze the determinants of involvement in Hybrid rice and to attribute a weight to those determinants the logit model is used. The Ordinary Least Squares (OLS) method of equations is also used for analyzing the determinants of participation of household at household level and at a member level.

The form of logit model equation is:

$\text{Log } (p/1-p) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_k X_k$

Where p is the probability that Y=1 and X_1 X_2 ……X_k are the independent variables. $\beta_0, \beta_1, \beta_2 \ldots\ldots \beta_k$ are known as the regression co-efficient which are estimated through the data. The Logit/Logistic regression estimates the probability of a certain event occurring.

In the present analysis the form of logit function is

$\text{Ln } Y = L_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6.$

Where,

Y= Dummy household Participation in Hybrid Rice.

L0= constant

X_1= Age (in years)

X_2= Education (number of years of schooling)

X_3= House Hold size (in numbers)

X_4= Size of worker (in numbers)

X_5= Farm Size Dummy

X_6= Irrigated land (in ha)

$\beta_1,\beta_2,\beta_3.....\beta_6$ are the regression co-efficient.

3.6.1 Discussion of the Regression Results:

Logit model of Regression:

The results of the Logit Regression are presented in the following Table 3.9

Table 3.9 – Determinants of participation in Hybrid rice Cultivation (Logit)

Variable	Co-efficient	Std. Error	't' value
Age(X1)	0.027	0.032	0.398
Education(X2)	0.091	0.067	0.173
HH Size (X3)	0.478	0.271	0.078
Size of worker (X4)	-0.615	0.349	0.078
Farm Size (X5)	-0.059	0.095	0.537
Irrigated land (X6)	0.291	0.195	0.135
Constant	-1.459	1.909	0.445
No. of observations = 100			
Log likelihood = 90.084			
Pseudo R^2 = 0.150			

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CHAPTER – IV

Impact of cultivation of hybrid rice on overall production of rice

Introduction:

Yield of hybrid rice, which is its main winning factor, over different size groups is analyzed in comparison with inbred varieties (HYV). The yield gains of hybrid rice over inbred varieties are also discussed size group wise in this chapter.

4.1. Yield performance of hybrid and HYV rice.

Data relating to mean yields of hybrid and HYV rice are presented in Table 4.1. Yield performance by farm size is analyzed here. Mean yield of hybrid rice has shown variation from 68.13 quintals per hectares in 1 – 2 hectare group to 80.62 quintal per hectare in 2 – 4 hectare group in the year 2009-10. In the same year mean yields of HYVs varied from 51.13 quintals per hectare in above 4 hectare group to 56.07 quintal per hectare in 1 – 2 hectare group. It appears from the yield data that there is not much significance to the farm size to yield levels.

Table 4.1: Mean yield levels of hybrids and HYVs of rice by farm size on sample farms

Farm Size classes (ha)	2009-10			2010-11		
	Mean Yield (Qtl./ha)		Percent difference	Mean Yield (Qtl./ha)		Percent difference
	Hybrid	HYVs		Hybrid	HYVs	
Below 1 ha	68.71	53.05	22.79	69.75	53.56	23.21
1-2	68.13	56.07	17.70	69.04	56.38	18.34
2-4	80.62	53.53	33.60	71.25	51.96	27.07
4 ha and above	70.01	51.13	26.97	70.25	51.4	26.83
All Sizes	70.93	54.00	23.87	69.99	53.37	23.75

Source: Field survey data

When differences in yields are compared by farm size, 1 – 2 hectare group has shown 18 per cent where as the highest difference 34 per cent formed in 2 – 4 hectare group in the year 2009-10. On an aggregate the mean yield of hybrid rice is 70.83 quintals per hectare and HYVs yielded 54 quintals per hectare. The average difference in the mean yield is 23.87 per cent in 2009-10. In the following year, is 2010-11 the overall mean yield has shown little decline and stands at 69.99 quintals per hectare for hybrids and 53.37 quintals per hectares for HYVs. The percentage difference in yield is 23.75.

4.2. Yield gain of hybrid rice over the inbred rice varieties.

Yield gain of Hybrid rice over HYVs varied from 12.06 per quintal in 1-2 hectare group to 27.09 per quintal in 2-4 hectare group in 2009-10. Overall average in 2009-10 is 16.93 quintals per hectare (Table 4.2). In the following year 2010-11, the yield gain varied from 12.66 to in 1-2 ha group to 18.85 quintals per hectare in 4 ha and above group. The average yield gain stands at 16.62 quintals per hectare.

Table 4.2: Size-group wise distribution of yield gain of hybrid rice over inbred rice (HYVs)

Size groups of Sample farms	During 2009-10	During 2010-11
	Yield gain of Hybrid over inbred rice (HYVs) qtls/ha.)	Yield gain of Hybrid over inbred rice (HYVs) qtls/ha.)
Below 1 ha	15.66	16.19
1-2	12.06	12.66
2-4	27.09	19.29
4 ha and above	18.88	18.85
All Sizes	16.93	16.62

SOURCE: Field survey

4.3 Factors affecting the yield of hybrid rice:

The log-linear function is estimated to observe the impact of independent variables over the yield in the above Table 4.3. In case of adopters, the variables employed in the regression analysis, only pesticides application and Human labour are found to be statistically significant. The significance of the coefficient of pesticides indicate that, since the yielding capacity of the seed deteriorates due to pest attacks, timely application of pesticide is important to maintain the strength of the seed by avoiding pest attacks. On the other hand the usage of machine labour is reported a negative and non-significant trend. Moreover, the negative co-efficient of seed indicates the non-suitability of the soil for this type of seeds.

On the other hand, in the case of non-adopters, among the variables only irrigation is reported to be significant. This indicates that, the timely and adequate irrigation results in obtaining better yields irrespective of the influence of other variables. Even in case of non-adopters the negative co-efficient of seed inferences the low fertility of the soil, for the usage of modern high yielding varieties of seeds.

Table 4.3 Factors affecting Yield of Rice

Sl.No	Independent Variable	Adopters			Non Adopters		
		b	std.Error	t	b	std.Error	t
1	Constant	2233.97 *	48.031	46.511	1683.517 *	153.846	10.943
2	seed	-0.032	-0.76	-1.204	-0.049	-0.377	0.457
3	Manure	0.007	0.027	0.058	0.06	0.045	1.334
4	Chemical Fertilizer	-0.007	0.021	0.274	0.024	0.043	0.562
5	Pesticide	0.061 ***	0.031	1.972	-0.169	-0.118	0.181
6	Irrigation	-0.002	0.018	-0.031	0.071 **	0.032	0.047
7	Human Labour	0	0.009	-0.051	0.009	0.02	0.683
8	Bullock Labour	0.151 **	0.069	1.017	-0.021	0.083	-0.255
9	Machine Labour	-0.04	0.025	-1.019	-0.009	0.035	-0.27

R2= 0.207 (Adopters), R2= 0.595

* 1% level Significance, ** 5% level of significance, *** 10% level of significance

CHAPTER – V

Comparative economics of hybrid and inbred rice cultivation

Introduction:

This chapter mainly aims to focus on comparative economics of hybrid and inbred rice cultivation by analyzing input use pattern, operation-wise labour use, relative input costs and comparative returns for the year 2009-10 and 2010-11.

5.1. Input use for hybrid and HYV rice cultivation:

The pattern of use of different inputs like seed, manure, chemical fertilizers, pesticides, number of irrigation given, charges incurred and human labour days employed on Hybrid and inbred rice are enumerated in Table 5.1. While the seed for inbred varieties is 55 kgs per hectare, the same farmers have reported lesser, almost one third, use of hybrid seed (15 kgs) per hectare. One way this compensates the high cost incurred on hybrid seed. Non-adopters of hybrid rice have reported slightly higher use of seed of 57 kgs per hectare in 2010-11. Cattle manure is widely used in the study area. Farmers who do not have cattle are buying manure from others. There is not much difference in use of manure between hybrid rice growers and non-adopters. It ranges from 5 tonnes to 5.25 tonnes per hectare. Though there is an impression that hybrid rice needs more fertilizers, farmers in the sample did not report any additional use of chemical fertilizers. Whereas hybrid rice farmers used same amount of chemical fertilizers i.e., 250 kgs per hectare the non-adopters used little more (260 kgs/ha) for inbred rice varieties. Even in the use of pesticides, hybrid rice farmers used restraint and sprayed only 3 times for both hybrid and inbred varieties. Non-adopters sprayed 4 times instead. A look at the irrigation charges reveal a lower expenditure of Rs1400 and Rs1410 for hybrid and inbred varieties respectively by hybrid rice farmers. Non-adopters incurred a higher cost of Rs1440 for inbred varieties of rice. Use of human labour is significantly lower in hybrid rice farming according to the sample farmers of hybrid growers. While they have employed 99.52 days of human labour for inbred varieties it was only 78.28 days for hybrid rice. Even use of bullock labour is less for hybrid rice cultivation when compared to HYVs amongst both hybrid and non-hybrid cultivators (Table 5.1).

Table 5.1
Input use pattern of Cultivation of Hybrid and Inbred Rice (2010-11)

Inputs	Hybrid Adopters		Non adopters
Costs	Hybrid	Hyvs	Hyvs
seed (Kg/ha)	15	55	57
Manure (tonne/ha)	5.25	5.00	5.20
chemical fertilisers(Kg/ha)	250	250	260
pesticides(No. of sprays)	3	3	4
irrigation (no of application)(charges in Rs/ha	1400	1410	1440
Human labour (days/ha)	78.28	99.52	99.52
Bullock labour (days/ha)	6.04	6.45	6.86

5.2 Labour absorption:

The data related to relative labour absorption is presented in Table 5.2. Mechanization is also seen in rice cultivation. Hence reduced human labour is observed to some extent in ploughing and harvesting. For ploughing HYV rice seems to be more labour intensive with 9.36 days per hectare whereas hybrid rice recorded 5.75 days/ha. For uprooting of seedlings also the same pattern is seen with 7.78 days/ha for HYVs and 6.54 days for hybrid rice. Since transplantation and harvesting have to be completed quickly more hired labour is employed for both hybrid and HYV rice. The sample farmers of hybrid rice have reported that they employ less number of labour for hybrid rice as single seedling per hill can be transplanted relatively quickly (17.14 days/ha). Multiple seedlings per hill in HYV rice would take little more labour (20.86 days/ha). Farmers in the sample reported little more (3.68 days/ha) labour use of manuring in hybrid cultivation against 2.47 days/ha in HYV rice. But for application of chemical fertilizer the converse is true as HYV rice has taken 7.69 days/ha and hybrid rice only 4.62 days/ha. The same trend is seen even in the application of plant protection chemicals with 5.84 days/ha for HYVs and 3.65 days/ha for hybrid rice. For irrigation there is not much difference (less than a day) between hybrid rice and HYV. Whereas less human labour is employed (27 days/ha) for harvesting and post harvesting operation put together for hybrid varieties the HYV

rice has taken 34.58 days/ha for the same. Overall total labour employed for hybrid rice comes to 78.28 days/ha and for HYV rice it is 99.52 days.

Table 5.2: Operation wise Human Labour Use in Hybrid and HYV Rice 2010-11

(for hybrid adopters only)

Type of operation	Hybrid rice			HYV rice		
	Family Labour (days/ha)	Hired Labour (days/ha)	Total Labour (days/ha)	Family Labour (days/ha)	Hired Labour (days/ha)	Total Labour (days/ha)
Ploughing	3.55	2.19	5.75	5.63	3.74	9.36
Uprooting of seedlings	3.17	3.41	6.54	4.34	3.33	7.78
Transplantation of seedlings						
a) Single seedlings per hill	3.41	13.91	17.14	--	--	--
b) Multiple seedlings per hill	--	--	--	4.58	16.46	20.86
Manuring	2.44	1.24	3.68	1.69	0.78	2.47
Application of Chemical fertilizer	3.26	1.36	4.62	5.77	1.92	7.69
Spraying plant protection chemicals	3.00	0.51	3.65	4.65	1.19	5.84
Irrigation	10.45	0.03	10.50	11.26	0.14	11.40
Harvesting	4.02	12.06	16.12	5.08	16.42	21.50
Post-harvesting	4.18	6.69	10.87	5.35	7.73	13.08
All Operations	37.47	41.33	78.28	48.51	51.87	99.52

Fig 5.1: Operation wise Human Labour Use in Hybrid Rice: 2010-11

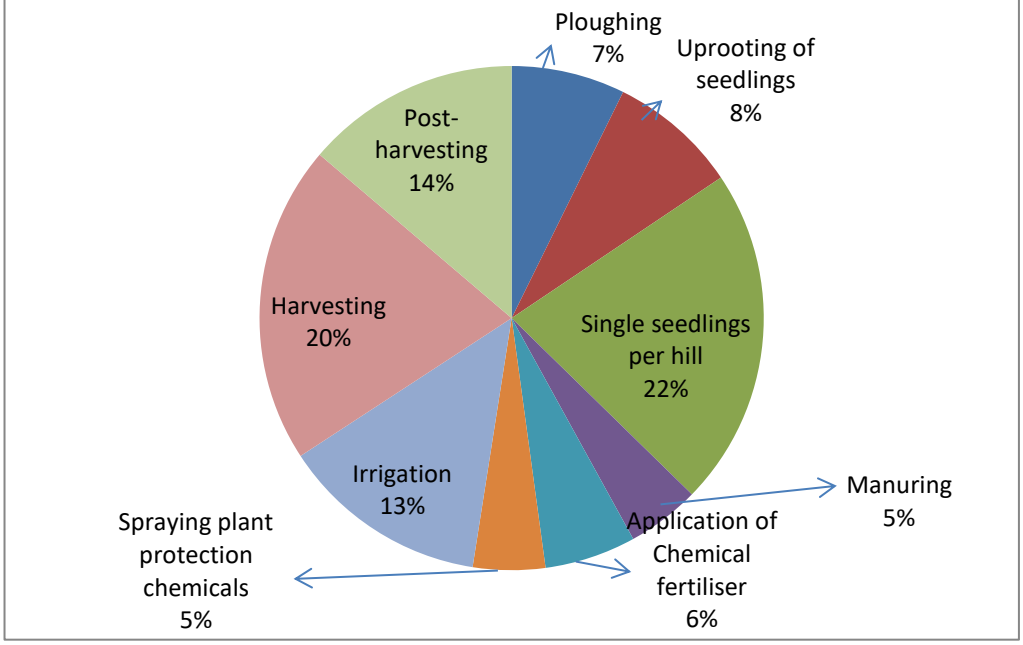
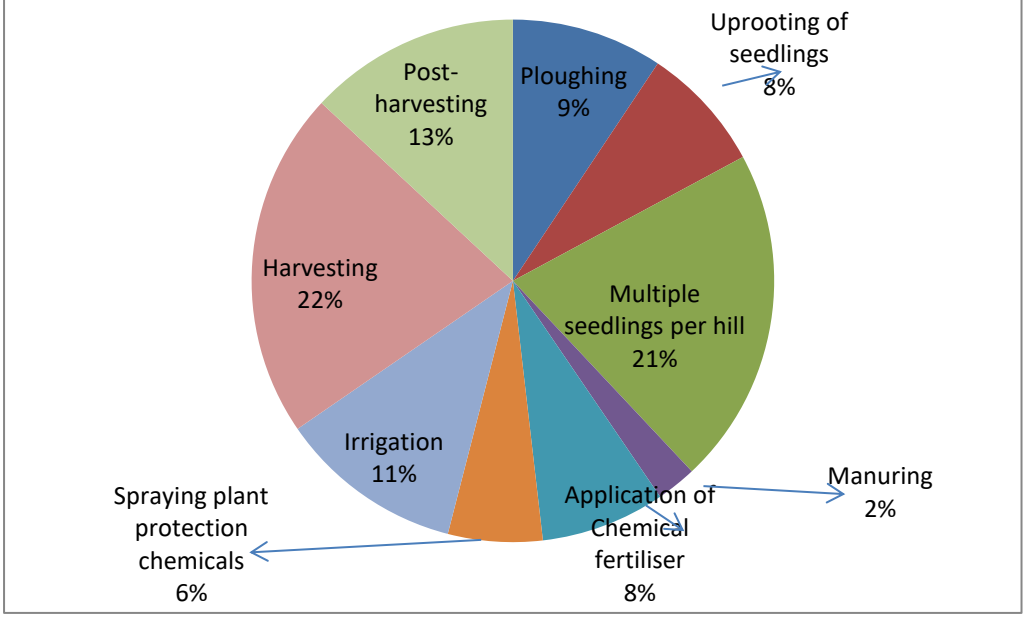


Fig 5.2: Operation wise Human Labour Use in HYV Rice: 2010-11



5.2.1 Absorption of female labour:

The relative use of female labour for different agricultural operations for hybrid and HYV rice is explained in Table 5.3. It can be observed from the analysis the relative higher use of female labour for hybrid rice in comparison to HYVs except for harvesting and post harvesting operations. Highest use, 80 per cent in hybrid rice and 79 per cent in HYV rice of female labour is seen in transplanting. Harvesting and post harvesting operation follow next with 74 per cent, 53 per cent for HYV rice and 65 per cent, 46 per cent for hybrid rice. When the total female labour absorption is compared between the two varieties no difference can be observed.

Table 5.3: Female Labour use Per Hectare (2010-11)

(for hybrid adopters only)

Type of operation	Hybrid rice			HYV rice		
	Female labour (days/ha)	Total Labour (days/ha)	Percent of Female Labour days used	Female labour (days/ha)	Total Labour (days/ha)	Percent of Female Labour days used
Ploughing	1.29	5.75	22.42	1.95	9.36	20.84
Uprooting of seedlings	3.44	6.54	52.57	3.74	7.78	48.09
Transplantation of seedlings						
Single seedlings per hill	13.67	17.14	79.74			
Multiple seedlings per hill				16.44	20.86	78.82
Manuring	1.15	3.68	31.23	0.77	2.47	31.13
Application of Chemical fertiliser	1.54	4.62	33.32	2.03	7.69	26.39
Spraying plant protection chemicals	1.46	3.65	39.99	2.02	5.84	34.57
Irrigation	3.18	10.50	30.28	2.84	11.40	24.91
Harvesting	10.52	16.12	65.27	15.81	21.50	73.54
Post-harvesting	4.95	10.87	45.55	6.87	13.08	52.52
All Operations	40.48	78.28	51.71	51.72	99.52	51.97

5.3. Costs and returns of hybrid and HYV rice:

Relative costs of inputs and returns of hybrid and HYV rice are discussed in Table 5.4. for the year 2009-10. The cost of hybrid rice seed is comparatively quite higher as it involves some additional processes in its cultivation and its limited availability in the market. As it cannot be used for the following year the farmer has to incur higher costs. In the hybrid adopter fields the rise in seed cost over HYV is 64 per cent. The same is 59 per cent in non-adopter fields. The cost of manure is relatively lower, 19 per cent in hybrid cultivator sample and 82 per cent in non-adapter sample. There is not much difference in costs in the use of chemical fertilizers as it is only one per cent lower for hybrids in adopter field and 4 per cent higher to non-adopter HYV fields. Hybrid adopters have spent more or less the same amount (one per cent higher) for insecticide and pesticides.

But the same cost seems to be 27 per cent higher for hybrid rice when compared with HYVs of non-adopters. The irrigation charges for hybrid rice are not higher. It is 1 per cent less for adopters and 3 per cent less for non-adopters when compared with HYVs. Machinery charges for hybrid rice seem to be lower, as much as 17 per cent of HYVs of non-adopters and 3 per cent of HYVs of adopters group. Hybrid rice cultivators incurred 18 per cent lower costs on hired human labour when compared with HYVs on their own fields. But non-adopters have reported slightly lower (3 per cent) costs on HYVs for the same. Use of bullock labour is lower for hybrid rice (9 per cent) in adopter group. It is 4 per cent lower when compared with HYVs of non-adopter group.

When total costs are considered the difference is small, 1 per cent higher between hybrid and HYV rice in hybrid adopter group. It is 5 per cent higher when compared with HYV rice of non-adopter sample group.

Table – 5.4

Comparison of Costs and Returns for Hybrid and Inbred Rice (2009-10)

(Rs./ha)

Particulars	2009-10				
	Hybrid Adopters		Non adopters	Percent increase over HYVs	
Costs	**Hybrid**	**HYVs**	**HYVs**	**Adopter**	**Non adopter**
seed (both farm produced and purchased)	4200	1505	1706	64.16	59.39
Manure (owned and purchased)	1500	1791	2725	-19.37	-81.68
chemical fertilisers	3333	3374	3208	-1.23	3.74
Insecticides &pesticides	1698	1682	1240	0.92	26.99
irrigation charges(both owned and hired)	1400	1410	1440	-0.71	-2.88
Machinery charges	3970	4093	4631	-3.10	-16.65
hired Human labour	9662	11423	9418	-18.23	2.52
Bullock labour(Owned and hired)	1143	1245	1186	-8.94	-3.74
total cost	**26906**	**26524**	**25555**	**1.42**	**5.02**
Unit cost of production (Rs. Per kg.)	3.79	4.91	4.48	-29.48	-18.04
Returns					
Yield of paddy (qtl/ha.)	71	54	57	23.87	19.54
Market price (Rs./qtl.)	1107	1186	1134	-7.14	-2.44
Value of grain yield (Rs/Ha)	69246	51046	51046	26.28	26.28
Value of straw yield (Rs./ha)	2167	3305	3539	-52.49	-63.29
Total value of the produce (gross return)	**71413**	**54350**	**54350**	**23.89**	**23.89**
Net Returns	**44507**	**27826**	**28795**	**37.48**	**35.30**
Benefit cost ratio	1:2.65	1:2.05	1:2.13	--	-

The unit cost of production is lower for hybrid rice (29 per cent) in comparison to HYV rice of same farmers. The same is 18 per cent lower when compared to HYVs of non-adopters.

Hybrids are known for their superior yields. It is 24 per cent higher in hybrid adopter group and 20 per cent higher than HYVs of non-adopter group. The yield is 71 quintals of hybrid rice per hectare as against 54 quintals and 57 quintals of HYVs of adopter and non-adopters respectively.

Market price is not very favourable to hybrid rice. It is Rs.1107/qtls as against Rs 1186/Qtls for HYV rice (7 per cent higher) in the same adopter group. The gross return for hybrid rice is 24 per cent higher when compared to HYV rice of both adopter and non-adopter farmers. The advantage is more pronounced in the net returns. It is 37 per cent higher to HYV rice for adopters and 35 per cent higher to HYVs of non-adopters. Ultimately the key to the success of hybrid rice technology is the cost-benefit ratio. It seems to be favourable for hybrid rice in the study. While it is 1:2.65 for hybrid rice, it is 1:2.05 for HYV rice of hybrid adopters. The same is 1:2.13 for HYV rice of non-adopter group.

5.3. 1: **Costs and returns of hybrid rice for the year 2010-11**

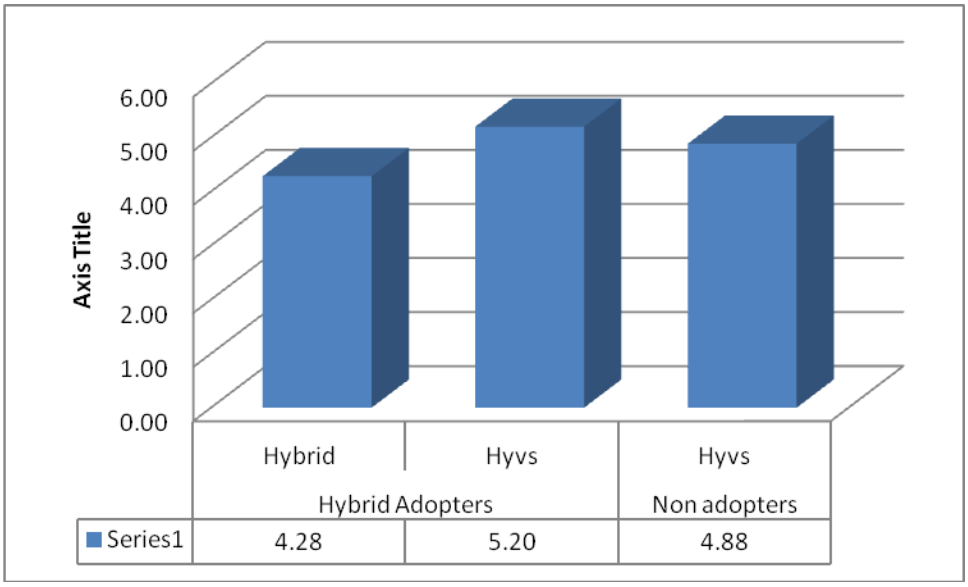
Costs and returns of hybrid rice for the year 2010-11 are discussed in Table 5.5. Use of chemical fertilizers has increased when compared to previous year for hybrid rice. It is over 5 per cent on HYVs of adopters and 4 per cent on non-adopters. Overall unit cost of production has increased to Rs. 4.28 from Rs. 3.79 for hybrid cultivators. For HYV farmers the increase is from Rs. 4.91 to Rs. 5.20 for adopters and from Rs. 4.48 to Rs. 4.88 for non-adopters. The gross returns has increased to Rs. 72,626 from Rs. 71,413 (27 per cent increase over HYVs of adopters) in 2010-11. In the same year net returns on hybrid rice dipped marginally from Rs. 44,507 to Rs. 42,638. The same kind of decrease is also seen for HYV of rice for adopters from previous year (from Rs. 27,826 to Rs. 25,117). For non-adopters of hybrid rice the net returns on HYV rice has slightly increased from Rs. 28,795 in 2009-10 to Rs. 29,335 in 2010-11. The cost benefit ratio has shown marginal decrease from 1:2.65 to 1:2.42 in Hybrid rice from previous year. The same is the case with HYV rice for both adopters ad non-adopters.

Table – 5.5
Comparison of Costs and Returns for Hybrid and Inbred Rice (2010-11)

(Rs./ha)

Particulars	2010-11				
	Hybrid Adopters		Non adopters	Percent increase over HYVs	
Costs	**Hybrid**	**HYVs**	**HYVs**	**Adopter**	**Non adopter**
seed (both farm produced and purchased)	4200	1571	1836	62.59	56.29
Manure (owned and purchased)	1350	1650	2725	-22.25	-101.87
chemical fertilisers	3801	3608	3643	5.08	4.17
Insecticides &pesticides	1789	1761	1559	1.58	12.88
irrigation charges(both owned and hired)	1744	1746	1621	-0.13	7.04
Machinery charges	4758	4466	5044	6.14	-6.01
hired Human labour	11137	11658	11206	-4.67	-0.62
Bullock labour(Owned and hired)	1209	1289	1372	-6.66	-13.55
Total cost	29988	27750	29006	7.47	3.28
Unit cost of production (Rs. Per kg.)	4.28	5.20	4.88	-21.36	-13.99
Returns					
Yield of paddy (qtl/ha.)	70	53	59	23.75	15.15
Market price (Rs./qtl.)	1140	1188	1174	-4.21	-2.98
Value of grain yield (Rs./Ha)	70429	50162	54737	28.78	22.28
Value of straw yield (Rs./ha)	2197	2705	3603	-23.10	-64.01
Total value of the produce (gross return)	**72626**	**52866**	**58341**	**27.21**	**19.67**
Net Returns	**42638**	**25117**	**29335**	**41.09**	**31.20**
Benefit cost ratio	1:2.42	1:1.91	1:2.01	--	--

Fig. 5.3: Unit Cost of Production (Rs./kg) of Hybrid Rice over HYV Rice at Adopter and Non Adopter Farms:2010-11.



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CHAPTER – VI

Grain quality and marketing

6.1 Grain quality

One of the reasons put forwarded by hybrid rice cultivators in discontinuing its cultivation is the problem of broken rice or lesser milling 'ratios'. Primary data related to hulling and milling is presented in Table 6.1 and 6.2 for the years 2009-10 and 2010-11 respectively. The hulling ratio of 60:40 is observed for both hybrid adopters and non-adopters in the year 2009-10 for the two varieties of hybrid and HYV rice. However, in case of milling ratio in the same year hybrid rice gave 62:38 proportions. For HYVs both adopters and non-adopters reported a slight higher ratio of 63.37.

Table 6.1: Grain quality traits of Hybrid rice vis-à-vis HYVs 2009-10

Grain quality traits	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
Hulling ratio	60:40	60:40	60.40
Milling ratio	62:38	63:37	63.37
Head rice recovery ratio	55:45	58:42	58.42

Table 6.2: Grain quality traits of Hybrid rice vis-à-vis HYVs 2010-11

Grain quality trits	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
Hulling ratio	60.40	60.40	60.40
Milling ratio	62.38	63.37	63.37
Head rice recovery ratio	54.46	58.42	58.42

Head rice recovery ratio for hybrid rice is slightly lower at 55:45. For HYVs it is 58:42 for adopter and non-adopters in 2009-10. While the same ratio is observed in the following year 2010-11 for HYVs of both categories the hybrids have shown a little lower ratio of 54:46.

6.2. Volume of marketing and Prices received:

The production of hybrid rice per farm varied from 108 quintals in below 1 hectare group to 340 quintals in above 4 hectare group. The average hybrid rice production per farm is 141 quintals. In the same pattern HYV production ranged from 39 quintals in below 1 hectare group to 150 quintals in the large size group (above 4 ha). Overall average is 94 quintals of HYV rice. Out of this the marketed quantity of hybrid rice ranged from 84.40 per cent in below 1 hectare group to 92.91 per cent in 2 to 4 hectare group. Overall average is 89.27 per cent which is 3.44 per cent higher than 85.83 per cent for HYV rice. This higher percentage of marketed volume of hybrid rice is an indicator of its lower preference for home consumption.

Higher price (Rs. 1122) per quintal for hybrid rice is received in 1 to 2 hectare group in 2009-10. The average price on the overall is Rs. 1103 in the same year. HYV rice received a price of Rs. 1070 in 2 to 4 hectare group while above 4 hectare group received higher price of Rs. 1150 in 2009-10. The average price is also slightly higher than the price of hybrid rice at Rs. 1112 in the same year. However, non-adopters could receive only Rs. 1061 as average price for HYVs (Table 6.3).

Hybrid rice production per farm varied from 63 quintals in below 1 hectare group to 131 quintals in above 4 hectare group. Overall average is 82 quintals per farm. The same pattern is seen in HYV rice production with an overall average of 77 quintals per farm for hybrid adopters in 2010-11.

The percentage of marketed volume of hybrid rice is highest in 2 to 4 hectare group at 93.91 while the lowest (86.28) is seen in below 1 hectare group in 2010-11. Again a higher percentage (91.13) of marketed average volume of hybrid rice than the HYV rice is observed in hybrid adopters where it is 84.34 per cent (Table 6.4).

The average price received for hybrid rice in the year 2010-11 does not vary much between the different land size groups and recorded Rs. 1103 on the overall. HYV paddy in the adopter category has shown wide variations from Rs. 1106 in 2 – 4 hectare group to Rs. 1150 in above 4 hectare group in the same year. The average price received for the same is Rs. 1124. This amounts to Rs. 21 higher to the average price of hybrids in the same year.

Table 6.3: Output and sale of paddy (unhusked) by size group of land holdings (2009-10)

Size group (Ha)	Crop	Hybrid adopters				Hybrid Non-adopters			
		Output Quantity (Qtl) per farm	Sale Quantity (Qtl) per farm	% of Output Sold	Average Price received	Output Quantity (Qtl) per farm	Sale Quantity (Qtl) per farm	% of Output Sold	Average Price received
Below 1 ha	Hybrid	108	91	84.40	1100				
		16	16						
	HYV	39	27	67.73	1129	56	43	75.39	1069
		16	16			8	8		
1-2	Hybrid	123	112	90.85	1122				
		12	12						
	HYV	97	84	86.93	1109	114	99	87.24	1080
		17	17			6	6		
2-4	Hybrid	209	194	92.91	1070				
		5	5						
	HYV	144	130	90.19	1079	146	125	85.47	1075
		12	12			4	4		
4 ha and above	Hybrid	340	315	92.65	1100				
		2	2						
	HYV	150	134	89.17	1150	174	158	90.52	950
		4	4			2	2		
All sizes	Hybrid	141	126	89.27	1103				
		35	35						
	HYV	94	81	85.83	1112	95	80	84.17	1061
		49	49			20	20		

Note: Figures in bottom row indicates number of farms

Table 6.4: Output and sale of paddy (unhusked) by size group of land holdings (2010-11)

Size group (Ha)	Crop	Hybrid adopters				Hybrid Non-adopters			
		Output Quantity (Qtl) per farm	Sale Quantity (Qtl) per farm	% of Output Sold	Average Price received	Output Quantity (Qtl) per farm	Sale Quantity (Qtl) per farm	% of Output Sold	Average Price received
Below 1 ha	Hybrid	63	54	86.28	1104				
		32	32						
	HYV	28	18	64.55	1138	60	48	79.88	1119
		16	16			8	8		
1-2	Hybrid	76	70	92.68	1101				
		24	24						
	HYV	85	73	85.59	1116	115	99	86.48	1092
		16	16			6	6		
2-4	Hybrid	104	97	93.91	1106				
		16	16						
	HYV	127	113	89.01	1106	151	128	84.30	1088
		9	9			4	4		
4 ha and above	Hybrid	131	122	93.31	1100				
		8	8						
	HYV	130	114	87.50	1150	187	165	88.47	1175
		4	4			2	2		
All sizes	Hybrid	82	74	91.13	1103				
		80	80						
	HYV	77	65	84.34	1124	98	83	84.37	1113
		45	45			20	20		

Note: Figures in bottom row indicates number of farms

The percentage of output sold of HYV paddy for non-adopters ranges from 79.88 to 88.47 across size groups in 2010-11. The highest is seen in above 4 hectare group. Overall average is 84.37 per cent. The average price received ranges from Rs. 1088 is 2 to 4 hectare group to Rs. 1175 in above 4 hectare group for non-adopters in 2010-11. On an overall the price comes to Rs. 1113 for HYV rice.

6.3. Seasonal flow of marketing:

Only paddy is marketed by the sample farmers without any processing in both districts. The time of sales ranges from November to June. There is variation between hybrid rice and HYVs in the time of marketing. In fact many farmers reported that both varieties are mixed when sold, so that hybrid varieties do not receive lesser price. The volume of sales is presented in Table 6.5 for 2009-10 and in Table 6.6 for 2010-11.

Table 6.5: Seasonal flow of marketing (sales) of paddy (Unhusked) (2009-10)

Month	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
January	37.67	24.3	20.5
%	30.00	30.00	25.00
February	12.56	8.10	12.30
	10.00	10.00	15.00
March	6.28	4.05	4.10
	5.00	5.00	5.00
April	31.40	20.30	12.3
	25.00	25.00	15.00
May	12.56	8.10	12.3
	10.00	10.00	15.00
June			4.1
			5.00
July			
August			
September			
October			
November	12.56	8.1	8.2
%	10.00	10.00	10.00
December	12.56	8.1	8.2
%	10.00	10.00	10.00

Paddy sales are starting in November and reaching a peak of 30 per cent in January for Kharif and 25 per cent in April for Rabi for hybrid adopters in 2009-10. About 25 per cent is sold in January in Kharif and another 30 per cent is sold in April and May by non-adopter farmers.

Table 6.6: Seasonal flow of marketing (sales) of paddy (Unhusked) (2010-11)

Month	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
January	21.9	19.5	21.25
%	30.00	30.00	25.00
February	7.3	6.5	12.75
	10.00	10.00	15.00
March	3.65	3.25	4.25
	5.00	5.00	5.00
April	18.25	16.25	12.75
%	25.00	25.00	15.00
May	7.3	6.5	12.75
%	10.00	10.00	15.00
June			4.25
			5.00
July			
August			
September			
October			
November	7.3	6.5	8.5
%	10.00	10.00	10.00
December	7.3	6.5	8.5
%	10.00	10.00	10.00

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CHAPTER – VII

Problems and prospects for increasing hybrid rice cultivation:

Introduction:

Hybrid rice cultivation was introduced to the state in 1993-94. But it did not find favour among cultivators due to variety of reasons. An attempt is made in this chapter to gauge the awareness of the farmers about hybrid rice technology, hurdles they face in seed procurement, management of crop production, marketing. Overall experience of the hybrid rice cultivators and reasons for non-adoption by other cultivators in the sample are analyzed here.

7.1. Awareness about hybrid rice technology:

Hybrid rice farmers were asked why they have chosen to cultivate the new varieties. The weighing factor according to majority was prospect of high production (47.50 per cent). This was followed by demonstration effect (31.25 per cent). About 12.50 per cent have said they were simply interested in the new technology. The easy availability of seed was another factor for 8.75 per cent to go for hybrid rice cultivation.

7.2. Availability of seed:

Accessibility of seed was no problem for 91.25 per cent of hybrid adopters. In both the sample districts all farmers reported the private companies as the main source for the seed supply. About 86.25 per cent of the hybrid farmers expressed satisfaction over the quality of the seed supplied only 13.75 per cent were not satisfied with quality. Timely availability of seed is crucial for a good harvest. When asked about this problem 97.50 per cent said that they did not face it. Only 7.50 per cent of sample farmers opined that the seed cost is not very high. Whereas the others felt the cost is too high. An overwhelming majority (86.25 per cent) were convinced of better yields of hybrid rice over inbred varieties. All of them expressed that they would get 15 – 20 per cent higher yields. Only 13.75 per cent were not very sure of better results. Though they incur higher costs, 49 per cent hybrid rice farmers are buying new seeds every year. But they are cultivating the same brand. Only a smaller percentage of 21.25 per

cent felt that they are unable to practice traditional way of saving old seed and exchanging among follow farmers.

Table – 7.1
Questions related to Hybrid Adopting Farmers' access to Hybrid Seed input

Sl. No.	Particulars	Answers	% of farmers reporting
1.	Have you used hybrid seed?	Yes No	100 ---
2.	If yes, why used -	Reason 1 Interested Reason 2 Easy Available Reason 3 High Production Reason 4 Demonstration	12.50 8.75 47.50 31.25
3.	Is the hybrid seed easily available?	Yes No	91.25 8.75
4.	What is the usual source of your seeds ?	Source 1 Private Company Source 2	100 ----
5.	Is the quality hybrid seed available in your area?	Yes No	86.25 13.75
6.	If yes, do you get seeds (a) during planting time and (b) at a reasonable price	Available during planting time Available at reasonable price	97.50 57.50
7.	Are you satisfied with quality of seed?	Yes No	86.25 13.75
8.	If no, reasons therefore (poor germination etc.)	Reason 1 poor germination Reason 2	13.75 --
9.	Are you convinced that hybrid seed yield better results than the inbred seeds?	Yes No	86.25 13.75
10.	If yes, indicate the percentage of yield increase.	5-10% 10-15% 15-20%	--- --- 100
11.	If Hybrid seeds bring lesser yields, indicate the percentage of yield loss due to hybrid rice.	5-10% 10-15% 15-20%	-
12.	Do you purchase new seeds of hybrid varieties every crop season/year?	Yes No	48.75 51.25
13.	Do you feel that adoption of hybrid seeds prevented traditional practice of saving and exchanging of seeds?	Yes No	21.25 78.25
14.	How often do you replace hybrid seed varieties?	Replacing every year Replacing every alternative year Replacing every 3 years Replacing after 3 years or more	41.25 27.50 31.25 --

Source: Field Survey

7.3. Fertilizer Availability:

Chemical fertilizers are widely used among hybrid rice farmers in the sample as 86.25 per cent reported it. Only 13.75 per cent did not use the same. They were asked whether any recommendations regarding the suitability and doses of fertilizers were received by them. Eighty one per cent did receive the advice while 18.75 per cent could not get it. The supply of

fertilizers was not a problem according to 82.50 per cent. The other 17.50 per cent said the fertilizer supply was not on time. Private traders were the only source for all hybrid cultivators. They have also said that hybrid rice does not need any additional fertilizer usage (63.75 per cent). But a third of the farmers differed and reported the need for higher usage. Details are given in Table 7.2.

Table –7. 2
Questions related to Hybrid Adopting Farmers access to Fertiliser input and its use

Sl.No.	Particulars	Answers	% of farmers reporting
1.	Have you used chemical fertilizer?	Yes No	86.25 13.75
2.	Whether received information from any source regarding what to use and the required doses?	Yes No	81.25 18.75
3.	If yes, have you applied recommended doses of fertilizer?	Yes No	81.25 18.75
4.	If not, state reasons therefor	Reason 1 Reason 2	--
5.	If fertilizer not used at all what are the reasons	Reason 1 Reason 2	--
6.	Is fertiliser easily available?	Yes No	82.50 17.50
7.	If yes, the source where it is available	Source 1 Private Source 2	100 ---
8.	Do you feel that hybrid seeds require more fertilizer than inbred seeds	Yes No	33.75 66.25

Source: Field Survey

7.4. Pesticide use and relative pest resistance of hybrid rice:

Damage due to pests and diseases was reported by 37.50 per cent of the sample farmers in the reference year. Susceptibility to this problem is equal to hybrid and inbred varieties according to them. Among these farmers, except for 17.50 per cent, all others used pesticides. Those who did not use cited higher cost (11 per cent) as one reason. About 6.50 per cent are not convinced of the efficiency of pesticide and did not use. Pesticides are easily available according to 86 per cent. About the same percentage of farmers felt that they had the requisite knowledge of use of correct chemical and dose. A large percentage of 92.50 have denied that hybrid rice varieties are more susceptible to pests and diseases. They were asked whether yield losses were lower in inbred varieties due to pests and diseases. Sixty four per

cent said 'no'. Only 36 per cent felt otherwise. A vast majority, ninety per cent, of hybrid rice cultivators in the sample felt that these varieties are highly sensitive to crop management practices, use of key inputs and time sensitive operations (Table 7.3).

Table –7. 3

Questions related to Hybrid Adopting Farmers access to Pesticide input and its use

Sl.No.	Particulars	Answers	% of farmers reporting
1.	Whether hybrid rice crop or any other variety of rice crops was attacked with pests and diseases ?	Yes No	37.50 62.50
2.	If yes, which variety (Hybrid/Hyvs) with area	Hybrid (area) HYVs (area)	--
3.	Have you applied pesticides?	Yes No	82.50 17.50
4.	If not, why not used?	Reason 1Costly Reason 2 Not Needed	10.00 7.50
5.	Is the pesticide easily available ?	Yes No	86.25 13.75
6.	Do you know the correct way of using and doses of plant protection pesticides?	Yes No	87.50 12.50
7.	Do you feel that hybrid rice varieties are more susceptible to pests and diseases?	Yes No	92.50 7.50
8.	Do you know the correct does of pesticides for hybrid seed varieties ?	Yes No	96.25 3.75
9.	Do you feel that hybrid rice cultivation is highly sensitive to crop management practices - use of key inputs and time bound operations?	Yes No	90.00 10.00
10.	Do you feel that the extent of yield loss due to pests and diseases for inbred variety is lower as compared to hybrids	Yes No	36.25 63.75

Source: Field Survey

7.5. Access to credit:

Credit is an important input component in crop production and it is more so when higher costs are involved in hybrid rice farming due to its recurring high seed cost. Accordingly 76 per cent of them expressed that they need more credit. For this they are depending on co-operative credit societies and rural banks (70 per cent). At the same time, other 30 per cent of credit needy farmers were unable to obtain loans from any institution. They have cited problems like surety documents and timely disbursal from these institutions. Because of these

reasons they have to resort to borrowings from private traders at high interest rate of 36 to 48 per cent.

Table – 7.4

Questions related to Hybrid Adopting Farmers' access to credit

Sl.No.	Particulars	Answers	% of farmers reporting
1)	Do you require more credit for using hybrid seed?	Yes-1 No-2	76.25 23.75
2)	Do you get required credit from the Co. Credit Society or any other institutional sources?	Yes-1 No-2	70.00 30.00
3)	If yes, which source	Source-1 Rural Bank Source-2	100.00
4)	If not, what are the problems in getting credit	Problem-1 Problem-2	**---** **---**

Source: Field Survey

7.6. Problems in Marketing of Hybrid Rice:

Easy marketing is crucial for any new product's success. For majority (68 per cent) of hybrid rice farmers marketing seems to be a problem. A third of the hybrid rice sample farmers could overcome this. Disinclination of consumers towards hybrid rice seems to be the major reason for lower prices of hybrid rice. About 64 per cent farmers complained of lower market prices. Especially in coastal Andhra Pradesh consumers are accustomed to thin and long variety of rice which have better cooking quality and would not become sticky. Poor cooking and keeping quality was the reason for lower prices according to 56 per cent of farmers. Among other reasons more broken rice after milling (23 per cent farmers), poor grain quality (21 per cent), lower head rice recovery (11 per cent) and traders reluctance (9 per cent farmers) are the causes for slower spread of hybrid rice varieties in the state. Details are given in Table 7.5.

Table – 7.5

Questions related to Hybrid Adopters' Perception about Marketing of Hybrid Rice

Sl. No.	Particulars	Answers	% of farmers reporting
1.	Do you face problems in marketing of hybrid rice produce?	Yes No	67.50 32.50
2.	If yes, state the nature of the problem faced	i. Lower market price ii. Poor cooking and keeping quality iii. Lower head – rice recovery (percentage of clean rice after milling) iv. More broken rice after milling v. Lack of consumer demand for hybrid rice grain vi. Poor grain quality and as a result lack of market acceptance vii. Traders not accepting hybrid rice grain lack of demand from millers and consumers	63.75 56.25 11.25 22.50 52.50 21.25 8.75

Source: Field Survey

7.8. Awareness about hybrid rice technology:

How far are the hybrid rice farmers exposed to new technology? This question is posed to the sample farmers to elicit information about their introduction and depth of knowledge they have gained. A major portion of 41.25 per cent of farmers revealed that they came to know about hybrid rice from local farmers. For another 31 per cent progressive farmers were the agents of change. Another 28 per cent depended on relatives and friends to receive knowledge. Frontline demonstration programmes were arranged by state agricultural department under NFSM- Rice in some areas. Only 8.75 per cent reported such existence. Some private companies also made some demonstrations. Arize 6444 gold and rabi seeds were demonstrated in the study area.

About 9 per cent of farmers reported undergoing training in hybrid rice cultivation for about a week. Related data are given in Table 7.6.

Table –7. 6

Questions related to Hybrid Adopters' Awareness about Hybrid Rice Technology

Sl. No.	Particulars	Answers	% of farmers reporting
1.	How has he become aware about hybrid rice technology?	Source – 1 Relatives & Friends Source – 2 Local People Source – 3 Progressive Farmer	27.50 41.25 31.25
2.	If yes have you participated in the programme?	Yes No	81.25 18.75
3.	Whether front line demonstration programme is organized in your area by the Government to create awareness about the hybrid rice technology?	Yes No	91.25 8.75
4.	Name the hybrids demonstrated and indicate the extent of yield advantage as demonstrated.	Hybrid – 1 ARIZE-6444 GOLD Yield advantage (%) Hybrid – 2 RASI Yield advantage (%)	56.25 43.75
5.	Whether the government organised training programmes for farmers?	Yes No	65.00 35.00
6.	If yes, had he participated?	Yes No	66.25 33.75
7.	If participated mention the number of training programmes participated and their duration.	Trainings participated Numbers Duration	-- -- --

Source: Field Survey

7.9. Overall Perception of hybrid rice cultivation:

Overall perception of hybrid rice farmers is analyzed in Table 7.7. A big majority of 78 per cent farmers are convinced of higher yield gain of hybrids over the best inbred rice varieties. Only 23 per cent have disagreed with this view. Except for 3 per cent all other sample farmers believed that hybrid rice production is profitable if suitable seeds are developed specifically to the cultivated area. About 59 per cent of farmers believe that poor cooking quality is hampering the spread of hybrid rice. Similarly, hybrid rice is perceived to be inferior to inbred rice due to poor grain quality (41 per cent farmers), low taste appeal (34 per cent) and stickiness of cooked rice (24 per cent of farmers). According to 95 per cent of farmers traders and millers are not coming forward to readily buy hybrid rice due to higher breakage of grain and poor acceptance by consumers. Only 55 per cent of hybrid rice farmers are convinced of its economic viability and its continuation. The remaining 45 per cent are unsure of its continuing cultivation. All the farmers who would like to continue hybrid rice farming are hoping for new hybrids with better grain quality and higher yields in the study.

Table –7. 7

Hybrid Adopting Farmers' overall Perception about Hybrid Rice Cultivation

Sl. No.	Particulars	Answers	% of farmers reporting
1.	Is there any yield gain from cultivation of hybrids over the best popular inbred rice varieties?	Yes No	77.50 22.50
2.	Is hybrid rice production profitable?	Yes No	97.50 2.50
3.	Do consumers perceive hybrid as inferior to inbreed in respect of grain quality?	**Hybrids inferior in respect of** a) Poor grain quality b) No taste c) Poor cooking quality d) Stickiness of cooked rice	 41.25 33.75 58.75 23.75
4.	Is hybrid rice grain acceptable to traders and millers?	Yes No	95.00 5.00
5.	Is he convinced with the economic viability of hybrid rice cultivation?	Yes No	95.00 5.00
6.	It no, reasons therefore	Reason – 1 Reason – 2	---
7.	Do you like to continue cultivating of hybrid rice?	Yes No	91.25 8.75
8.	If yes, reasons for continuing hybrid rice production	**Reasons for continuing hybrid rice cultivation** a) Expecting to get new hybrids with better quality in the near future b) Higher yield of hybrid rice	 100.00 100.00

Source: Field Survey

7.10. Reasons for non adoption of Hybrid rice:

About 20 farmers, who are non-adopters of hybrid rice, are queried about their knowledge of hybrid rice cultivation. Only 5 per cent of them have heard about hybrid rice varieties. They have heard about Arize 6444 gold (15 per cent) and Rasi (45 per cent) varieties. The same farmers have reported seeing standing hybrid crop and heard about government's hybrid rice promotion under NFSM programme. Among them, 95 per cent were recommended to grow hybrid rice and agricultural officers (10 per cent) relatives (60 per cent) fellow cultivators (60 per cent) private company agents (50 per cent). About 10 per cent have also seen government's demonstration farm. Among the non-adopters 55 per cent are willing to try hybrid rice varieties after exposure. Another 45 per cent are not willing to go for the new technology (Table 7.8).

Table –7. 8

Questions related to Reasons for non-adoption of hybrid rice (reaction of non-participants)

Sl. No.	Particulars	Answers	% of farmers reporting
1.	Have you heard of any of the new hybrid varieties of rice?	Yes-1, No-2	95.00 5.00
2.	If yes, what are they? (name them)	1.ARIZE-6444- GOLD 2.RASI 3.SRI	15.00 45.00 35.00
3.	Have you heard of the Govts. Hybrid rice promotion programme?	Yes-1, No-2	95.00 5.00
4.	Have you seen any standing rice crop of hybrid variety in your area?	Yes-1, No-2	95.00 5.00
5.	Did anybody suggest you to grow this variety?	Yes-1, No-2	90.00 10.00
6.	If yes, state who suggested?	a) V.L.W b) BDO c) AEO d) Relative e) Other cultivators f) Known from government demonstration g) Others (Specify)	-- --- --- 60.00 60.00 60.00 50.00
7.	Will you be growing this variety next year?	Yes No	55.00 45.00
8.	What are the reasons for your not using this year?	i. Not heard of the variety ii. Not heard of the Govt. assistance for expansion of hybrid rice seeds. iii. Non-availability of seed a. Not at all b. Not in time c. Pure hybrid seed not available iv. Seed is too costly v. Seed available, but at too far a distance vi. Pre-treatment of seed is necessary and have never done it before. vii. Govt. Seed germination rate too low viii. Not convinced that the seed is of high quality ix. Not convinced that its yield is sufficiently high x. Lower yield for hybrid than for inbred xi. Yield gain but lower profitability of Hybrid rice xii. Variety too coarse xiii. Higher risks xiv. Will fetch lower price as compared to inbred variety xv. Needs too much of fertilizers xvi. Soil type not suitable xvii. Not insects pests and disease resistant. xviii. The extent of yield loss due to pests and diseases is higher for hybrids. xix. Needs more water xx. Fodder quality not good xxi. Credit – not available in time xxii. Credit not at all available xxiii. Restrictions on disposal i.e. should be sold to a particular agency xxiv. Any other (Specify)	10.00 30.00 5.00 5.00 85.00 45.00 20.00 90.00 10.00 40.00 30.00 15.00 45.00 25.00 15.00 15.00 85.00 25.00 85.00 15.00 30.00 15.00 30.00 0 35.00 0
9.	Are you ready to accept new hybrid rice varieties in future considering superior grain quality and higher yield potential?	Yes No	100 --
10.	If no, reasons therefore.	Reasons – 1 Reasons – 2	---

Source: Field Survey

As 95 per cent of non-adopters are completely ignorant of hybrid rice technology, the other 5 per cent were asked to express their opinions on varieties of input technicalities. Thirty per cent of them replied that they are not aware of any government assistance to promote hybrid rice cultivation. A large majority (85 per cent) expressed that pure hybrid seed is not available. While 5 per cent felt that hybrid seed is not at all available, the same percentage reported that even if available it is not on time. The hybrid seed is very expensive according to 95 per cent of the farmers. About 20 per cent said they had to travel long distance to buy hybrid seed. Pre-treatment of seed, which they have never done before, was the stumbling block for another 10 per cent of cultivators. There are farmers (15 per cent) who believe that the hybrids yield lower than inbred varieties. Some others (30 per cent) are convinced that hybrid yields are not sufficiently high. Though 45 per cent have agreed that yield gain of hybrid rice is high they are apprehensive of low profitability. While 15 per cent of them are averse of high risks involved, 25 per cent complained about grain quality. About 85 per cent believed that hybrid rice varieties need higher dose of fertilizers the same percentage are also vary of lower resistance to pests and diseases and consequent yield loss. More irrigation is needed for hybrid rice according to 30 per cent farmers. Only 15 per cent have doubts about quality of fodder. When asked about their willingness to cultivate hybrid rice if better varieties are developed with superior grain quality and higher yield all of them said 'yes'.

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CHAPTER – VIII

Summary and policy recommendations

Introduction:

Rice is a staple food crop for major population in India. Expanding population invariably puts pressure on its production. Food security, heralded by Green Revolution slowly petered out with population growth. Changes in life style seeped through all sections of society including the farmer community forcing them to look for higher incomes from the farm. More yields are the motto. This syncs with the pressure the policy makers and scientists are undergoing to raise the yields to meet the supply gap. As the scope of expanding the cultivable area being limited higher focus is put on productivity. In addition to intensification, developing seeds of high yield potential was a challenge for the scientists. Research in to Hybrid rice was given a fillip in the early nineties.

Countries such as China have taken a big leap in rice production by going in for hybrid rice cultivation in a big way. Hybrid rice was first commercially cultivated in China in 1976. Area under hybrid rice expanded to more than 13 million hectares by 1990. Hybrid rice not only has a distinct yield advantage over inbred varieties but also is more responsive to fertilizers and can adapt to varying environments.

Rice productivity had witnessed deceleration during 1990s. The productivity potential of modern varieties had hit a plateau. Increase in population and shift in consumption from inferior to superior grains has driven the demand for rice to shoot up in the last few years. According to one estimate India would require 118 million tonnes of rice by 2020 to fulfill the requirement of its rising population. The consumption growth in rice is likely to outpace production increase, which might hurt exports. In case of pronounced slowdown, it will inevitably lead to food insecurity and deficiency. A report, prepared by ASSOCHAM says "If we presume less severe conditions for next decade and expect population growth to decline to 1.6 per cent and assume per capita consumption of rice to remain steady at the current 78.5 kg per year, the country will require about 109 million tonnes of rice in 2020. If the acreage remains stagnant in the next decade and the country manages to keep the average yield growth of 1.2

per cent of the last decade in the forthcoming years, the production is likely to grow to about 108 million tonnes". Whatever be the estimates the yield levels of rice remain to be poor when compared to other countries.

India is the World's second largest rice producer. However, by productivity it ranked as low as 16. Close to 40 per cent of the total area under food grains is covered by rice. Out of this 57% of area is rainfed. This underlines the fact that hybridization needs to focus on disease resistant, shorter duration, hardier varieties in addition to increased yields.

Hybrid seed production technology has been developed and demonstrated by producing an average seed yield of 1.0 to 1.5 tonne per hectare. During the kharif season of 1996 more than 60,000 hectares were planted with hybrid rice in India. Present area under hybrid rice (2009) is 1.32 million hectares out of total rice area of 44 million hectares (3 per cent).

Based on research farm data it was reported that average yield of some hybrid rice varieties was 6 to 6.5 tonnes per hectare which was about 15 to 20 per cent higher than the yield of the popular conventional HYV/inbred varieties (DRR 1996, 1999).

8.1. Rice in Andhra Pradesh:

Rice is the Principal crop extensively cultivated in all the districts of Andhra Pradesh both in kharif and rabi seasons. It accounted for 32.74 per cent of the total cropped area, 70.99 per cent of the total food grain production during 2010-11. The area under rice during 2010-11 was 47.51 lakh hectares as against 34.41 lakh hectares in 2009-10, recording an increase of 38.07 per cent. The area under rice increased due to favourable seasonal conditions during the south west monsoon period. The productivity of rice is 3035 kgs/hectares in 2010-11 as against 3150 kgs/hectare in 2009-10.

Andhra Pradesh leads other states in production with 14.42 million tonnes in 2010-11. In terms of area it is next only to Uttar Pradesh (5.66) with 4.75 million hectares. But yield wise, it is far superior with 3036 kg/ha against 2118 for Uttar Pradesh. Overall it comes next to Punjab, where the yield is 3830 kg/ha in 2010-11. The productivity of rice at all India level increased from 1984 kg per hectare in 2004-05 to 2372 kg per hectare in 2011-12.

Bayer is the major company selling Hybrid rice in Andhra Pradesh. It sold 750 kgs of seed in 2011 kharif and it increased to 11000 kgs in 2012 kharif. These seeds are comparable with MTU-1001 in kharif and MTU-1010 in rabi in grain quality. It sells under ARIZE-444 GOLD brand. It launched ARIZE DHANI in 2008. According to the company it offers a holistic solution to BLB, a dreaded rice disease causing considerable loss (20-60 percent) to production. The company is optimistic in increasing its sales in the coming years.

8.2. Need for the study:

Lot of impetus has been given to research in Rice production and many programmes were launched to break the yield platen that has been experienced in rice crop in the past. A number of steps are being taken by the government to popularize new hybrid rice varieties through frontline demonstration, mini-kit supply, organizing training programmes for farmers, farm women, seed growers, seed production personnel of public and private seed agencies, extension functionaries of state departments of agriculture, researchers of state agricultural universities and NGOs. But there is no clear data to estimate the results of the concerted efforts put in by the government. Therefore, it has become necessary to conduct a study to assess the actual spread of newly developed varieties in terms of area with simultaneous reduction in area under conventional HYVs of rice and the increase in the average yield per hectare. It is hoped that the results of the study would enable the government to formulate the necessary changes in shaping the programmes like "Bringing Green Revolution to Eastern India (BGREI)".

8.3. Objectives of the study:

The study aims to:

- Indicate the extent of adoption and the level of participation by different categories of farmers in the cultivation of hybrid rice.
- Assess the overall impact on rice production and productivity of hybrid rice Cultivation
- Study the Economics of Cultivation of hybrid rice varieties vis-à-vis inbred varieties.
- Identify factors determining the adoption of hybrid rice varieties.
- Address various constraints and outline the prospects for increasing hybrid rice cultivation
- Suggest policy measures for expansion of hybrid rice cultivation.

8.4. Database and research methodology:

The study is based on both primary and secondary data. The data is sourced from Directorate of Economics and Statistics Publications to arrive at the trends in area, production and productivity of rice. The performance of rice in the pre-introduction period of hybrid rice with that in post-introduction period is analyzed. As first hybrids were developed and released for commercial cultivation in India in 1994, the study period was divided into three sub periods viz., 1984-85 to 1993-94, 1994-95 to 2003-04 and 2004-05 to 2009-10. The period 1 viz., 1984-85 to 1993-94 refers to the pre-introduction period hybrid rice while other two periods viz., period – 2 and 3 correspond to post-introduction periods.

For primary survey, NFSM cell in the state department of Agriculture was consulted and two districts where higher concentration of hybrid rice cultivation was practiced were chosen. No proper records were found regarding hybrid rice cultivation either with Department of Agriculture or with Directorate of Economics and Statistics as its cultivation is very sparse and widely distributed. Farmers who cultivate hybrid rice in successive years are even rare. Nizamabad district in Telangana and Srikakulam from North Coastal Andhra area were selected on the advice of state Agricultural Department where higher concentration of hybrid farmers

were found. In fact, Nizamabad is known for hybrid rice seed production. In each district, 40 hybrid rice growers from the list of hybrid rice growing cultivators from different size groups, marginal (less than 1 hectare), small (1 to 2 ha), medium (2 to 4 hectares) and large (more than 4 hectares) including SC, ST and Women farmers were selected on the basis of their proportion in the Universe. In addition to this sample, 10 inbred variety (traditional HYVs) rice growers but non-adopters of hybrid rice were selected randomly from the same land size groups following the same procedure. Thus, 50 rice growing cultivators were selected from each district.

For the primary survey, the reference years are 2009-10 and 2010-11. Accordingly, 2 kharif and 2 rabi seasons for the rice crop were covered in the study. A structured schedule/questionnaire was used to obtain information from the sample cultivators.

8.5. Growth and Instability of Rice Production in the State:

The growth rates of production and yield of paddy are found to be statistically significant, though there is no significant increase in area. Across the sub-periods, the yield of paddy showed a significant growth in the first and second sub-periods. While in the third sub period no significance is observed. The growth rates of Area in all the sub periods are found to be not significant but showed a negative growth in the second sub-period.

Observing the seasonal growth rates of yields across the sub-periods, positive significance of yields is observed in the two seasons of 1st sub period. While the yield rate in Rabi of second sub-period is only is reported as significant. No significant growth is reported in any case of both seasons during third-sub-period. As a whole it can be concluded that the reason for showing significance of yield rates may be due to the quality seed but not due to the changes in any of other variables.

8.6. Exposure of sample households to Hybrid rice cultivation:

It is well known that education is the key in accepting new-technologies. In the same vein it is significant to note that 2.44 per cent of people in hybrid adopter group pursued education beyond graduate level while it is nil in non-adopters. In hybrid adopter group 14.63 per cent of people are graduates while it is 10 per cent in non-adopters. Of the remaining educated in the hybrid farmer group 26.83 per cent had primary education and 45.12 per cent had secondary education. In the non-adopters the corresponding figures are 45 and 25 per cent. Illiterates are higher in non-adopters while it is only half in hybrid rice adopters. These observations indicate that technology acceptance has a positive link with level of education.

Predominant crops in kharif are hybrid paddy, HYV paddy, Groundnut and Turmeric. In rabi season again paddy, both hybrid and HYV are grown along with Blackgram, Sesamum, Groundnut, Turmeric are grown. Maize and Greengram are also raised in small areas.

Hybrid adopters have brought more area under hybrid paddy in 2010-11 when compared to 2009-10. It increased from 29.38 per cent to 39.35 per cent. Understandably area under HYVs recorded a decrease from 54.30 per cent to 44.60 per cent in this group for the same period. For non-adopters the area under HYV paddy remained the same.

Hybrid rice cultivation is relatively new to Srikakulam district whereas Nizamabad district has some pockets where hybrid rice seed production is popular. The channels of information is analyzed below. Seventy farmers (87.50 per cent) were exposed to this technology through frontline demonstration programme conducted by government followed by 64 (20 per cent) who got the knowledge from private seed companies, Government extension workers are also seem to be active as 63 (78.75) per cent reported having gained this knowledge from them. About 44 per cent got the information through television whereas news papers were the medium of knowledge for 40 per cent. Progressive farmers have also played a key role in dispersing this knowledge as 31 per cent of farmers got benefitted by them.

Receiving information about the new technology of hybrid rice is only first step. Better results would follow only when the recommended practices are translated at the field level. As expected, farmers who cultivate inbred or HYVs are better equipped technologically. Hence, all of them are practicing recommended packages. In hybrid rice technology demonstration programme 88 per cent of farmers have participated. About 79 per cent of them are also practicing the recommendations of the extension workers of state department of agriculture. Training programmes conducted by the government did not show much impact as only 38 per cent of hybrid farmers are practicing their suggestions.

8.7. Yield performance of hybrid and HYV rice:

Yield performance by farm size is analyzed here. Mean yield of hybrid rice has shown variation from 68.13 quintals per hectares in 1 – 2 hectare group to 80.62 quintal per hectare in 2 – 4 hectare group in the year 2009-10. In the same year mean yields of HYVs varied from 51.13 quintals per hectare in above 4 hectare group to 56.07 quintal per hectare in 1 – 2 hectare group. It appears from the yield data that there is not much significance to the farm size to yield levels.

When differences in yields are compared by farm size, 1 – 2 hectare group has shown 18 per cent where as the highest difference 34 per cent formed in 2 – 4 hectare group in the year 2009-10. On an aggregate the mean yield of hybrid rice is 70.83 quintals per hectare and HYVs yielded 54 quintals per hectare. The average difference in the mean yield is 23.87 per cent in 2009-10. In the following year, i.e., 2010-11 the overall mean yield has shown little decline and stands at 69.99 quintals per hectare for hybrids and 53.37 quintals per hectare for HYVs. The percentage difference in yield is 23.75.

Yield gain of Hybrid rice over HYVs varied from 12.06 per quintal in 1-2 hectare group to 27.09 per quintal in 2-4 hectare group in 2009-10. Overall average in 2009-10 is 16.93 quintals per hectare. In the following year 2010-11, the yield gain varied from 12.66 to in 1-2 ha group to 18.85 quintals per hectare in 4 ha and above group. The average yield gain stands at 16.62 quintals per hectare.

8.8. Comparative economics of hybrid and inbred rice cultivation:

While the seed for inbred varieties is 55 kgs per hectare, the same farmers have reported lesser, almost one third, use of hybrid seed (15 kgs) per hectare. One way this compensates the high cost incurred on hybrid seed. Non-adopters of hybrid rice have reported slightly higher use of seed of 57 kgs per hectare in 2010-11. Cattle manure is widely used in the study area. Farmers who do not have cattle are buying manure from others. There is not much difference in use of manure between hybrid rice growers and non-adopters. It ranges from 5 tonnes to 5.25 tonnes per hectare. Though there is an impression that hybrid rice needs more fertilizers, farmers in the sample did not report any additional use of chemical fertilizers. Whereas hybrid rice farmers used same amount of chemical fertilizers i.e., 250 kgs per hectare the non-adopters used little more (260 kgs/ha) for inbred rice varieties. Even in the use of pesticides, hybrid rice farmers used restraint and sprayed only 3 times for both hybrid and inbred varieties. Non-adopters sprayed 4 times instead. A look at the irrigation charges reveal a lower expenditure of Rs1400 and Rs1410 for hybrid and inbred varieties respectively by hybrid rice farmers. Non-adopters incurred a higher cost of Rs1440 for inbred varieties of rice. Use of human labour is significantly lower in hybrid rice farming according to the sample farmers of hybrid growers. While they have employed 99.52 days of human labour for inbred varieties it was only 78.28 days for hybrid rice. Even use of bullock labour is less for hybrid rice cultivation when compared to HYVs amongst both hybrid and non-hybrid cultivators. Overall total human labour employed for hybrid rice comes to 78.28 days/ha and for HYV rice it is 99.52 days.

The cost of hybrid rice seed is comparatively quite high as it involves some additional processes in its cultivation and its limited availability in the market. As it cannot be used for the following year the farmer has to incur higher costs. In the hybrid adopter fields the rise in seed cost over HYV is 64 per cent. The same is 59 per cent in non-adopter fields. The cost of manure is relatively lower, 19 per cent in hybrid cultivator sample and 82 per cent in non-adopter sample. There is not much difference in costs in the use of chemical fertilizers as it is only one per cent lower for hybrids in adopter field and 4 per cent higher to non-adopter HYV fields. Hybrid adopters have spent more or less the same amount (one per cent higher) for

insecticide and pesticides. But the same cost seems to be 27 per cent higher for hybrid rice when compared with HYVs of non-adopters. The irrigation charges for hybrid rice are not higher. It is 1 per cent less for adopters and 3 per cent less for non-adopters when compared with HYVs. Machinery charges for hybrid rice seem to be lower, as much as 17 per cent of HYVs of non-adopters and 3 per cent of HYVs of adopters group. Hybrid rice cultivators incurred 18 per cent lower costs on hired human labour when compared with HYVs on their own fields. But non-adopters have reported slightly lower (3 per cent) costs on HYVs for the same. Use of bullock labour is lower for hybrid rice (9 per cent) in adopter group. It is 4 per cent lower when compared with HYVs of non-adopter group. When total costs are considered the difference is small, 1 per cent higher between hybrid and HYV rice in hybrid adopter group. It is 5 per cent higher when compared with HYV rice of non-adopter sample group. The unit cost of production is lower for hybrid rice (29 per cent) in comparison to HYV rice of same farmers. The same is 18 per cent lower when compared to HYVs of non-adopters.

Hybrids are known for their superior yields. It is 24 per cent higher in hybrid adopter group and 20 per cent higher than HYVs of non-adopter group. The yield is 71 quintals of hybrid rice per hectare as against 54 quintals and 57 quintals of HYVs of adopter and non-adopters respectively.

Market price is not very favourable to hybrid rice. It is Rs.1107/qtls as against Rs 1186/Qtls for HYV rice (7 per cent higher) in the same adopter group. The gross return for hybrid rice is 24 per cent higher when compared to HYV rice of both adopter and non-adopter farmers. The advantage is more pronounced in the net returns. It is 37 per cent higher to HYV rice for adopters and 35 per cent higher to HYVs of non-adopters. Ultimately the key to the success of hybrid rice technology is the cost-benefit ratio. It seems to be favourable for hybrid rice in the study. While it is 1:2.65 for hybrid rice, it is 1:2.05 for HYV rice of hybrid adopters. The same is 1:2.13 for HYV rice of non-adopter group.

Costs and returns of hybrid rice for the year 2010-11 are discussed below. Use of chemical fertilizers has increased when compared to previous year for hybrid rice. It is over 5

per cent on HYVs of adopters and 4 per cent on non-adopters. Overall unit cost of production has increased to Rs. 4.28 from Rs. 3.79 for hybrid cultivators. For HYV farmers the increase is from Rs. 4.91 to Rs. 5.20 for adopters and from Rs. 4.48 to Rs. 4.88 for non-adopters. The gross returns has increased to Rs. 72,626 from Rs. 71,413 (27 per cent increase over HYVs of adopters) in 2010-11. In the same year net returns on hybrid rice dipped marginally from Rs. 44,507 to Rs. 42,638. The same kind of decrease is also seen for HYV of rice for adopters from previous year (from Rs. 27,826 to Rs. 25,117). For non-adopters of hybrid rice the net returns on HYV rice has slightly increased from Rs. 28,795 in 2009-10 to Rs. 29,335 in 2010-11. The cost benefit ratio has shown marginal decrease from 1:2.65 to 1:2.42 in Hybrid rice from previous year. The same is the case with HYV rice for both adopters and non-adopters.

8.9. Grain quality and marketing:

One of the reasons put forwarded by hybrid rice cultivators in discontinuing its cultivation is the problem of broken rice or lesser milling 'ratios'. The hulling ratio of 60:40 is observed for both hybrid adopters and non-adopters in the year 2009-10 for the two varieties of hybrid and HYV rice. However, in case of milling ratio in the same year hybrid rice gave 62:38 proportions. For HYVs both adopters and non-adopter reported a slight higher ratio of 63.37.

Head rice recovery ratio for hybrid rice is slightly lower at 55:45. For HYVs it is 58:42 for adopter and non-adopters in 2009-10. While the same ratio is observed in the following year 2010-11 for HYVs of both categories the hybrids have shown a little lower ratio of 54:46.

8.10. Volume of marketing and Prices received:

The production of hybrid rice per farm varied from 108 quintals in below 1 hectare group to 340 quintals in above 4 hectare group. The average hybrid rice production per farm is 141 quintals. In the same pattern HYV production ranged from 39 quintals in below 1 hectare group to 150 quintals in the large size group (above 4 ha). Overall average is 94 quintals of HYV rice. Out of this, the marketed quantity of hybrid rice ranged from 84.40 per cent in below 1 hectare group to 92.91 per cent in 2 to 4 hectare group. Overall average is 89.27 per cent

which is 3.44 per cent higher than 85.83 per cent for HYV rice. This higher percentage of marketed volume of hybrid rice is an indicator of its lower performance for home consumption.

Higher price (Rs. 1122) per quintal for hybrid rice is received in 1 to 2 hectare group in 2009-10. The average price on the overall is Rs. 1103 in the same year. HYV rice received a price of Rs. 1070 in 2 to 4 hectare group while above 4 hectare group received higher price of Rs. 1150 in 2009-10. The average price is also slightly higher than the price of hybrid rice at Rs. 1112 in the same year. However, non-adopters could receive only Rs. 1061 as average price for HYVs. Hybrid rice production per farm varied from 63 quintals in below 1 hectare group to 131 quintals in above 4 hectare group. Overall average is 82 quintals per farm. The same pattern is seen in HYV rice production with an overall average of 77 quintals per farm for hybrid adopters in 2010-11. The average price received for hybrid rice in the year 2010-11 does not vary much between the different land size groups and recorded Rs. 1103 on the overall. HYV paddy in the adopter category has shown wide variations from Rs. 1106 in 2 – 4 hectare group to Rs. 1150 in above 4 hectare group in the same year. The average price received for the same is Rs. 1124. This amounts to Rs. 21 higher to the average price of hybrids in the same year. The percentage of output sold of HYV paddy for non-adopters ranges from 79.88 to 88.47 across size groups in 2010-11. The highest is seen in above 4 hectare group. Overall average is 84.37 per cent. The average price received ranges from Rs. 1088 is 2 to 4 hectare group to Rs. 1175 in above 4 hectare group for non-adopters in 2010-11. On an overall the price comes to Rs. 1113 for HYV rice.

8.11. Problems and prospects for increasing hybrid rice cultivation:

Hybrid rice cultivation was introduced to the state in 1993-94. But it did not found favour among cultivators due to variety of reasons. Hybrid rice farmers were asked why they have chosen to cultivate the new varieties. The weighing factor according to majority was prospect of high production (47.50 per cent). This was followed by demonstration effect (31.25 per cent). Hybrid rice farmers were asked why they have chosen to cultivate the new varieties. The weighing factor according to majority was prospect of high production (47.50 per cent). This was followed by demonstration effect (31.25 per cent). In both the sample districts all farmers reported the private companies as the main source for the seed supply. An

overwhelming majority (86.25 per cent) were convinced of better yields of hybrid rice over inbred varieties. All of them expressed that they would get 15 – 20 per cent higher yields. Only 13.75 per cent were not very sure of better results. Though they incur higher costs, all hybrid rice farmers are buying new seeds every year. But they are cultivating the same brand. The supply of fertilizers was not a problem according to 82.50 per cent. The other 17.50 per cent said the fertilizer supply was not on time. Private traders were the only source for all hybrid cultivators. They have also said that hybrid rice does not need any additional fertilizer usage (63.75 per cent). But a third of the farmers differed and reported the need for higher usage. Damage due to pests and diseases was reported by 37.50 per cent of the sample farmers in the reference year. Susceptibility to this problem is equal to hybrid and inbred varieties according to them. Pesticides are easily available according to 86 per cent. About the same percentage of farmers felt that they had the requisite knowledge of use of correct chemical and dose. A large percentage of 92.50 have denied that hybrid rice varieties are more susceptible to pests and diseases. They were asked whether yield losses were lower in inbred varieties due to pests and diseases. Sixty four per cent said 'no'. A vast majority, ninety per cent, of hybrid rice cultivators in the sample felt that these varieties are highly sensitive to crop management practices, use of key inputs and time sensitive operations. Credit is an important input component in crop production and it is more so when higher costs are involved in hybrid rice farming due to its recurring high seed cost. Accordingly 76 per cent of them expressed that they need more credit. For this they are depending on co-operative credit societies and rural banks (70 per cent). At the same time, other 30 per cent of credit needy farmers were unable to obtain loans from any institution. They have cited problems like surety documents and timely disbursal from these institutions. Because of these reasons they have to resort to borrowings from private traders at thigh interest rate of 36 to 48 per cent.

Credit is an important input component in crop production and it is more so when higher costs are involved in hybrid rice farming due to its recurring high seed cost. Accordingly 76 per cent of them expressed that they need more credit. For this they are depending on co-operative credit societies and rural banks (70 per cent). At the same time, other 30 per cent of credit needy farmers were unable to obtain loans from any institution. They have cited problems like surety documents and timely disbursal from these institutions. Because of these

reasons they have to resort to borrowings from private traders at thigh interest rate of 36 to 48 per cent.

Easy marketing is crucial for any new product's success. For majority (68 per cent) of hybrid rice farmers marketing seems to be a problem. A third of the hybrid rice sample farmers could overcome this. Disinclination of consumers towards hybrid rice seems to be the major reason for lower prices of hybrid rice. About 64 per cent farmers complained of lower market prices. Especially in coastal Andhra Pradesh consumers are accustomed to thin and long variety of rice which have better cooking quality and would not become sticky. Poor cooking and keeping quality was the reason for lower prices according to 56 per cent of farmers. Among other reasons more broken rice after milling (23 per cent farmers), poor gain quality (21 per cent), lower hard rice recovery (11 per cent) and traders reluctance (9 per cent farmers) are the causes for slower spread of hybrid rice varieties in the state.

A big majority of 78 per cent farmers are convinced of higher yield gain of hybrids over the best inbred rice varieties. Only 23 per cent have disagreed with this view. Except for 3 per cent all other sample farmers believed that hybrid rice production is profitable if suitable seeds are developed specifically to the cultivated area. About 59 per cent of farmers believe that poor cooking quality is hampering the spread of hybrid rice. Similarly, hybrid rice is perceived to be inferior to inbred rice due to poor grain quality (41 per cent farmers), low taste appeal (34 per cent) and stickiness of cooked rice (24 per cent of farmers). According to 95 per cent of farmers traders and millers are not coming forward to readily buy hybrid rice due to higher breakage of grain and poor acceptance by consumers. Only 55 per cent of hybrid rice farmers are convinced of its economic viability and its continuation. The remaining 45 per cent are unsure of its continuing cultivation. All the farmers who would like to continue hybrid rice farming are hoping for new hybrids with better grain quality and higher yields in the study.

As 95 per cent of non-adopters are completely ignorant of hybrid rice technology, the other 5 per cent were asked to express their opinions on varieties of input technicalities. Thirty per cent of them replied that they are not aware of any government assistance to promote

hybrid rice cultivation. A large majority (85 per cent) expressed that pure hybrid seed is not available. While 5 per cent felt that hybrid seed is not at all available, the same percentage reported that even if available it is not on time. The hybrid seed is very expensive according to 95 per cent of the farmers. About 20 per cent said they had to travel long distance to buy hybrid seed. Pre-treatment of seed, which they have never done before, was the stumbling block for another 10 per cent of cultivators. There are farmers (15 per cent) who believe that the hybrids yield lower than inbred varieties. Some others (30 per cent) are convinced that hybrid yields are not sufficiently high. Though 45 per cent have agreed that yield gain of hybrid rice is high they are apprehensive of low profitability. While 15 per cent of them are averse of high risks involved, 25 per cent complained about grain quality. About 85 per cent believed that hybrid rice varieties need higher dose of fertilizers the same percentage are also vary of lower resistance to pests and diseases and consequent yield loss. More irrigation is needed for hybrid rice according to 30 per cent farmers. Only 15 per cent have doubts about quality of fodder. When asked about their willingness to cultivate hybrid rice if better varieties are developed with superior grain quality and higher yield all of them said 'yes'.

8.12. POLICY RECOMMENDATIONS:

1. Development of hybrid seed varieties that are suitable for the local area and comparable to the conventional HYVs is vital to win the confidence of the farmers for area expansion.

2. Tardy spread of hybrid rice varieties over the years show lack of efforts by the government agencies in its promotion.

3. Private companies' hybrid varieties did not attract the farmers due to poor grain, cooking quality and low market price.

4. The government may consider giving Minimum Support Price for hybrid rice separately by procuring for central pool in PDS programme.

5. Consumers in the state prefer long and thin variety of grain for home consumption. Present hybrid varieties do not fulfill this criterion. Seed developers need to focus more on this aspect to popularize their varieties.

6. Availability of hybrid rice seed on time and on subsidy is crucial for its adoption by the farmers.

7. As one third of the farmers reported problems in accessing institutional credit, efforts should be made in liberalizing the processes involved in speedy disbursal.

8. Though some demonstration programmes were held by the state agricultural department, the knowledge of the farmers with regards to hybrid rice cultivation is poor.

9. Though efforts are needed to raise productivity of any crop, excessive stress on rice crop needs to be reviewed in the back drop of huge buffer stocks being wasted due to improper storage and record exports of rice last year. Twice that value of edible oils is being imported. Policy makers may consider raising the production of edible oils and pulses which in fact need lesser irrigation. More support may be given to popularize minor millets that have more nutritional value. Broader policy initiatives may be undertaken to make availability of wide spectrum food grains in PDS programme.

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NO MODIFICATIONS WERE SUGGESTED BY THE CO-ORDINATOR

Executive summary

Introduction:

Rice is a staple food crop for major population in India. Expanding population invariably puts pressure on its production. Food security, heralded by Green Revolution slowly petered out with population growth. Changes in life style seeped through all sections of society including the farmer community forcing them to look for higher incomes from the farm. More yields are the motto. This syncs with the pressure the policy makers and scientists are undergoing to raise the yields to meet the supply gap. As the scope of expanding the cultivable area being limited higher focus is put on productivity. In addition to intensification, developing seeds of high yield potential was a challenge for the scientists. Research in to Hybrid rice was given a fillip in the early nineties.

Countries such as China have taken a big leap in rice production by going in for hybrid rice cultivation in a big way. Hybrid rice was first commercially cultivated in China in 1976. Area under hybrid rice expanded to more than 13 million hectares by 1990. Hybrid rice not only has a distinct yield advantage over inbred varieties but also is more responsive to fertilizers and can adapt to varying environments.

Rice productivity had witnessed deceleration during 1990s. The productivity potential of modern varieties had hit a plateau. Increase in population and shift in consumption from inferior to superior grains has driven the demand for rice to shoot up in the last few years. According to one estimate India would require 118 million tonnes of rice by 2020 to fulfill the requirement of its rising population. The consumption growth in rice is likely to outpace production increase, which might hurt exports. In case of pronounced slowdown, it will inevitably lead to food insecurity and deficiency. A report, prepared by ASSOCHAM says "If we presume less severe conditions for next decade and expect population growth to decline to 1.6 per cent and assume per capita consumption of rice to remain steady at the current 78.5 kg per year, the country will require about 109 million tonnes of rice in 2020. If the acreage remains stagnant in the next decade and the country manages to keep the average yield growth of 1.2 per cent of the last decade in the forthcoming years, the production is likely to grow to about 108 million tonnes". Whatever be the estimates the yield levels of rice remain to be poor when compared to other countries.

Hybrid seed production technology has been developed and demonstrated by producing an average seed yield of 1.0 to 1.5 tonne per hectare. During the kharif season of 1996 more than 60,000 hectares were planted with hybrid rice in India. Present area under hybrid rice (2009) is 1.32 million hectares out of total rice area of 44 million hectares (3 per cent). Based on research farm data it was reported that average yield of some hybrid rice varieties was 6 to 6.5 tonnes per hectare which was about 15 to 20 per cent higher than the yield of the popular conventional HYV/inbred varieties (DRR 1996, 1999).

Rice is the Principal crop extensively cultivated in all the districts of Andhra Pradesh both in kharif and rabi seasons. It accounted for 32.74 per cent of the total cropped area, 70.99 per cent of the total food grain production during 2010-11. The area under rice during 2010-11 was 47.51 lakh hectares as against 34.41 lakh hectares in 2009-10, recording an increase of 38.07 per cent. The area under rice increased due to favourable seasonal conditions during the south west monsoon period. The productivity of rice is 3035 kgs/hectares in 2010-11 as against 3150 kgs/hectare in 2009-10.

Andhra Pradesh leads other states in production with 14.42 million tonnes in 2010-11. In terms of area it is next only to Uttar Pradesh (5.66) with 4.75 million hectares. But yield wise, it is far superior with 3036 kg/ha against 2118 for Uttar Pradesh. Overall it comes next to Punjab, where the yield is 3830 kg/ha in 2010-11. The productivity of rice at all India level increased from 1984 kg per hectare in 2004-05 to 2372 kg per hectare in 2011-12.

Bayer is the major company selling Hybrid rice in Andhra Pradesh. It sold 750 kgs of seed in 2011 kharif and it increased to 11000 kgs in 2012 kharif. These seeds are comparable with MTU-1001 in kharif and MTU-1010 in rabi in grain quality. It sells under ARIZE-444 GOLD brand. It launched ARIZE DHANI in 2008. According to the company it offers a holistic solution to BLB, a dreaded rice disease causing considerable loss (20-60 percent) to production. The company is optimistic in increasing its sales in the coming years.

Need for the study:

Lot of impetus has been given to research in Rice production and many programmes were launched to break the yield plateau that has been experienced in rice crop in the past. A number of steps are being taken by the government to popularize new hybrid rice varieties through frontline demonstration, mini-kit supply, organizing training programmes for farmers, farm women, seed growers, seed production personnel of public and private seed agencies, extension functionaries of state departments of agriculture, researchers of state agricultural universities and NGOs. But there is no clear data to estimate the results of the concerted efforts put in by the government. Therefore, it has become necessary to conduct a study to assess the actual spread of newly developed varieties in terms of area with simultaneous reduction in area under conventional HYVs of rice and the increase in the average yield per hectare. It is hoped that the results of the study would enable the government to formulate the necessary changes in shaping the programmes like "Bringing Green Revolution to Eastern India (BGREI)".

Objectives of the study:

The study aims to:

- Indicate the extent of adoption and the level of participation by different categories of farmers in the cultivation of hybrid rice.
- Assess the overall impact on rice production and productivity of hybrid rice Cultivation
- Study the Economics of Cultivation of hybrid rice varieties vis-à-vis inbred varieties.
- Identify factors determining the adoption of hybrid rice varieties.
- Address various constraints and outline the prospects for increasing hybrid rice cultivations
- Suggest policy measures for expansion of hybrid rice cultivation.

Database and research methodology:

The study is based on both primary and secondary data. The data is sourced from Directorate of Economics and Statistics Publications to arrive at the trends in area, production and productivity of rice. The performance of rice in the pre-introduction period

of hybrid rice with that in post-introduction period is analyzed. As first hybrids were developed and released for commercial cultivation in India in 1994, the study period was divided into three sub periods viz., 1984-85 to 1993-94, 1994-95 to 2003-04 and 2004-05 to 2009-10. The period 1 viz., 1984-85 to 1993-94 refers to the pre-introduction period of hybrid rice while other two periods viz., period – 2 and 3 correspond to post-introduction periods.

For primary survey, NFSM cell in the state department of Agriculture was consulted and two districts where higher concentration of hybrid rice cultivation was practiced were chosen. No proper records were found regarding hybrid rice cultivation either with Department of Agriculture or with Directorate of Economics and Statistics as its cultivation is very sparse and widely distributed. Farmers who cultivate hybrid rice in successive years are even rare. Nizamabad district in Telangana and Srikakulam from North Coastal Andhra area were selected on the advice of state Agricultural Department where higher concentration of hybrid farmers were found. In fact, Nizamabad is known for hybrid rice seed production. In each district, 40 hybrid rice growers from the list of hybrid rice growing cultivators from different size groups, marginal (less than 1 hectare), small (1 to 2 ha), medium (2 to 4 hectares) and large (more than 4 hectares) including SC, ST and Women farmers were selected on the basis of their proportion in the Universe. In addition to this sample, 10 inbred variety (traditional HYVs) rice growers but non-adopters of hybrid rice were selected randomly from the same land size groups following the same procedure. Thus, 50 rice growing cultivators were selected from each district.

For the primary survey, the reference years are 2009-10 and 2010-11. Accordingly, 2 kharif and 2 rabi seasons for the rice crop were covered in the study. A structured schedule/questionnaire was used to obtain information from the sample cultivators.

Growth and Instability of Rice Production in the State:

The growth rates of production and yield of paddy are found to be statistically significant, though there is no significant increase in area. Across the sub-periods, the yield of paddy showed a significant growth in the first and second sub-periods. While in the third sub period no significance is observed. The growth rates of Area in all the sub periods are found to be not significant but showed a negative growth in the second sub-period.

Observing the seasonal growth rates of yields across the sub-periods, positive significance of yields is observed in the two seasons of 1st sub period. While the yield rate in Rabi of second sub-period is only is reported as significant. No significant growth is reported in any case of both seasons during third-sub-period. As a whole it can be concluded that the reason for showing significance of yield rates may be due to the quality seed but not due to the changes in any of other variables.

Exposure of sample households to Hybrid rice cultivation:

It is well known that education is the key in accepting new-technologies. In the same vein it is significant to note that 2.44 per cent of people in hybrid adopter group pursued education beyond graduate level while it is nil in non-adopters. In hybrid adopter group 14.63 per cent of people are graduates while it is 10 per cent in non-adopters. Of the remaining educated in the hybrid farmer group 26.83 per cent had primary education and 45.12 per cent had secondary education. In the non-adopters the corresponding figures are 45 and 25 per cent. Illiterates are higher in non-adopters while it is only half in hybrid rice adopters. These observations indicate that technology acceptance has a positive link with level of education.

Predominant crops in kharif are hybrid paddy, HYV paddy, Groundnut and Turmeric. In rabi season again paddy, both hybrid and HYV are grown along with Blackgram, Sesamum, Groundnut, Turmeric are grown. Maize and Greengram are also raised in small areas.

Hybrid adopters have brought larger area under hybrid paddy in 2010-11 when compared to 2009-10. It increased from 29.38 per cent to 39.35 per cent. Understandably area under HYVs recorded a decrease from 54.30 per cent to 44.60 per cent in this group for the same period. For non-adopters the area under HYV paddy remained the same.

Hybrid rice cultivation is relatively new to Srikakulam district whereas Nizamabad district has some pockets where hybrid rice seed production is popular. The channels of information is analyzed below. Seventy farmers (87.50 per cent) were exposed to this technology through frontline demonstration programme conducted by government followed by 64 (20 per cent) who got the knowledge from private seed companies, Government

extension workers are also seem to be active as 63 (78.75) per cent reported having gained this knowledge from them. About 44 per cent got the information through television whereas news papers were the medium of knowledge for 40 per cent. Progressive farmers have also played a key role in dispersing this knowledge as 31 per cent of farmers got benefitted by them.

Yield performance of hybrid and HYV rice:

Yield performance by farm size is analyzed here. Mean yield of hybrid rice has shown variation from 68.13 quintals per hectares in 1 – 2 hectare group to 80.62 quintal per hectare in 2 – 4 hectare group in the year 2009-10. In the same year mean yields of HYVs varied from 51.13 quintals per hectare in above 4 hectare group to 56.07 quintal per hectare in 1 – 2 hectare group. It appears from the yield data that there is not much significance to the farm size to yield levels.

When differences in yields are compared by farm size, 1 – 2 hectare group has shown 18 per cent where as the highest difference 34 per cent formed in 2 – 4 hectare group in the year 2009-10. On an aggregate the mean yield of hybrid rice is 70.83 quintals per hectare and HYVs yielded 54 quintals per hectare. The average difference in the mean yield is 23.87 per cent in 2009-10. In the following year, i.e., 2010-11 the overall mean yield has shown little decline and stands at 69.99 quintals per hectare for hybrids and 53.37 quintals per hectare for HYVs. The percentage difference in yield is 23.75.

Yield gain of Hybrid rice over HYVs varied from 12.06 per quintal in 1-2 hectare group to 27.09 per quintal in 2-4 hectare group in 2009-10. Overall average in 2009-10 is 16.93 quintals per hectare. In the following year 2010-11, the yield gain varied from 12.66 to in 1-2 ha group to 18.85 quintals per hectare in 4 ha and above group. The average yield gain stands at 16.62 quintals per hectare.

Comparative economics of hybrid and inbred rice cultivation:

While the seed for inbred varieties is 55 kgs per hectare, the same farmers have reported lesser, almost one third, use of hybrid seed (15 kgs) per hectare. One way this compensates the high cost incurred on hybrid seed. Non-adopters of hybrid rice have

reported slightly higher use of seed of 57 kgs per hectare in 2010-11. Cattle manure is widely used in the study area. Farmers who do not have cattle are buying manure from others. There is not much difference in use of manure between hybrid rice growers and non-adopters. It ranges from 5 tonnes to 5.25 tonnes per hectare. Though there is an impression that hybrid rice needs more fertilizers, farmers in the sample did not report any additional use of chemical fertilizers. Whereas hybrid rice farmers used same amount of chemical fertilizers i.e., 250 kgs per hectare the non-adopters used little more (260 kgs/ha) for inbred rice varieties. Even in the use of pesticides, hybrid rice farmers used restraint and sprayed only 3 times for both hybrid and inbred varieties. Non-adopters sprayed 4 times instead. A look at the irrigation charges reveal a lower expenditure of Rs1400 and Rs1410 for hybrid and inbred varieties respectively by hybrid rice farmers. Non-adopters incurred a higher cost of Rs1440 for inbred varieties of rice. Use of human labour is significantly lower in hybrid rice farming according to the sample farmers of hybrid growers. While they have employed 99.52 days of human labour for inbred varieties it was only 78.28 days for hybrid rice. Even use of bullock labour is less for hybrid rice cultivation when compared to HYVs amongst both hybrid and non-hybrid cultivators. Overall total human labour employed for hybrid rice comes to 78.28 days/ha and for HYV rice it is 99.52 days.

The cost of hybrid rice seed is comparatively quite high as it involves some additional processes in its cultivation and its limited availability in the market. As it cannot be used for the following year the farmer has to incur higher costs. In the hybrid adopter fields the rise in seed cost over HYV is 64 per cent. The same is 59 per cent in non-adopter fields. The cost of manure is relatively lower, 19 per cent in hybrid cultivator sample and 82 per cent in non-adopter sample. There is not much difference in costs in the use of chemical fertilizers as it is only one per cent lower for hybrids in adopter field and 4 per cent higher to non-adopter HYV fields. Hybrid adopters have spent more or less the same amount (one per cent higher) for insecticide and pesticides. But the same cost seems to be 27 per cent higher for hybrid rice when compared with HYVs of non-adopters. The irrigation charges for hybrid rice are not higher. It is 1 per cent less for adopters and 3 per cent less for non-adopters when compared with HYVs. Machinery charges for hybrid rice seem to be lower, as much as 17 per cent of HYVs of non-adopters and 3 per cent of HYVs of adopters group. Hybrid rice cultivators incurred 18 per cent lower costs on hired human labour when compared with HYVs on their own fields. But non-adopters have reported slightly lower (3 per cent) costs on HYVs for the same. Use of bullock labour is lower for hybrid rice (9 per

cent) in adopter group. It is 4 per cent lower when compared with HYVs of non-adopter group. When total costs are considered the difference is small, 1 per cent higher between hybrid and HYV rice in hybrid adopter group. It is 5 per cent higher when compared with HYV rice of non-adopter sample group. The unit cost of production is lower for hybrid rice (29 per cent) in comparison to HYV rice of same farmers. The same is 18 per cent lower when compared to HYVs of non-adopters.

Hybrids are known for their superior yields. It is 24 per cent higher in hybrid adopter group and 20 per cent higher than HYVs of non-adopter group. The yield is 71 quintals of hybrid rice per hectare as against 54 quintals and 57 quintals of HYVs of adopter and non-adopters respectively.

Market price is not very favourable to hybrid rice. It is Rs.1107/qtls as against Rs 1186/Qtls for HYV rice (7 per cent higher) in the same adopter group. The gross return for hybrid rice is 24 per cent higher when compared to HYV rice of both adopter and non-adopter farmers. The advantage is more pronounced in the net returns. It is 37 per cent higher to HYV rice for adopters and 35 per cent higher to HYVs of non-adopters. Ultimately the key to the success of hybrid rice technology is the cost-benefit ratio. It seems to be favourable for hybrid rice in the study. While it is 1:2.65 for hybrid rice, it is 1:2.05 for HYV rice of hybrid adopters. The same is 1:2.13 for HYV rice of non-adopter group.

Costs and returns of hybrid rice for the year 2010-11 are discussed below. Use of chemical fertilizers has increased when compared to previous year for hybrid rice. It is over 5 per cent on HYVs of adopters and 4 per cent on non-adopters. Overall unit cost of production has increased to Rs. 4.28 from Rs. 3.79 for hybrid cultivators. For HYV farmers the increase is from Rs. 4.91 to Rs. 5.20 for adopters and from Rs. 4.48 to Rs. 4.88 for non-adopters. The gross returns has increased to Rs. 72,626 from Rs. 71,413 (27 per cent increase over HYVs of adopters) in 2010-11. In the same year net returns on hybrid rice dipped marginally from Rs. 44,507 to Rs. 42,638. The same kind of decrease is also seen for HYV of rice for adopters from previous year (from Rs. 27,826 to Rs. 25,117). For non-adopters of hybrid rice the net returns on HYV rice has slightly increased from Rs. 28,795 in 2009-10 to Rs. 29,335 in 2010-11. The cost benefit ratio has shown marginal decrease from

1:2.65 to 1:2.42 in Hybrid rice from previous year. The same is the case with HYV rice for both adopters and non-adopters.

Grain quality and marketing:

One of the reasons put forwarded by hybrid rice cultivators in discontinuing its cultivation is the problem of broken rice or lesser milling 'ratios'. The hulling ratio of 60:40 is observed for both hybrid adopters and non-adopters in the year 2009-10 for the two varieties of hybrid and HYV rice. However, in case of milling ratio in the same year hybrid rice gave 62:38 proportions. For HYVs both adopters and non-adopter reported a slight higher ratio of 63.37.

Head rice recovery ratio for hybrid rice is slightly lower at 55:45. For HYVs it is 58:42 for adopter and non-adopters in 2009-10. While the same ratio is observed in the following year 2010-11 for HYVs of both categories the hybrids have shown a little lower ratio of 54:46.

Volume of marketing and Prices received:

The production of hybrid rice per farm varied from 108 quintals in below 1 hectare group to 340 quintals in above 4 hectare group. The average hybrid rice production per farm is 141 quintals. In the same pattern HYV production ranged from 39 quintals in below 1 hectare group to 150 quintals in the large size group (above 4 ha). Overall average is 94 quintals of HYV rice. Out of this, the marketed quantity of hybrid rice ranged from 84.40 per cent in below 1 hectare group to 92.91 per cent in 2 to 4 hectare group. Overall average is 89.27 per cent which is 3.44 per cent higher than 85.83 per cent for HYV rice. This higher percentage of marketed volume of hybrid rice is an indicator of its lower performance for home consumption.

Higher price (Rs. 1122) per quintal for hybrid rice is received in 1 to 2 hectare group in 2009-10. The average price on the overall is Rs. 1103 in the same year. HYV rice received a price of Rs. 1070 in 2 to 4 hectare group while above 4 hectare group received higher price of Rs. 1150 in 2009-10. The average price is also slightly higher than the price of hybrid rice at Rs. 1112 in the same year. However, non-adopters could receive only Rs. 1061 as average price for HYVs. Hybrid rice production per farm varied from 63 quintals in

below 1 hectare group to 131 quintals in above 4 hectare group. Overall average is 82 quintals per farm. The same pattern is seen in HYV rice production with an overall average of 77 quintals per farm for hybrid adopters in 2010-11. The average price received for hybrid rice in the year 2010-11 does not vary much between the different land size groups and recorded Rs. 1103 on the overall. HYV paddy in the adopter category has shown wide variations from Rs. 1106 in 2 – 4 hectare group to Rs. 1150 in above 4 hectare group in the same year. The average price received for the same is Rs. 1124. This amounts to Rs. 21 higher to the average price of hybrids in the same year. The percentage of output sold of HYV paddy for non-adopters ranges from 79.88 to 88.47 across size groups in 2010-11. The highest is seen in above 4 hectare group. Overall average is 84.37 per cent. The average price received ranges from Rs. 1088 is 2 to 4 hectare group to Rs. 1175 in above 4 hectare group for non-adopters in 2010-11. On an overall the price comes to Rs. 1113 for HYV rice.

Problems and prospects for increasing hybrid rice cultivation:

Hybrid rice cultivation was introduced to the state in 1993-94. But it did not found favour among cultivators due to variety of reasons. Hybrid rice farmers were asked why they have chosen to cultivate the new varieties. The weighing factor according to majority was prospect of high production (47.50 per cent). This was followed by demonstration effect (31.25 per cent). Hybrid rice farmers were asked why they have chosen to cultivate the new varieties. The weighing factor according to majority was prospect of high production (47.50 per cent). This was followed by demonstration effect (31.25 per cent). In both the sample districts all farmers reported the private companies as the main source for the seed supply. An overwhelming majority (86.25 per cent) were convinced of better yields of hybrid rice over inbred varieties. All of them expressed that they would get 15 – 20 per cent higher yields. Only 13.75 per cent were not very sure of better results. Though they incur higher costs, all hybrid rice farmers are buying new seeds every year. But they are cultivating the same brand. The supply of fertilizers was not a problem according to 82.50 per cent. The other 17.50 per cent said the fertilizer supply was not on time. Private traders were the only source for all hybrid cultivators. They have also said that hybrid rice does not need any additional fertilizer usage (63.75 per cent). But a third of the farmers differed and reported the need for higher usage. Damage due to pests and diseases was reported by 37.50 per cent of the sample farmers in the reference year. Susceptibility to this problem is equal to hybrid and inbred varieties according to them. Pesticides are easily available according to 86 per cent. About the same percentage of farmers felt that they had

the requisite knowledge of use of correct chemical and dose. A large percentage of 92.50 have denied that hybrid rice varieties are more susceptible to pests and diseases. They were asked whether yield losses were lower in inbred varieties due to pests and diseases. Sixty four per cent said 'no'. A vast majority, ninety per cent, of hybrid rice cultivators in the sample felt that these varieties are highly sensitive to crop management practices, use of key inputs and time sensitive operations. Credit is an important input component in crop production and it is more so when higher costs are involved in hybrid rice farming due to its recurring high seed cost. Accordingly 76 per cent of them expressed that they need more credit. For this they are depending on co-operative credit societies and rural banks (70 per cent). At the same time, other 30 per cent of credit needy farmers were unable to obtain loans from any institution. They have cited problems like surety documents and timely disbursal from these institutions. Because of these reasons they have to resort to borrowings from private traders at thigh interest rate of 36 to 48 per cent.

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Easy marketing is crucial for any new product's success. For majority (68 per cent) of hybrid rice farmers marketing seems to be a problem. A third of the hybrid rice sample farmers could overcome this. Disinclination of consumers towards hybrid rice seems to be the major reason for lower prices of hybrid rice. About 64 per cent farmers complained of lower market prices. Especially in coastal Andhra Pradesh consumers are accustomed to thin and long variety of rice which have better cooking quality and would not become sticky. Poor cooking and keeping quality was the reason for lower prices according to 56 per cent of farmers. Among other reasons more broken rice after milling (23 per cent farmers), poor gain quality (21 per cent), lower hard rice recovery (11 per cent) and traders reluctance (9 per cent farmers) are the causes for slower spread of hybrid rice varieties in the state.

A big majority of 78 per cent farmers are convinced of higher yield gain of hybrids over the best inbred rice varieties. Only 23 per cent have disagreed with this view. Except for 3 per cent all other sample farmers believed that hybrid rice production is profitable if suitable seeds are developed specifically to the cultivated area. About 59 per cent of farmers believe that poor cooking quality is hampering the spread of hybrid rice. Similarly, hybrid rice is perceived to be inferior to inbred rice due to poor grain quality (41 per cent farmers), low taste appeal (34 per cent) and stickiness of cooked rice (24 per cent of farmers). According to 95 per cent of farmers traders and millers are not coming forward to readily buy hybrid rice due to higher breakage of grain and poor acceptance by consumers. Only 55 per cent of hybrid rice farmers are convinced of its economic viability and its continuation. The remaining 45 per cent are unsure of its continuing cultivation. All the farmers who would like to continue hybrid rice farming are hoping for new hybrids with better grain quality and higher yields in the study.

As 95 per cent of non-adopters are completely ignorant of hybrid rice technology, the other 5 per cent were asked to express their opinions on varieties of input technicalities. Thirty per cent of them replied that they are not aware of any government assistance to promote hybrid rice cultivation. A large majority (85 per cent) expressed that pure hybrid seed is not available. While 5 per cent felt that hybrid seed is not at all available, the same percentage reported that even if available it is not on time. The hybrid seed is very expensive according to 95 per cent of the farmers. About 20 per cent said they had to travel long distance to buy hybrid seed. Pre-treatment of seed, which they have never done before, was the stumbling block for another 10 per cent of cultivators. There are farmers (15 per cent) who believe that the hybrids yield lower than inbred varieties. Some others (30 per cent) are convinced that hybrid yields are not sufficiently high. Though 45 per cent have agreed that yield gain of hybrid rice is high they are apprehensive of low profitability. While 15 per cent of them are averse of high risks involved, 25 per cent complained about grain quality. About 85 per cent believed that hybrid rice varieties need higher dose of fertilizers the same percentage are also vary of lower resistance to pests and diseases and consequent yield loss. More irrigation is needed for hybrid rice according to 30 per cent farmers. Only 15 per cent have doubts about quality of fodder. When asked about their willingness to cultivate hybrid rice if better varieties are developed with superior grain quality and higher yield all of them said ‘yes’.

POLICY RECOMMENDATIONS:

1. Development of hybrid seed varieties that are suitable for the local area and comparable to the conventional HYVs is vital to win the confidence of the farmers for area expansion.

2. Tardy spread of hybrid rice varieties over the years show lack of efforts by the government agencies in its promotion.

3. Private companies' hybrid varieties did not attract the farmers due to poor grain, cooking quality and low market price.

4. The government may consider giving Minimum Support Price for hybrid rice separately by procuring for central pool in PDS programme.

5. Consumers in the state prefer long and thin variety of grain for home consumption. Present hybrid varieties do not fulfill this criterion. Seed developers need to focus more on this aspect to popularize their varieties.

6. Availability of hybrid rice seed on time and on subsidy is crucial for its adoption by the farmers.

7. As one third of the farmers reported problems in accessing institutional credit, efforts should be made in liberalizing the processes involved in speedy disbursal.

8. Though some demonstration programmes were held by the state agricultural department, the knowledge of the farmers with regards to hybrid rice cultivation is poor.

9. Though efforts are needed to raise productivity of any crop, excessive stress on rice crop needs to be reviewed in the back drop of huge buffer stocks being wasted due to improper storage and record exports of rice last year. Twice that value of edible oils is being imported. Policy makers may consider raising the production of edible oils and pulses which in fact need lesser irrigation. More support may be given to popularize minor millets that have more nutritional value. Broader policy initiatives may be undertaken to make availability of wide spectrum food grains in PDS programme.

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Report No. 138

HYBRID RICE:
SPREAD OF NEW VARIETIES AND THEIR IMPACT ON THE OVERALL PRODUCTION AND PRODUCTIVITY IN ANDHRA PRADESH

Executive summary

SRI N.RAMGOPAL

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Andhra University
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AUGUST, 2013

AGRO-ECONOMIC RESEARCH CENTRE

(FOR ANDHRA PRADESH AND ODISHA)
(SPONSORED BY MINISTRY OF AGRICULTURE, GOVT.OF INDIA)

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From:
PROF.P. TARA KUMARI
Head of the Department of Economics &
Honorary Director

AERC/15/4/69/
Dt. 02.09.2013

To
Dr. Saumya Chakrabarti,
Honorary Director,
Agro-Economic Research Centre,
Viswa-Bharati University,
SANTINIKETAN – 731 255.
West Bengal

Dear Sir,

Sub: Submission – Draft Report on **"Hybrid Rice Spread of New Varieties and their Impact on the overall production and Productivity in Andhra Pradesh"** – Regarding.

* * *

It is herewith enclosed a copy of the Draft Report of the study **"Hybrid Rice Spread of New Varieties and their Impact on the overall production and Productivity in Andhra Pradesh"** for your comments.

I therefore request you to kindly send your suggestions at an early date, so that we can finalize the report and submit the same to the Ministry.

The receipt of the Report may kindly be acknowledged.

Thanking you,

Yours sincerely,

(**P. TARA KUMARI**)

Encl: Draft Report

Copy to:
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