CHAPTER – I

INTRODUCTION

1.1 Background

With over one billion people in India, there is a need to increase food production to meet the demand of the burgeoning population. As rice is the staple food in most parts of India and there is a need to increase production of rice and productivity of land under rice cultivation. India has the largest acreage under rice at 43.97 million hectare with a production of 104.32 million tones and yield of 2372 kg/ha (Government of India, 2012).

In fact the rice research programme in India over the past 50 years has largely centred on shifting the yield frontier which contributed substantially to achieving food security through increased rice supplies (CRRI, 1996). Several studies indicated high payoffs to rice research in India *(Evenson & McKinsey, 1991); Evenson, 1993; Kumar & Rosegranht, 1994; Pingali et.al, 1997; Jha & Kumar, 1998 as quoted in Pingali & Hossain, 1999).* The rice output growth was 2.80 per cent per annum during 1966-99 with the highest rate of growth (4.00% per year) achieved during the 1980s. Yield improvement in rice were major sources of strong output growth, largely due to widespread adoption of modern rice varieties in favourable irrigated environments *(Baker & Herdt, 1985; David & Outsuka, 1994; Hossain, 1996; Pingali et.al 1997).* However, the sense of complacency in the demand-supply balance began disappearing in early 1990s, when it was observed that yield advances in rice drastically slowed down for the irrigated rice systems in India as well as in other Asian countries. The intensive rice growing states of Andhra Pradesh, Tamil Nadu, Punjab & Haryana, which performed significantly in terms of yield improvements until the 1980s, have been witnessing either a plateau or negative yield growth during the 1990s. The economically exploitable yield of existing High Yield Varieties (HYVs) of rice has almost reached the technical optimum in irrigated rice systems with the universal adoption of HYVs.

Among various approaches and options available policymakers and research managers considered development and use of hybrid rice technology in the late 1980s as a readily available option to shift upward and yield frontier in the irrigated environments in India. Further, the miraculous success of hybrid rice technology in China, which greatly contributed to the growth of rice production in that country *(Lin, 1994; Virmani et.al 1998),* triggered an interest in strengthening research efforts in some tropical countries in Asia including India in early 1990s.

Several international agencies like UNDP, FAO, ADB and International Rice Research Institute (IRRI) have generously supported the hybrid rice research and development at many national research institutions in tropical Asia including India in the early 1990s. India received nearly US $ 8 million in financial support from these external agencies between 1990 & 2000 for activities under the hybrid rice programme initiated in 1989 at the Directorate of Rice Research, Hyderabad. An additional to external funding with the Central Government through the ICAR and State Governments have invested huge capital and human resources for the development and supply of suitable hybrid rice technology for Indian farmers. The private sector participated in hybrid rice research programme and seed production in a big way in the early 1990s, expecting a huge seed business and a guaranteed seed market in view of rice being a widely cultivated crop in the country and the farmer not being able to keep hybrid seed from his/her own produce. Among about 130 private seed companies engaged in rice business across the country, 15 larger companies participated in hybrid rice seed production and distribution in early 1990s. **After four years of rigorous research (1989-93), the first hybrid rice was released in Andhra Pradesh in 1993-94 rabi season.** Subsequently, as a result of concerted efforts over a period of two decades since the inception of the National Programme on Hybrid Rice (1989), a total of 43 rice hybrids have been released for commercial cultivation in the country of which 27 as indicated in table No. 1.1 were developed by public sector institutions and 16 were developed by private sector *(Shoba Rani et. Al., 2010, p. 36).* In contrast, in China the initial phase of development of hybrid rice was solely a public sector affair.

Table No. 1.1: Hybrid Rice Released/Notified in India

SN	Rice Hybrids	Year of Release	Yield (t/ha)
Central Release: Private Sector			
1.	KRH2	1996	7.40
2.	Pusa RH 10	2001	4.35
3.	DRRH 2	2005	5.35
4.	Rajlakshmi (CRHR 5)	2005	5.84
5.	Sahyadri 4	2008	6.80
6.	DRRH 3	2009	6.07
7.	CRHR 32	2010	5.43
Central Release: Private Sector			
8.	PHB 71	1997	7.86
9.	PA 6201	2000	6.20
10.	PA 6444	2001	6.11
11.	Suruchi 5401	2004	5.94
12.	JKRH 401	2006	6.22
13.	PA 6129	2007	6.58
14.	GK 5003	2008	6.04
15.	DRH 775	2009	7.70
16.	HRI 157	2009	6.50
17.	PAC 835	2009	5.60
18.	PAC 837	2009	6.30
19.	US 312	2010	5.76
20.	INDAM 200-017	2010	6.60
21.	27 P11	2010	5.67
22.	NK 5251	2012	NA
States Release			
23.	Pant Sankar Dhan	2004	6.12
24.	Ajay (CRHR 7)	2005	6.07
25.	CORH 3	2006	NA
26.	Indira Sona	2007	7.00
27.	JRH 8	2008	7.50

Source: Directorate of Rice Development, Patna

At present hybrid rice is reported to be grown approximately 2 lakh hectares. Area under hybrid rice will further increase after heterotic hybrids suitable for high productivity areas of Punjab, Haryana, coastal region of Andhra Pradesh and

shallow low land areas are identified and an effective transfer of technology is taken up vigorously in the target states (Viraktamat, 2010). Based on the quantity of hybrid seed sold in 2008, it is estimated that hybrid rice was cultivated on 0.15 m ha. The National Food Security Mission (NFSM) launched in 2007 envisioned an increase of 10 m. tons by the end of 11th Five Year Plan (2012). Of this hybrid rice is expected to contribute 3.4 MT if grown in 3.4 m ha (@ on tone advantage). The ultimate goal of the mission is to extend 20.00 per cent of the total rice area planted with hybrid rice. In an effort to enhance rice productivity, the present government has, in a policy shift, decided to encourage the cultivation of hybrid varieties by offering subsidies even in those cases where the seeds are not certified, but are truthfully labeled and notified. Under the NFSM, the approach is to bridge the yield gap in respect of rice through dissemination of improved technology and farm management practices. Added emphasis is being given for adoption of hybrid rice under the special scheme namely; **"Bringing Green Revolution to Eastern India (BGREI)."** The programme covers traditional rice growing areas such as Uttar Pradesh, Bihar, Jharkhand, West Bengal, Madhya Pradesh, Chattisgarh & Assam and these states account for 80.00 per cent of adoption. It is to be pointed out here that adoption of rice hybrids developed in India did not take place in the in green revolution areas where productivity plateau. The extent of adoption of hybrid rice in South India is very low (5.00%) and North-West India (Punjab, Haryana & Maharashtra account for 15.00 Per cent.

Moreover, Janaiah (2002) argues that in spite of huge capital and human resources invested over the past decade to develop and supply hybrid rice technology for Indian farmers, there has not been a noticeable impact on the sector. India has tried to emulate China's success story in the area of hybrid rice research and development, but Indian farmers have not readily accepted hybrid rice technology. If one looks at adoption of hybrid rice in different states the adoption, empirical results found that the farmers have not adopted hybrid rice for various reasons. In spite of attempts over a decade to popularize hybrid rice in states like Andhra Pradesh, Tamil Nadu & Karnataka in south the adoption is very low *(Janaiah; 2003;*

Chengappa et.al; 2003 & Ramasamy et.al, 2003). The reasons for resistance to adopt hybrid rice in India are (a) shortage of hybrid rice in terms of quantity and quality, (b) poor hybrid rice grain formation, (c) yield, biotic stresses like bacterial and pest attack, (d) lack of market for hybrid rice because of consumer's preferences regarding grain quality, shape, colour and cooking quality, and; (e) high cost of hybrid seed. In fact, recently the Bihar Government paid Rs. 61 crore to farmers who cultivated hybrid rice because the grain formation did not occur in the seed and hence farmers incurred losses. Despite all above, a number of varieties, as staged in table No. 1.1, have been released by the Central Government and states as well to meet the demand of the farmers; the spread of these new varieties in place of traditional ones has not been examined adequately. In fact, there is no comprehensive study to record farm level experiences of hybrid rice, thus, the Ministry of Agriculture, Government of India has decided to assign the study entitled **"Spread of New Varieties of Hybrid Rice and their Impact on the Overall Production and Productivity"** to its Agro-Economic Research Centres in their respective states. Accordingly, this Centre has been undertaken the study in Bihar.

1.2 Need of the Study

After realizing the great potential of hybrid rice, the Government of India has notified newer varieties with a view to break the yield constraints that usually found in traditional varieties. A number of steps have come into effect to popularize these newer varieties. These are mainly demonstrations, supply of minikits, trainings deployment of extension workers etc. for the farmers. But there are no perfect information to see the exact status of these strategies, which have caused the policy managers in fix. Therefore, it is high time to conduct the study for assessing the actual spreading of these newer varieties in terms of area, production and productivity. This will help the Ministry of Agriculture, Government of India to sketch a plan for augmenting the spread of new varieties of Hybrid rice in place of the old ones. Besides, it will also provide feed back to the concerned state governments to see the performance of the hybridization process in their states for future interventions and so there is need of the study.

1.3 Objectives of the Study

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

ii. To assess the overall impact on rice production and productivity of hybrid rice cultivation.

iii. To study the economics of cultivation of hybrid rice varieties vis-à-vis inbred varieties.

iv. To identify factors determining the adoption of hybrid rice varieties.

v. To address various constraints and outline the prospects for increasing hybrid rice cultivation and finally

vi. To suggests policy measures for expansion of hybrid rice cultivation.

1.4 Data Base, Sampling Design, Methodology and Coverage

This study is based on both secondary and primary data. Secondary data relating to area, production and yield of rice crop were collected from the Directorate of Agriculture, Government of Bihar. Secondary data were also obtained from the publications of Government of Bihar and Government of India. These are mainly Economic Survey of Bihar, Statistical Handbook of Bihar, Agricultural Statistics--- At a Glance: 2012 etc. To arrive at the conclusion regarding trends in APY of rice secondary data were collected for the years from 1984-85 to 2009-10. These periods were divided into three sub-periods viz., Period – I, (1984-85 to 1993-94), Period – II, (1994-95 to 2003-04) & Period – III, (2004-05 to 2009-10) with a view to have glimpse over the pre and post introduction of hybrid rice across the periods respectively. Primary data is confined to the National Food Security Mission (NFSM) paddy districts (18 districts) of Bihar. Out of these 18 NFSM paddy districts, two (02) districts namely; Muzaffarpur and Gaya were selected on the basis of having higher concentration of hybrid seeds cultivation. From Muzaffarpur districts, two representative blocks namely; Minapur, Motipur & from Gaya district Aamas & Dumaria blocks were chosen following same criteria. Thereafter from each of the selected blocks, two villages namely; Shital Sema & Minapur from Minapur Block and Morsandi and Tajpur from Motipur Block and Mahua and Bazitpur from Aamas Block and Karhani and Bokaha from Dumaria Block were selected for in-depth enquiry. From each of the selected villages, lists of cultivating households growing hybrid rice varieties and inbred varieties were prepared separately and stratified

according to farm size groups such as marginal (< 1 ha), small (1 to 2 ha), semi-medium (2 to 4 ha), medium (4 to10 ha) and large (10 ha & above). Due attention was given in the sample to accommodate the social composition of the villages. As regards the sample size is concerned, 40 hybrid rice growers from the list of hybrid rice growers and 10 inbred rice growers from the list of inbred rice growers were randomly chosen, making a total of 50 paddy growers from each of the sample district were selected. This way the total size of the sample is 100 paddy growers, equally spread over in two selected districts from the state (Bihar).

The reference period of primary data was 2009-10 and 2010-11. Primary data was obtained by administering a duly structured schedule.

The details of sample distribution by size classes, districts, blocks and villages may be seen in table 1.2 below:

Table No. 1.2: Distribution of Sample Households.

SN	Districts	Marginal	Small	Semi-Medium	Medium	Large	Total
1.	Muzaffarpur	23	15	8	4	---	50
2.	Gaya	22	16	8	4	---	50
	Total	45	31	16	8	---	100

1.5 Organization of the Report

The present report is divided into eight chapters. Chapter one deals with the introduction which spells out background, need of the study, objectives and research methodology. Status of rice in Bihar has been presented in chapter two. Chapter three is focused on status of adoption of hybrid rice at the farm level. Impact of hybrid rice cultivation on overall production of rice has been examined in chapter four. Chapter five analyses the comparative economics of hybrid rice and inbred rice cultivation. Grain quality considerations and the aspect of marketing have been analyzed in chapter six. Chapter seven pertains to problems and prospects of hybrid rice cultivation and finally chapter eight provides summary and policy suggestions emerged from the study.

CHAPTER – II

STATUS OF RICE IN BIHAR

This chapter is pertained to status of rice in the state during 1984-85 to 2009-10 in respect of area, production and yield. Compound Growth Rate (CGR) and Co-efficient of Variation (CV) of rice production and yield of HYV rice and total rice for three specified periods i.e., 1983-84 to 1993-94, 1994-95 to 2003-2004 and 2004-05 to 2009-10 for all the three seasons have been analyzed since there is no availability of secondary data relating to hybrid rice area, production and yield in the state, so it could not be analyzed in this chapter. The following sections deals with above facts and figures:

2.1 Status of Rice in Bihar

Bihar is endowed with fertile Gangetic alluvial soil with abundant water resources, particularly groundwater. With varied soil categories associated with different agro-climatic zones, the farmers grow a variety of crops. Apart from food grains, the state produce oilseeds, fibre crops, sugarcane, fruits, vegetables and other minor food crops. The first agricultural roadmap (2007-12) has ensured productivity steadily rise in the fields. This is corroborated by the fact that the state has reached the productivity of 2240 kg/ha for paddy in recent years. Because of the use of new 'SRI' technique and use of newer agricultural implements, there was enormous rise

in rice production. The level of rice production prior to 2010-11 was not consistent and there was much variation in the production level over the years. The average production figure was around 50 lakh tones during the period from 2007-08 to 2010-11. The efforts taken under NFSM (Rice) and BGREI and adoption of SRI technology resulted to significant increase in yield/productivity of rice crop in the state. One can observe the comparative productivity levels by the percentage change between the two trienniums viz., 2002-03 and 2009-12. It is 8.00 per cent in case of rice productivity. In fact the state government is putting in a strong agricultural monitoring system so that nothing is left to chance. Support services in irrigation, seeds, fertilizer, farm mechanization, agricultural credit and awareness programmes are being stressed to make agricultural more viable. The state government has formed an 'Agriculture Cabinet,' first of its kind in India, consisted of 18 related departments of agricultural operations so that a comprehensive focus on agricultural development could be made. Being enthused by the overwhelming response at all the levels, the prospects of rice production in the state is such that the state has targeted to achieve the production of 98 lakh metric tones of rice during the year 2013-14. However, the state has achieved the production level of 80 lakh MT in the year 2012-13.

2.2 Trend and Composition of Rice in the State

Rice is one of the important crops in Bihar. There are three seasons of rice as such Autumn (Bhadai), Winter (Aghani) and Boro (Summer). The trend and composition of rice in the state according to seasons and year wise is imposed in table No. 2.1. Analysis of this table reveals that winter (Aghani) rice is the most important season out of the three rice growing seasons in Bihar in terms of area sown and production. In 2009-10 winter rice accounted for 36.99 per cent of total output and 80.93 per cent of total area cultivated under rice. The importance of winter rice output in total production has fallen from 91.41 per cent in 1984-85 to 36.99 per cent in 2009-10 while that of Boro rice has risen from 1.65 per cent in 1984-85 to 2.07 per cent in 2009-10 except a few years. Increase in the share of output in case of autumn rice (Bhadai) is due to increased in area from 6.94 per cent in 1984-85 to 88.61 per cent in 2007-08. However, it declined to 60.95 per cent in 2009-10. For summer rice, increased share in production is attributable to increase in both area and production. The relative importance of winter rice has also sharply fallen in terms of acreage planted and production. It is noted that average rice yield in Bihar increased to 1475 kg per

hectare in 2006-07 except 2008-09 & 2009-10. These were 928 kg per hectare in 1987-88 and 1211 kg per ha in 1984-85, the period when rice crop of the state was yet to switch over to the hybrid technology. In case of summer rice, yield rate increased from 1406 kg per ha in 1984-85 to 2053 kg per ha in 1998-99, which again increased to 1736 kg per ha in 2009-10. For winter rice, yield level increased from 1098 kg per ha in 1984-85 to 1142 kg per ha in 2009-10 through 1555 kg per ha in 2006-07 whereas autumn rice recorded yield levels of 947 kg per ha in 2009-10 which was 1648 kg per ha in 2008-09 against 771 kg per ha in 1984-85. Above analysis showed that there has been overall increase in rice production during the period under study 1984-85 to 2009-10.

Table No. 2.1: Trend and Composition of Rice in the state (Bihar)

Year	Winter rice			Autumn rice			Summer rice			Total rice *(= 100%)*		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1984-85	4130 (86.68)	5214 (91.41)	1098	513 (10.89)	396 (6.94)	771	67 (1.43)	94 (1.65)	1406	4710	5704	1211
1985-86	4289 (87.98)	5949 (91.62)	1127	518 (10.63)	447 (6.88)	862	68 (1.39)	97 (1.50)	1426	4875	6493	1331
1986-87	4315 (87.58)	4479 (87.28)	1068	528 (10.75)	549 (10.70)	1039	69 (1.40)	104 (2.02)	1507	4912	5132	1045
1987-88	4101 (87.68)	3879 (89.36)	946	508 (10.86)	345 (7.95)	680	68 (1.46)	117 (2.70)	1717	4677	4341	928
1988-89	4268 (87.33)	5079 (85.74)	1190	548 (11.21)	754 (12.73)	1376	71 (1.46)	91 (1.53)	1286	4887	5924	1212
1989-90	4249 (87.25)	5337 (89.22)	1256	545 (11.19)	543 (9.08)	998	76 (1.56)	102 (1.70)	1334	4870	5982	1228
1990-91	4333 (87.50)	6454 (90.95)	1215	543 (10.57)	552 (7.78)	1018	76 (1.53)	90 (1.27)	1134	4952	7096	1433
1991-92	4100 (86.68)	4613 (85.84)	922	541 (11.44)	626 (11.65)	1156	89 (1.88)	135 (2.51)	1504	4730	5374	1136
1992-93	3631 (57.96)	3488 (59.71)	788	2553 (40.75)	2236 (38.27)	876	81 (1.29)	118 (2.02)	1466	6265	5842	932
1993-94	3793 (86.26)	5896 (88.46)	1279	502 (11.42)	564 (8.46)	1124	102 (2.32)	205 (3.08)	2007	4397	6665	1516
1994-95	3903 (86.37)	6094 (88.85)	1284	521 (11.53)	595 (8.67)	1142	95 (2.10)	170 (2.48)	1789	4519	6859	1518
1995-96	4044 (86.52)	6442 (88.99)	1307	531 (11.36)	610 (8.43)	1148	99 (2.12)	187 (2.58)	1888	4674	7239	1549
1996-97	4074 (86.19)	7042 (88.76)	1424	544 (11.51)	683 (8.61)	1255	109 (2.30)	209 2.63)	2049	4727	7934	1678
1997-98	4110 (85.86)	6513 (86.83)	1346	558 (11.66)	756 10.08)	1353	120 (2.50)	213 (2.84)	1917	4787	7501	1567
1998-99	4100 (86.21)	4275 (82.86)	1043	528 (11.10)	620 (12.02)	1175	128 (2.69)	264 (5.12)	2053	4756	5159	1085
1999-00	4007 (85.78)	5052 (84.26)	1261	540 (11.56)	698 (11.64)	1292	124 (2.66)	246 (4.10)	1976	4671	5996	1284
2000-01	2939 (80.39)	4444 (81.63)	1512	592 (16.19)	787 (14.46)	1330	125 (3.42)	213(3.91)	1701	3656	5444	1489
2001-02	2843 (80.04)	4244 (81.57)	1492	594 (16.72)	736 (14.15)	1239	114 (2.19	221 (4.08)	1932	3552	5203	1465
2002-03	2881 (80.36)	4205 (84.34)	1459	583 (16.26)	583 (11.69)	1170	120 (2.41)	197 (3.97)	1641	3585	4986	1391
2003-04	2907 (81.25)	4589 (86.36)	1459	553 (15.46)	553 (10.41)	1242	117 (2.20)	169 (3.23)	1453	3578	5314	1485
2004-05	2489 (79.27)	1828 (72.28)	734	534 (17.01)	534 (21.12)	893	116 (4.59)	166 (6.60)	1430	3140	2529	805
2005-06	2604 (80.10)	3023 (81.50)	1160	533 (16.39)	503 (13.56)	944	113 (3.05)	182 (4.94)	1614	3251	3709	1141
2006-07	2845 (81.92)	4426 (86.43)	1555	518 (14.92)	530 (10.35)	1023	109 (2.13)	163 (3.22)	1498	3473	5121	1475
2007-08	524 (15.09)	321 (7.18)	612	2842 (81.85)	3968 (88.61)	1395	106 (3.06)	189 (4.21)	1722	3472	4478	1287
2008-09	547 (15.65)	727 (13.03)	1329	2843 (81.34)	4684 (83.97)	1648	105 (3.01)	167 (3.00)	1644	3495	5578	1047
2009-10	2600 (80.93)	2970 (36.99)	1142	517 (16.09)	4894 (60.95)	947	96(2.98)	166 (2.07)	1736	3213	3626	1128

Note: Figures in the parentheses indicate percentages of total rice

A = Area in thousand hectare, P = Production in thousand tonnes, Y = Yield in Kg/ Hectare.

Source: Directorate of Statistics & Evaluation, Patna, Bihar,
Economic Survey, Govt. of Bihar – 2008-09, 2009-10 & 2010-11

2.2.1 Trend and Composition of HYV Rice in the State

The season and year wise trend and composition of HYV rice in the state is presented in table 2.2. Analysis of this table showed that the total area under HYV rice has increased from 1401 thousand ha in 1994-95 to a peak of 1984 thousand ha in 1999-2K but it has fallen in subsequent years and reached to the level of 1691 thousand ha in 2009-10. But it has increased from 1401 thousand ha in 1994-95 to 1691 thousand ha in 2009-10, registering an increase of 20.70 per cent in area. In case of production almost similar pattern was observed. It increased from 2065 thousand MT in 1994-95 to 2203 thousand MT in 2009-10, accounting for an increase in production by 6.69 per cent during the period. The yield level has also increased from 1474 kg per ha in 1994-95 to 1611 kg per ha in 2008-09 but it has fallen in 2009-10 and touched to second lowest i.e, 1302 kg per ha during 1994-95 to 2009-10. Of the total HYV rice area in the state, the share of autumn and boro rice was nearly 94.00 per cent and 6.00 per cent respectively in 1994-95, which have marginally increased in autumn rice (95.33%) in 2009-10 and fallen in case of boro rice (4.67%) in 2009-10. It further reveals that the absolute area under HYV rice has increased in case of autumn HYV rice only. It may be due to less or poor irrigational facilities in growing HYV rice in summer season. Almost similar trend has been found in case of production of HYV rice in the state. It increased from 1930 thousand MT in 1994-95 to 2079 thousand MT in 2009-10 for autumn rice and in case of boro rice it has fallen from 135 thousand MT in 1994-95 to 124 thousand MT in 20098-10, registering an increase by 7.72 per cent in case of autumn HYV rice and a fall of 8.14 per cent in case of boro HYV rice. The yield rate has fallen in both the seasons by 12.01 per cent in case of autumn HYV rice and 3.55 per cent in case of boro HYV rice in 2009-10 over 1994-95. Thus, it can be concluded that the cultivation of HYV rice in the state is significantly picking up in autumn season only but its yield level is yet to be picked up in a significant manner.

Table No. 2.2: Trend and Composition of HYV Rice in the state (Bihar)

Year	Winter (Aghani)			Aman (Bhadai)			Boro (Garma)			Total		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1984-85	---	---	---	---	---	---	---	---	---	---	---	---
1985-86	---	---	---	---	---	---	---	---	---	---	---	---
1986-87	---	---	---	---	---	---	---	---	---	---	---	---
1987-88	---	---	---	---	---	---	---	---	---	---	---	---
1988-89	---	---	---	---	---	---	---	---	---	---	---	---
1989-90	---	---	---	---	---	---	---	---	---	---	---	---
1990-91	---	---	---	---	---	---	---	---	---	---	---	---
1991-92	---	---	---	---	---	---	---	---	---	---	---	---
1992-93	---	---	---	---	---	---	---	---	---	---	---	---
1993-94	---	---	---	---	---	---	---	---	---	---	---	---
1994-95	1317 (94.00)	1930 (93.46)	1465	---	---	---	83 (6.00)	135 (6.54)	1634	1401 (100.00)	2065 (100.00)	1474
1995-96	1378 (93.93)	1887 (92.64)	1369	---	---	---	89 (6.07)	150 (7.36)	1688	1467 (100.00)	2037 (100.00)	1388
1996-97	1409 (93.56)	2357 (93.05)	1672	---	---	---	97 (6.44)	176 (6.95)	1822	1506(100.00)	2533 (100.00)	1682
1997-98	1441 (93.39)	2732 (93.31)	1896	---	---	---	102 (6.61)	196 (6.69)	1928	1543(100.00)	2928 (100.00)	1897
1998-99	1851 (93.75)	3215 (92.17)	1737	---	---	---	124 (6.25)	273 (7.83)	2204	1975(100.00)	3488(100.00)	1766
1999-00	1881 (94.81)	3344 (93.77)	1778	---	---	---	103 (5.19)	222 (6.23)	2157	1984(100.00)	3566(100.00)	1797
2000-01	1649 (94.93)	2879 (94.70)	1746	---	---	---	88 (5.07)	161 (5.30)	1833	1737(100.00)	3040(100.00)	1750
2001-02	1608 (94.48)	2788 (93.65)	1734	---	---	---	94 (5.52)	189 (6.35)	2017	1702(100.00)	2977(100.00)	1749
2002-03	1583 (93.01)	2695 (93.25)	1703	---	---	---	119 (6.99)	195 (6.75)	1641	1702(100.00)	2890(100.00)	1698
2003-04	1556 (94.65)	2816 (95.52)	1810	---	---	---	88 (5.35)	132 (4.48)	1502	1644(100.00)	2948(100.00)	1718
2004-05	1411 (94.63)	1329 (91.66)	942	---	---	---	80 (5.37)	121 (8.34)	1521	1491(100.00)	1450(100.00)	972
2005-06	1525 95.19)	2148 (94.79)	1409	---	---	---	76 (4.81)	118 (5.21)	1552	1602(100.00)	2266(100.00)	1414
2006-07	1636 (94.95)	2926 (95.34)	1789	---	---	---	87 (5.05)	143 (4.66)	1643	1723(100.00)	3069(100.00)	1723
2007-08	1732 (94.96)	2764 (94.53)	1596	---	---	---	92 (5.04)	160 (5.47)	1741	1824(100.00)	2924(100.00)	1526
2008-09	1734 (95.54)	3231 (96.05)	1863	---	---	---	81 (4.46)	133 (3.95)	1648	1815(100.00)	3364(100.00)	1611
2009-10	1612 (95.33)	2079 (94.37)	1289	---	---	---	79 (4.67)	124 (5.63)	1576	1691(100.00)	2203(100.00)	1302

Note: Figures in the parentheses indicate percentages of total

A = Area in thousand hectare, P = Production in thousand tonnes, Y = Yield in Kg/ Hectare.

Source: Agricultural Statistics at a glance 2008-09 & 2010-11, MoA, GoI.

2.3 Growth and Instability of Rice Production in the State

The rice production in the state has been divided into three sub period viz., 1984-95 to 1993-94 refers to the pre introduction period of hybrid rice cultivation, while other two periods viz., period-II (1994-95 to 2003-04) and period – III (2004-05 to 2009-10) corresponding to post introduction periods. The growth trends of area, production and productivity of rice in each of the three rice season separately for the three sub periods by using a semi log trend exponential model has been calculated.

The compound growth rates of area, production and productivity of total paddy in the state of Bihar shown in table 2.3. Analysis of this table reveals that growth rate in area of total paddy on an aggregate level during the period-I (1984-85 to 1993-94) was estimated as 0.68 per cent per annum which decreased to -2.83 per cent per annum during the period – II (1994-95 to 2003-04). But thereafter it increased at the rate of 12.95 per cent per annum during the period – III (2004-05 to 2009-10). Thus, it clearly indicates that the area under total paddy on an aggregate level in the state of Bihar has increased significantly during the period – III (2004-05 to 2009-10). The production of total paddy had recorded increase at the rate of 1.45 per cent per annum during period-I (1984-85 to 1993-94), and 15.93 per cent per annum during the period – III (2004-05 to 2009-10) except decrease in period – II (1994-95 to 2003-04) by 4.63 per cent per annum. Similarly, the productivity of total paddy had also increased at the rate of 0.77 per cent per annum during period – I (1984-85 to 1993-94) and 2.64 per cent per annum till during the period – III (2004-05 to 2009-10). But it has fallen by 0.97 per cent per annum during the period – II (1994-95 to 2003-04). The season wise analyzing showed that during winter season, the area under total paddy had increased at the rate of 1.38 per cent per annum only during the period – III (2004-05 to 2009-10). But it had decreased at the rate of 1.22 per cent and 4.65 per cent per annum during other two periods i.e; I & II respectively. Similarly the rate of growth in production of total paddy had increased at the rate of 10.91 per cent per annum during the period – III (2004-05 to 2009-10) while it decreased at the rate of 0.55 per cent and 5.34 per cent per annum during the periods I & II. As regards the productivity of total paddy it was found increased in periods II & III by 1.64 per cent and 9.30 per cent per annum respectively. Analysis of autumn rice showed that the

area under total paddy increased from 7.08 per cent per annum during 1984-85 to 1993-94 to 140.44 per cent per annum till the period of 2004-05 to 2009-10. The production of autumn had increased from the rate of 10.31 per cent per annum during the period – I (1984-85 to 1993-94) and 75.89 per cent per annum during the period – III (2004-05 to 2009-10) but it fell by 0.22 per cent per annum during the period – II (1994-95 to 2003-04). The yield had increased from 3.03 per cent per annum in 1984-85 to 1993-94 to 3.57 per cent per annum in 2004-05 to 2009-10 whereas analysis of summer rice revealed that area under total rice decreased from 4.13 per cent per annum in 1984-85 to 1993-94 to 2.17 per cent per annum during 1994-95 to 2003-04. But it decreased by 3.50 per cent per annum during the period – III (2004-05 to 2009-10).

Similarly the CGR of production of summer season showed an increase at the rate of 5.62 per cent per annum in 1984-85 to 1993-94 but its growth retarded at 0.31 per cent per annum during the period – II (1994-95 to 2003-04). Further it fell by 0.31 per cent per annum during the period – III (2004-05 to 2009-10). The yield of summer season increased at the rate of 1.33 per cent per annum during the period of 1984-85 to 1993-94 and 3.38 per cent per annum during the period of 2004-05 to 2009-10. But it fell by 2.13 per cent per annum during the period of 1994-95 to 2003-04.

Table No. 2.3: Compound Growth Rates of Area, Production and Productivity of Rice in the state (Bihar)

(Per cent per annum)

Period	Winter rice			Autumn rice			Summer rice			Total rice		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1984-85 – 1993-94	-1.22	-0.55	-0.64	7.08	10.31	3.03	4.13	5.62	1.33	0.68	1.45	0.77
1994-95 -- 2003-04	-4.65	-5.34	1.64	1.12	-0.22	0.53	2.17	0.32	-2.13	-2.83	-4.63	-0.97
2004-05 — 2009 - 10	1.38	10.91	9.30	140.44	75.89	3.57	-3.50	-0.31	3.38	12.95	15.93	2.64

2.3.1 Growth of High Yielding Varieties in the State

The compound growth rates of area, production and productivity of HYV paddy in the state of Bihar is presented in table 2.4. An analysis of this table showed that the growth rate in area of total HYV paddy was estimated as 2.11 per cent per annum during the period of 1994-95 to 2003-04 which increased to 3.08 per cent per annum

during the period of 2004-05 to 2009-10. Thus, it is clearly indicated that the area under total HYV paddy on an aggregate level in the state of Bihar has increased. Correspondingly, the production of total HYV paddy had also increased at the rate of 4.08 per cent per annum during 1994-95 to 2003-04 to 8.38 per cent per annum till the period of 2004-05 to 2009-10. Thus, the production of total HYV paddy had also considerably increased in the state as whole. Likely, the productivity of total HYV paddy had also increased at the rate of 1.69 per cent per annum during the period of 1994-95 to 2003-04 to 5.07 per cent per annum till the period of 2004-05 to 2009-10. Thus, the area, production and productivity of total HYV paddy had considerably increased in the state of Bihar. While during autumn season, the area under HYV paddy had increased from 2.18 per cent per annum during 1994-95 to 2003-04 to 3.22 per cent per annum till the period of 2004-05 to 2009-10. The production of HYV paddy had also increased at the rate of 4.29 per cent per annum during 1994-95 to 2003-04 to 10.22 per cent per annum till the period of 2004-05 to 2009-10. The productivity of HYV paddy also showed increased from 2.08 per cent per annum during the period of 1994-95 to 2003-04 to 6.77 per cent per annum till 2004-05 to 2009-10. Thus, the area, production and productivity of HYV paddy of autumn season had showed increasing level in the state of Bihar. The analysis of Boro HYV paddy revealed that area had increased at the rate of 1.08 per cent per annum during the period of 1993-94 to 2003-04 and at 0.53 per cent during the period of 2004-05 to 2009-10. The production of Boro HYV rice had increased at the rate of 0.73 per cent per annum during the period of 1994-95 to 2003-04 and at 1.71 per cent during the period of 2004-05 to 2009-10. While, the productivity of HYV Boro rice had decreased at the rate of 0.38 per cent per annum during the period of 1994-95 to 2003-04 and at the rate of 1.19 per cent per annum during the period of 2004-05 to 2009-10.

Table No. 2.4: Compound Growth Rates of Area, Production and Productivity of HYV Rice in the state (Bihar)

(Per cent per annum)

Period	Aghani			Aman			Boro			Total		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1984-85 – 1993-94	-	-	-	-	-	-	-	-	-	-	-	-
1994-95 --2003-04	2.18	4.29	2.08	-	-	-	1.08	0.73	-0.38	2.11	4.08	1.69
2004-05 -2009 - 10	3.22	10.22	6.77	-	-	-	0.53	1.71	1.19	3.08	8.38	5.07

2.3.2 Instability of Rice Production

The coefficient of variation (CV) in area, production and productivity of total paddy in the state of Bihar is presented in table 2.5. an analysis of this table indicates that coefficient of variation on an aggregate in the area of total paddy was estimated to 10.10 per cent during the period of 1984-85 to 1993-94 which varied to 26.76 per cent till the period of 2004-05 to 2009-10. While, the coefficient of variation in production of total paddy had varied in increasing direction from 13.58 per cent in the period of 1984-85 to 1993-94 to 27.19 per cent till the period of 2004-05 to 2009-10. But the coefficient of variation in yield of total paddy was recorded to 16.38 per cent during 1984-85 to 1993-94, which increased to 20.25 per cent till the period of 2004-05 to 2009-10. Thus, area, production and yield of total paddy had varied significantly in increasing order.

As regards to the coefficient of variation in area, production and productivity of winter paddy, the variation in area had been recorded a little increased from 5.70 per cent in the period of 1984-85 to 1993-94 to 5.83 per cent till the period of 2004-05 to 2009-10. The variation in production shows increased from 18.63 per cent in 1984-85 to 1993-94 to 30.84 per cent till the period of 2004-05 to 2009-10 whereas, the variation in yield indicate an increased from 14.71 per cent in 1984-85 to 1993-94 to 26.11 per cent till the period of 2004-05 to 2009-10. Thus, coefficient of variation in area, production and yield of total winter paddy had varied in either constant or increasing rate.

As responses to the coefficient of variation in area, production and yield of autumn paddy, the variation in area increased from 87.79 per cent in 1984-85 to 1993-94 to 198.77 per cent in 2004-05 to 2009-10. The variation in production showed also increased from 78.66 per cent in 1984-85 to 1993-94 to 87.63 per cent during the period of 2004-05 to 2009-10. While, the variation in yield decreased from 20.51 per cent in 1984-85 to 1993-94 to 16.87 per cent till the period of 2004-05 to 2009-10. Thus, coefficient of variation in area and production of autumn rice had varied with increasing rate.

Similarly, the coefficient of variation in area, production and yield of summer paddy, the variation in area decreased from 14.73 per cent in 1984-85 to 1993-94 to 6.84 per cent till the period of 2004-05 to 2009-10. The variation in production indicates decreasing from 30.00 per cent in 1984-85 to 1993-94 to 6.18 per cent till the period of 2004-05 to 2009-10. The yield also show decreased from 16.29 per cent in 1984-85 to 1993-94 to 7.59 per cent till the period of 2004-05 to 2009-10. Thus, coefficient of variation in area, production and yield of summer paddy had varied in decreasing direction.

Table No. 2.5: Coefficient of variation (CV) in Area, Production and Productivity of Rice in the state (Bihar)

Period	Winter rice			Autumn rice			Summer rice			Total rice		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1984-85 – 1993-94	5.70	18.63	14.71	87.79	78.66	20.51	14.73	30.00	16.29	10.10	13.58	16.38
1994-95 -- 2003-04	16.63	21.00	10.50	4.84	12.20	6.08	9.59	14.55	10.49	16.75	18.06	11.42
2004-05 — 2009 - 10	5.83	30.84	26.11	198.77	87.63	16.87	6.84	6.18	7.59	26.76	27.19	20.25

The analysis of coefficient of variation in area, production and productivity of HYV paddy is presented in table 2.6 showed that the variation in total area of HYV paddy during the period of 1994-95 to 2003-04 was calculated to 11.93 per cent which decreased to 7.57 per cent during the period of 2004-05 to 2009-10. The variation in total production was estimated to 18.01 per cent during the period of 1994-95 to 2003-04 which increased to 24.20 per cent during the period of 2004-05 to 2009-10. The variation in total productivity was recorded to be 8.94 per cent during the period of 1994-95 to 2003-04 which also increased to 18.68 per cent during the period of 2004 - 05 to 2009-10. Thus, production as well as productivity of total HYV paddy had varied largely in increasing order but area had varied in decreasing direction. As regards to the coefficient of variation in area, production and productivity of Aghani HYV paddy, the variation in area during the period of 1994-95 to 2003-04 was estimated to 12.16 per cent which decreased to 7.75 per cent during the period of 2004-05 to 2009-10. The variation in production was found to 18.10 per cent during the period of 1994-95 to 2003-04 which increased to 28.79 per cent during the period of 2004-05 to 2009-10. The variation in productivity was indicated to 9.37 per cent

during the period of 1994-95 to 2003-04, which increased to 23.12 per cent during the period of 2004-05 to 2009-10. Thus, in Aghani season coefficient of variation in production and productivity was higher during the period of 2004-05 to 2009-10 compared to the period of 1994-95 to 2003-04.

The analysis of coefficient of variation for Boro HYV paddy shows that the variation in area during the period of 1994-95 to 2003-04 was estimated to 13.83 per cent, which decreased to 7.14 per cent during the period of 2004-05 to 2009-10. The variation in productivity of Boro HYV paddy during the period of 1994-95 to 2003-04 was calculated to 12.69 per cent, which decreased to 4.96 per cent during the period of 2004-05 to 2009-10 while, the variation in production was also decreased from 23.41 per cent during the period of 1994-95 to 2003-04 to 12.01 per cent during the period of 2004-05 to 2009-10. Thus, the variation in area, production and productivity of Boro HYV paddy varied in decreasing direction. It may be due to shortage of irrigation facilities.

Table No. 2.6: Coefficient of variation (CV) in Area, Production and Productivity of HYV Rice in the state (Bihar)

Period	Aghani			Aman			Boro			Total		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1984-85 – 1993-94	-	-	-	-	-	-	-	-	-	-	-	-
1994-95 --2003-04	12.16	18.10	9.37	-	-	-	13.83	23.41	12.69	11.93	18.01	8.94
2004-05 —2009 - 10	7.75	28.79	23.12	-	-	-	7.14	12.01	4.96	7.57	24.20	18.68

2.3.3 Contribution of Hybrid Rice Technology

The first hybrid rice was developed and released for commercial cultivation in India in 1994. The reference of the study for secondary data is period of 1984-85 to 2009-10 for examination of the trend and its composition. But in case of hybrid rice cultivation in the state, there is no availability of secondary data in this regard. However, the cultivation of hybrid rice has begun since last 3-4 years. This study has analyzed its area production and yield rate at the field level data only.

The data presented in table 2.7 showed, the share of area and production of HYV rice in total rice area and production. The table reveals that the share in area of HYV rice was 31.00 per cent in 1994-95, which touched to the level of 52.63 per cent in 2009-10. Similarly the share in production of HYV rice to total rice production in the year

1994-95 was 30.11 per cent, which doubled in the year 2009-10. The increase in area and production of HYV rice may be due to centrally sponsored programmes viz., NFSM (Rice) and Bringing Green Revolution to Eastern India (BGREI), which have been launched in 2006-07 and 2010-11, respectively. However, the share in production of HYV rice to total rice production in the year 2008-09 has a bit fallen due to poor and erratic rainfall during the year. It is to be pointed out here that the rice crop in the state is mainly dependent on monsoon rain despite sound ground water resources. Rainfall not only helps to meet moisture requirement of the crop, it also sets the desired ambience exhibiting coolness and humidity needed for rice growth in general and HYV rice in particular. Moreover 'SRI' technology has also contributed a lot in increasing the production of HYV rice in the state in recent years.

Table No. 2.7: Share of HYVs in Total Rice Cultivation (Bihar)

(Percentages)

Year	Share of HYVs in		Total Rice (= 100)	
	Area	Production	Area	Production
1994-95	1401 (31.00)	2065 (30.11)	4519	6859
1995-96	1467 (31.39)	2037 (28.14)	4674	7239
1996-97	1506 (31.86)	2533 (31.93)	4727	7934
1997-98	1543 (32.23)	2928 (39.03)	4788	7501
1998-99	1975 (41.53)	3488 (67.61)	4756	5159
1999-00	1984 (42.47)	3566 (59.47)	4671	5996
2000-01	1737 (28.97)	3040 (55.84)	5996	5444
2001-02	1702 (47.92)	2977 (57.21)	3552	5203
2002-03	1702 (47.48)	2890 (57.96)	3585	4986
2003-04	1644 (45.95)	2948 (55.48)	3578	5314
2004-05	1491 (47.48)	1490 (58.92)	3140	2529
2005-06	1601 (49.25)	2266 (61.09)	3251	3709
2006-07	1723 (49.61)	2969 (57.98)	3473	5121
2007-08	1824 (52.53)	2850 (63.64)	3472	4478
2008-09	1815 (51.93)	2924 (52.42)	3495	5578
2009-10	1691 (52.63)	2203 (60.76)	3213	3626

CHAPTER – III

STATUS OF ADOPTION OF HYBRID RICE AT THE FARM LEVEL

Bihar is endowed with fertile Gangetic alluvial soil with abundant water resources, particularly groundwater. With varied soil categories associated with different agro-climatic zones, the farmers grow a variety of crops both food and non-food. It has been seen that the total food grains production in 2011-12 was 172.42 lakh tones. The same figure in 2010-11 was 103.52 lakh tones. This quantum jump in production figure is due to high rise in rice production from 4472.70 thousand tones in 2007-08 to 8187.60 thousand tones in 2011-12, registering a Compound Annual Growth Rate (CAGR) of 6.10 per cent during the period of 2007-08 to 2011-12. Because of the use of 'SRI' technique, HYV and hybrid seeds and use of newer agricultural implements, there was enormous rise in rice production. Thus, this chapter deals with the status of adoption of hybrid rice at the farm level.

3.1 Sample Farmers and their Distribution according to Farm Size

The agricultural economy of Bihar is largely dependent on marginal and small operational holdings, which accounts for 96.92 per cent, followed by semi-medium (2.56%), medium (0.50%) and large (0.02%). Besides, out of the total working population (33.88%), 77.35 per cent are engaged in agricultural activities (cultivators plus agricultural labourers) in the state. In this background, it is important to know the pattern of land distribution for understanding the real position of rural farm households.

The farm wise distribution of sample farm households according to their adoption and non-adoption categories is presented in table 3.1. As stated earlier, the two sample districts namely; Muzaffarpur and Gaya are almost in the line of states land distribution scenario. Table 3.1 reflects that out of 80 adopters' farm household marginal and small farmer together account for 77.50 per cent followed by semi-medium (15%) and medium (7.50%). Similarly in case of non-adopters farm families,

70.00 per cent account for marginal and small farms, 20.00 per cent semi-medium and 10.00 per cent medium farms. Thus, there was preponderance of marginal and small farms in the study area in both the categories.

Table No. 3.1: Distribution of sample farmers according to farm size

(In No.)

Size classes of operational holdings (ha)	Hybrid adopters		Non-adopters	
	No of farms	Percent of farms	No of farms	Percent of farms
Below 1ha (Marginal)	37	46.25	8	40.00
1 – 2 (Small)	25	31.25	6	30.00
2 – 4 (Semi-medium)	12	15.00	4	20.00
4 – 10 (Medium)	06	7.50	2	10.00
10 ha and above (Large)	---	---	---	---
All Farmers	80	100.00	20	100.00

3.2 Socio-Economic Features of Sample Farm Households

The relevant data on socio-economic characteristics of sample hybrid paddy adopters and non-adopters farm families are presented in table 3.2. The table indicates that on an average there were 7.39 persons in a farm family constituting 62.66 per cent male and 37.24 per cent female. It was 7.43 persons among the adopters' farm households and 7.25 among the non-adopters farm households. As regards the size of workers, there were 4.04 workers/households at aggregate level constituting 2.34 workers/households (57.92%) male and 1.70 workers per households (42.08%) female. Among the adopter farm household, these figures were 4.07 workers per household and 3.90 workers per household among the non-adopters farm household. The average age of the head of family is largely in the category of 18 to 60 years (92%) at the overall level; however, it was a little bit higher among the adopters' category (92.50%), and that of 90.00 per cent among the non-adopter farm households. As regards the attainment of educational status, 36.00 per cent farm households have attained up to primary level followed by 28.00 per cent up to secondary level, 16.00 per cent each were illiterate and attained educational level up to graduation level and 4.00 per cent were found post graduate at the overall level. A total of 35.00 per cent of adopter farm households were studied up to primary level as against 40.00 per cent of non-adopter. It is clear from the table that the level of education is comparatively better among the adopters farm households than non-adopters farm households. The caste composition of

households reveals that 60.00 per cent are belonged to other backward castes followed by general category of castes (30%) and scheduled castes (10%) on overall basis. Among the adopters farm households, these figures were 57.50 per cent for other backward castes, 32.50 per cent for general category of castes, and 10.00 per cent scheduled castes against the non adopter's farm households of other backward castes (70%), general category of castes (20%) and scheduled castes (10%). Thus, it reveals the preponderance of other backward castes on both among the hybrid adopters and non-adopters categories of farm households.

Table No. 3.2: Socio-economic Characteristics of Sample Farm Households

Characterizes		Hybrid adopters	Non-adopters	Aggregate
Household size	Male	4.65	4.55	4.63
	%	62.59	62.76	62.66
	Female	2.78	2.70	2.76
	%	37.41	37.24	37.34
	Total	7.43 (100.00)	7.25 (100.00)	7.39 (100.00)
Size of worker	Male	2.35	2.30	2.34
	%	57.74	58.97	57.92
	Female	1.72	1.60	1.70
	%	42.26	41.03	42.08
	Total	4.07 (100.00)	3.90 (100.00)	4.04 (100.00)
Age group	< 18	0.00	0.00	0.00
	%	0.00	0.00	0.00
	18 - 60	74	18	92
	%	92.50	90.00	92.00
	> 60	6	2	8
	%	7.50	10.00	8.00
Educational status	Illiterate	12	4	16
	%	15.00	20.00	16.00
	Up to Primary	28	8	36
	%	35.00	40.00	36.00
	Up to secondary	22	6	28
	%	27.50	30.00	28.00
	Up to Graduate	14	2	16
	%	17.50	10.00	16.00
	Above Graduate	4	00	4
	%	5.00	0.00	4.00
Caste	SC	8	2	10
	%	10.00	10.00	10.00
	ST	0.00	0.00	0.00
	%	0.00	0.00	0.00
	OBC	46	14	60
	%	57.50	70.00	60.00
	General	26	4	30
	%	32.50	20.00	30.00
Main occupation of the head	Self-employed Farming	52	11	63
	%	65.00	55.00	63.00
	Self-employed Non-farming/ Business	6	4	10
	%	7.50	20.00	10.00
	Salaried Person	4	1	5
	%	5.00	5.00	5.00
	Agriculture Labour	---	---	---
	%	---	---	---

	Non-agricultural Labour	2	2	4
	%	2.50	10.00	4.00
	Pensioner,	2	---	2
	%	2.50	---	2.00
	Household Work	14	2	16
	%	17.50	10.00	16.00
	Student	---	---	---
	%	---	---	---
	Others (specify)	---	---	---
	%	---	---	---
Average size of holding (ha)	Ownership holdings	1.31	1.28	1.30
	Operational holdings	1.25	1.22	1.24
Average size of irrigated land (ha)	Kharif	0.80	0.79	0.79
	%	64.52	62.20	63.20
	Rabi	0.44	0.48	0.46
	%	35.48	37.80	36.80
	Summer	---	---	---
	%	---	---	---
	Total	1.24	1.27	1.25
	%	100.00	100.00	100.00

As regards the main occupation of the head of the farm households, the majority were found engaged in self-employed farming i.e., agriculture (63%) followed by households works (16%), self-employed non-farming/business (10%), salaries persons (10%), non-agricultural labour (4%) and pensioners (2%). Among adopter category of farm households, 65.00 per cent were reported engaged in agriculture, 17.50 per cent in household works, 7.50 per cent self-employed non farming/business, 5.00 per cent salaried, 2.50 per cent each in pensioner category and non-agricultural activities. Within the category of non-adopters, 55.00 per cent were engaged in farming, 20.00 per cent in self-employed non-farming/business, 10.00 per cent each non-agricultural labourers and household works. The average size of ownership holdings was 1.30 ha on overall level where as that of 1.31 ha among the adopters and 1.28 ha non-adopters. The average size of operational holdings was estimated at 1.24 ha on aggregate level. It was 1.25 ha among the adopters and 1.2 ha non-adopters. Out of the total gross irrigated area, about 63.20 per cent of area receives irrigation during the kharif season and rest 36.80 per cent in rabi season. In case of adopters, these figures were 64.52 per cent for kharif season and 35.48 per cent for rabi season as against 62.20 per cent and 37.80 per cent respectively among non-adopters category.

3.3 Cropping Pattern

The cropping pattern as adopted by the sample households for the years 2009-10 and 2010-11 has been presented in table 3.3. It indicates that on the farms of sample hybrid adopters during kharif season of 2009-10, about 47.11 per cent of the Gross Cropped Area (GCA) was adopted by paddy, 13.09 per cent by maize and 11.46 per cent by other crops. While during 2010-11, 48.68 per cent was covered by kharif paddy crop, 12.53 per cent by kharif maize and 10.68 per cent by other crops. Thus, during 2010-11, the area from maize and other crops was shifted to paddy which reveals that hybrid paddy adoption by sample farmers has increased during 2010-11 over 2009-10. In rabi season, hybrid adopters have placed 19.13per cent of the GCA under wheat crop, 5.96 per cent under pulses, 2.04 per cent under maize and 1.21 per cent under other crops during 2009-10. While during 2010-11, the coverage under wheat was 19.69 per cent, 5.23 per cent under pulses, 1.62 per cent under rabi maize and 1.57 per cent under other crops. It indicates the area under the rabi crops during 2010-11 has slashed for some crops over 2009-10, which may be due to marginal shifting of area under wheat crop grown in the same season. It further reveals that the coverage under kharif crops was about 70.00 per cent plus of the GCA among the hybrid adopters sample households during both the years.

Table No. 3. 3: Cropping Pattern during 2009-10 and 2010-11

Seasons/Crops	Hybrid adopters				Hybrid Non-adopters			
	2009-10		2010-11		2009-10		2010-11	
	Area (ha)	percent	Area (ha)	percent	Area (ha)	percent	Area (ha)	percent
Kharif								
Paddy	65.25	47.11	68.00	48.68	16.61	49.23	15.97	48.97
Maize	18.13	13.09	17.50	12.53	4.02	11.92	3.89	11.83
Others	15.87	11.46	14.92	10.68	4.17	12.36	4.28	13.01
Rabi								
Wheat	26.50	19.13	27.50	19.69	6.11	18.11	5.87	17.85
Pulses	8.25	5.96	4.30	5.23	1.09	3.23	1.11	3.39
Maize	2.83	2.04	2.26	1.62	1.02	3.02	1.03	3.13
Others	1.67	1.21	2.19	1.57	0.73	2.13	0.73	2.22
GCA	138.50	100.00	139.67	100.00	33.74	100.00	32.88	100.00

Among the non adopters of hybrid rice, the staple crop is paddy which was grown in 49.33 per cent of the GCA in 2009-10 and 48.57 per cent of the GCA in 2010-11. Though, it has marginally slashed during 2010-11 over 2009-10. During khrif season, the coverage under maize crop in 2010-11 also slashed marginally over 2009-10 but it

was reported a little increase under other crops during 2010-11 over 2009-10. During rabi season, wheat was grown in 18.11 per cent of the GCA in 2009-10 and 17.85 per cent in 2010-11. The area under pulses, rabi maize and other crops was found a little higher in 2010-11 over 2009-10. The aggregate share of kharif crops of the GCA was almost 73.00 per cent plus among the non-adopters of hybrid rice during both years.

3.4 Extent of Adoption of Hybrid Rice at Farm Level

As stated earlier SRI technology has been largely promoting in the state, which resulted to significant increase in rice production during last 2-3 years. In fact adoption of HYVs and hybrid seeds of rice yielded improvement in rice production. Besides application of these seeds, higher use of micro nutrients, fertilizer, irrigational use and other package of practices have together helped in increasing the production of rice in the state. Responding to good results and even record production of rice, the state government has set a new target of rice production of 100 lakh MT during the current kharif season. The relevant data collected to analyze the extent of adoption of hybrid rice has been presented in table 3.4.

Table No. 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 1ha	0.41	0.31	0.37	0.04	87.09	12.11	0.41	0.38	0.27	0.06	81.82	18.18
1 – 2	1.07	0.63	0.54	0.09	85.71	14.29	1.07	0.68	0.56	0.12	82.35	17.65
2 – 4	2.09	1.35	1.18	0.18	86.76	13.24	2.00	1.37	1.17	0.20	85.40	14.60
4 – 10	6.30	3.59	3.11	0.48	86.63	13.37	6.30	3.62	3.10	0.52	85.63	13.37
10 ha and above	---						---					
All sizes	1.31	0.82	0.71	0.11	86.58	13.42	1.31	0.85	0.70	0.15	82.36	17.64

The table indicates that during the years 2009-10 and 2010-11, the average size of farms was 1.31 ha. During the year 2009-10, the average area under rice was estimated at 0.82 ha (62.60%) of the average farm size. Out of which 0.71 ha (86.58%) was devoted on HYVs and 0.11 ha (13.42%) hybrid. The proportion of rice area allocated to hybrid rice accounted for 12.11 per cent (0.04% ha) on marginal farms, 14.29 per cent (0.09 ha) on small farms, 13.24 per cent (0.18 ha) on semi medium farms and 13.37 per cent (0.48 ha) on medium farms. Similarly in 2010-11, the

average area under rice was estimated at 0.85 ha (64.88%) of the average farm size. Out of which 0.70 ha (82.36%) was devoted on HYVs and 0.15 ha (17.64%) on hybrid rice. The proportion of rice area allocated to hybrid rice accounted for 18.18 per cent (0.06 ha) on marginal farms, 17.65 per cent (0.12 ha) on small farms, 14.60 per cent (0.20 ha) on semi-medium farms and 13.37 per cent (0.52 ha) on medium farms. The analysis of all sizes farm and as according to farms clearly reveals that the coverage under hybrid rice has been due to the fact that the farmers have been realizing the vast potential of hybrid over inbred varieties of rice. Though, its promotion by continuing the assistance under SRI technique at the farm level is the most important.

3.5 Access to Hybrid Rice Technology

This sections deal with the access of farm household to hybrid rice technology, which more specifically pertains to farmers accessing source of information on hybrid rice technology, quality of information, adoption of recommend package of practices in rice cultivation sources of seed for hybrid rice cultivation. These are the qualitative responses of the farmers in regard to their access to hybrid rice technology. It is generally believed that farmers do not receive adequate information on modern agricultural development be it the case of technology its application. Since knowing about the technology without its skillful application may be said no use of technology. Thus, in order to assess the access of the farmers towards the technology, we have gathered information at farm level. The data presented in table 3.5 is relating to farmers accessing source of information on hybrid rice technology.

Table No. 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	---	---
Participation in training programme organized by the government	36	45.00
Krishi Vigyan Kendra	4	5.00
Extension worker of state department of agriculture	49	61.25
Television	---	---
Radio	---	---
Newspaper	---	---
Input dealer	---	---
Progressive farmer	17	21.25
Private agency/ NGO	---	---
Output buyers/food processor	---	---
Credit agency	---	---

Others	---	---

Table 3.5 shows that out of 80 sample hybrid rice adopters, 49 (61.25%) have reported about the Extension Workers of State Department of Agriculture, more specifically the SMS and Kisan Salahkar (KS) followed by participation in training programme under SRI Technology (45%), progressive farmers (17%) and Krishi Vigyan Kendra (5%). It is crystal clear, among the sources; the most popular was the extension worker of the state department of Agriculture. Further when asked about the quality of information received among those sources; the responses given by then have been presented in table 3.6.

Table No. 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	27 (75.00)	9 (25.00)	---
Krishi vigyan Kendra	3 (75.00)	1 (25.00)	---
Extension worker of state department of agriculture	37 (75.51)	8 (16.33)	4 (8.16)
Progressive Farmer	5 (29.41)	12 (70.59)	---

Note: Figures in brackets indicate percentages

Table 3.6 reveals that majority of the sample hybrid adopters were received good quality of information from all the major sources of information except the progressive farmers.

Hybrid adopter households when asked about the adoption of recommended package of practices in rice cultivation, they reported that of them who have received the knowledge from the training programme organized by the government, 61.11 per cent adopted the same. About 50.00 per cent of the hybrid cultivators who obtained knowledge from the KVK have adopted the recommend package of practices. Out of the knowledge obtained from the extension workers of SDA, 46.94 per cent adopted the same whereas out knowledge gained from progressive farmers,

52.94 per cent adopted the recommended package of practices in cultivation of hybrid rice (table 3.7).

Table No. 3.7: Farmers reporting adopted recommended Package of Practices in Rice Cultivation

(Per cent of farmers reporting)

Source of information	Hybrid Adopters		Non-Adopters
	Hybrid Rice	HYV Rice	HYV Rice
Participation in training programme conducted by the government	61.11	---	---
Krishi Vigyan Kendra	50.00	---	---
Extension worker of state department of agriculture	46.94	---	---
Progressive Farmer	52.94	---	---

The farmers accessing sources of seed for hybrid rice cultivation has been presented in table No. 3.8. The table indicates that during the year 2009-10, about 40.00 per cent of the sample hybrid adopters have received the seed from the district office of the department of agriculture on full subsidy, 32.50 per cent on partial subsidy and 27.50 per cent from local input dealers. While during the year 2010-11, 45.00 per cent of the hybrid adopters have obtained the seed from district office of the department of agriculture on full subsidy followed by 30.00 per cent from the government on partial subsidy and 25.00 per cent purchased from licensed local input dealers. Thus, it is clear that majority of the sample hybrid adopters have obtained seeds from the government department.

Table No. 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	32	40.00	36	45.00
Public on partial subsidy	26	32.50	24	30.00
Input Dealers	22	27.50	20	25.00
Total	80	100.00	80	100.00

CHAPTER – IV

IMPACT OF HYBRID RICE CULTIVATION ON OVERALL PRODUCTION OF RICE

As a result of various initiative taken by the Government in the implementation of a number of Crop Development Schemes, the productivity of rice has increased from 1901 kg/ha in 2000-01 to 2372 kg/ha in 2011-12 (4th Adv. Estimate) and it touched a record production of 104.32 million tones in 2011-12. All-India average annual growth rate of yield of rice has shown a growth of 1.47 per cent per annum during 2000-01 to 2010-11 compared to 1.36 per cent per annum during 1990-91 to 1999-2000. The turn around seems to be in the eastern states (including Bihar) where the government is implementing the BGREI (Bringing Green Revolution to Eastern India) Programme since 2010-11.

In Bihar, because of use of new 'SRI' technique, there was enormous rise in rice production. The level of rice production prior to 2010-11 was not consistent and there was much variation in the production over the years. This is due to the fact that around 50.00 per cent of net sown area is bereft of irrigation and dependent on rain. The average production figure was around 50 lakh tones during the period from 2007-08 to 2010-11. Major initiative taken by the government through its 1st Agricultural Road Map (2007-12) was to provide quality seeds are --- Chief Ministers' Crash Seed Programme, Seed Village Programme (Beej Gram Yojana), provision of subsidy for the production and use of certified seeds, revival of dormant Bihar Rajya Beej Nigam (BRBM), strengthening of Bihar Seed Certification agency and multiplication of seeds by state farms. All these together have contributed much towards agricultural productivity in the state. Recently, the

scheme called 'Mukhyamantri Tibra Beej Vistar Karyakram' has helped farmers immensely for hybrid paddy cultivation. The SRR for major crops like rice has increased substantially from 26.40 per cent in 2009-10 to 38.00 per cent in 2011-12. During kharif 2011, SRI technique was used for paddy cultivation and hybrid varieties of paddy in 4.10 lakh hectares. These interventions resulted into record rice production in state. Paddy productivity rose to as high as 22.40 MT per hectare one of the regular efforts by the state government in extension services is to average for minikit distributions at the Panchayat or village level. The number of demonstrations for paddy (5 kg), which was 35,880 in 2008-09 increased to 36,188 in 2011-12. The number of demonstrations for HYV paddy (6 kg) was 8014 in 2009-10, 3346 in 2010-11 and 5500 in 2011-12. This comprehensive effort resulted to increase in productivity of rice from 1457 kg/ha in triennium average for 2000-03 to 1574 kg per hectare in triennium for 2009-12, registering a percentage change between the two trienniums of 8.03 per cent.

In above backdrop, the present chapter deals with impact of hybrid rice cultivation on overall production of rice in Bihar are following sections.

4.1 Yield Performance of Hybrid and HYVs Rice

In table No. 4.1 mean yield levels of hybrid and HYVs rice by farm sizes on sample farms has been worked out. The table indicates that on overall, hybrid rice performed better with mean yield of 6288 kg/ha than the mean yield of 3955 kg/ha for HYVs rice during the year 2009-10. The percentage difference between the hybrid and HYVs rice was calculated at 58.98 per cent. While the mean yield of hybrid rice was 6311 kg/ha than the mean yield of 4051 kg/ha for HYVs during the year 2010-11. The percentage difference between the hybrid and HYVs rice was estimated at 55.79 per cent. During 2009-10, the percentage difference between the mean yields of hybrid and HYVs rice was better than the percentage difference between the mean yields of hybrid and HYVs rice of 2010-11. The farm wise analysis of percentage difference between the mean yields of hybrid and HYVs rice was not found in a definite trend during the year 2009-10. It was found higher on

small farms followed by semi-medium, marginal and medium farms. However, during 2010-11, it was found declining with the increase of farm sizes.

Table No. 4.1: Mean yield levels of hybrids and HYVs of rice by farm size on sample farms

(Hybrid adopters only)

Farm size classes (ha)	2009-10			2010-11		
	Mean yield (Kg/ha)		Percent difference	Mean yield (Kg/ha)		Percent difference
	Hybrid	HYVs		Hybrid	HYVs	
Below 1ha	6137	3892	57.68	6185	3925	57.58
1 – 2	6260	3917	59.82	6272	3996	56.96
2 – 4	6352	4012	58.32	6384	4085	56.28
4 – 10	6381	4052	57.48	6405	4196	52.65
10 ha and above	---	---	---	---	---	---
All sizes	6288	3955	58.98	6311	4051	55.79

Note: paired t-test may be used to test the significance in the difference between hybrid and hyvs.

4.2 Yield Gain from Hybrid Rice over Inbred Rice Varieties

The yield gain of hybrid rice over HYVs rice may be seen from the table 4.1. On an average the yield gain was 58.98 per cent obtained by all sizes of farm in 2009-10, while that of 55.79 per cent in 2010-11. It reveals that the yield gain on overall farms was a little higher in 2009-10 over 2010-11. The yield gain across the farm sizes during 2010-11 was obtained higher with the decrease of farm sizes whereas that of were no definite trend during 2009-10. In fact, it was little higher on small and semi-medium farms compared to marginal and medium farms.

4.3 Factors affecting the yield of Hybrid and Inbred Rice

The farm size wise distribution of factors affecting the yield of hybrid and inbred rice on the sample farms during the years 2009-10 and 2010-11 has been presented in table 4.2. The table indicates that during 2009-10, out of 80 sample hybrid adopters, about 52.50 per cent reported the lack of irrigational facilities followed by lack of availability of seeds in time (50%), costlier seeds (47.50%), lack of adequate training facilities and information (47.50%), lack of credit facilities (41.25%) and inadequate input package (28.75%). While, during 2010-11, out of 80.00 hybrid adopters, 50.00 per cent reported about the costlier seeds followed by lack of credit facilities (38.75%), lack of availability of seeds in time (37.50), lack of adequate training and

information (32.50%), lack of irrigational facilities (31.25%) and inadequate input package (23.75%). Farm wise analysis of the factors affecting the yield of hybrid and inbred rice reveals that marginal farmers have been largely affected by costlier seeds (27.50%, small farmers by lack of irrigational facilities (23.75%), semi-medium farmers by lack of adequate training and information (6.25%) whereas medium farms by lack of irrigational facilities (3.75%) and lack of adequate training and information (3.75%) during the year 2009-10. While during the year 2010-11, marginal farmers largely reported for costlier seeds (28.75%), small farmers for lack of credit facilities (17.50%), semi-medium farmers for costlier seeds (6.25%) and lack of adequate training and information (6.25%) whereas medium farmers reported for lack of irrigational facilities (3.75%).

Table No. 4.2: Factors affecting the Yield of Hybrid and HYVs Rice for Hybrid adopters.

Factors	Marginal (< 1ha)	Small (1-2 ha)	Semi-Med (2-4 ha)	Medium (4-10 ha	All
	2009-10				
Costly Seeds	22 (27.50)	11 (13.75)	3 (3.75)	2 (2.50)	38 (47.50)
Lack of availability of Seeds in time	19 (23.75)	17 (21.25)	4 (5.00)	---	40 (40.00)
Lack of Irrigational Facilities	17 (21.25)	19 (23.75)	3 (3.75)	3 (3.75)	42 (52.50)
Inadequate input Package	9 (11.25)	11 (13.75)	2 (2.50)	1 (1.25)	23 (28.75)
Lack of adequate training and Information	14 (17.50)	16 (20.00)	5 (6.25)	3 (3.75)	38 (37.50)
Lack of Credit Facilities	17 (21.25)	14 (17.50)	2 (2.50)	---	33 (41.25)
	2010-11				
Costly Seeds	23 (28.75)	10 (12.50)	5 (6.25)	2 (2.50)	40 (50.00)
Lack of availability of seeds in time	17 (21.25)	9 (11.25)	4 (5.00)	---	30 (37.50)
Lack of Irrigational Facilities	12 (15.00)	7 (8.75)	3 (3.75)	3 (3.75)	25 (31.25)
Inadequate input Package	9 (11.25)	8 (10.00)	2 (2.50)	---	19 (23.75)
Lack of adequate training and Information	13 (16.25)	6 (7.50)	5 (6.25)	2 (2.50)	26 (32.50
Lack of Credit Facilities	17 (21.25)	14 (17.50)	---	---	31 (38.75)

In parenthesis percentage figures are shown.

CHAPTER – V

COMPARATIVE ECONOMICS OF HYBRID AND INBRED RICE CULTIVATION

The present chapter deals with the input use pattern, operation wise labour absorption including female labour, cost of input used and economic return obtained by adopters over non-adopters of hybrid rice technology in the study area.

5.1 Input use Pattern for Cultivation of Hybrid & HYV Rice

The input use pattern of cultivation of hybrid and inbred rice concerted to hybrid rice growers and non-adopters of hybrid rice is presented in table 5.1. It is observed from table that seed rate (kg/ha) is significantly lower for the hybrid than for HYVs. This is fact that hybrids required only one or two seedling per hill for transplanting. Seed rate for hybrids is 14.32 kg/ha whereas it is 62.84 kg per hectare for HYVs. In case of non-adopter more or less similar seed rate is used. Organic and farm-yard manure use for hybrid was nearly 21.90 per cent higher than that for HYVs. The use of chemical fertilizer is also 25.97 per cent higher than that for HYVs. While in case of non-adopter of hybrid rice, it is higher by 23.96 per cent. The number of pesticides used is relatively lower for hybrid varieties than HYVs viewing hybrids relatively less sensitive to insect and pest attack. But irrigation is almost same for the hybrid and inbred varieties. Labour use is significantly higher for the hybrid than that for HYVs. Among the group of hybrid adopters, the intensity of human labour used is about on an average 94.50 days per hectare for hybrid as compared to 86.71 days per hectare for HYVs. That is 88.65 day per ha for non-adopter against hybrid rice adopters. Bullock labour use in terms of days per hectare is merely higher for

hybrids than HYVs for the hybrid adopters who cultivated HYVs along with hybrids. For non-adopters, bullock labour used for HYVs is marginally lower than that for hybrids.

Table No. 5.1: Input Use Pattern of Cultivation of Hybrid and Inbred Rice (2010-11)

Inputs	Hybrid Adopters		Non-adopters
	Hybrid	HYVs	HYVs
Seed (kg/ha)	14.32	62.84	63.28
Manure (tonne/ha)	1.28	1.05	0.96
Chemical fertilizer (kg/ha)	225.18	178.75	181.64
Pesticide (no. of sprays)	1.59	2.05	2.08
Irrigation (no. of application)	2.25	1.98	1.67
Human labour (days/ha)	94.50	86.71	88.65
Bullock labour (days/ha)	5.25	3.28	3.78

5.2 Operation wise Labour absorption in Hybrid and HYV Rice

Field level data indicated that farmers had to incur higher labour for hybrids as compared to HYVs. Higher labour use associated with hybrid cultivation as compared to HYVs was purposively for transplanting the seedlings of paddy since it involved an improved method of planting one or two seedlings per hill whereas multiple seedlings per hill in inbred varieties. Operation wise labour use pattern incorporated in table 5.2 revealed that labour requirement is highest in post harvesting operations followed by harvesting and transplanting operation respectively both in hybrids and HYVs.

Table No. 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	3.12	1.78	4.90	2.52	1.09	3.61
Uprooting of seedlings	4.18	6.55	10.73	4.78	7.36	12.14
Transplantation of seedlings						
a) Single seedlings per hill	12.05	13.09	25.14	0.00	0.00	0.00
b) Multiple seedlings per hill	0.00	0.00	0.00	7.84	13.34	21.18
Manu ring	1.68	1.45	3.13	1.46	1.48	2.94
Application of	2.06	3.02	5.08	2.09	3.14	5.23

chemical fertilizer						
Spraying plant protection chemicals	2.38	3.65	6.03	2.04	1.59	3.63
Irrigation	4.96	3.78	8.74	3.08	1.13	4.21
Harvesting	10.08	18.24	28.32	9.06	16.15	25.21
Post-harvesting	12.04	24.32	36.36	11.15	22.26	33.41
All operations	52.55	78.88	128.43	44.02	67.54	111.56

However, more labour is used in transplanting of hybrid rice (25.14 days) as compared to HYVs (21.18 days). In addition to hybrid rice, more labour is used for ploughing, spraying plant protection chemical and irrigation than that for HYVs paddy. Further operation associated with higher labour content involved more of hired labour as compared to family labour both in case of hybrids and HYVs.

An analysis of table 5.3 revealed that female labour use was more or less similar for transplanting of hybrid and HYV. Paddy including uprooting of seedling of hybrid paddy engaged more female labour (19.38%) comparing to HYV (16.72%). Hybrid rice cultivation is thus likely to generate additional employment opportunities for female worker in rural area.

Table No. 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	0.00	4.90	0.00	0.00	3.61	0.00
Uprooting of seedlings	2.08	10.43	19.38	2.03	12.14	16.72
Transplantation of seedlings	---	---	---	---	---	---
a) Single seedlings per hill	19.95	25.14	79.38	0.00	0.00	0.00
b) Multiple seedlings per hill	0.00	0.00	0.00	17.05	21.18	80.52
Manu ring	0.00	3.13	0.00	0.00	2.94	0.00
Application of chemical fertilizer	0.00	5.08	0.00	0.00	5.23	0.00
Spraying plant protection chemicals	0.00	6.03	0.00	0.00	3.63	0.00
Irrigation	2.03	8.74	23.22	0.76	4.21	18.05
Harvesting	18.65	28.32	65.88	16.45	25.21	65.29
Post-harvesting	14.04	36.36	38.62	13.78	33.41	41.26
All operations	56.75	128.43	43.70	50.21	111.56	45.01

5.3 Cost of Inputs Incurred on Hybrid and HYVs Rice

During 2010-11, the average cost of production of hybrid rice was calculated at Rs. 23752.25 per hectare whereas, for inbred rice (HYVs) it was Rs. 18640.56 shown in table 5.4. Among all the components of total cost, expenditure on human labour formed the single largest item accounted for 27.62 per cent and 33.64 per cent of the total cost for hybrid and inbred varieties respectively. Machinery charges accounted for the next most important item at about 25.47 and 29.28 per cent of the total cost in hybrid and HYVs respectively. The cost incurred on seed was next one which formed about 14.17 per cent of total cost for hybrids whereas that was calculated at 4.80 per cent for HYVs. Manure and fertilizer together formed about 15.90 per cent of the total cost in case of hybrid as against 15.58 per cent for HYVs. The cost of irrigation, seeds and pesticides were significantly higher in hybrid rice production. Cost of irrigation was calculated 12.17 per cent of total cost in hybrid rice while, it was 10.62 for inbred (HYVs) rice. Pesticides use was significantly higher (1.54%) over 1.50 per cent for inbred rice. Pesticides use was significant for hybrid rice indicating that hybrid rice varieties did not adequate resistant to pest and diseases and are more susceptible to pests and diseases.

Table No. 5.4: Comparison of Costs and Returns for Hybrid and Inbred Rice (2009-10)

(Rs./ha)

Sl. No.	Particulars	Hybrid Adopters		Non-adopters
		Hybrid	HYVs	HYVs
A.	Costs:			
1.	Seed (both farm produced and purchased)	3264.96	813.15	821.37
2.	Manure (owned and purchased)	675.06	450.09	475.04
3.	Chemical fertilisers	2972.0	2640.16	2655.98
4.	Insecticides & Pesticides	350.12	225.18	296.29
5.	Irrigation charges (both owned and hired)	2785.05	2050.07	2060.14
6.	Machinery charges	5690.16	4685.06	4640.18
7.	Hired human labour charges	6465.19	6055.22	6050.29
8.	Bullock labour (owned and hired)	656.25	408.36	472.50
9.	Total cost (1 to 8)	22858.79	17327.29	17471.79
10.	Unit cost of production (Rs. Per Kg.)	3.63	4.38	4.40
B.	Returns:			
1.	Yield of paddy (qtl/ha)	62.88	39.55	39.68
2.	Market price (Rs./qtl)	1240.00	1215.00	1213.00
3.	Value of grain yield (Rs./ha)	77971.20	48053.25	48131.84
4.	Value of straw yield (qtl/ha)	5026.58	8670.29	8316.35
5.	Total value of the produce (gross return)	82997.78	56723.54	56448.19
6.	Net return (5 – 9)	60138.94	39396.25	38976.40
7.	Benefit cost ratio:	1:3.63	1:3.27	1:3.23

It was calculated from table 5.5 that total cost of input was about 27.42 per cent higher for hybrids than that for HYVs. The largest difference in cost items between the hybrid and the inbred was on account of seeds, pesticides and irrigation charges. The total seed cost for hybrid rice was about 3.75 times higher than that for HYVs. This was due to the large difference in seed prices of hybrid and inbred rice although the seed rate for the hybrids were substantially lower (about 4.39 times) than HYV rice. The cost of hybrid seed per kg being much higher than that of HYVs seed, discourage farmers for adopting hybrid rice technology unless it is compensated by additional yield gain. The cost structure does not vary much over the years under study.

Table No. 5.5: Comparison of Costs and Returns for Hybrid and Inbred Rice (2010-11)

(Rs./ha)

Sl. No.	Particulars	Hybrid Adopters		Non-adopters
		Hybrid	HYVs	HYVs
A.	Costs:			
1.	Seed (both farm produced and purchased)	3365.20	895.47	908.06
2.	Manure (owned and purchased)	725.35	466.65	465.98
3.	Chemical fertilizers	3050.55	2450.05	2455.38
4.	Insecticides & Pesticides	365.15	280.24	285.18
5.	Irrigation charges (both owned and hired)	2890.26	2352.08	2360.17
6.	Machinery charges	6050.08	5460.12	5465.08
7.	Hired human labour charges	6560.16	6270.19	6275.24
8.	Bullock labour (owned and hired)	745.50	465.76	536.76
9.	Total cost (1 to 8)	23752.25	18640.56	18751.85
10.	Unit cost of production (Rs. Per Kg.)	3.76	4.61	4.64
B.	Returns:			
1.	Yield of paddy (qtl/ha)	63.11	40.51	40.43
2.	Market price (Rs./qtl)	1245.08	1218.06	1216.42
3.	Value of grain yield (Rs./ha)	78576.99	49343.61	49179.86
4.	Value of straw yield (qtl/ha)	5142.19	4835.05	4793.02
5.	Total value of the produce (gross return)	83719.18	54178.66	53972.88
6.	Net return (5 – 9)	59966.93	35538.10	35221.03
7.	Benefit cost ratio:	1:3.52	1:2.91	1:2.88

5.4 Economic Return to Hybrid and Inbred Rice Cultivation.

The details of the costs and returns for hybrids and HYVs are shown in table 5.4 and 5.5 for consecutive year viz. 2009-10 and 2010-11 respectively. During 2010-11, the farmers growing hybrid rice received a gross return of Rs. 83719.18 per hectare while the gross return for inbred varieties was Rs. 54178.66. Thus, the gross return was 54.52 per cent higher in hybrid rice cultivation. However, the profit (net return) realized in hybrid and inbred rice was Rs. 59966.93 and Rs. 35538.10 per hectare respectively. Thus, the profit gain realized in hybrid rice production was Rs.

24428.83 per hectare or 68.74 per cent over inbred varieties of rice. Consequently the benefit cost ratio was also higher in hybrid rice cultivation (3.52:1). Now, net return from hybrids over the reference periods has merely decreased from Rs. 60138.94 per hectare in 2009-10 to Rs. 59966.93 per hectare in 2010-11 accounting for 0.28 per cent decreased in 2010-11. Also for inbred rice, the net return decreased from Rs. 39396.25 per hectare in 2009-10 to Rs. 35538.10 per hectare in 2010-11 accounting for 9.97 per cent decreased. The net result has been decreased in benefit cost ratio for hybrid rice cultivation from 3.63:1 in 2009-10 to 3.52:1 in 2010-11. Correspondingly, there has been decline in benefit cost ratio for inbred rice from 3.27:1 in 2009-10 to 2.91:1 during the same period of time. It is important to say that some active factors that accounted for the higher profit margin in case of hybrid rice cultivation. Of course, the higher profit margin in hybrid rice cultivation is a matter of concern since the adoption of a new technology depends much on profitability. It can be seen from table 5.3B; hybrid rice growers incurred additional costs for all the inputs with higher productivity.

Hybrid rice growers incurred an additional expenditure of Rs. 2469.73 per hectare on seed alone. Similarly hybrid rice growers incurred higher expenditure on labour including hired human labour and bullock labour (569.71) per hectare for performing various cultural operations. More expenditure on fertilizer (Rs. 600.50), irrigation (Rs. 538.18), and pesticides (Rs. 84.91) also contributed to pushing up the cost of production of hybrid rice. Coupling with higher production cost was higher market price realization for hybrid paddy. On an average, during the year 2010-11 the hybrid rice growing farmers realized a sale price of Rs. 1245.08 per quintal of paddy sold in the market which was higher by Rs. 27.02 per quintal realized for inbred rice. The cost price difference was quite sharp during 2009-10 and during same period of time, market price per quintal of hybrid rice was higher by Rs. 25.00 compared with inbred rice. During the year 2010-11, hybrid rice was Rs. 24428.83 more profitable accounting for 68.74 per cent than HYVs, while in 2009-10, the net return (profit) realized in hybrid rice cultivation was higher Rs. 20742.69 per hectare as compared to HYVs.

Higher costs of production along with higher market price have contributed to higher profit margin of hybrid rice cultivation to HYVs even with higher grain yield acquired (obtained) of 55.79 per cent for hybrid rice over inbred rice varieties. This is fact that there is need for improved technology to reduce costs of cultivation and enhancing the quality attributes of hybrid rice.

CHAPTER – VI

GRAIN QUALITY CONSIDERATION AND THE ASPECT OF MARKETING

Rice is always used as most important food item; therefore, cooking and eating quality traits assume special significance. For consumer acceptance, it is essential that the hybrids developed have good quality characteristics apart from high yield potential. About 80-85 per cent of sample farmers who both produce and consume hybrid rice reported that the grain of hybrid rice was inferior to that of the popular inbred rices in terms of cooking and storage quality and more sickness of cooked rice. Therefore, acceptance of hybrids by consumers in primarily determined by cooking and eating quality characteristics. The price for volume of marketing for farmer's produce is also determined by quality traits. The present chapter deals with the grain quality consideration and the different aspect of marketing including output and sale of paddy, and seasonal flow of sale of unhusked and husked rice of hybrid and inbred rice by the adopter and non-adopter of improved technology of rice.

6.1 Grain Quality Traits of Hybrid and HYV Rice

A sensitivity analysis was done to assess the minimum required yield gain under various scenarios in order to attract the farmers and make hybrid rice cultivation commercially viable. A frequently raised concern on the prospects of large scale adoption of hybrid rice is the acceptability of the quality of hybrid rice grain among consumers. Consumer acceptance is the ultimate factor that determines the price of the product which ultimately affects the gross revenues particularly of those who

sell the product in the market. The role of consumer acceptance is much greater in the irrigated rice system for hybrid rice, where rice farming is highly commercialized and considered a market oriented farm enterprise. An important criterion for farmers in selecting a new variety of rice in a progressive region is consumer demand in the market and their willingness to pay a premium price for the product. Hence quality considerations are important parameter for the popularization and large scale adoption of hybrid rice.

The quality of grain is find out from the view point of following ratio viz. hulling ratio, milling ratio and head rice recovery ratio. Grain quality features of hybrids vis-à-vis HYVs are incorporated in table 6.1 & 6.2 for the two consecutive years viz., 2009-10 and 2010-11 respectively. It is find out from table 6.1A that hybrids have hulling, milling and head rice recovery ratio of 66.67 per cent, 63.16 per cent and 60.01 per cent respectively. The corresponding figures for HYVs were calculated at 70.58 per cent, 65.22 per cent and 61.86 per cent respectively whereas Non-adopter reporting hulling ratio (71.43%), milling ratio (66.66%) and head rice recovery ratio (65.21%). Over the years under study, the following ratio remained almost same both in hybrid and HYVs rice.

Table No. 6.1: Grain quality traits of Hybrid rice vis-a-vis HYVs 2009-2010

Grain quality traits	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
Hulling ratio	66.67	70.58	71.43
Milling ratio	63.16	65.22	66.66
Head rice recovery ratio	60.00	61.86	65.21

Table No. 6.2: Grain quality traits of Hybrid rice vis-a-vis HYVs 2010-2011

Grain quality traits	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
Hulling ratio	65.22	68.18	69.76
Milling ratio	61.85	63.82	64.52
Head rice recovery ratio	58.25	57.14	63.83

6.2 Volume of Marketing

The economic growth and development is always associated with an increase in the volume of output marketing in the agricultural sector. Thus, it is necessary to focus on the quantum of marketing of the produce in the market. On the viewing of

farmers/producers side, volume of marketing would indicate their motivation towards adopting hybrid rice cultivation.

The output and sale of paddy (unhusked) in different categories of land holding is presented in table 6.3. It is observed from the analysis of table 6.3 that on an overall average of size group 62.26 per cent and 42.89 per cent of total output have been sold by adopters of hybrid and HYVs rice respectively in the market and rice growers received a price of Rs. 1240.28 per quintal and Rs. 1221.53 per quintal for hybrid and HYVs rice respectively. As regards to different size of farms, not much variation was found in quantity sold by the farmers for hybrid. It ranged from 60.50 per cent to 64.50 per cent among marginal and medium farmer and price received ranged from Rs. 1230.20 per quintal (marginal) to Rs. 1250.52 per quintal (medium) farmers. Analysis of this showed that very little variation was found in quantity sold by the farmer for hybrid and HYVs because most of sample size was marginal and small farmer, they used their produce in large quantity as home consumption and remaining amount sold for purchasing agriculture inputs.

As regards to non-adopters are pursuid, overall average of total output farmers sold about 43.22 per cent in the market at average price of Rs. 1210.42 per quintal which ranged between 40.17 per cent (marginal) to 46.75 per cent (medium) at the price of Rs. 1205.18 to Rs. 1215.68 per quintal respectively.

Table No. 6.3: Output and sale of paddy (unhusked) by size groups 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 1ha	Hybrid	2.45 (37)	1.48 (37)	80.50	1230.20	----- ( )	---- ( )	---	---
	HYVs	10.51 (37)	4.23 (37)	40.25	1210.15	15.11 (8)	6.07 (8)	40.17	1205.18
1 – 2	Hybrid	5.63 (25)	3.47 (25)	61.75	1230.38	----- ( )	---- ( )		
	HYVs	21.15 (25)	8.98 (25)	42.50	1215.08	41.36 (6)	17.55 (6)	42.46	1205.26
2 – 4	Hybrid	11.43 (12)	7.12 (12)	62.30	1250.03	----- ( )	---- ( )		
	HYVs	47.34 (12)	20.47 (12)	43.25	1230.20	79.70 (4)	34.67 (4)	43.50	1215.54
4 – 10	Hybrid	30.63 (6)	19.76 (6)	64.50	1250.52	----- ( )	---- ( )		
	HYVs	126.02 (6)	57.40 (6)	45.55	1230.68	161.81 (2)	75.65 (2)	46.75	1215.68

10 ha and above	Hybrid	---- ( )	---- ( )	---	---	----- ( )	---- ( )		
	HYVs	---- ( )	---- ( )	---	---	----- ( )	---- ( )		
All Sizes	Hybrid	6.92 (80)	4.31 (80)	62.26	1240.28	----- ( )	---- ( )		
	HYVs	28.08 (80)	12.04 (80)	42.89	1221.53	32.72 (20)	14.14 (20)	43.22	1210.42

Note: Figures in brackets indicate number of farms

The output and sale of rice (unhusked) in different size of farms in the year 2010-11 was also observed and presented in table 6.4. It is estimated from analysis that on overall size 63.01 per cent and 43.74 per cent were found to be sold in the market on an average price of Rs. 1242.63 and Rs. 1227.67 per quintal by adopters of hybrid rice and HYVs rice growers respectively while, non-adopters of hybrid sold their 42.44 per cent of total output in the market on an average rate of Rs. 1217.88 per quintal. The quantity sold in different size of farm was found to be similar and vary from 61.25 per cent to 64.50 per cent for marginal to medium with respect to hybrid rice adopter respondents whereas for HYVs, it vary from 41.50 per cent to 46.20 per cent with respect to marginal and medium farmers while it vary from 39.28 per cent to 46.25 per cent with respect to non-adopter of hybrid respondents. The size group wise analysis revealed that the price of output was found almost same in all the categories of farms ranged from Rs. 1240.05 (marginal) to Rs. 1250.25 (medium) per quintal and Rs. 1225.07 (marginal) to Rs. 1235.28 (medium) per quintal for hybrid and HYVs adopters respectively whereas, the price varied from Rs. 1210.28 per quintal to Rs. 1225.48 per quintal with respect to non adopter farms.

Table No. 6.4: Output and sale of paddy (unhusked) by size groups 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 1ha	Hybrid	3.70 (37)	2.27 (37)	61.25	1240.05	----- ( )	---- ( )	----	----
	HYVs	10.60 (37)	4.40 (37)	41.50	1225.07	13.67 (8)	5.37 (8)	39.28	1210.28
1 – 2	Hybrid	7.53 (25)	4.71 (25)	62.50	1240.09	----- ( )	---- ( )		
	HYVs	21.98 (25)	9.40 (25)	42.75	1225.15	40.20 (6)	16.60 (6)	41.29	1210.36
2 – 4	Hybrid	12.77 (12)	8.15 (12)	63.80	1240.15	----- ( )	---- ( )		
	HYVs	47.44 (12)	21.11 (12)	44.50	1225.19	81.10 (4)	35.30 (4)	43.53	1225.42
4 – 10	Hybrid	33.31 (6)	21.48 (6)	64.50	1250.25	----- ( )	---- ( )		
	HYVs	130.08	60.09	46.20	1235.28	164.21	75.94	46.25	1225.48

		(6)	(6)			(2)	(2)		
10 ha and above	Hybrid	---- ( )	---- ( )	---	---	----- ( )	---- ( )	----	
	HYVs	---- ( )	---- ( )	---	---	----- ( )	---- ( )	----	
All Sizes	Hybrid	9.92 (80)	6.25 (80)	63.01	1242.63	----- ( )	---- ( )	----	
	HYVs	28.36 (80)	12.40 (80)	43.74	1227.67	31.99 (20)	13.58 (20)	42.44	1217.88

Note: Figures in brackets indicate number of farms

The output and sale of rice (husked) in different size of farms in the year 2009-10 was analyzed and presented in table 6.5. It was observed from analysis of table 6.3A that 42.83 per cent and 43.33 per cent of their output were found to be sold in the market on an average price of Rs. 1816.80 per quintal and Rs. 1965.33 per quintal by adopters of hybrid and HYVs rice respectively while, non-adopters sold 44.06 per cent of their total produce in the market with on an average price of Rs. 1964.52 per quintal.

The quantity sold in different size of farm ranged from 29.63 per cent (small farm) to 64.38 per cent (marginal farm) and from 8.07 per cent (marginal farm) to 71.99 per cent (medium) with regard to hybrid and HYV adopter farmers and price received by them vary from Rs. 1812.10 to Rs. 1825.20 and from Rs. 1915.25 to Rs. 2015.25 per quintal respectively. Whereas, size group wise analysis of hybrid non adopters revealed that quantity sold in market vary from 19.32 per cent to 56.01 per cent with on an average price of Rs. 1914.30 to Rs. 2013.40 per quintal with regard to marginal and medium farmers respectively.

Table No. 6.5: Output and sale of paddy (Husked) by size groups 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 1ha	Hybrid	0.73 (37)	0.47 (25)	64.38	1812.10	----- ( )	---- ( )	----	----
	HYVs	4.71 (37)	0.38 (25)	8.07	1915.25	6.78 (8)	1.31 (6)	19.32	1914.80
1 – 2	Hybrid	1.62 (25)	0.48 (18)	29.63	1813.40	----- ( )	---- ( )		
	HYVs	9.13 (25)	2.01 (18)	22.02	1918.50	17.86 (6)	8.74 (5)	48.93	1920.15
2 – 4	Hybrid	3.23 (12)	1.45 (12)	44.89	1816.50	----- ( )	---- ( )		
	HYVs	20.15 (12)	7.25 (12)	35.98	2012.32	23.77 (4)	12.36 (4)	51.99	2010.25
4 – 10	Hybrid	8.15 (6)	4.40 (6)	53.99	1825.20	----- ( )	---- ( )		
	HYVs	51.46 (6)	37.05 (6)	71.99	2015.25	64.62 (2)	36.19 (2)	56.01	2013.40

10 ha and above	Hybrid	---- ( )	---- ( )	---	---	----- ( )	---- ( )		
	HYVs	---- ( )	---- ( )	---	---	----- ( )	---- ( )		
All Sizes	Hybrid	1.96 (80)	0.84 (61)	42.83	1816.80	----- ( )	---- ( )		
	HYVs	12.03 (80)	5.21 (61)	43.33	1965.33	13.93 (20)	6.13 (17)	44.06	1964.52

Note: Figures in brackets indicate number of farms

The output and sale of rice (husked) for different size of farms in the year 2010-11 was presented in table 6.6. It is observed from the analysis of this table that 70.12 per cent and 46.12 per cent of their total produce were estimated to be sold in the market on an average price of Rs. 1821.87 per quintal and Rs. 1967.53 per quintal by adopters of hybrid and HYVs growers respectively; while non-adopters sold their 53.64 per cent of total output in the market on an average price of Rs. 1965.64 per quintal.

The size group wise analysis revealed that quantity sold by different size of farm was estimated to range from 62.12 per cent to 78.03 per cent and from 9.03 per cent to 66.17 per cent with on an average price of Rs. 1815.21 to Rs. 1828.11 per quintal and Rs. 1918.05 to Rs. 2018.06 per quintal by adopters of hybrids and HYVs respectively. It was also found that semi-medium farmers sold highest percentage (78.03%) of their total produce of hybrid rice followed by small (75.83%) and marginal (64.49%) farmers whereas in case of HYVs, medium farmers had sold highest percent (66.17%) of their produce by hybrid adopters. The quantity sold by non-adopter farmers vary from 18.14 per cent to 70.14 per cent with average price variation of Rs. 1915.25 to Rs. 2015.11 while all size of non-adopters sold 53.64 per cent of their total produce with average price of Rs. 1965.64. Among all size of farm medium farmers sold highest percentage (70.14%) of their produce followed by semi-medium (68.15%) and small farmers (58.15%).

Table No. 6.6: Output and sale of paddy (Husked) by size groups 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 1ha	Hybrid	1.07 (37)	0.69 (37)	64.49	1815.21	----- ( )	---- ( )		
	HYVs	4.65 (37)	0.42 (37)	9.03	1918.05	6.23 (8)	1.13 (6)	18.14	1915.25
1 – 2	Hybrid	2.11 (25)	1.60 (25)	75.83	1819.08	----- ( )	---- ( )		
	HYVs	9.44 (25)	4.83 (25)	51.17	1920.22	17.70 (6)	10.29 (6)	58.14	1920.18
2 – 4	Hybrid	3.46 (12)	2.70 (12)	78.03	1825.07	----- ( )	---- ( )		
	HYVs	19.75 (12)	11.48 (12)	58.13	2014.01	34.35 (4)	23.41 (4)	68.15	2012.05
4 – 10	Hybrid	8.87 (6)	5.51 (6)	62.12	1828.11	----- ( )	---- ( )		
	HYVs	52.49 (6)	34.73 (6)	66.17	2018.06	66.20 (2)	46.43 (2)	70.14	2015.11
10 ha and above	Hybrid	---- ( )	---- ( )			----- ( )	---- ( )		
	HYVs	---- ( )	---- ( )			----- ( )	---- ( )		
All Sizes	Hybrid	2.75 (80)	1.92 (80)	70.12	1821.87	----- ( )	---- ( )		
	HYVs	11.97 (80)	5.29 (80)	46.12	1967.53	13.81 (20)	7.41 (18)	53.64	1965.64

Note: Figures in brackets indicate number of farms

6.3 Seasonal Flow of Marketing

The seasonal flow of marketing (sales) of paddy (unhusked) for the year 2009-10 is shown in table 6.7. Analysis of month wise flow of marketing of paddy (unhusked) for the year 2009-10 revealed that most of the hybrid adopters sold their greater proportion of paddy output immediately after the harvest in the month of November and December, although the marketing was spread over the month except April to October. This is experienced both in the case of hybrids and HYVs, which indicated that immediate cash need compelled them to sales in the months of November and December ranged between 25.48 and 28.17 per cent of total output sold for hybrid paddy respectively. Almost similar proportion of sales occurred in the month of November 26.31 per cent and December 35.02 per cent in the case of HYV paddy. For non adopters, the corresponding proportion of sales of paddy

accounted for 22.20 per cent and 23.81 per cent in the month of November and December respectively.

Table No. 6.7: Seasonal flow of marketing (sales) of paddy (unhusked) (2009-10)

(Sales quantity in qtl.)

Month	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
January	66.15 (19.15)	68.35 (7.04)	98.32 (22.16)
February	55.73 (16.13)	48.08 (4.95)	60.25 (13.58)
March	38.25 (11.07)	35.09 (3.61)	13.60 (3.06)
April	----- ( )	28.05 (2.89)	10.09 (2.27)
May	----- ( )	18.29 (1.88)	6.28 (1.42)
June	----- ( )	16.55 (1.71)	5.35 (1.21)
July	----- ( )	7.84 (0.81)	8.55 (11.93)
August	----- ( )	38.25 (3.94)	9.25 (2.08)
September	----- ( )	42.30 (4.36)	10.75 (2.42)
October	----- ( )	72.65 (7.48)	17.13 (3.86)
November	88.05 (25.48)	255.50 (26.31)	98.50 (22.20)
December	97.33 (28.17)	340.10 (35.02)	105.65 (23.81)
Total	345.51 (100.00)	971.05 (100.00)	443.72 (100.00)

Note: Figures in brackets indicate percentages of total sales

The seasonal flow of marketing (sales of paddy (unhusked) for the year 2010-11 is incorporated in the table 6.8. Analysis of this table shows months wise flow of marketing of paddy (unhusked) for the year 2010-11 indicated that most of the hybrid adopters sold their greater proportion of paddy output immediately after the harvest in the month of November and December. During the year 2010-11, in case of hybrid adopters, 21.19 per cent and 23.96 per cent of total annual sales of hybrid paddy occurred in the month of November and December respectively as against the corresponding proportions of 26.53 per cent and 35.16 per cent for HYVs respectively. The proportion of sales recorded in the corresponding month for non

adopters accounted for 22.57 per cent and 26.43 per cent of the total annual sales, followed by January and February month with 21.58 per cent and 12.72 per cent respectively. The remaining proportion of sales in the month viz., from March to October was rather small in case of hybrids and HYVs during the reference year (2009-10 & 2010-11). This is fact that most of the sample farmers both hybrid adopter and non adopters have not been able to received high prices and greater amount of sales in the month of November and December just after harvest the crops was mainly effected by the small land holders who compelled to sell their output to meet their bare requirement.

Table No. 6.8: Seasonal flow of marketing (sales) of paddy (unhusked) (2010-11)

(Sales quantity in qtl.)

Month	Adopters		Non-Adopters
	Hybrid	HYVs	HYVs
January	68.25 (15.93)	110.50 (10.92)	94.08 (21.58)
February	56.58 (13.21)	95.35 (9.43)	55.45 (12.72)
March	42.05 (9.82)	64.08 (6.32)	14.72 (3.38)
April	35.62 (18.31)	35.15 (3.47)	12.09 (2.77)
May	----- ( )	28.85 (2.85)	6.30(1.45)
June	----- ( )	19.30 (1.91)	8.60 (1.97)
July	----- ( )	8.25 (0.82)	5.35 (1.23)
August	----- ( )	6.13 (0.61)	4.80 (1.10)
September	----- ( )	4.05 (0.41)	4.55 (1.04)
October	32.47 (7.58)	15.95 (1.58)	16.40 (3.76)
November	90.80 (21.19)	268.35 (26.53)	98.40 (22.57)
December	102.65 (23.96)	355.70 (35.16)	115.25 (26.43)
Total	**428.42 (100.00)**	**1011.66 (100.00)**	**436.00 (100.00)**

Note: Figures in brackets indicate percentages of total sales

CHAPTER – VII

PROBLEMS AND PROSPECTS FOR INCREASING HYBRID RICE CULTIVATION

The present chapter deals with the problem and prospects for increasing hybrid rice cultivation in the study area. To assess farmer's perception with their own experience regarding hybrid rice cultivation, farmers responses were collected from sample hybrid rice growers through personnel interviews with the help of well scheduled questionnaire. Farmers' awareness about hybrid rice technology, assess to input use including fertilizer, pesticide, credit and their overall perception are considered during course of investigation. An attempt has been made to elicit the perception of non-participants with regard to reasons for non-adopting of hybrid rice.

7.1 Farmers' Awareness about Hybrid Rice Technology

There has been made an attempt asked to sample hybrid growers' about awareness of hybrid rice technology including source of knowledge, frontline demonstration and training programme organized by government are presented in table 7.1. An analysis of this table showed that 73.50 per cent of the sample farmers reported extension worker of the state department of the agriculture as their source of awareness about hybrid rice technology. Newspaper and other cultivators considered as other sources were reported to be 12.25 per cent and 14.25 per cent respectively. Majority of sample farmers (74%) reported that frontline demonstration programme was organized by the government in order to create awareness about hybrid rice technology. As regard to their participation in the demonstration programme, 72.00 of the farmers reported in favour of participation.

Demonstration of the hybrid rice for the extension of hybrid rice cultivation included PHB-71 as reported by 42.00 per cent having yield advantage of 72.00 per cent over HYVs, US-312 (35%) with 65.00 per cent yield advantage and PAC-835 (28%) with 58.00 per cent of yield advantage. 78.00 per cent of the sample farmers held their view that training programme was organized by the government and out of them 72.00 per cent reported their participation in the training programme, majority of those 81.50 per cent reported in favour of one day duration.

Table No. 7.1: 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 – 1Govt. Extn. Workers Source – 2 Newspaper & Other	**73.50** **12.25** **14.25**
2.	If yes have you participated in the programme?	Yes No	**72.00** **28.00**
3.	Whether front line demonstration programme is organized in your area by the Government to create awareness about the hybrid rice technology?	Yes No	**74.00** **26.00**
4.	Name the hybrids demonstrated and indicate the extent of yield advantage as demonstrated.	Hybrid – 1 PHB - 71 Yield advantage (%) (72) Hybrid – 2 US- 312 Yield advantage (%) (65) Hybrid – 3 PAC – 835 (58)	**42.00** **35.00** **28.00**
5.	Whether the government organised training programmes for farmers?	Yes No	**78.00** **22.00**
6.	If yes, had he participated?	Yes No	**72.00** **28.00**
7.	If participated mention the number of training programmes participated and their duration.	Trainings participated Numbers Duration (One day)	 **81.50**
	Hybrid varieties	Total days	**18.50**

7.2 Problems Faced by the Farmers in Input Accessibility, Production and Marketing.

An analysis of table 7.2 revealed that usual source of seed for the farmers 68.00 per cent of total farmers reported government supply as source of seed. However, seeds available during planting time were reported by 39.50 per cent of the farmers and only 10.50 per cent of the farmers who reported availability of seeds at reasonable price. It is noted that quality of seeds is concerned, a total of 44.25 per cent of the farmers reported to be satisfied with the quality of seeds. As per information by the sample farmer, only 32.00 per cent of respondent reported hybrid seed is easily

available in the study area and remaining 68.00 per cent of the farmers told about negative responses. In response to the yield superiority of hybrid seed over HYVs, hybrid adopters (100%) reported that hybrid seed gives better results than the inbred seeds. 8.25 per cent of respondent farmers reported yield gain of (5 to 10%) moreover inbred variety. Yield gain of (10-15%) more in hybrid rice production was reported by 15.50 per cent of the sample farmers. Yield received of (15-20%) more in hybrid rice was informed by 32.75 per cent of the respondent farmers and yield realized in hybrid rice higher by 20.00 per cent and above as compared to inbred (HYVs) rice was reported by 43.50 per cent of the farmers. An information concerned with adoption of hybrid seeds prevented traditional practices of saving and exchanging of seeds, 65.00 per cent of the hybrid adopters reported that they are replacing seeds every year while remaining 25.00 and 10.00 per cent replacing seeds every alternative and every three year respectively.

Table No. 7.2: 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	68.50 31.50
2.	If yes, why used -	Reason 1 Higher yield Reason 2 Free supply	82.00 90.00
3.	Is the hybrid seed easily available?	Yes No	32.00 68.00
4.	What is the usual source of your seeds?	Source 1 Govt. supply Source 2 Pvt. supply	75.80 24.20
5.	Is the quality hybrid seeds available in your area?	Yes No	40.00 60.00
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	39.00 10.50
7.	Are you satisfied with quality of seed ?	Yes No	44.25 45.75
8.	If no, reasons therefor (poor germination etc.)	Reason 1 Reason 2	100.00 0.00
9.	Are you convinced that hybrid seed yield better results than the inbred seeds?	Yes No	100.00 0.00
10.	If yes, indicate the percentage of yield increase.	5-10% 10-15% 15-20% 20% & above	8.25 15.50 32.75 43.50
11.	If Hybrid seeds bring lesser yields, indicate the percentage of yield loss due to hybrid rice.	5-10% 10-15% 15-20%	0.00 0.00 0.00
12.	Do you purchase new seeds of hybrid varieties every crop season/year?	Yes No	80.00 20.00
13.	Do you feel that adoption of hybrid seeds prevented traditional practice of saving and	Yes No	100.00 0.00

	exchanging of seeds?		
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	 65.00 25.00 10.00 ---

Information related to hybrid adopters' access to fertilizer input and its use are incorporated in table 7.3. Analysis of this table revealed that majority of the farmers about 82.00 per cent reported to receive information from any source regarding what to use and the required doses. A major proportion (85.50%) of the respondent farmers also noticed to have used recommended doses of the fertilizer input. There was some reasons concerned with sample farmers those who have not used fertilizer in recommended doses, reported lack of knowledge (44.25%) and financial constraint (55.75%) as the main reasons for non-adoption of recommended doses of the fertilizer. The majority of the sample farmers (80%) reported that fertilizer is easily available from private outlet at market. Hybrid seeds require more fertilizer than inbred seed (HYVs) reported by cent per cent of the sample farmers.

Table No. 7.3: Questions related to Hybrid Adopting Farmers access to Fertilizer input and its use

Sl.No.	Particulars	Answers	% of farmers reporting
1.	Have you used chemical fertilizer?	Yes No	100.00 0.00
2.	Whether received information from any source regarding what to use and the required doses ?	Yes No	82.00 18.00
3.	If yes, have you applied recommended doses of fertilizer ?	Yes No	85.50 14.50
4.	If not, state reasons therefor	Reason 1 Financial security Reason 2 Lack of knowledge	44.25 55.75
5.	If fertilizer not used at all what are the reasons	Reason 1 Reason 2	0.00 0.00
6.	Is fertiliser easily available ?	Yes No	80.00 20.00
7.	If yes, the source where it is available	Source 1 Pvt. Outlet at market Source 2	100.00 0.00
8.	Do you feel that hybrid seeds require more fertilizer than inbred seeds	Yes No	100.00 0.00

Information related to hybrid adopters' access to pesticide input and its use are shown in table 7.4. Analysis of table 7.4 revealed that 90.00 per cent of sample farmers reported, hybrid rice or any other variety of rice was attacked with pests and diseases. Farmers' level responses received in course of pests and diseases, hybrid

rice are more susceptible to pests and diseases reported by most of the sample farmers (88.25%). However, 79.50 per cent of the respondents reported to have used pesticides. Out of those who had not used pesticides, 65.25 per cent and 34.75 per cent reported lack of knowledge and lack of money respectively as the main reason for non-adoption of pesticides. It is noted that majority of the sample farmers 84.50 per cent know the correct way of using and doses of plant protection pesticides for general and hybrid rice. While, 79.50 per cent of the respondents reported know correct doses of pesticides for hybrid seed variety. All the sample farmers (100%) informed that pesticides are easily available in the sample area. Also all the sample farmers informed that the extent of yield loss due to pests and diseases for inbred variety (HYVs) is lower as compared to hybrid rice.

Table No. 7.4: 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	90.00 10.00
2.	If yes, which variety (Hybrid/Hyvs) with area	Hybrid (area) HYVs (area)	85.00 15.00
3.	Have you applied pesticides ?	Yes No	83.00 17.00
4.	If not, why not used?	Reason 1 Lack of knowledge Reason 2 Lack of money	65.25 34.75
5.	Is the pesticide easily available ?	Yes No	100.00 0.00
6.	Do you know the correct way of using and doses of plant protection pesticides?	Yes No	84.50 15.50
7.	Do you feel that hybrid rice varieties are more susceptible to pests and diseases?	Yes No	88.25 11.75
8.	Do you know the correct does of pesticides for hybrid seed varieties ?	Yes No	79.50 20.50
9.	Do you feel that hybrid rice cultivation is highly sensitive to crop management practices - use of	Yes No	78.00 22.00
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	100.00 0.00

Hybrid adopting farmers' access to credit is presented in table 7.5. Analysis of this table revealed that most of the respondent farmers (71.50%) reported to be negative in responses of more requirement of credit for using hybrid seed one of those who require credit, 38.00 per cent of sample farmers reported that they get credit from the institutional sources. Farmers in majority (cent-per cent) receive credit from the Bank. Those farmers who are not availing of credit facilities suffered with major

problem of procedural formalities as perceived by 74.50 per cent of the farmers apart from the problem (25.50%) in getting credit.

Table No. 7.5: 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	**28.50** **71.50**
2)	Do you get required credit from the Co. Credit Society or any other institutional sources?	Yes-1 No-2	**38.00** **62.00**
3)	If yes, which source	Source-1 Bank Source-2	**100.00** **0.00**
4)	If not, what are the problems in getting credit	Problem-1 Security Problem-2	**25.50** ---

Hybrid adopters' perception about marketing of hybrid rice is presented in table 7.6. Analysis of this table showed that majority of the sample hybrid adopting farmers (84.50%) reported that they face problems in marketing of hybrid rice produce. Lack of consumer demand for hybrid rice grain, lower head rice recovery and finally lower price received in the market were the major problems faced by the hybrid growers. One of the major problems notified by the adopters included poor cooking and keeping quality (78%), poor grain quality and as a result lack of market acceptance 88.50 per cent, traders not accepting hybrid rice grain lack of demand from millers and consumers 81.50 per cent and rice broken more after milling 52.00 per cent.

Table No. 7.6: 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	84.50 15.50
2.	If yes, state the nature of the problem faced	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	96.00 78.00 100.00 52.00 92.00 88.00 81.50

7.3 Farmers' Overall Perception of Hybrid Rice Cultivation

The information of farmers regarding their overall perception of hybrid rice grower is presented in table 7.7. An analysis of this table indicated that all the sample farmers (cent-per cent) reported that there was more yield gain in hybrid over the best popular inbred rice varieties (HYVs). Also hybrid rice production was considered to be more profitable as response by 74.50 per cent of the sample farmers. Almost 88.50 per cent of the sample farmers reported that grain quality of hybrid rice is poor as compared with the grain quality of the existing HYVs varieties of rice while about 56.25 per cent of the farmers said hybrid rice is not suitable for their taste.

The various respondents of the sample farmer 78.50 per cent said hybrid rice has poor cooking quality. High stickiness of cooked rice is also convinced by 80.00 per cent of the sample respondents. A total of 76.00 per cent of sample farmers informed that traders and millers do not want to accept rice grain with on account of its poor grain qualities. However, farmers are responses with the economic viability of hybrid rice cultivation. Most of the sample farmers 72.50 per cent reported that they are convinced with the economic viability of hybrid rice cultivation. One who are not convinced with the economic viability of hybrid rice cultivation due to some reasons comprising less or not availability of seed and higher cost of cultivation 22.00 per cent, more susceptible to insect pest and diseases 13.00 per cent, poor quality of the grain 32.00 per cent, poor knowledge about hybrid cultivation, technology and management 21.00 per cent and poor marketing of hybrid rice with 12.00 per cent responses. Among hybrid growers 15.00 per cent was not in favour of continuing cultivation of hybrid rice. About 85.00 per cent of hybrid adopters expressed their view for continuing hybrid rice production 71.50 per cent with the reasons of higher yield potential of hybrid rice. Out of them, 28.50 per cent are expecting new variety of hybrid rice with better quality in the near future. Consequently, analysis of hybrid adopting farmers' overall perception about hybrid rice cultivation viewed that future research on hybrid rice development should have

attention on improvement of grain quality besides yield in the further hybrid generation.

Table No. 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	100.00 100.00
2.	Is hybrid rice production profitable?	Yes No	74.50 25.50
3.	Do consumers perceive hybrid as inferior to inbreed in respect of grain quality?	**Hybrids inferior in respect of** Poor grain quality No taste Poor cooking quality Stickiness of cooked rice	 88.50 56.25 78.50 80.00
4.	Is hybrid rice grain acceptable to traders and millers?	Yes No	24.00 76.00
5.	Is he convinced with the economic viability of hybrid rice cultivation?	Yes No	72.50 27.50
6.	It no, reasons therefore	Reason – 1 Less/Non-availability of seed, higher cost of cultivation Reason – 2 More susceptible to pest & diseases Reason – 3 Poor quality of seed/grain Reason – 4 Poor knowledge about hybrid cultivation, Technology & management Reason – 5 Poor marketing of hybrid rice	22.00 13.00 32.00 21.00 12.00
7.	Do you like to continue cultivating of hybrid rice?	Yes No	85.00 15.00
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 Higher yield of hybrid rice	 28.50 71.50

7.4 Reasons for Non-adoption of Hybrid Rice Cultivation (Non-adopters' Experience)

Some reasons related to non-adoption of hybrid rice are shown in table 7.8. analysis of this table revealed that about 38.00 per cent of sample non-adopters reported that they have not heard about new variety of hybrid rice while 62.00 per cent of the non adopting farmers viewed in favour of heard about some varieties of hybrid rice and as such varieties are PHB-71 as reported by 59.68 per cent of the farmers

corresponding to US-312 (62.45%) and PAC-835 (68.03%). About 52.00 per cent of the farmers viewed in favour of heard of the government's hybrid rice promotion programme. When farmers interviewed 57.00 per cent of non adopting farmers reported no seen any standing rice crop of hybrid varieties. Almost 39.00 per cent of the sample non adopters reported that nobody had suggested to grow hybrid variety in their area. Among those, 61.00 per cent who get suggestions from any source, majority 60.50 per cent informed that they have received suggestions from Agricultural Extension Officer (AEO) of the state department of agriculture followed by Village Level Worker (VLW) with 42.18 per cent and known from government demonstration 25.25 per cent.

About 68.00 per cent of the sample respondent non adopters had viewed their willingness to grow hybrid variety of rice next year. Remaining 38.00 per cent viewed no growing hybrid variety next year. According to non-adopting farmers, yield gain but less profitability of hybrid rice (66.50%) is major reasons for non-adopting of hybrid rice followed by seed is too costly 42.00 per cent and not heard of the government assistance for expansion of hybrid rice seed with 30.00 per cent responses. Government seed germination too low is reported by 26.00 per cent of sample respondents. Another 20.45 per cent of non adopters reported that the extent of yield loss due to pests and diseases is higher for hybrids. About 18.25 per cent of sample non adopting farmers reported that fertilizer need to much and 14.30 per cent and 8.35 per cent of sample respondent viewed with credit not available in time and not heard of the hybrid variety respectively. All the non adopting farmers (cent-per cent) reported that they are interested to adopt new hybrid rice variety in future corresponding higher yield potential.

Table No. 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)	Yes – 1 No – 2	62.00 38.00
2.	If yes, what are they? (name them)	---	---
3.	Have you heard of the Govts. Hybrid rice promotion programme? (Yes-1, No-2)	Yes – 1 No - 2	52.00 48.00
4.	Have you seen any standing rice crop of hybrid variety in your area? (Yes-1, No-2)	Yes – 1 No - 2	43.00 57.00
5.	Did anybody suggest you to grow this variety? (Yes-1, No-2)	Yes – 1 No - 2	61.00 39.00
6.	If yes, state who suggested?	V.L.W BDO AEO Relative Other cultivators Known from government demonstration Others (Specify)	42.18 4.20 60.50 --- 10.45 25.25 15.75
7.	Will you be growing this variety next year?	Yes No	68.00 32.00
8.	What are the reasons for your not using this year?	Not heard of the variety ii. Not heard of the Govt. assistance for expansion of hybrid rice seeds. Non-availability of seed Not at all Not in time Pure hybrid seed not available Seed is too costly Seed available, but at too far a distance vi. Pre-treatment of seed is necessary and have never done it before. 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 Lower yield for hybrid than for inbred xi. Yield gain but lower profitability of Hybrid rice Variety too coarse Higher risks xiv. Will fetch lower price as compared to inbred variety Needs too much of fertilizers Soil type not suitable Not insects pests and disease resistant. xviii. The extent of yield loss due to pests and diseases is higher for hybrids. Needs more water Fodder quality not good Credit – not available in time Credit not at all available xxiii. Restrictions on disposal i.e. should be sold to a particular agency Any other (Specify)	8.35 30.00 42.00 26.00 66.50 18.25 20.45 14.30
9.	Are you ready to accept new hybrid rice varieties in future considering superior grain quality and higher yield potential?	Yes No	100.00
10.	If no, reasons therefore.	Reasons – 1 Reasons – 2	NIL

CHAPTER – VIII

SUMMARY & POLICY RECOMMENDATIONS

8.1 Background

With over one billion people in India, there is a need to increase food production to meet the demand of the burgeoning population. As rice is the staple food in most parts of India and there is a need to increase production of rice and productivity of land under rice cultivation. India has the largest acreage under rice at 43.97 million hectare with a production of 104.32 million tones and yield of 2372 kg/ha (Government of India, 2012).

In fact the rice research programme in India over the past 50 years has largely centred on shifting the yield frontier which contributed substantially to achieving food security through increased rice supplies (CRRI, 1996). Several studies indicated high payoffs to rice research in India *(Evenson & McKinsey, 1991); Evenson, 1993; Kumar & Rosegranht, 1994; Pingali et.al, 1997; Jha & Kumar, 1998 as quoted in Pingali & Hossain, 1999).* The rice output growth was 2.80 per cent per annum during 1966-99 with the highest rate of growth (4.00% per year) achieved during the 1980s. Yield improvement in rice was major sources of strong output growth, largely due to widespread adoption of modern rice varieties in favourable irrigated environments *(Baker & Herdt, 1985; David & Outsuka, 1994; Hossain, 1996; Pingali et.al 1997).* However, the sense of complacency in the demand-supply balance began disappearing in early 1990s, when it was observed that yield advances in rice drastically slowed down for the irrigated rice systems in India as well as in other Asian countries. The intensive rice growing states of Andhra Pradesh, Tamil Nadu,

Punjab & Haryana, which performed significantly in terms of yield improvements until the 1980s, have been witnessing either a plateau or negative yield growth during the 1990s. The economically exploitable yield of existing High Yield Varieties (HYVs) of rice has almost reached the technical optimum in irrigated rice systems with the universal adoption of HYVs.

Among various approaches and options available policymakers and research managers considered development and use of hybrid rice technology in the late 1980s as a readily available option to shift upward and yield frontier in the irrigated environments in India. Further, the miraculous success of hybrid rice technology in China, which greatly contributed to the growth of rice production in that country *(Lin, 1994; Virmani et.al 1998),* triggered an interest in strengthening research efforts in some tropical countries in Asia including India in early 1990s.

Several international agencies like UNDP, FAO, ADB and International Rice Research Institute (IRRI) have generously supported the hybrid rice research and development at many national research institutions in tropical Asia including India in the early 1990s. India received nearly US $ 8 million in financial support from these external agencies between 1990 & 2000 for activities under the hybrid rice programme initiated in 1989 at the Directorate of Rice Research, Hyderabad. An additional to external funding with the Central Government through the ICAR and State Governments have invested huge capital and human resources for the development and supply of suitable hybrid rice technology for Indian farmers. The private sector participated in hybrid rice research programme and seed production in a big way in the early 1990s, expecting a huge seed business and a guaranteed seed market in view of rice being a widely cultivated crop in the country and the farmer not being able to keep hybrid seed from his/her own produce. Among about 130 private seed companies engaged in rice business across the country, 15 larger companies participated in hybrid rice seed production and distribution in early 1990s. **After four years of rigorous research (1989-93), the first hybrid rice was released in Andhra Pradesh in 1993-94 rabi season.** Subsequently, as a result of concerted efforts over a period of two decades since the inception of the National

Programme on Hybrid Rice (1989), a total of 43 rice hybrids have been released for commercial cultivation in the country of which 27 as indicated in table No. 1.1 were developed by public sector institutions and 16 were developed by private sector *(Shoba Rani et. Al., 2010, p. 36).* In contrast, in China the initial phase of development of hybrid rice was solely a public sector affair.

At present hybrid rice is reported to be grown approximately 2 lakh hectares. Area under hybrid rice will further increase after heterotic hybrids suitable for high productivity areas of Punjab, Haryana, coastal region of Andhra Pradesh and shallow low land areas are identified and an effective transfer of technology is taken up vigorously in the target states (Viraktamat, 2010). Based on the quantity of hybrid seed sold in 2008, it is estimated that hybrid rice was cultivated on 0.15 m ha. The National Food Security Mission (NFSM) launched in 2007 envisioned an increase of 10 m. tons by the end of 11th Five Year Plan (2012). Of this hybrid rice is expected to contribute 3.4 mt if grown in 3.4 m ha (@ on tone advantage). The ultimate goal of the mission is to extend 20.00 per cent of the total rice area planted with hybrid rice. In an effort to enhance rice productivity, the present government has, in a policy shift, decided to encourage the cultivation of hybrid varieties by offering subsidies even in those cases where the seeds are not certified, but are truthfully labeled and notified. Under the NFSM, the approach is to bridge the yield gap in respect of rice through dissemination of improved technology and farm management practices. Added emphasis is being given for adoption of hybrid rice under the special scheme namely; **"Bringing Green Revolution to Eastern India (BGREI)."** The programme covers traditional rice growing areas such as Uttar Pradesh, Bihar, Jharkhand, West Bengal, Madhya Pradesh, Chattisgarh & Assam and these states account for 80.00 per cent of adoption. It is to be pointed out here that adoption of rice hybrids developed in India did not take place in the in green revolution areas where productivity plateau. The extent of adoption of hybrid rice in South India is very low (5.00%) and North-West India (Punjab, Haryana & Maharashtra account for 15.00 Per cent.

Moreover, Janaiah (2002) argues that in spite of huge capital and human resources invested over the past decade to develop and supply hybrid rice technology for Indian farmers, there has not been a noticeable impact on the sector. India has tried to emulate China's success story in the area of hybrid rice research and development, but Indian farmers have not readily accepted hybrid rice technology. If one looks at adoption of hybrid rice in different states the adoption, empirical results found that the farmers have not adopted hybrid rice for various reasons. In spite of attempts over a decade to popularize hybrid rice in states like Andhra Pradesh, Tamil Nadu & Karnataka in south the adoption is very low *(Janaiah; 2003; Chengappa et.al; 2003 & Ramasamy et.al, 2003)*. The reasons for resistance to adopt hybrid rice in India are (a) shortage of hybrid rice in terms of quantity and quality, (b) poor hybrid rice grain formation, (c) yield, biotic stresses like bacterial and pest attack, (d) lack of market for hybrid rice because of consumer's preferences regarding grain quality, shape, colour and cooking quality, and; (e) high cost of hybrid seed. In fact, recently the Bihar Government paid Rs. 61 crore to farmers who cultivated hybrid rice because the grain formation did not occur in the seed and hence farmers incurred losses. Despite all above, a number of varieties, as staged in table No. 1.1, have been released by the Central Government and states as well to meet the demand of the farmers; the spread of these new varieties in place of traditional ones has not been examined adequately. In fact, there is no comprehensive study to record farm level experiences of hybrid rice, thus, the Ministry of Agriculture, Government of India has decided to assign the study entitled **"Spread of New Varieties of Hybrid Rice and their Impact on the Overall Production and Productivity"** to its Agro-Economic Research Centres in their respective states. Accordingly, this Centre has been undertaken the study in Bihar.

8.2 Objectives of the Study

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

ii. To assess the overall impact on rice production and productivity of hybrid rice cultivation.

iii. To study the economics of cultivation of hybrid rice varieties vis-à-vis inbred varieties.

iv. To identify factors determining the adoption of hybrid rice varieties.

v. To address various constraints and outline the prospects for increasing hybrid rice cultivation and finally

vi. To suggests policy measures for expansion of hybrid rice cultivation.

8.3 Data Base and Methodology

This study is based on both secondary and primary data. Secondary data relating to area, production and yield of rice crop were collected from the Directorate of Agriculture, Government of Bihar. Secondary data were also obtained from the publications of Government of Bihar and Government of India. These are mainly Economic Survey of Bihar, Statistical Handbook of Bihar, Agricultural Statistics--- At a Glance: 2012 etc. To arrive at the trends in APY of rice secondary data were collected for the years from 1984-85 to 2009-10. Primary data is confined to the National Food Security Mission (NFSM) paddy districts (18 districts) of Bihar. Out of these 18 NFSM paddy districts, two (02) districts namely; Muzaffarpur and Gaya were selected on the basis of having higher concentration of hybrid seeds cultivation. From Muzaffarpur districts, two representative blocks namely; Minapur, Motipur & from Gaya district Aamas & Dumaria blocks were chosen following same criteria. Thereafter from each of the selected blocks, two villages namely; Shital Sema & Minapur from Minapur Block and Morsandi and Tajpur from Motipur Block and Mahua and Bazitpur from Aamas Block and Karhani and Bokaha from Dumaria Block were selected for in-depth enquiry. From each of the selected villages, lists of cultivating households growing hybrid rice varieties and inbred varieties were prepared separately and stratified according to farm size groups such as marginal (< 1 ha), small (1 to 2 ha), semi-medium (2 to 4 ha), medium (4 to10 ha) and large (10 ha & above). Due attention was given in the sample to accommodate the social composition of the villages. As regards the sample size is concerned, 40 hybrid rice growers from the list of hybrid rice growers and 10 inbred rice growers from the list of inbred rice growers were randomly chosen, making a total of 50 paddy growers from each of the sample district were selected. This way the total

size of the sample is 100 paddy growers, equally spread over in two selected districts from the state (Bihar). The reference period of primary data was 2008-09 and 2009-10. Primary data was obtained by administering a duly structured schedule.

8.4 Major Findings

Followings are major findings of the study:

Out of the three rice growing seasons, winter (Aghani) is the most important season in Bihar in terms of area sown and production. In 2009-10 winter rice accounted for 36.99 per cent of total output and 80.93 per cent of total area cultivated under rice. The importance of winter rice output in total production has fallen from 91.41 per cent in 1984-85 to 36.99 per cent in 2009-10 while that of Boro rice has risen from 1.65 per cent in 1984-85 to 2.07 per cent in 2009-10 except a few years. Increase in the share of output in case of autumn rice (Bhadai) is due to increased in area from 6.94 per cent in 1984-85 to 88.61 per cent in 2007-08. However, it declined to 60.95 per cent in 2009-10. For summer rice, increased share in production is attributable to increase in both area and production. The relative importance of winter rice has also sharply fallen in terms of acreage planted and production. It is noted that average rice yield in Bihar increased to 1475 kg per hectare in 2006-07 except 2008-09 & 2009-10. These were 928 kg per hectare in 1987-88 and 1211 kg per ha in 1984-85, the period when rice crop of the state was yet to switch over to the hybrid technology. In case of summer rice, yield rate increased from 1406 kg per ha in 1984-85 to 2053 kg per ha in 1998-99, which again increased to 1736 kg per ha in 2009-10. For winter rice, yield level increased from 1098 kg per ha in 1984-85 to 1142 kg per ha in 2009-10 through 1555 kg per ha in 2006-07 whereas autumn rice recorded yield levels of 947 kg per ha in 2009-10 which was 1648 kg per ha in 2008-09 against 771 kg per ha in 1984-85. Above analysis showed that there has been overall increase in rice production during the period under study 1984-85 to 2009-10.

Total area under HYV rice has increased from 1401 thousand ha in 1994-95 to a peak of 1984 thousand ha in 1999-2K but it has fallen in subsequent years and reached to the level of 1691 thousand ha in 2009-10. But it has increased from 1401 thousand ha in 1994-95 to 1691 thousand ha in 2009-10, registering an increase of 20.70 per cent in area. In case of production almost similar pattern was observed. It increased from 2065 thousand MT in 1994-95 to 2203 thousand MT in 2009-10, accounting for an increase in production by 6.69 per cent during the period.

Compound Growth Rate (CGR) in area of total paddy on an aggregate level during the period-I (1984-85 to 1993-94) was estimated as 0.68 per cent per annum which decreased to -2.13 per cent per annum during the period – II (1994-95 to 2003-04). But thereafter it increased at the rate of 12.95 per cent per annum during the period – III (2004-05 to 2009-10). Thus, it clearly indicates that the area under total paddy on an aggregate level in the state of Bihar has increased significantly during the period – III (2004-05 to 2009-10). Compound Growth Rate of production of total paddy had recorded increase at the rate of 1.45 per cent per annum during period-I (1984-85 to 1993-94), and 15.93 per cent per annum during the period – III (2004-05 to 2009-10) except decrease in period – II (1994-95 to 2003-04) by 4.63 per cent per annum. Similarly, the CGR of productivity of total paddy had also increased at the rate of 0.77 per cent per annum during period – I (1984-85 to 1993-94) and 2.64 per cent per annum till during the period – III (2004-05 to 2009-10). But it has fallen by 0.97 per cent per annum during the period – II (1994-95 to 2003-04).

Co-efficient of variation on an aggregate in the area of total paddy was estimated to 10.10 per cent during the period of 1984-85 to 1993-94 which varied to 26.76 per cent till the period of 2004-05 to 2009-10. While, the coefficient of variation in production of total paddy had varied in increasing direction from 13.58 per cent in the period of 1984-85 to 1993-94 to 27.19 per cent till the period of 2004-05 to 2009-10. But the coefficient of variation in yield of total paddy was recorded to 16.38 per cent during 1984-85 to 1993-94, which increased to 20.25 per cent till the period of 2004-05 to 2009-10.

The compound growth rate in area of total HYV paddy was estimated as 2.11 per cent per annum during the period of 1994-95 to 2003-04 which increased to 3.08 per cent per annum during the period of 2004-05 to 2009-10. The compound growth rate in production of total HYV paddy had also increased at the rate of 4.08 per cent per annum during 1994-95 to 2003-04 to 8.38 per cent per annum till the period of 2004-05 to 2009-10.

The co-efficient of variation in total area of HYV paddy during the period of 1994-95 to 2003-04 was calculated to 11.93 per cent which decreased to 7.57 per cent during the period of 2004-05 to 2009-10. The variation in total production was estimated to 18.01 per cent during the period of 1994-95 to 2003-04 which increased to 24.20 per cent during the period of 2004-05 to 2009-10. The variation in total productivity was recorded to be 8.94 per cent during the period of 1994-95 to 2003-04 which also increased to 18.68 per cent during the period of 2004 - 05 to 2009-10.

The table reveals that the share in area of HYV rice was 31.00 per cent in 1994-95, which touched to the level of 52.63 per cent in 2009-10. Similarly the share in production of HYV rice to total rice production in the year 1994-95 was 30.11 per cent, which doubled in the year 2009-10.

The agricultural economy of Bihar is largely dependent on marginal and small operational holdings, which accounts for 96.92 per cent, followed by semi-medium (2.56%), medium (0.50%) and large (0.02%). Besides, out of the total working population (33.88%), 77.35 per cent are engaged in agricultural activities (cultivators plus agricultural labourers) in the state.

Out of 80 adopters' farm household marginal and small farmer together account for 77.50 per cent followed by semi-medium (15%) and medium (7.50%). Similarly in case of non-adopters farm families, 70.00 per cent account for marginal and small farms, 20.00 per cent semi-medium and 10.00 per cent medium farms.

On an average there were 7.39 persons in a farm family constituting 62.66 per cent male and 37.24 per cent female. It was 7.43 persons among the adopters' farm households and 7.25 among the non-adopters farm households.

The average age of the head of family is largely in the category of 18 to 60 years (92%) at the overall level; however, it was a little bit higher among the adopters' category (92.50%), and that of 90.00 per cent among the non-adopter farm households.

The caste composition of households reveals that 60.00 per cent are belonged to other backward castes followed by general category of castes (30%) and scheduled castes (10%) on overall basis.

On the farms of sample hybrid adopters during kharif season of 2009-10, about 47.11 per cent of the Gross Cropped Area (GCA) was adopted by paddy, 13.09 per cent by maize and 11.46 per cent by other crops. While during 2010-11, 48.68 per cent was covered by kharif paddy crop, 12.53 per cent by kharif maize and 10.68 per cent by other crops.

The area under pulses, rabi maize and other crops was found a little higher in 2010-11 over 2009-10. The aggregate share of kharif crops of the GCA was almost 73.00 per cent plus among the non-adopters of hybrid rice during both years.

During the year 2009-10, the average area under rice was estimated at 0.82 ha (62.60%) of the average farm size. Out of which 0.71 ha (86.58%) was devoted on HYVs and 0.11 ha (13.42%) hybrid. Similarly in 2010-11, the average area under rice was estimated at 0.85 ha (64.88%) of the average farm size. Out of which 0.70 ha (82.36%) was devoted on HYVs and 0.15 ha (17.64%) on hybrid rice.

Out of 80 sample hybrid rice adopters, 49 (61.25%) have reported about the Extension Workers of State Department of Agriculture, more specifically the SMS and Kisan Salahkar (KS) followed by participation in training programme under SRI Technology (45%), progressive farmers (17%) and Krishi Vigyan Kendra (5%).

Majority of the sample hybrid adopters were received good quality of information from all the major sources of information except the progressive farmers.

During the year 2009-10, about 40.00 per cent of the sample hybrid adopters have received the seed from the district office of the department of agriculture on full

subsidy, 32.50 per cent on partial subsidy and 27.50 per cent from local input dealers. While during the year 2010-11, 45.00 per cent of the hybrid adopters have obtained the seed from district office of the department of agriculture on full subsidy followed by 30.00 per cent from the government on partial subsidy and 25.00 per cent purchased from licensed local input dealers.

The percentage difference between the hybrid and HYVs rice was calculated at 58.98 per cent. During 2009-10, the percentage difference between the mean yields of hybrid and HYVs rice was better than the percentage difference between the mean yields of hybrid and HYVs rice of 2010-11. On an average the yield gain was 58.98 per cent obtained by all sizes of farm in 2009-10, while that of 55.79 per cent in 2010-11.

Marginal farmers have been largely affected by costlier seeds (27.50%, small farmers by lack of irrigational facilities (23.75%), semi-medium farmers by lack of adequate training and information (6.25%) whereas medium farms by lack of irrigational facilities (3.75%) and lack of adequate training and information (3.75%) during the year 2009-10. While during the year 2010-11, marginal farmers largely reported for costlier seeds (28.75%), small farmers for lack of credit facilities (17.50%), semi-medium farmers for costlier seeds (6.25%) and lack of adequate training and information (6.25%) whereas medium farmers reported for lack of irrigational facilities (3.75%).

Seed rate (kg/ha) is significantly lower for the hybrid than for HYVs. The use of chemical fertilizer is also 25.97 per cent higher than that for HYVs. While in case of non-adopter of hybrid rice, it is higher by 23.96 per cent. Labour use is significantly higher for the hybrid than that for HYVs. However, more labour is used in transplanting of hybrid rice (25.14 days) as compared to HYVs (21.18 days). Among all the components of total cost, expenditure on human labour formed the single largest item accounted for 27.62 per cent and 33.64 per cent of the total cost for hybrid and inbred varieties respectively. The cost incurred on seed was next one which formed about 14.17 per cent of total cost for hybrids whereas that was calculated at 4.80 per cent for HYVs. Total cost of input was about 27.42 per cent

higher for hybrids than that for HYVs. The total seed cost for hybrid rice was about 3.75 times higher than that for HYVs.

During 2010-11, the farmers growing hybrid rice received a gross return of Rs. 83719.18 per hectare while the gross return for inbred varieties was Rs. 54178.66. Thus, the gross return was 54.52 per cent higher in hybrid rice cultivation. However, the profit (net return) realized in hybrid and inbred rice was Rs. 59966.93 and Rs. 35538.10 per hectare respectively. Thus, the profit gain realized in hybrid rice production was Rs. 24428.83 per hectare or 68.74 per cent over inbred varieties of rice. Consequently the benefit cost ratio was also higher in hybrid rice cultivation (3.52:1). Now, net return from hybrids over the reference periods has merely decreased from Rs. 60138.94 per hectare in 2009-10 to Rs. 59966.93 per hectare in 2010-11 accounting for 0.28 per cent decreased in 2010-11.

Hybrids have hulling, milling and head rice recovery ratio of 66.67 per cent, 63.16 per cent and 60.01 per cent respectively. The corresponding figures for HYVs were calculated at 70.58 per cent, 65.22 per cent and 61.86 per cent respectively whereas Non-adopter reporting hulling ratio (71.43%), milling ratio (66.66%) and head rice recovery ratio (65.21%).

On an overall average of size group 62.26 per cent and 42.89 per cent of total output have been sold by adopters of hybrid and HYVs rice respectively in the market and rice growers received a price of Rs. 1240.28 per quintal and Rs. 1221.53 per quintal for hybrid and HYVs rice respectively.

Very little variation was found in quantity sold by the farmer for hybrid and HYVs because most of sample size was marginal and small farmer, they used their produce in large quantity as home consumption and remaining amount sold for purchasing agriculture inputs.

On overall size 63.01 per cent and 43.74 per cent were found to be sold in the market on an average price of Rs. 1242.63 and Rs. 1227.67 per quintal by adopters of hybrid rice and HYVs rice growers respectively while, non-adopters of hybrid sold their 42.44 per cent of total output in the market on an average rate of Rs. 1217.88 per

quintal. 42.83 per cent and 43.33 per cent of their output were found to be sold in the market on an average price of Rs. 1816.80 per quintal and Rs. 1965.33 per quintal by adopters of hybrid and HYVs rice respectively while, non-adopters sold 44.06 per cent of their total produce in the market with on an average price of Rs. 1964.52 per quintal. 70.12 per cent and 46.12 per cent of their total produce were estimated to be sold in the market on an average price of Rs. 1821.87 per quintal and Rs. 1967.53 per quintal by adopters of hybrid and HYVs growers respectively; while non-adopters sold their 53.64 per cent of total output in the market on an average price of Rs. 1965.64 per quintal.

Most of the hybrid adopters sold their greater proportion of paddy output immediately after the harvest in the month of November and December, although the marketing was spread over the month except April to October.

During the year 2010-11, in case of hybrid adopters, 21.19 per cent and 23.96 per cent of total annual sales of hybrid paddy occurred in the month of November and December respectively as against the corresponding proportions of 26.53 per cent and 35.16 per cent for HYVs respectively.

Most of the sample farmers both hybrid adopter and non adopters have not been able to received high prices and greater amount of sales in the month of November and December just after harvest the crops was mainly effected by the small land holders who compelled to sell their output to meet their bare requirement.

73.50 per cent of the sample farmers reported extension worker of the state department of the agriculture as their source of awareness about hybrid rice technology.

Demonstration of the hybrid rice for the extension of hybrid rice cultivation included PHB-71 as reported by 42.00 per cent having yield advantage of 72.00 per cent over HYVs, US-312 (35%) with 65.00 per cent yield advantage and PAC-835 (28%) with 58.00 per cent of yield advantage.

Usual source of seed for the farmers 68.00 per cent of total farmers reported government supply as source of seed. However, seeds available during planting time were reported by 39.50 per cent of the farmers and only 10.50 per cent of the farmers who reported availability of seeds at reasonable price.

Yield gain of (10-15%) more in hybrid rice production was reported by 15.50 per cent of the sample farmers. Yield received of (15-20%) more in hybrid rice was informed by 32.75 per cent of the respondent farmers and yield realized in hybrid rice higher by 20.00 per cent and above as compared to inbred (HYVs) rice was reported by 43.50 per cent of the farmers.

A major proportion (85.50%) of the respondent farmers also noticed to have used recommended doses of the fertilizer input. There was some reasons concerned with sample farmers those who have not used fertilizer in recommended doses, reported lack of knowledge (44.25%) and financial constraint (55.75%) as the main reasons for non-adoption of recommended doses of the fertilizer.

Majority of the sample farmers 84.50 per cent know the correct way of using and doses of plant protection pesticides for general and hybrid rice. While, 79.50 per cent of the respondents reported know correct doses of pesticides for hybrid seed variety.

Most of the respondent farmers (71.50%) reported to be negative in responses of more requirement of credit for using hybrid seed one of those who require credit, 38.00 per cent of sample farmers reported that they get credit from the institutional sources.

One of the major problems notified by the adopters included poor cooking and keeping quality (78%), poor grain quality and as a result lack of market acceptance 88.50 per cent, traders not accepting hybrid rice grain lack of demand from millers and consumers 81.50 per cent and rice broken more after milling 52.00 per cent.

All the sample farmers (cent-per cent) reported that there was more yield gain in hybrid over the best popular inbred rice varieties (HYVs). Also hybrid rice production was considered to be more profitable as response by 74.50 per cent of the

sample farmers. Almost 88.50 per cent of the sample farmers reported that grain quality of hybrid rice is poor as compared with the grain quality of the existing HYVs varieties of rice while about 56.25 per cent of the farmers said hybrid rice is not suitable for their taste.

About 38.00 per cent of sample non-adopters reported that they have not heard about new variety of hybrid rice while 62.00 per cent of the non adopting farmers viewed in favour of heard about some varieties of hybrid rice and as such varieties are PHB-71 as reported by 59.68 per cent of the farmers corresponding to US-312 (62.45%) and PAC-835 (68.03%).

Majority 60.50 per cent informed that they have received suggestions from Agricultural Extension Officer (AEO) of the state department of agriculture followed by Village Level Worker (VLW) with 42.18 per cent and known from government demonstration 25.25 per cent.

According to non-adopting farmers, yield gain but less profitability of hybrid rice (66.50%) is major reasons for non-adopting of hybrid rice followed by seed is too costly 42.00 per cent and not heard of the government assistance for expansion of hybrid rice seed with 30.00 per cent responses. Government seed germination too low is reported by 26.00 per cent of sample respondents.

8.5 Policy Implications

On the basis of above findings and field level observations followings are the policy implications:

1. The cost of irrigation, seeds and pesticides were significantly higher in hybrid rice production than HYVs, which may be reduced by providing skill oriented training & incentivization programme to hybrid rice growers over HYV rice growers ***(Attn: Directorate of Agriculture, Government of Bihar).***
2. The access for hybrid rice technology was poor. So there is need to promote such technology by way of training, extension services, monitoring etc. ***(Attn: Directorate of Agriculture, Government of Bihar).***

3. Since most of the hybrid adopters sold their output just after harvesting causing them low returns, so hybrid adopters should be encouraged to process and sell husked paddy to make it more profitable. It requires proper storage facilities also **(*Attn: Directorate of Agriculture, Government of Bihar).***
4. Most of hybrid adopters reported about the quality of hybrid in terms of cooking and keeping was much poor. So there is need to improve the quality by promoting more scientific applications ***(Attn: SAUs, Government of Bihar).***
5. Adoption of hybrid paddy was found poor, which needs to be increased. ***(Attn: Directorate of Agriculture, Government of Bihar).***
6. Since efforts is required to encourage small & marginal farmers for adoption of hybrid rice. To popularize the same, distribution of rice minikits (hybrid rice kits) among them should be at larger scale ***(Attn: Directorate of Agriculture, Government of Bihar).***
7. Effective implementation and monitoring of NFSM (Rice) and BGREI Programme is need of hour to increase the rice area, production and yield in the state because of high potentiality of the region/state in terms of having rice based cropping system ***(Attn: Directorate of Agriculture, Government of Bihar).***

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Comments on the 'Draft Report' on "Spread of New Varieties of Hybrid Rice and their Impact on the overall Production and Productivity – in the state of Bihar".

Report by AERC, Bhagalpur

A. The Date of Receipt of the draft Report ..... 05/08/2013.

B. The Coordinator`s comment dispatched on ..... 14/08/2013.

Comments:

1. The Report is well drafted, where all the objectives have been addressed properly.

2. a) In the First Chapter under 1.4 (Database, Sampling Design. Methodology and Coverage), in case of secondary data one statement should be included to arrive at the conclusion regarding trends in APY of rice Viz. 1984-85 to 1993-94, 1994-95 to 2003-2004 and 2004-2005 to 2009-2010 to have a glimpse over the **pre and post introduction of hybrid rice across Period-I, Period-II and Period-III respectively.**

2. b) The reference years in the study design are mentioned as 2009-2010 and 2010-2011, but here the reference years have been taken as 2008-2009 and 2009-2010. This variation should be explained.

3. In most of the chapters sequences of sub-chapters (numbering and heading) are not maintained accordingly and it starts from the sub chapter 2.3 in page number 13. In Chapter III, IV, and chapter V such type of mis-numbering is also found. It will create difficulties to the coordinator during consolidation of the studies. Please rectify.

4. In Chapter III analyses of determinants of participation in Hybrid Rice Cultivation are not found. This is extremely important to assess the role of determining factors for introduction of Hybrid Rice in the respective States.

5. The Chapter IV is abruptly ended without explaining the Yield Response Function for Inbred Rice as mentioned in the Study design.

6. Chapters V, VI and VII are well drafted barring the disorganized design of sub-chapter sequences.

7. In case of Policy Implications (in Chapter VIII) some points are repeated viz. Point 1 and 2 can be merged into one. Suggestions need to be more concretized.

Overall presentation and acceptability of the Report:-

The Report may be accepted after the necessary modifications and corrections are done.

Comments prepared by Mr. K.S. Chattopadhyay, Coordinator for this Study.
Kindly acknowledge the receipt of these comments.

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AERC Website: http://www.visva-bharati.ac.in/InstitutionsCentresSchools/Contents/AERC-DETAIL/aerc-detail.htm/

Appendix –II

ACTION TAKEN REPORT

Name of the Study : Spread of New Varieties of Hybrid Rice and their Impact on the Overall Production and Productivity in Bihar

Date of received comments : 16/08/2013

Date of dispatch of Report : 10/09/2013

Comment wise Action Taken

1. No action is required.

2 (a) Corrections made accordingly by incorporating in the report at proper place.
(b) The variation in reference years is due to mistake at our end while comparing from the manuscript. Necessary corrections made accordingly.

3. The chapter sequences of sub-chapters (numbering and heading) rectified accordingly in all the chapters.

4. It could not be incorporated as per the comments but meaningful determinants can be seen from the section 3.5 and table Nos. 3.5 to 3.8.

5. In lack of statistical staff in this Centre, it could not be statistically presented. However, the tabular analysis made in this chapter (IV) is sufficient to cover the objectives of the study.

6. Sub-chapter sequences of chapter V, VI & VII have been corrected.

7. Point – I & Point – II of policy implication in chapter – VIII have been merged in one point.

Rambalak Choudhary
Research Officer -Cum-Project Leader