Ind. Jn. of Agri. Econ.
Vol. 61, No. 1, Jan.-March 2006

ARTICLES

Trend of Production, Adoption and Utilisation of High Quality Paddy Seeds: A Study in Orissa

Trilochan Tripathy, Steve Harisson and Bimal K. Mohanty*

I

INTRODUCTION

India is expected to be the most populous country of the world by 2050 if the present growth rate perpetuates. In order to meet the growing needs of the expanding population, it is compelled to produce more than 200 million tonnes of foodgrains per year. Indian agriculture experienced a spectacular increase in foodgrains production particularly in the production of wheat and paddy during 1960s. The jump in the productivity rates of these crops was so sudden and conspicuous that some economists termed the phenomenon as 'Green Revolution' which was basically the outcome of the use of package of improved practices which include the use of improved seeds, balanced use of fertilisers and manures, pesticides, improved implements, proper soil and water management.

Plants are the 'primary factory of agriculture' where seeds are like 'machines', fertilisers and water like the 'fuel' and herbicides, pesticides, equipment, credit and technological know-how are 'accelerators' to increase the output of this industry. The output in the plant industry is indirectly linked with genetic potential of the seeds. The history of agricultural progress from the early days of human civilisation has been the history of seeds. Indian scientists were the first to report on the possibility of developing hybrid seeds in rice at the Central Rice Research Institute, Cuttack in the early part of 1950s. The recent technological revolution in agriculture is described as a euphemism for the high-yielding varieties (HYV) of crops. Among all the inputs needed for agricultural production, 'seed' is the most vital input because agricultural productivity and production both are closely linked with the overall quality and quantity of seeds. It is considered as the crucial and basic input to increase the crop

*Senior Lecturer, ICFAI Business School, Dehradun-248 006,Uttaranchal; Associate Professor, Department of Economics, The University of Queensland, Brisbane, Old 4072, Australia and Reader in Economics, Ravenshaw College, Cuttack-753 003, (Orissa), respectively.

The authors are highly grateful to an anonymous referee of the Journal for his/her constructive and valuable comments. They are solely responsible for the remaining errors, if any.

yield per acre and to improve the agricultural economy of a country. However, all this scientific research and technological advancement in agriculture would be of little or no meaning to farmers unless they get seeds which are genetically pure and possess other desired qualities such as high germination percentage and vigour, high purity and sound health. By high quality seed it is meant that the seed is genetically pure (true to type), geographically adopted, has high germination, capable of producing vigorous seedling, free from diseases and free from weeds and other crop seeds (Chatterjee and Bhattacharya, 1986). When the farmers do not get these seeds and sow the others inferior to the former, the actual yield from cultivation may not be as high as expected. Only seeds with assured quality can be expected to respond to fertilisers and other inputs appropriately (Rao, 1993). Thus HYV seed is one of the most important agricultural inputs like irrigation and fertilisers to help achieve the yield potential contained in the seed by providing conducive environment. It is the proper seed which holds the key to agricultural success and abundance. None of the following like soil conservation programmes, manure, fertiliser and improved tillage can alone be capable of resulting in an increased harvest. But it is the quality seed, other factors remaining constant, which can bring a substantial increase in production. The secret of success in farming lies in the selection and use of high-yielding seeds appropriate to particular agro-climatic and agro-edaphic situation.

The use of high-yielding seeds has not only resulted in substantial increase in foodgrains production but also has been acknowledged as one of the basic agricultural inputs essential for continued development of Indian agriculture. Till the introduction of the high-yielding rice seeds in the 1960s, the dramatic potential of seeds in increasing agricultural productivity could not be well appreciated in this country (Sengupta, 1986). In spite of all the efforts to increase the productivity of agriculture, the desired result of self-sufficiency in food grains production could not be achieved in India. To achieve the objective of self-sufficiency in food supply, among others, the use of qualitative seeds is considered to be one of the primary requirements. Three factors that are important in agricultural production technology are the right seed, right soil and right season. Of course, sometimes the yield capacity of seeds, irrespective of its variety depends on agro-climatic adaptability. High quality seeds are the most important basic inputs for scientific agriculture and in increasing crop production. It is the most precious basic input in any agricultural production programme. It has been experimentally found that 20-25 per cent increase in productivity could be achieved only by replacing the old local varieties by high quality seeds and hybrids (Das, 1991).

Green Revolution has contributed substantially to the increase in the productivity of Indian agriculture, but it has remained confined to particular agrarian pockets of India. The economy of a state has been directly influenced by the degree of adoption of scientific packages of agriculture. Higher the degree of adoption of scientific agricultural technologies, greater is the extent of economic development of the state. If the agrarian economy of the state is backward in the use of agricultural technology,

it is also equally backward in terms of development. This is corroborated by the economic prosperity achieved by some of the Indian states like Punjab and Haryana in the post-Green Revolution period and Gujarat and Andhra Pradesh in recent times. These states have pushed forward their economies by introducing and practicing a state of art agricultural packages. States like Orissa, Madhya Pradesh, Bihar and Assam are still backward because their agriculture is backward and stagnated in terms of the use of new agricultural technologies in a wider scale. In this backdrop, the present study makes an attempt to highlight the production, adoption and utilisation of high quality paddy seeds in Orissa as a means to increasing the productivity of its agriculture.

II

OBJECTIVES

Production of high quality seeds of improved variety alone does not solve the problem of low productivity of agriculture; what really stands as a solution to such a problem is high adoption and extensive utilisation of such seeds by farmers on continuous basis. Keeping this in view, the present study attempts to (1) make a trend analysis of rice production in Orissa during the last decade 1990-91 – 2001-02, (2) determine the area under HYV paddy vis-à-vis traditional paddy and the extent of responsiveness of the former to irrigation during the decade, (3) ascertain the accessibility of the farmers of Orissa to the quality seeds and the extent to which such seeds are adopted by them in cultivation and (4) locate the main constraints which prohibit the farmers of Orissa to purchase the quality seeds from the seeds sale centres. By keeping these objectives in view, the paper proposes to test the hypotheses that (1) the trends of rice production and food grains production do not keep pace with each other, (2) the area under HYV paddy is increasing over years and that the adoption of such seeds responds faster to irrigation than to areas without irrigation, (3) the adoption of high quality seeds in cultivation and the size of landholdings of farmers are directly related, (4) adoption of high quality seeds is inversely related with the distance between the native place of the farmers and the seeds sale centres and (5) the non-availability of such seeds in right time and in appropriate quantity has been a major cause of non-use of these seeds by most of the farmers in Orissa in spite of their willingness to use them.

III

DATA AND METHODOLOGY

The present study is based on the data collected from both primary and secondary sources. The secondary data are collected from several issues of *Economic Survey* of the Government of Orissa, books, reports and unpublished theses. Primary data have been collected from the farmers' households during the last quarter of 2002 by

canvassing two different structured interview schedules- one for the sample households and the other for the officials of the agricultural extension services spread over different agro-climatic regions of Orissa. The schedule meant for the farmers' households covered a range of questions relating to adoption and utilisation of high quality paddy seeds and also the constraints faced by them in respect of their access to such seeds. The schedule meant for the officials in charge of promoting the use of such seeds by the farmers cover certain aspects of which the most important one is the cause of their failure to promote the habits of the farmers to adopt these seeds in cultivation. A multi-stage sampling method has been used to select the ultimate sample units of the study. The existing 30 districts of Orissa are distributed over three regions (Central, Northern and Southern) determined mostly by dissimilarity in agro-climatic conditions. Of these thirty districts, twelve districts in all, four districts from each region and from each district one Community Development Block and from each block three villages being classified into three different categories on the basis of their distance from the departmental seeds sale centers, viz., up to 5 km, 5-10 km and above 10 km have been chosen at random. For each of the 36 sample villages, a list of farmers having land and households of landless sharecroppers has been drawn before the commencement of data collection. In this respect, both the agricultural workers and farmers of the village have been thoroughly consulted. The ultimate sample units of farmers have been classified into three broad groups on the basis of their landholdings such as big (> 3 ha), small (1 to 3 ha) and marginal (< 1 ha). Having followed the methodology, three farmers from each size class per village aggregating 324 farmers over three regions have been chosen for the study and each has been interviewed through a pre-designed questionnaire. Over and above, the extension officers and the officers in-charge of the seeds sale centres (i.e. two centres from each district) have also been interviewed in order to cross-check the reliability of the information furnished by the farmer respondents.

IV

RESULTS AND DISCUSSIONS

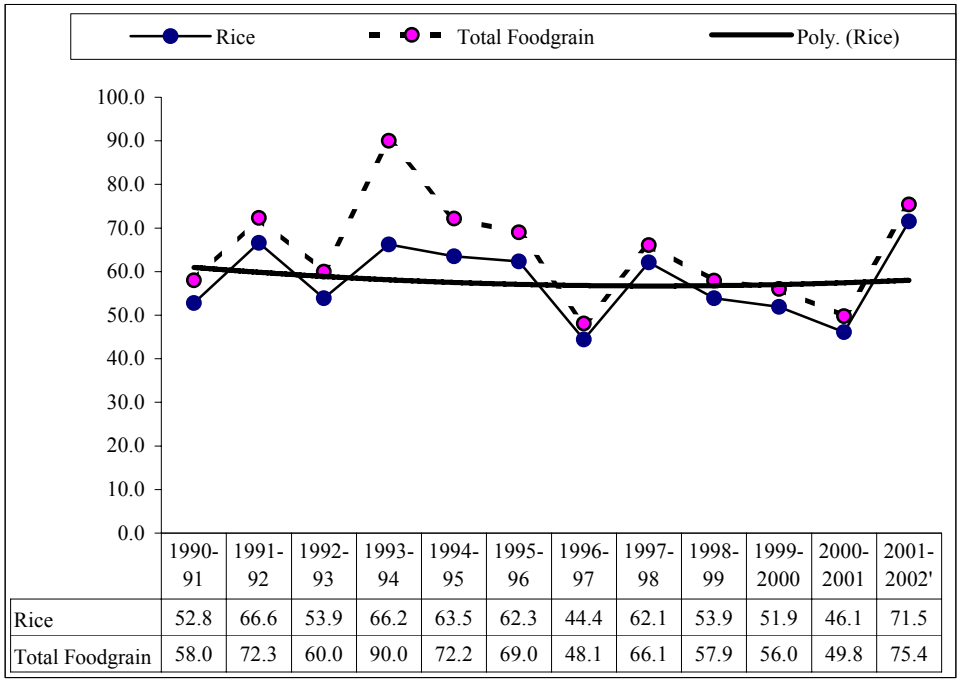
The results of the study have been arranged under five categories conforming to a particular aspect.

(1) *Production of Paddy vis-à-vis Total Food Grains Production in Orissa*

Agriculture occupies a pivotal place in the economy of Orissa. It provides 65 per cent of employment to the total workforce of the state. In spite of this,

agriculture of Orissa continues to be characterised by low productivity due to traditional agricultural practices, inadequate capital formation, low investment, inadequate irrigation facilities and uneconomic size of land holdings (Government of Orissa, 2002-03). Nearly 62 per cent of the cultivable land is rainfed and exposed to the vagaries of monsoon. The per capita availability of cultivable land has declined from 0.39 hectares in 1950-51 to 0.17 hectares in 2001-02. As per Agricultural Census 1995-96, out of total number of operational holdings of 39.7 lakh, the small and marginal farmers hold 81.9 per cent. In terms of foodgrains production, Orissa is lagging behind. Its contribution to the food grains basket of the country is 2.54 per cent against the population contribution of 3.4 per cent in 2000-01. Figure 1 presents the behaviour of rice production and total foodgrains production in Orissa during 1990-91 – 2001-02 along with a polynomial trend for rice production abbreviated as Poly. (Rice) on the body of the figure. It is evident that the production of food grains and also of rice in the state during the last decade 1990-91 – 2001-02 has been subject to wide fluctuations. The production of foodgrains declined from 58 lakh MT in 1990-91 to 49.8 lakh MT in 2000-01 but rose to 75.4 lakh MT in 2001-02. Thanks to good monsoon and favourable weather conditions there was such an unimaginable spurt in the production of foodgrains in Orissa by 51.41 per cent as compared with 2000-01. Of course, the state government played a role in the promotion of food grains production in 2001-02. In the immediate previous year (2000-01), there was a sharp fall in the foodgrains production by 3.3 per cent in comparison to that for the year 1999-2000. With a view to reviving the agricultural economy of Orissa, the government made concerted efforts by giving incentive support to the farmers and also by generating a climate of awareness among the farming community (Government of Orissa, 2002-03). There was bumper harvest during 1991-92 with a production of 72.3 lakh MT of foodgrains in which the share of rice alone was 66.6 lakh MT. But the production of food grains declined to 48.1 lakh MT in 1996-97, 56.0 lakh MT in 1999-2000 and 49.8 lakh MT in 2000-01 along with the production of rice. The decline in food production was due to unprecedented drought both in 1996-97 and 2000-01. The drastic fall in foodgrains production in Orissa during 1999-2000 is attributed to the wide scale devastation caused by 'super cyclone' which ravaged 14 fertile coastal districts of Orissa in the month of October - the time appropriate for the *kharif* crop to be enriched. All this points to the conclusion that the foodgrains production in Orissa is never smooth and is subject to wide scale fluctuations over time. These fluctuations are basically the outcomes of the role that nature plays.

(in Lakh MT)



	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002'
Rice	52.8	66.6	53.9	66.2	63.5	62.3	44.4	62.1	53.9	51.9	46.1	71.5
Total Foodgrain	58.0	72.3	60.0	90.0	72.2	69.0	48.1	66.1	57.9	56.0	49.8	75.4

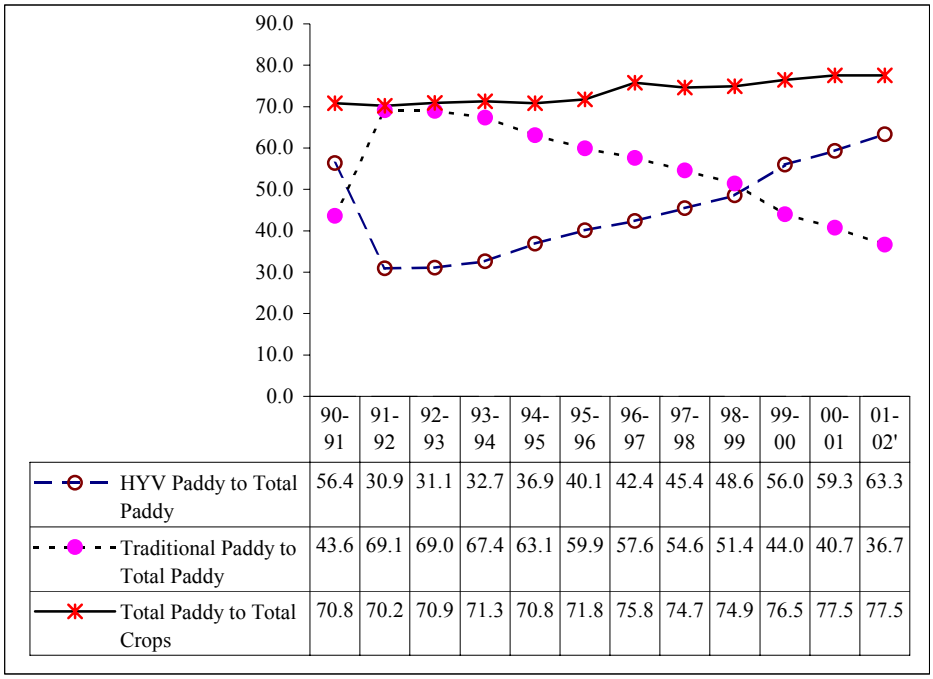
Source: *Economic Survey 1995-96 – 2002-03*, Government of Orissa.

Figure 1. Trend of Agricultural Production in Orissa

TREND OF THE DISTRIBUTION OF HYV PADDY VIS-À-VIS TRADITIONAL PADDY

There are many ways to identify whether a new technology has affected the way of cultivation. If the farmers continuously go to replace the traditional varieties of seeds by high quality seeds, it can be one way to confirm that there has been the impact of Green Revolution on the methods of cultivation. But the simple replacement of high-yielding variety seeds may not influence much the level of foodgrains production without being accompanied by other agricultural technologies like the expansion of irrigation potentialities, fertilisers and pesticides. Figure 2 presents the extent of replacement of traditional variety of seeds by high-yielding varieties and at the same time displays the area under HYV paddy with irrigation accessibility during 1990-91 – 2001-02 in Orissa. Starting with the year 1991-92, there has been an increase in the area under the cultivation of HYV paddy as a percentage of total cropped area and therefore, the area under traditional paddy as percentage of total cropped area has diminished. While the former has increased from 56.36 per cent in 1990-91 to 63.33 per cent in 2001-02, the latter has diminished from 43.64 per cent in 1990-91 to 36.67 per cent in 2001-02. One of the most revealing

facts is that during the period under reference, the land area under paddy cultivation in the state has increased by 2.18 per cent. But area under the cultivation of HYV paddy has increased by 14.83 per cent against a decline of land area under traditional paddy cultivation by 14.2 per cent. This shows that the farmers of Orissa have not only diverted some of their land holdings beforehand put to the cultivation of traditional paddy to the cultivation of HYV paddy but also they have shifted a part of their cultivable land which was put to the cultivation of other crops (excluding paddy) before hand. Thus the production of HYV paddy is gaining reputation in the state of Orissa.



	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02'
HYV Paddy to Total Paddy	56.4	30.9	31.1	32.7	36.9	40.1	42.4	45.4	48.6	56.0	59.3	63.3
Traditional Paddy to Total Paddy	43.6	69.1	69.0	67.4	63.1	59.9	57.6	54.6	51.4	44.0	40.7	36.7
Total Paddy to Total Crops	70.8	70.2	70.9	71.3	70.8	71.8	75.8	74.7	74.9	76.5	77.5	77.5

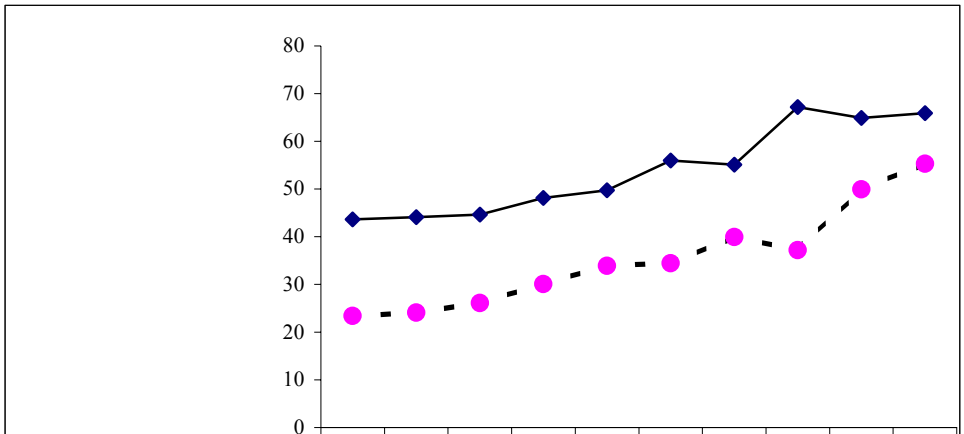
Source: Economic Survey 1995-96 – 2002-03, Government of Orissa.

Figure 2. Percentage Distribution of the Area Under HYV and Traditional Paddy to Total Area Under Paddy in Orissa

(2) *Trend of Area under HYV Paddy under Irrigated and Unirrigated Conditions*

The 'Integrated Cereal Development Programme Rice' is being implemented in the state since 1994-95 with an objective to augment the production of rice and enhancing its productivity through adoption of a package of scientific practices in cultivation. The major component of this programme is to increase coverage area under the high-yielding variety seeds. Despite inadequate irrigation facilities, short

supply of HYV seeds, low use of fertilisers and pesticides, there has been a significant expansion in area under HYV crops in the state of Orissa. The fact is that the ratio of irrigated area under HYV paddy cultivation to total area under HYV paddy cultivation has diminished from 57.1 per cent in 1990-91 to 40.5 per cent in 2001-02 and hence, the ratio of unirrigated area under HYV paddy cultivation to total area under HYV paddy cultivation has increased from 42.9 per cent in 1990-91 to 59.5 per cent in 2001-02.



	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001
Irrigated HYV Paddy toTotal Irrigated Paddy	43.6	44.1	44.6	48.1	49.7	56	55.1	67.2	64.9	65.9
Unirrigated HYV Paddy to Total Unirrigated Paddy	23.4	24.1	26.1	30.1	33.9	34.4	39.9	37.2	49.9	55.3

*Sources:*1. *Economic Survey 1995-96- 2002-03*, Government of India.

2. *Area and Production of Principal Crops in India 1993-94 to 1995-96*, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi, India.

3. *Economic Intelligence Service Report on Agriculture March 2005*, Center for Monitoring Indian Economy Pvt. Ltd., Mumbai, India.

Note: 1. Year 1990-91 and 2001-02 could not be brought under the purview of discussion due to non-availability of detailed data for these two years.

Figure 3. Distribution of Area under HYV Paddy Between Irrigated and Unirrigated Areas

Figure 3 shows the trend in the percentage distribution of area under HYV paddy cultivation between irrigated and unirrigated land. With the advent of HYV seeds many a thought came in the minds of the prejudice-ridden cultivators who were applying traditional methods of cultivation and using traditional seeds. One such thought was that irrigation was a precondition for successful application of such

variety of seeds. The trend so derived in the current research contradicts the common belief that irrigated land alone could accommodate and promote HYV paddy cultivation. Unirrigated cultivable land can also be effective in the cultivation of HYV paddy. In Figure 3, this is quite visible. In recent times, during '*kharif*' season (from June to December) the farmers who were otherwise using traditional seeds, profusely use HYV seeds, and hence larger percentage of unirrigated cultivable land is being brought under the HYV paddy cultivation. Therefore, irrigation is not necessarily a pre-condition for the application of HYV seeds. However, paddy cultivation during '*rabi*' season (from January to May) inevitably requires irrigation facilities without which it would be quite a risky venture.

ADOPTION AND UTILISATION OF HYV PADDY

The decision to adopt and utilise high quality paddy seeds by the farmers is believed to be governed by the distance of farmer households to the government seeds sale centres and also the land holding size of the farmers. The farmers who purchase seeds from departmental seeds centres at least once in three years so as to maintain the purity and germination capability are considered regular in using the high quality seeds included in the study. The information collected from primary sources are compiled according to farmers' categories and distance wise and have been presented in Tables 1 through Table 4.

Table 1 indicates that on an average 55.6 per cent of the total farmers in Orissa are adopting high quality rice seeds. Of these farmers, 82.4 per cent staying within a radius of 5 km, 54.6 per cent residing within a radius of 5-10 km and 29.6 per cent dwelling beyond 10 km either have purchased or are in the habit of purchasing seeds from their nearest departmental stores. It has also been observed that there exist inter-regional variations across the regions of the state in adopting high quality rice seeds in agricultural practices. The farmers of the central region of Orissa have been highly accustomed to adopting high quality rice seeds, which constitute 63 per cent of the total farmers of that region followed by 52.8 per cent and 50.9 per cent from the northern and southern regions, respectively. Further in the central region, on an average, 88.9 per cent farmers staying within a radius of 5 km, 58.3 per cent residing within a radius of 5-10 km and 41.7 per cent dwelling beyond 10 km from the departmental seeds sale centres have either purchased or are in the habit of purchasing seeds from their nearest seeds sale centres. On the other hand, 80.6 per cent, 50 per cent and 27.8 per cent of farmers in the northern region and 77.8 per cent, 55.6 per cent and 19.4 per cent of the farmers in the southern region of the state within a radius of 5 km, 5-10 km and more than 10 km respectively have the habit of adopting high quality rice seeds. All this has led to the conclusion that irrespective of variations in agro-climatic conditions and agricultural practices over the regions of Orissa, the adoption and utilisation of high quality paddy seeds is highly responsive to the distance between the farmers' households and the nearest seeds sale centres.

TABLE 1. UTILISATION OF HIGH QUALITY SEEDS BY FARMER GROUPS AS PER THE DISTANCE FROM SEEDS SALE CENTRES

Region		Distance from seeds centres			
		I	II	III	
	Districts	<5 km	5-10 km	>10 KM	Total
(1)	(2)	(3)	(4)	(5)	(6)
Central	Jajpur	88.9	55.6	33.3	59.3
	Kendrapada	77.8	66.7	44.4	63.0
	Mayurbhanj	88.9	44.4	33.3	55.6
	Puri	100.0	66.7	55.6	74.1
	Total	88.9	58.3	41.7	63.0
		(32)	(210)	(15)	(68)
Northern	Angul	88.9	66.7	33.3	63.0
	Sundargarh	77.8	33.3	22.2	44.4
	Bolangir	66.7	33.3	22.2	40.7
	Bargarh	88.9	66.7	33.3	63.0
	Total	80.6	50.0	27.8	52.8
		(29)	(18)	(10)	(57)
Southern	Kalahandi	66.7	66.7	22.2	51.9
	Kandhamal	77.8	33.3	11.1	40.7
	Nabarangpur	77.8	66.7	33.3	59.3
	Raygada	88.9	55.6	11.1	51.9
	Total	77.8	55.6	19.4	50.9
		(28)	(20)	(7)	(55)
Orissa		82.4	54.6	29.6	55.6
		(89)	(59)	(32)	(180)

Source: Field survey 2002.
Note: All figures are percentages excepting the ones in the parentheses which are absolute numbers.

Table 2 shows that 36.1 per cent of the marginal farmers, 54.6 per cent of the small farmers and 75.9 per cent of the large farmers usually procure their requirements for seeds from the seeds sale centres run by the Department of Agriculture. Inter-regional variations in respect of adoption of high quality seeds exist among different categories of farmers. It is the category of large farmers who have been highly habituated in adopting high quality seeds followed by small and marginal farmers irrespective of the region to which they belong. The farmers of the central region are marked to have enjoyed relative advantage over each of the respective categories of farmers in the northern and southern regions in regard to the adoption of high quality seeds. The range of variations in adopting high quality seeds among large, small and marginal farmers are seen to have been varied between 66.7 and 86.1 per cent, 50 and 58.3 per cent and 27.8 and 44.4 per cent, respectively, in the state of Orissa. Thus, it is quite inevitable that the category of marginal farmers may be using smaller quantities of high quality paddy seeds in comparison to the other two size classes of farmers, but the extent of variation measured by the range of variation in the choice of such seeds in cultivation is the least.

TABLE 2. UTILISATION OF HIGH QUALITY SEEDS BY REGION AND FARMERS' GROUPS

		Farm size groups			
		I	II	III	
Region	Districts	Marginal	Small	Large	Total
(1)	(2)	(3)	(4)	(5)	(6)
Central	Jajpur	55.6	55.6	66.7	59.3
	Kendrapada	44.4	55.6	88.9	63.0
	Mayurbhanj	22.2	55.6	88.9	55.6
	Puri	55.6	66.7	100.0	74.1
	Total	44.4	58.3	86.1	63.0
		(16)	(21)	(31)	(68)
Northern	Angul	33.3	66.7	88.9	63.0
	Sundargarh	33.3	44.4	55.6	44.4
	Bolangir	11.1	44.4	66.7	40.7
	Bargarh	33.3	66.7	88.9	63.0
	Total	27.8	55.6	75.0	52.8
		(10)	(20)	(27)	(57)
Southern	Kalahandi	44.4	55.6	55.6	51.9
	Kandhamal	33.3	33.3	55.6	40.7
	Nabarangpur	33.3	55.6	88.9	59.3
	Raygada	33.3	55.6	66.7	51.9
	Total	36.1	50.0	66.7	50.9
		(13)	(18)	(24)	(55)
Orissa		36.1	54.6	75.9	55.6
		(39)	(59)	(82)	(180)

Source: Field survey 2002.
Note: All figures are percentages excepting the ones in the parentheses which are absolute numbers.

Table 3 presents the extent of utilisation of high quality seeds in cultivation by farmers both by their land holdings and distance of their residence from the seeds sale centres. It has been noticed that for Orissa in general, 66.7 per cent of the marginal farmers, 83.3 per cent of the small farmers and 97.2 per cent of the large farmers within a radius of 5 km are regularly availing of the facilities against 33.3, 52.8 and 77.8 per cent of the farmers residing within a radius of 5-10 km respectively from the seeds sale centres. The corresponding figures are 8.3, 27.8 and 52.8 per cent respectively if their place of residence are above 10 km from the seeds sale centres. On an average irrespective of their land holding size, 82.4 per cent of the farmers dwelling within a distance of 5 km, 54.6 per cent of the farmers between 5 and 10 km and 29.6 per cent of the farmers beyond 10 km have availed the benefits of seed distribution programme of the government as against 36.1 per cent of the marginal farmers, 54.6 per cent of the small farmers and 75.9 per cent of large farmers irrespective of the distance of their residence from the seeds sale centres in Orissa. Further considering the inter-regional variations in the habit of adopting high quality seeds among the farmers' households by distance and land holding size, it has been deduced from the field survey data that the farmers belonging to the central region of the state residing within a distance of 5 km from the departmental seeds sale centres have actualised the opportunities to the greatest extent, i.e., 88.9 per cent followed by 80.6 per cent and 77.85 per cent, respectively, from the northern and southern regions of the state. Among the marginal, small and large farmer categories if each one is

held to have been residing within a radius of 5 km or less, the large farmers always have been benefited the most from the programme. It is the marginal farmers irrespective of their places of residence and the region to which they belong have always been left behind. But the habit of adopting high quality seeds in rice production among the different categories of farmers have continuously declined with increase in the distance from the departmental seeds sale centres.

TABLE 3. UTILISATION OF HIGH QUALITY SEEDS BY DISTANCE AND FARMERS' GROUP WISE

		Land category			
Region	Distance from seeds sale centres	I Marginal	II Small	III Large	Total
(1)	(2)	(3)	(4)	(5)	(6)
Central	< 5 km	75.0	91.7	100.0	88.9
	5-10 km	33.3	50.0	91.7	58.3
	>10 km	25.0	33.3	66.7	41.7
	Total	44.4	58.3	86.1	63.0
		(16)	(21)	(31)	(68)
Northern	< 5km	58.3	83.3	100.0	80.6
	5-10 km	25.0	50.0	75.0	50.0
	> 10 km	…	33.3	50.0	27.8
	Total	27.8	55.6	75.0	52.8
		(10)	(20)	(27)	(57)
Southern	< 5 km	66.7	75.0	91.7	77.8
	5-10 km	41.7	58.3	66.7	55.6
	>10 km	…	16.7	41.7	19.4
	Total	36.1	50.0	66.7	50.9
		(13)	(18)	(24)	(55)
Orissa	< 5 km	66.7	83.3	97.2	82.4
					[49.4]
	5-10 km	33.3	52.8	77.8	54.6
					[32.8]
	>10 km	8.3	27.8	52.8	29.6
					[17.8]
	Total	36.1	54.6	75.9	55.6
					[100]

Source: Field survey 2002.

Note: In the lower panel of the Table 3, figures given in the first bracket ( ) are absolute numbers; figures in the square brackets [ ] are row per cent to the Orissa total and rest of the figures are in per cent.

If the same is considered for the state of Orissa as a whole, 55.6 per cent of the total farmers avail of the benefit of seed distribution programme at least in every three years. Stated differently, 18.5 per cent of the total farmers of the state turn up every year to collect their seeds from the departmental seeds sale centres of which 21.7 per cent are marginal farmers, 32.8 per cent are small farmers and 45.6 per cent are large farmers. This upholds the hypothesis that the utilisation and adoption of high quality paddy seeds increases with the land holding size of the farmers. In this category of farmers who have adopted high quality paddy seeds, 49.4 per cent are within a distance of 5 km, 32.8 per cent are within a distance of 5-10 km and 17.8 per cent are in a distance of above 10 km from the government depot dealing with the

sales of high quality paddy seeds (Table 3). All the facts contained in Table 3 confirm the validity of the hypothesis that the adoption of high quality paddy seeds by farmers diminishes with the increase in the distance from the seeds sale centres. These findings corroborate the findings of Mahabal (1986) and Singh (1979).

It is derived from the above analysis that the habit of adoption of high quality seeds in rice cultivation in the state of Orissa has been directly linked with the land holding size and inversely with the distance of the places of residence of farmers from the departmental seeds sale centres. In one of the studies on adoption and utilisation of high quality seeds completed in respect of Bangladesh (Hossain *et al.,* 2003a), it has observed the presence of an inverse relationship between farm size and the adoption of hybrid paddy seeds in cultivation. Possibly such an event has been the outcome of small and marginal farmers having enhanced the household rice production from small pieces of land under their possession to meet the family requirements for rice. But the present study contradicts the results of the country level study made in Bangladesh, which is in fact due to three major reasons. Firstly, it was observed during the field study that the small and marginal farmers are not using the high quality paddy seeds and other agricultural technologies to that extent as in case of large farmers, because of the involvement of high input material costs, which even sometimes exceeds the output earnings.[1] Secondly, the high quality paddy requires lot of care and is exposed to higher risk of disease and natural calamities than the traditional varieties. Thirdly, the large farmers are having access to and capable enough to cover their crops under formal crop insurance schemes, while the small and marginal farmers, due to their relatively small land holdings are not able to afford such schemes. As a result, large farmers are in a habit of adoption of high quality paddy seeds to a greater degree than the small and marginal farmers in the state of Orissa.

In order to identify the contribution of different factors to the adoption and utilisation of high quality seeds by farmers across different regions of the state of Orissa, a logit model has been fitted to the data collected from the sample households. This model specifies a binary response function in which the dependent variable is a dummy variable being dichotomous in character. The dummy dependent variable assumes a value 1 for those who are adopters of the hybrid type seeds in cultivation, other wise 0 (for non-adopters). The probability of adoption is expressed in terms of logistic distribution function. Then the variable logit or L is defined as the natural logarithm of the ratio of the probability of adoption to probability of non-adoption or the log-odd ratio. The logit is then regressed on the variables comprising farm size, distance from seeds sale centres, age and education of farmers and a dummy variable for region. The logit function in the present context is specified as:

$$L_i = \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \gamma_1 Z_1 + \gamma_2 Z_2 + \gamma_3 Z_3 + \delta S + u_i$$

where X_1 and X_2 are two demographic variables, namely, age and number of years spent in educational institutions respectively, Z_1, Z_2 and Z_3 are economic

variables like land holdings of the farmers, price of factor inputs and distance from seeds sale centers, respectively and S is the dummy variable for regions of Orissa. The logit model so framed is estimated from the field survey data under the assumption that the random term u is normally distributed with zero mean and constant variance so as to avoid the problem of heteroscedasticity in estimation. The results of the estimation of the logit model are presented in Table 4.

TABLE 4. ESTIMATION OF THE LOGIT MODEL

Variables (1)	Coefficients (2)	Z-Statistics (3)
Constant	1.312	1.294
Age	-0.034	-1.883**
No. of years in schools/colleges	0.0675	2.821*
Land holding size	0.0217	1.693***
Input prices	-0.0348	-3.126*
Distance from the seeds sale centres	-0.0239	-2.827*
Region	0.1524	1.921*

***, ** and * Significant at 10, 5 and 1 per cent level, respectively.

The probability of adopting and utilising the high quality rice seeds in Orissa is seen to have been inversely related with the age of farmers, input prices and the distance from the seeds sale centres but are directly connected with the number of years of education of the farmers, their land holding size and the regional location of the farmers' households. The central region has the highest potential for the application of high quality paddy seeds in cultivation which is highly sensitive to irrigation as compared with the farmer households having chosen to apply high quality paddy seeds belonging to other two regions of the state.

FACTORS AFFECTING THE ADOPTION OF HYV SEEDS

A good number of studies both in India and outside have been made on the economics of HYV seeds. These studies have discovered the causes of discontinuation of the use of hybrid paddy seeds by the farmers. Of these factors the most significant ones are the non-availability of seeds in adequate quantity and in appropriate time during the planting season which lasts for a few weeks, high cost of seeds, lower market price of paddy (rice) and low consumer preference for such variety. A study conducted in Bangladesh (Hossain *et al.,* 2003a) has outlined the major causes of attraction in the use of high-yielding variety of seeds in paddy cultivation. These include subsidy on seeds and to a limited extent on fertilisers, the provision of knowledge on the yield-potential of such seeds which acted as the motivational force behind the adoption of high-yielding varieties of seeds. In spite of this, there has not been much increase in the use of such seeds by the farmers of Bangladesh. With a view to exploring the causes of such contradiction, the authors

made an attempt to identify them. They identified that the high cost of production due to higher cost of seeds, larger quantity of fertilisers and labour use in the process of production of such hybrid variety paddy accompanied with lower market price of the produce have completely off set the yield gain recorded for hybrid rice. A World Bank study conducted in Vietnam has revealed that the farmers in South Vietnam in particular have not been very much convinced about the economic superiority of the hybrid rice over the existing inbred varieties and therefore, they have not adopted the former variety in cultivation (Hossain *et al.,* 2003b).

The data collected from the cross-section of farmers' households in Orissa for the current study shows that 57 per cent of the farmers in the state of Orissa avail the benefit of the seeds distribution programme. In spite of this, some factors do exist which have inhibited the other farmers from availing of such benefit. These factors include among others, non-availability of seeds in appropriate time and in desired variety, higher price of seeds, unreliable quality of the seeds, transport bottleneck, inadequate extension backups, lack of confidence in the productive efficiency of the new varieties and availability of low-priced local substitutes. Table 5 lists the percentage distribution of farmers by land holding type over these constraining factors.

TABLE 5. FACTORS AFFECTING THE PURCHASE OF SEEDS FROM SEEDS SALE CENTRES

(per cent)

Constraining factors	I Marginal	II Small	III Large	Total
(1)	(2)	(3)	(4)	(4)
Non-availability of seeds	39.8	44.4	66.7	50.3
(a) in time	22.2	27.7	38.9	29.6
(b) by desired variety	17.6	16.7	27.8	20.7
Higher price	22.2	15.7	3.7	13.9
Unreliable quality	7.8	7.4	10.5	8.6
Transportation bottleneck	9.3	8.3	3.8	7.1
Inadequate extension backups	6.7	7.8	5.7	6.7
Lack of confidence in new varieties	4.4	3.3	1.9	3.2
Availability of low priced-local substitutes	4.4	5.6	2.8	4.3
No constraints	5.6	7.4	4.6	5.9
Total	108	108	108	324

Source: Field survey 2002.

It is derived from the percentages so computed that on an average more than 50 per cent of the farmers reported lack of timeliness, unavailability and non-availability of desired varieties of seeds in the departmental seeds sale centres. Factors like unreliable quality, transportation bottlenecks and inadequate extension backup supports combinedly account for 22.4 per cent of the total cases. The marginal and small farmers face problems of higher prices (22.2 and 15.7 per cent respectively) more intensely than the large farmers (3.7 per cent). Bicycles are the only mode of

transportation for the former categories of farmers whereas the large farmers have their own vehicles for transport of seeds from the sale centres to their farm houses or residence. Due to inadequate market intelligence and extension backups, 6.7 per cent of the farmers failed to gather information as to the timing of the arrival and price of their desired varieties. Around 8.6 per cent of the farmers resisted themselves from adopting such hybrid brands on account of their strong doubts in the quality of the seeds supplied through the departmental sale centres. Their doubts in productive efficiency of the seeds are confirmed not because of the fault with the seeds but because of several other conditions completely extraneous to the quality of the seeds. These factors include change in agro-climatic and adaphic conditions and improper agronomic practices which are responsible for the varieties of seeds having failed to prove their superiority over the locally bred varieties. These circumstances infuse in the minds of the farmers all about the low risk-bearing ability of the new varieties and therefore, they refrain themselves from using such varieties in cultivation. In the current work, 4.3 per cent of the farmers studied are seen to have refrained them from using such seeds. The inferences is all based on the responses of the farmer households (Table 6). The view points of the officials in charge of distribution of such seeds and providing the extension services to the farmers may now be presented.

TABLE 6. RESPONSES OF THE OFFICIALS

Factors (1)	Per cent of officials (2)
Non-availability of seeds	58.3
(a) in time	33.3
(b) by desired variety	25.0
Higher price	16.7
Unreliable quality	8.3
Transportation bottlenecks	8.3
Inadequate extension backup	8.3
Total (number)	100

Source: Field survey 2002.

Among the officers in-charge of the sale centres, 58.3 per cent admitted that farmers are not getting their indented seeds in appropriate time. It is basically due to short supply of seeds to their departmental stores. Regarding quality, these officials disclosed that they are not in the possession of any scientific instrument so as to test the moisture content, purity, viability and other distinguishing qualities. These officials test germination percentages by applying crude method only, and in many cases they do not even find time to test the germination percentage which requires at least seven days in case of most of the seeds. In majority of the cases, the farmers take the seed as soon as it reaches the market. The officials in-charge of providing extension services are reluctant to pass on the information to farmers of the locality with the fear that by the time the farmers from distant places (> 10 km) reach the

centres to purchase the seeds the stocks might have been exhausted by sales to the farmers from surrounding villages. This will make things worse and highly unpleasant. The acuteness in short supply of seeds is marked in respect of seeds for cash crops like jute, cotton and groundnut and some varieties of paddy which are grown and harvested in a short duration of time. However, similar situation is not usual for certain promising paddy varieties. Following the years of flood or drought or any natural calamity affecting cultivation, the demand for quality seeds gets doubled or even trebled as reported by these officials. They create an embarrassing situation and displeasure of the farmers if an attempt is made to meet all such unusual demands from the regular and normal quota of the sale centre. On account of so many constraints and problems, it becomes impossible to meet all the demands for seeds of high-yielding varieties of crops in India only through government supplying agencies (Mahabal, 1986). Singh (1979) has shown that farmers in India do not get their required quota of high quality seeds in appropriate time. Further a field survey conducted in Maharashtra concluded the fact that about 31.7 per cent of the farmers in Maharashtra do not get improved variety of seeds in time of their requirements (Desai *et al*., 1997).

V

SUMMARY AND CONCLUSIONS

By way of summing up the findings of the study, we submit that the production of both rice and food grains in Orissa in the last decade (1990-91 – 2001-02) has been subject to wide fluctuations. In the absence of adequate irrigation facilities in Orissa, nature plays a vital role in shaping the productivity of crops. Undeniably, in the system of cultivation in Orissa particularly of paddy cultivation, HYV seeds are continuously replacing traditional varieties but such replacement has tended more towards unirrigated cultivable land than the irrigated ones. This conclusion has been the outcome of the study of secondary data. Primary data analysis produces more interesting results which have been summarized as follows. On an average, 18.5 per cent of the total farmers turn every year to purchase quality seeds from the departmental seeds sale centres. Among those who actually purchase seeds, 21.7 per cent are marginal farmers, 32.8 per cent are small farmers and 45.6 per cent are large farmers and 49.9 per cent are within a distance of 5 km, 32.8 per cent are within a distance of 5-10 km and 17.8 per cent are from places beyond 10 km. It therefore indicates that the benefits from the subsidised seed distribution programme in Orissa go mostly to large farmers who reside within a distance of 5 km or less from the departmental seeds sale centres. Among the constraints, more severe is the non-availability of seeds in appropriate quality and variety. This has affected more than 29.6 per cent of the farmers of the state in spite of their willingness to adopt and utilise such seeds in paddy cultivation. Moreover, 20.7 per cent of the farmers are affected by non-availability of seeds in desired variety. While 13.9 per cent of the

farmers are affected by higher prices of seeds, 8.7 per cent are affected by unreliable quality, 7.1 per cent are affected by transportation bottlenecks and 6.7 per cent are affected by inadequate extension services. The marginal and small farmers are found to be more susceptible to higher prices of seeds in comparison to large farmers. All this points to a common conclusion that the farmers of Orissa are not getting the benefit from the supply of high quality seeds through seeds sale centres managed and run by the government in spite of their high expectations for such a benefit. With a view to overcome the situation and meeting the high expectations of the farming class, the Government of Orissa should make enormous efforts in providing the high quality seeds in appropriate time, in appropriate quantity and quality and at favourable prices along with a package of other requirements of agriculturists for increasing productivity of agriculture like quality of fertilisers and pesticides, extension services and irrigation facilities.

Received May 2004. *Revision accepted January 2006.*

NOTE

1. During the field study, a number of small farmers from different regions of Orissa expressed that farmers do not often take into account the imputed labour cost in their total cost of production of high quality paddy. If this labour cost would be included in the total cost of production of high quality paddy, the input cost would exceed the output earnings.

REFERENCES

Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE) (2005), *Economic Intelligence Service Report on Agriculture*, Mumbai, March.

Chatterjee, B.N. and K.K.Bhattacharya (1986), *"Principles and Practice of Grain Legume Production*, Oxford & IBH Publishing Company, New Delhi.

Das, S.N. (1991), *Orissa University of Agriculture and Technology's Support on Foundation Seeds*, Orissa University of Agriculture and Technology, Bhubaneswar.

Desai, B.R., K.A.Girase and R.P.Patil (1997), "Constraints Faced by Contract Farmers in Adoption of New Technology", *Agriculture Extension Review*, Vol. 9, No.2.

Government of India, *Area and Production of Principal Crops in India 1993-94 to 1995-96*, Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, New Delhi, India.

Government of Orissa (1995-96–2002-03), *Economic Survey*, Planning and Co-ordination Department, Bhubaneswar.

Hossain, M.; A. Janaiah and M. Husain (2003a), "Hybrid Rice in Bangladesh: Farm Level Performance", *Economic and Political Weekly*, Vol.38, No.25, June 21-27.

Hossain, M.; Ut Tran Thi and A.Janaiah (2003b), "Vietnam's Experience with Hybrid Rice", *Economic and Political Weekly*, Vol. 38, No.25, June 21-27.

Mahabal, Ram (1986), *High Yielding Varieties of Crops*, Oxford & IBH Publishing Company, New Delhi.

Panigrahi, B.C. (1991), *Seed Production Programme for Pulses and Oil Seeds*, Souvenir, Orissa State Seed Corporation, Orissa.

Rao, V.M. (1993), "Seed Treatment and Its Importance", *Farmers and Parliament,* Vol. 27, No. 9.

Sengupta, S.K. (1986), "*Indian Seed Industry*", *Seeds and Farms*; N.S.C.Ltd., Vol.12, No.12.

Singh, J.P. (1979), *New Seeds Adoption and Yield*, Sterling Publishers Pvt. Ltd., New Delhi.