EXECUTIVE SUMMARY STUDY NO. 177

Spread of New Varieties of Hybrid Rice and their Impact on the Overall Production and Productivity

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Preface

The present executive summary of the consolidated report on "Spread of New Varieties of Hybrid Rice and their Impact on the Overall Production and Productivity" has been assigned by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India to five AERCs as a common study. However, the coordination of the study and drafting of consolidated report has been done by this Centre.

Encouraged by the success of hybrid rice technology in enhancing the rice production and productivity in China, the Indian Council of Agricultural Research (ICAR) initiated a national program for development and large scale adoption of hybrid rice in the country in December 1989. The project was implemented through a National Network comprising research, seed production and extension networks. The hybrid rice research network consisted of 11 research centres and many voluntary centres spread across the country. The seed production network consisted of public sector seed production agencies such as National Seed Corporation, State Farms Corporation of India and the State Seed Development Corporations in addition to many private sector seed companies. The extension network consisted of state departments of Agriculture, extension wings of the SAUs, Krishi Vignan Kendras (Farm science centres) and the NGOs. Effective linkages were established within the different sub-components of the network. The entire project was co-ordinated and implemented by the Directorate of Rice Research (DRR), Hyderabad. The project initiated by the ICAR, was strengthened by the technical support from IRRI Philippines, FAO, the financial support from the UNDP, Mahyco Research Foundation (MRF), World Bank funded National Agricultural Technology Project (NATP) and IRRI/ADB Project on Hybrid Rice.

The present consolidated report has been drafted by Prof. Pranab Kanti Basu, Department of Economics & Politics, Visva-Bharati University, while Dr. Debajit Roy, AERC, Santiniketan assisted him in aggregation of data, preparation of tables & graphs and digitization of the report.

On behalf of the Centre, I extend my heartfelt thanks to the Ministry of Agriculture, Government of India, and all the participating centres, viz. AERC Allahabad, AERC Jabalpur, AERC Vizag & AERC Bhagalpur for their sincere cooperation and help.

Sd/-
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Executive Summary

I. Background of the study

India has a large agrarian economy with majority of its rural population subsisting on farming. Over the decades since independence, Government of India has made concerted efforts to improve the lot of the farmers. By the mid sixties it was realized that for India to achieve self-sufficiency in food-grains, there was no alternative to technological change in agriculture. The spread of HYV technology resulting in the green revolution in India in the last decades and achievement of self-sufficiency in food-grains represent a success story for the Science and Technology sector. The most widely debated issue about the green revolution was the growing disparities in income between the different regions and the different classes of farmers. This was observed in the early phase of the green revolution i.e. until about the mid seventies. These trends however got reversed after the mid seventies which are typical of a diffusion process characterized by the spread of green revolution to new areas, and the increasing adoption of new technology by the small farmers. The achievements so far in respect of raising yields and reducing variability in the unfavourable agro-climatic regions are not comparable with those realized for the favourable environments. The limited spread of the green revolution can be explained partly by the nature of available technology itself and partly by the uneven development of infrastructure, physical as well as institutional which is pre-requisite for the adoption of improved practices. It was also observed that the rise in yield as a result of green revolution had reached a plateau. Further there was apprehension that it might take a downturn because of inherent drawbacks in the bio-technological character of the revolution. For example it was causing a much faster rate of depletion of ground water resources.

Against such a background it is necessary to examine the needed changes in agricultural research strategy. Minimising regional imbalances in growth, imparting stability to agricultural output and bringing the benefits of agricultural research technology to the resource poor farmers are the three major concerns that motivate research. The research scientists considered hybrid rice technology as a readily available option to shift the yield frontier upward in the face of declining trend of the yield potential of the existing varieties. It was projected that hybrid rice technology would bring about another rice revolution in the

country. However, although a number of varieties of hybrid rice are released by the Government, the extent of adoption of hybrid rice varieties in the country is too meagre to make an impact on rice production. Against this backdrop, the present study is conceptualised and undertaken at the instance of the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India with a view to assessing the actual spread of hybrid rice varieties replacing the conventional HYVs to make an overall impact of rice production.

Encouraged by the success of hybrid rice technology in enhancing the rice production and productivity in China, the Indian Council of Agricultural Research (ICAR) initiated a national program for development and large scale adoption of hybrid rice in the country in December 1989. The project was implemented through a National Network comprising research, seed production and extension networks. The hybrid rice research network consisted of 11 research centres and many voluntary centres spread across the country. The seed production network consisted of public sector seed production agencies such as National Seed Corporation, State Farms Corporation of India and the State Seed Development Corporations in addition to many private sector seed companies. The extension network consisted of state departments of Agriculture, extension wings of the SAUs, Krishi Vignan Kendras (Farm science centres) and the NGOs. Effective linkages were established within the different sub-components of the network. The entire project was co-ordinated and implemented by the Directorate of Rice Research (DRR), Hyderabad. The project initiated by the ICAR, was strengthened by the technical support from IRRI Philippines, FAO, the financial support from the UNDP, Mahyco Research Foundation (MRF), World Bank funded National Agricultural Technology Project (NATP) and IRRI/ADB Project on Hybrid Rice.

Hybrid rice technology is likely to play a key role in increasing the rice production. During the year 2008, hybrid rice was planted in an area of 1.4 m.ha. and an additional rice production of 1.5 to 2.5 m.t. was added to our food basket through this technology. More than 80 per cent of the total hybrid rice area is in eastern Indian states like Uttar Pradesh, Jharkhand, Bihar, Chhattisgarh, with some little area in states like Madhya Pradesh, Assam, Punjab and Haryana. As rice is a key source of livelihood in eastern India, a considerable increase in yield through this technology will have a major impact on household food and nutritional security, income generation, besides an economic impact in the region. In view of this, hybrid rice has been identified as one of the components under the National Food Security Mission (NFSM) launched by the Government of India (GOI) with the aim to enhance rice production by 10 million tonnes by 2011-12. Under the scheme it has been

targeted to cover 3 million ha area under hybrid rice by the year 2011-12. The approach is to bridge the yield gap in respect of rice through dissemination of improved technology and farm management practices. Similarly, added emphasis is being given for adoption of hybrid rice under the special scheme (BGREI) of GOI to bring green revolution to eastern India.

As a result of concerted efforts for over two decades, a total of 46 hybrids have been released for commercial cultivation in the country. Among these, 29 have been released from the public sector while remaining 17 have been developed and released by the private sector. Though 46 hybrids have been released in the country so far, some of them have been outdated, and some are not in the production chain. Such hybrids related to production chain and available for commercial cultivation are listed in Table-1.1.

The farmers of the country are growing mostly the varieties bred by the research system such as ICAR, State Agricultural Universities (SAUs) and other Research Institutions connected to agriculture. The varieties are normally bred taking into consideration, various characters like yield potential, resistance to biotic and abiotic stress of the existing popular variety/varieties. The new varieties are bred by the Research Institutions and screened for their performance at different locations through initial evolution trial and advance varietal trial. A Technical Committee finally considers these varieties and release only those varieties which are found superior over the existing best varieties. While releasing these varieties the Technical Committee also specifies the ecology i.e. the State area within State, season in which the varieties are to be grown. The newly released varieties normally have edge over the existing varieties in yield, resistant to serious pest and diseases, resistant to the abiotic stresses i.e water related problems like drought etc. Although a number of varieties are being released by the Government to meet the demand of the farmers, the spread of these newer varieties in place of the conventional varieties that are grown by the farmers for a longer period has not been assessed properly. There is no comprehensive evaluation study to document farm-level insights into hybrid rice performance except very few studies citing the instance of yield superiority of hybrid rice but less profitable than the inbred varieties i.e conventional Hyvs (Janaiah, 2003, Chengappa et.al 2003).

II. Need for the Study

The spread of the newer varieties replacing the older varieties need to be closely monitored to take advantage of the superior characters of these newer varieties released by various Research Institutions. This will help to break the yield plateau in rice production of the recent past. Though the Government is taking a number of steps to popularize these varieties like Frontline Demonstration, minikit supply, organising training programmes (1-21days) for farmers, farm women, seed growers, seed production personnel of public and private seed agencies, extension functionaries of state departments of agriculture, officials of state agricultural universities and NGOs, there is no concrete evidence that the newer varieties of rice are spreading faster and replacing the older ones. Therefore, it is essential to conduct a study to assess the actual spreading of these newer varieties in terms of area. This will help the Government of India to draw a plan for augmenting the spread of the superior newer varieties.

III: Objectives of the Study

The specific objectives of the study are

1. To indicate the extent of adoption and the level of participation by the different categories of farmers in the cultivation of hybrid rice.
2. To assess the overall impact of hybrid rice cultivation on rice production and productivity.
3. To study the economics of cultivation of hybrid rice varieties vis-a-vis inbred varieties.
4. To identify factors determining the adoption of hybrid rice varieties.
5. To determine constraints and outline the prospects for increasing hybrid rice cultivation.
6. To suggest policy measures for expansion of hybrid rice cultivation.

IV: Data Base, Sampling Design, Methodology and Coverage of the Study

The study is based on both secondary and primary data. Secondary data was obtained from different state government publications relating to area, production and productivity of rice.

- West Bengal: Statistical Abstract, Government of West Bengal and Economic Review, Government of West Bengal.
- Uttar Pradesh: Farms and seeds sections of the Directorate of Agriculture of the state of Uttar Pradesh, Lucknow farms and seeds sections of the Directorate of Agriculture of the state of Uttar Pradesh, Lucknow.
- Bihar: 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.
- Madhya Pradesh: various issues of Madhya Pradesh agriculture statistics, Land Record Office of Gwalior Madhya Pradesh and web sites like www.agricoop.nic.in, www.mpkrishi.org, www.dacnet.nic.in.
- Andhra Pradesh: Directorate of Economics and Statistics Publications was used.

Keeping in mind that the first hybrids was developed and released for commercial cultivation in India in 1994, the study period was divided into three sub-periods viz. 1984-85 to 1993-94, 1994-95 to 2003-04 and 2004-05 to 2009-10. The period-I viz. 1984-85 to 1993-94 refers to the pre-introduction period of hybrid rice while other two period's viz. period-II & III correspond to post-introduction periods.

Primary survey was confined to the National Food Security Mission (NFSM) districts in the states. The two districts having relatively higher concentration of hybrid seeds cultivation within the group of NFSM districts were chosen for the study. In each of the district, two representative blocks were taken and within each block two villages are selected. In each village, a complete list of cultivating households growing hybrid rice varieties and inbred varieties were prepared and stratified according to four standard land size groups such as marginal (less than 1 hectare), small (1 to 2 hectares), medium (2 to 4 hectares) and large (more than 4 hectares) farmers. In each district, 40 hybrid rice growers from the list of hybrid rice growing cultivators were drawn at random from different land size groups on the basis of their proportion in the universe. In addition to this sample, 10 inbred variety (traditional HYVs) rice growers but non-adopters of hybrid rice were selected randomly from the different land size groups amongst inbred rice growing cultivators following the same procedure. Thus altogether, 50 rice growing cultivators were chosen from each selected district. In all, 100 rice growing cultivators in each state equally spread over two selected districts constituted the size of the sample in the study. Primary survey was conducted over 2009-10 and 2010-11. Some state surveys covered different seasons over these years.

However, this consolidated report does not present the seasonal patterns in the body because of non-comparability over states.

V: Analytical Approach

Farm level data is analyzed using a simple tabular analysis to study spread and impact of hybrid rice technology. Compound growth rates of area, production and productivity of the crops have been calculated from secondary data. In measuring the instability in crop production, the co-efficient of variation technique is used.

VI: Organization of the Report

The Report is divided into eight chapters. Chapter-I is the introductory chapter which spells out the background, objectives, data base and methodology of the study. Chapter-II describes the status of rice in the states studied. Chapter-III analyzes the status of adoption of hybrid rice at the farm level. Chapter-IV examines the impact of hybrid rice cultivation on overall production of rice. Chapter-V studies the comparative economics of hybrid and inbred rice cultivation. Chapter-VI analyzes grain quality characteristics of hybrid rice vis-à-vis inbred rice. Chapter-VII discusses the problems faced by hybrid rice growers and examines the prospect for increasing hybrid rice cultivation. Chapter-VIII provides concluding remarks and policy suggestions emerging from the study.

VII: Major Findings and Recommendations

- Yield and productivity under paddy in all states together increased in all the periods. Area fluctuated and there was no upward trend. In fact the area under paddy at the end of the entire study period was lower than at the beginning. This indicates that the scope of increasing output through extension of area has been exhausted and it is imperative to concentrate on yield improvement, through Hybrid seeds, etc. It is also noticeable that yield and productivity performed substantially better during the pre-hybrid period (1984-85 to 1993-94). This probably

indicates the fact that HYV performance tapered off since the 90s. Hybrid cultivation did not spread sufficiently so as to compensate.

- It can also be observed that the increase in production can be attributed more to gain in productivity than to increase in area under crop, which in fact declined, as we have already indicated. Both yield and production showed similar and substantial gains.
- For both years surveyed the receptivity by size class to hybrid cultivation takes the form of a U, with the size class 2 to 4 ha being the least receptive***. This suggests that there is a conflict between equity and efficiency in the case of hybrid cultivation.***
- In striking contrast the receptivity to HYV takes the form of an inverted U, with the same size class being most receptive.
- Further apart from the largest farms, area under hybrid cultivation has increased between 2009-10 and 2010-2011. Correspondingly, there has been a decline in area under HYV. Though the time span is too short, the result is intuitively expected. With time information about and confidence in hybrid cultivation is likely to increase.
- A significantly higher proportion of head of households adopting hybrid farming belong to the *younger generation*.
- The ability to read literature on hybrid cultivation is *sufficient* for adoption of new technology and that higher formal education is unnecessary.
- A significantly larger proportion of SC, ST farmers compared to general caste cultivators go in for hybrid cultivation.
- The state plays predominant role in dissemination of information of new agricultural technology mainly through extension workers and, next through training programmes. ***So the spread of this technology cannot be entirely entrusted to the private sector.***
- ***Training programmes have to be toned up***, as the extension workers are more effective in persuading farmers to adopt appropriate input mix, while participation in training programmes yields much poorer results. Participation in demonstration programmes is even less effective for disseminating knowledge about proper input mix.

- There is also great regional variation in effectiveness of government servants and programmes in disseminating information. ***This suggests that some monitoring devise has to be positioned.***
- Hybrid technology is substantially more productive compared to HYV across farm sizes. It is noticeably more productive in the largest farm size. ***This suggests that the spread of the technology may have regressive impact on distribution.***
- Hybrid cultivation is more labour intensive than HYV cultivation. Hybrid rice cultivation also involves greater use of female labour. ***Hybrid rice cultivation is thus likely to generate additional employment opportunities for workers in general and specially for female labour rural areas.***
- Area wise the cost of hybrid cultivation was significantly higher. But the higher productivity compensated. Thus the cost per quintal was lower for hybrid. ***This suggests that to popularise hybrid cultivation credit needs have to be addressed.***
- The average rate of return on working capital was higher for hybrid cultivation, though in some states the opposite obtained.
- Grain quality of hybrid rice, in terms of hulling and milling ratios is inferior to HYV rice. ***This suggests that research must concentrate on improving this aspect of hybrid rice.***
- A greater percentage of hybrid output is marketed compared to HYV. ***This suggests that hybrid cultivation is suitable to the expansion of grain markets.***
- The price of hybrid rice is lower than that of HYV rice, on an average.
- Though government is the main source of hybrid seeds, there is great regional variation in the proportion of seeds supplied by government sources. ***There is, therefore, scope for improving government intervention in this area.*** Also seeds are not often supplied in time. ***This needs to be looked into.***
- There is a perception of poor quality of seeds supplied. The reasons for this are not clear. This needs investigation.

- Hybrid cultivators are often using inputs in incorrect proportion. Though lack of financial ability has been indicated as a reason, lack of knowledge has also played a significant role. ***Thus the government needs to improve the quality of knowledge dissemination and also provide sufficient credit. The need for proper credit provision is more pronounced because hybrid cultivation is costlier.***
- The quality of hybrid rice, in the perception of the consumer, is poorer than HYV rice. This makes marketing difficult. ***This suggests that research should concentrate on improving quality like decreasing stickiness of cooked hybrid rice. The rate of degeneration or 'keeping quality' also needs to be improved.***