"Strengthening partnerships in Agricultural Research for Development in the context of Globalization"

A. SUMMARY

1. Title: Development and use of Hybrid Rice Technology in India

2. Duration: 1989-99

3. Objectives:
   - Development of high yielding hybrids with an yield advantage of 15-20% over the conventional varieties.
   - Optimization of seed production package
   - Standardization of agronomic package for cultivation of hybrids
   - Strengthening the human resource development
   - Large scale adoption of hybrid rice in the country

4. Activities:
   - Development and evaluation of hybrids in multi location trials
   - Screening of hybrids and parents for quality and resistance to major pests and diseases
   - Conducting multi location trials on important aspects to optimize the hybrid seed production package
   - Identification, development and improvement of parental lines
   - Exploring the possibility of deploying innovative methods such as two line breeding and indica/japonica hybrids to enhance the level of heterosis
   - Conducting agronomic trials on various aspects to standardize the cultivation package for hybrids
   - Organizing training programmes (In-country and outside India) to strengthen the human resource
   - Organizing large number of frontline demonstrations in farmers fields to create awareness and to popularize the technology

5. Area: GRM

6. Region: Asia-Pacific
B. STAKEHOLDERS

1. Beneficiaries

Hybrid rice has the potential to benefit a wide range of stakeholders. Considering the prospects of covering a large area under hybrid rice in the country, the farmers, rice consumers, seed growers, farm labour and the seed companies would get benefited from this technology. With the additional yield advantage of 1.0 t/ha by growing hybrids, the hybrid rice farmers will gain an extra income of Rs. 3000-3500/ha (US $ 80/ha). The rice consumers will have better accessibility to rice with increased level of productivity. More than 3000 tons of hybrid seed was produced in the country and this has benefited the seed growers with a net profit of Rs. 20,000-25,000/ha (US $ 500/ha). With increase in seed production area, the benefits will be enormous. Seed production activity has created additional employment opportunities (250 man days/ha) for the rural poor and the farm women and their wage earning capacity has also been enhanced considerably. The seed companies are benefited by hybrid seed production where the profit margins are lucrative. With wider adoption of this technology, the country can add a ton of extra rice to its food basket with increase in every hectare under hybrid rice.

2. Research Partners

India is a vast country with very diverse eco-geographical situations in which rice is grown and hence research in partnership mode is more meaningful than the isolated efforts. Major research partners involved in the project are as follows.

**National**

<table>
<thead>
<tr>
<th>National Organization</th>
<th>Coordinating Institute</th>
<th>Cooperating centres</th>
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<tbody>
<tr>
<td>1. Indian Council of Agricultural Research (ICAR), New Delhi</td>
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<tr>
<td>2. Directorate of Rice Research (DRR), Hyderabad</td>
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<tr>
<td>3. Research Institutes under ICAR (Indian Agricultural Research Institute (ARI), New Delhi; Central Rice Research Institute (CRRI), Cuttack</td>
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<tr>
<td>4. Research Stations under State Agricultural Universities - Mandya (UAS), Coimbatore (TNAU), Maruteru (ANGRAU), Faizabad (NDUAT), Pantnagar (GBPUAT), Karnal (CCS, HAU), Karjat (KKV), Kapurthala (PAU).</td>
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<td>5. State Department of Agriculture (RRS, Chinsurah, West Bengal)</td>
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<td>6. Private seed companies with independent R &amp; D wings</td>
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<td>7. Krishi Vigyan Kendras (KVK) and NGO's</td>
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**International**

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<thead>
<tr>
<th>Collaborating organizations</th>
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<tbody>
<tr>
<td>1. International Rice Research Institute, Philippines.</td>
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<tr>
<td>2. China National Hybrid Rice Research and Development Centre, Changsha, China</td>
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<tr>
<td>3. University of Kyoto, Japan</td>
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<tr>
<td>4. Member countries of IRRI/ADB project (Bangladesh, Philippines, Indonesia, Sri Lanka and Vietnam).</td>
</tr>
</tbody>
</table>
3. Donors

The project was financially supported by national and international organizations including a private research foundation and the details are furnished below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Organization</th>
<th>Period</th>
<th>Budget (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Indian Council of Agricultural Research (ICAR)</td>
<td>1989-2003</td>
<td>13,60,000</td>
</tr>
<tr>
<td>2.</td>
<td>United Nations Development Programme (UNDP) and Food and Agricultural Organization (FAO)</td>
<td>1991-1996, 1999-2001</td>
<td>55,60,000</td>
</tr>
<tr>
<td>3.</td>
<td>Mahyco Research Foundation (MRF)</td>
<td>1997-2000</td>
<td>7,50,000</td>
</tr>
<tr>
<td>4.</td>
<td>IRRI-ADB Project</td>
<td>1999-2000</td>
<td>43,520</td>
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</tbody>
</table>

All the scientific personnel working in the project have been provided in kind by respective research organizations.

C. PROJECT RESULTS AND IMPACT

1. Main Results

The project on "Development and use of Hybrid Rice in India" was launched by the Indian Council of Agricultural Research (ICAR), New Delhi during 1989 when there were no hybrids available in the country and the research efforts were isolated and mostly academic. Concerted efforts made through a well organized national network coupled with good support from the active partners have helped the country to enter into an "Era of hybrid rice" next only to China. As a result of systematic evaluation of more than 1000 experimental hybrids in multi-locational trials, twelve hybrids developed by the public sector have been released for commercial cultivation (Annexure-A). Another significant aspect of this project was the involvement of the private sector in the hybrid rice research and seed production activities from the beginning itself. The private sector having a strong seed production base and its own Research and Development wings has made significant contributions over the years. One hybrid viz., PHB 71 bred by Pioneers Overseas Corporation has been released by the Central Variety Release Committee and another 6-8 hybrids are being marketed by the private sector seed companies. The project has made available wide range of hybrids to the farming community from which they can choose the most suitable ones for their specific situations. These hybrids with an yield advantage of about 1 t/ha over the inbred varieties can help the farmers to earn extra income and substantially improve their living standards. Besides the released hybrids, half a dozen new hybrids with better yield advantage are in the pipeline.

Development and release of hybrids for commercial cultivation has been one of the foremost significant contributions of the project.

Efficient and economic hybrid seed production is the most important pre-requisite for the success of hybrid rice technology. Keeping this point in view, greater emphasis was given to optimize the seed production technology. Based on extensive multilocation trials conducted over the years on important aspects, a seed production package has been optimized (Annexure-B). Seed growers can obtain seed yields of 1.5 to 2.0 t/ha by adopting this package. Hybrid seed production activity, which involves the seed growers, seed companies, farm workers and farm women has tremendous potential to transform the lives of those who are involved in it. Hybrid rice seed growers can earn a net profit of Rs. 20,000-25,000/ha. Since hybrid rice seed production is more profitable and labour oriented, the farm labour including farm women not only get additional employment but higher wages too. The seed villages will become more progressive bringing the prosperity to the farmers and the rural folk.
A package for cultivation of hybrids was the long felt need of this innovative technology. Extensive trials were conducted on various agronomic aspects and a package has been developed for cultivation of hybrids (Annexure-C). The main feature of this package is the use of lower seed rate of 15-20 kg/ha as against 50-60 kg/ha for inbred varieties which is achieved by lower seeding density (20 g/m²) in the nursery and planting of single seedling/hill in the main field. This package has become popular among the farmers and they are able to adopt the changes especially the lower seed rate to their advantage. Adoption of lower seed rate in hybrid rice cultivation could increase the profit margin to the farmers and it is the key component of this package which has been developed after detailed experimentation.

2. Dissemination of the results

An innovative technology such as hybrid rice need to be disseminated expeditiously to reach the end users. Towards this end, efforts were made to train large number of farmers and farm women on hybrid rice cultivation. Similarly, seed production personnel, progressive farmers and seed growers were imparted training on hybrid seed production. During the project period, more than 7000 persons were trained in 130 training programmes (Annexure-D). Many trained people are helping as resource persons for the new training programmes conducted at different centres.

Involvement of farmers in the selection of hybrids prior to their release has catalytic role in the spread of this technology. This aspect was made an integral part of this project. Accordingly 20 hybrids found promising in the national trials were evaluated in 800 on-farm trials in seven states. Ten hybrids among them have been released for commercial cultivation. This exercise provided an opportunity to get feed back from the end users themselves about the performance of hybrids.

Creating awareness about the benefits of hybrid rice technology among the farmers is one of the basic steps in popularizing hybrid rice. More than 300 frontline demonstrations of one hectare each were laid out with released hybrids in farmers fields. Field days were organized in which thousands of farmers visited the demonstrations and evinced keen interest in hybrid rice. The best hybrid rice farmers are being given awards as incentives. These efforts have tremendous positive effects and these are able to convince the farmers and the policy makers about the benefits of hybrid rice technology.

Publications in local languages on hybrid rice cultivation and hybrid seed production have been brought out by the network centres. Periodical reports published by the coordinating and other network centres also immensely help in disseminating the knowledge on hybrid rice technology. Mass media methods such as radio talks, video films, news paper articles were also deployed to disseminate the results. All these efforts have helped to create awareness about the technology and there is greater response from the farming community to adopt this technology.

3. Impact of the project

The project has made available number of high yielding rice hybrids to the Indian farmers which were non existent prior to the launching of this project. More than 1,25,000 ha area has been covered with rice hybrids and efforts are underway to bring in more area under hybrid rice in next couple of years. Hybrid rice farmers can obtain additional yield of 1.0 to 1.5 t/ha thus enhancing their farm income.

Involvement and strengthening of private seed industry through this project has played a catalytic role to popularize hybrid rice in the country. More than 3000 tons of hybrid seed was produced in the country benefiting thousands of seed growers, farm labourers and the farm women. There is tremendous scope for the seed industry to go in a big way with hybrid seed production, thus helping the stakeholders.
Human resource development achieved through this project has been the key factor for the success of this technology. Hybrid rice technology, being new, the intricacies were to be learnt by the people involved in the project. More than 50 scientists trained abroad on various aspects of hybrid rice are the source of knowledge as they are helping as resource persons for various national and international training programme. Trained manpower has become an asset to the country.

D. PARTNERSHIP

1. Respective roles of different stakeholders and coordination mechanism

This project on hybrid rice has been one of the best examples of effective collaboration between various partners at national and international levels. All the partners and stakeholders are involved at various levels of project planning, implementation and impact assessment studies. Brief description on the roles of different partners in decision making at various levels is given below

a) Project design

Once the decision to launch a project on hybrid rice was taken, a series of meetings were held by involving all the stakeholders. The project was initiated by the Indian Council of Agricultural Research during 1989 and all the modalities were worked out in consultation with Vice Chancellors of respective cooperating centres and Directors of research institutes. One Principal Investigator was identified for each centre and they were actively involved in formulating the technical programme. During 1991, the United Nations Development Programme and Food and Agricultural Organization came forward to support the project. Specific areas of support, mechanism of support and details for implementation of the project were worked out in consultation with the officials of ICAR, Ministry of Agriculture, UNDP and FAO. UNDP/FAO supported the programme by providing consultancy services, training fellowships abroad, study tours to managers and essential equipments to strengthen the working facilities at network centres. Identification of consultants, selection of candidates for training etc. were done in consultation with the concerned stakeholders.

Mahyco Research Foundation, a non profit private organization also came forward to support the hybrid rice programme during 1997. This is the activities for this project were designed by a high level steering committee supported by a well represented Technical Committee. Similarly, few specific activities are also supported by the IRRI/ADB Project under the guidance of a steering and Technical Committees comprised of members from 6 member countries.
b. Project implementation

The project is being implemented by the Indian Council of Agricultural through the Directorate of Rice Research, Hyderabad. All the policy decisions are taken by the ICAR through various committees constituted for the purpose, by involving respective stakeholders. The technical programmes for each year are discussed and finalized in an Annual Group Meeting before the cropping season in which all the partners take part. The hybrids nominated by different centres and those received from IRRI are pooled and different trials are constituted and sent to all the centres including the private companies which nominate hybrids for evaluation. International Rice Research Institute (IRRI), Philippines has been helping the project through the supply of germplasm, providing consultancy and imparting training to Indian scientists. Similarly, China National Hybrid Rice Research and Development Centre, Changsha, China, has deputed experts including Prof. Yuan Long Ping, Father of Hybrid Rice, as consultants to this project. Indian scientists were trained in China on various aspects of hybrid rice. Consultancy services and training fellowships were financed by UNDP and these were facilitated through FAO. Public and private seed companies have helped in the implementation of the project by taking up large scale seed production and refining the technology to suit the local conditions. Large number of farmers, labourers including farm women have contributed their best in hybrid rice cultivation and seed production to popularize this technology. Krishi Vigyan Kendras (KVK) and Non-Government Organizations have evaluated hybrids, trained the farmers and farm women and also produced hybrid seed.

c. Project Management

The project is managed by the various committees constituted specifically to plan, implement and review the project. Some of the major committees are

i) Steering committee

This committee is headed by the Secretary, DARE and Director General, ICAR. The Vice Chancellors of State Agricultural Universities, Directors of Selected ICAR Institutes, Managing Directors of Public and Private Seed Companies, Agricultural Commissioner, Govt. of India, Directors of Agriculture of Target States, Representative of UNDP, FAO and nominated members from NGO's and other donor agencies are the members of this high level committee. This committee meets once or twice in a year and takes policy decisions to run the project.

ii) Technical committee

This committee is chaired by the Deputy Director General (Crop Science), ICAR and all the cooperators of network centres, representatives of Public and Private Sector Seed agencies are its members. This committee meets once in a year before the cropping season and formulates the technical programme and work plan for the year.

iii) Coordinating agency

The project is coordinated by the Directorate of Rice Research (DRR), Hyderabad. It is the responsibility of DRR to implement the project effectively, as per the guidelines formulated by steering and technical committees. The Directorate constitutes the trials, send the material to cooperators, plans monitoring tours, compile, analyze data and prepare annual reports.

Annual group meetings are held every year to review the progress and to formulate the annual work plan. All the partners take part in this meeting and exchange their views to streamline the project.
d) Results dissemination

Different stakeholders are involved in the process of disseminating the results to the end users. The details are furnished below:

<table>
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<tr>
<th>Stakeholder</th>
<th>Function</th>
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<tbody>
<tr>
<td>1. ICAR</td>
<td>Planning and financing various transfer of technology activities</td>
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<tr>
<td>2. UNDP/FAO/MRF</td>
<td>Financing and reviewing the progress</td>
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<tr>
<td>3. Coordinating Unit (DRR)</td>
<td>Programme formulation for conducting training programmes, demonstrations, etc.</td>
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<tr>
<td>4. Network Research Centres</td>
<td>• Conducting training programmes</td>
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<td></td>
<td>• Organizing demonstrations</td>
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<td>• Organizing study tours for farmers</td>
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<td>• Organizing field days</td>
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<td>• Publishing extension bulletins</td>
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<tr>
<td>5. Department of Agriculture's and KVKs/NGOs</td>
<td>• Conducting training programmes for farmers, farm women and extension workers</td>
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<tr>
<td></td>
<td>• Conducting demonstrations</td>
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<td>• Publishing extension bulletins in local languages</td>
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2. Added value of partnership

Meaningful and effective partnerships at national and international levels, which have been the mainstay of this project were not only instrumental in bringing about a spectacular success but also in improving the output qualitatively. Significant aspects of value addition due to these partnerships are outlined below.

- Consultancies by experts of international repute, provided through UNDP and FAO were really useful to have a sound base for the project.

- Free exchange of germplasm between the partners and evaluation of hybrids in large number of multilocation trials has been the most positive and significant feature of this project. This facilitated the partners to freely use the diverse genetic material to develop hybrids.

- Human resource developed through in-country and overseas training programmes has helped to strengthen the capability of local manpower. In fact, this trained manpower has become an invaluable asset to the country.

- Taking the private seed sector as an equal partner and providing the parental lines and training was a motivating factor and this step has enabled the private sector to come up in a big way for hybrid seed production.

- Collaboration with international institutes such as IRRI, CNHRROC, Kyoto University has helped in a big way as the Indian scientists could visit these countries and learn many new things about hybrid rice.

- Involvement of KVK’s, NGO’s and the farmers and farm women at various levels of project implementation had tremendous feeling of togetherness and this could be one of the reasons for the good progress made in this project.
E. CONCLUSIONS

a) Lessons learned

♣ Conviction, commitment and support from respective governments and policy makers is a must to capitalize on innovative technology such as hybrid rice.

♣ A goal oriented project with clear cut objectives which is implemented in a mission mode approach will be far more successful than half hearted academic exercises.

♣ The project has to function in a partnership mode by involving the concerned stakeholders in order to reap the real benefits from the project of this kind in which collaboration and cooperation from between national and international agencies should become a focal point.

♣ For the success of any new technology like hybrid rice, consultancies through experts and providing training in advanced laboratories or centres of repute will have profound positive impact on the outcome of the project.

♣ Involvement and participating of public and private sector seed agencies in the project activities effectively complimented the efforts, especially in large scale hybrid seed production.

♣ Adequate planning, meticulous implementation, effective management, regular review and monitoring are the corner stones for the success of this project.

A network approach with well defined role for each of the cooperating centre is more ideal than isolated and scattered efforts. Development of an effective research network involving the research centres, public and private agencies, government and non-government organizations, seed production agencies, international organizations etc. and establishing effective linkages among the partners and clearly defining their role and responsibilities is the major requirement.

b) Future thrust

The benefits of hybrid rice technology have been clearly demonstrated in the country and the first generation hybrids are now available for cultivation. For large scale adoption of hybrid rice, efforts are to be focussed on some of the following aspects.

♥ Development of high yielding hybrids with better grain quality and resistance to major pests and diseases.

♥ Development of hybrids suitable for shallow low lands, *boro* season and high quality basmati hybrids.

♥ Creating awareness among the farmers by organizing training programmes, frontline demonstrations and study tours.

♥ Enhancing the levels of heterosis by two-line breeding and inter sub-specific hybridization.

♥ Refinement of hybrid seed production technology to raise the seed yields and to reduce the seed cost.

♥ Development of hybrid and region specific agronomic package for cultivation of hybrids.
c. **Sustainability**

Many critical reviews by both national and international teams have supported the fact that the technology is sustainable under Indian conditions, in view of its higher labour: land ratio, proven yield advantage of the hybrids, presence of well organized public and private seed sectors, well trained manpower and enthusiastic farming community. Availability of second generation hybrids with still higher level of heterosis and massive transfer of technology efforts would help in large scale adoption of hybrid rice in the country.

d. **Partnership continuation**

The project which was implemented meticulously with close collaboration between the partners was applauded as one of the best programmes in recent years. Following this success and to realize the benefits of the first phase, the project is being continued with still increased support from its stakeholders. ICAR has approved to continue the project for another 5 years under the National Agricultural Technology Project. Similarly, the UNDP also has approved the second phase for a period of three years w.e.f. 1999. IRRI/ADB project will also support the efforts to popular hybrid rice in India through its second phase which is under finalization. The success of the project so far, keen interest of donor agencies to support the programme and continued active involvement of all the stakeholders are a pointer to the usefulness of this project and all these will prove a point that the spectacular success achieved in this project is a result of whole hearted and relentless efforts of the partners involved in the project and the credit for this achievement should go to each of the partners.