Participatory Crop Improvement in Eastern India: A Preliminary Impact Assessment

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ABSTRACT

DFID-PSP has funded Participatory Plant Breeding (PPB) in rice in eastern India. The project was jointly undertaken by the Gramin Vikas Trust Eastern India Rainfed Farming Project (GVT(E)), Birsa Agricultural University (BAU), Ranchi and the Centre for Arid Zone Studies (CAZS) University of Wales, Bangor, UK.

As the result of PPB, two varieties of rice (Ashoka 200F and Ashoka 228) were officially recommended for upland rainfed farming systems in Jharkhand, and a preliminary impact assessment was undertaken in 2002 to determine their impact on the livelihoods of farmers in eastern India.

The new rice varieties performed extremely well during the extreme drought of 2002. In the worst drought hit area of Kalahandi district of Orissa the Deputy Director of Agriculture reported the outstanding performance of Ashoka 228 (Ashoka 200F was not tested) when the local varieties had failed. As a result, seed multiplication is being undertaken by a range of non-governmental and governmental organisations to meet anticipated demand for the seed.

Farmer preference for the new varieties was high; about 97% of farmers indicated that they would grow the new varieties next year. Most farmers perceived the new varieties to be earlier, higher yielding, more resistant to drought and lodging and easier to market with higher prices than the local cultivars.

The new varieties significantly improved household income, with a large proportion reporting that the effect on income was large. A preliminary financial analysis, using very conservative assumptions for the adoption rates of the new rice varieties indicate that the cumulative benefits from this project by 2010 will be greater than the total expenditure on the Plant Sciences Research Programme 1995-2005.

INTRODUCTION

Poor farmers in marginal areas have benefited little from high yielding, 'green revolution' varieties that have transformed the productivity of more favourable areas. Hence in Jharkhand, eastern India, farmers who cultivate upland rice on low-fertility, sloping soils continue to grow low-yielding landraces that are susceptibility to diseases and pests. Participatory plant breeding (PPB) in such areas offers a rapid, cost effective strategy for developing farmer-preferred, superior varieties. New varieties can give these farmers higher and more stable yields without the need for more labour or purchased inputs.

In May 2001, the Birsa Agricultural University (BAU) in Jharkhand, eastern India, released the first-ever early maturing, high yielding, superfine rice varieties for rainfed uplands. A maize variety was also released at this time. All three of these varieties were the products of a highly successful PPB programme. They were bred during a collaborative project, which has been operating since 1997, between the Gramin Vikas Trust East (GVT(E)) in Ranchi, Jarkhand, India, BAU, and the Centre for Arid Zone Studies, Bangor, Wales. The following is a preliminary impact assessment of the outputs of the collaborative PPB project to improve local rice varieties for rainfed uplands.

IMPACT IN INDIA

Background

Farmers of rainfed uplands require early varieties that mature in less than 100 days, but still give a good yield of grain and fodder. Using participatory varietal selection (PVS), GVT(E) provided a range of choices to farmers. Farmers identified Kalinga III, a rice variety that has become somewhat popular for its early maturity (a mechanism of drought escape), high grain and fodder yield and good cooking quality. Furthermore, it is the only superfine grained variety that can grow in uplands. However, adoption has been limited by its poor inherent resistance to drought. PPB was used to improve upon Kalinga III, by using it as a parent in a cross with IR64, and the result was two outstanding rice varieties (Ashoka 200F and Ashoka 228). They are drought resistant, tall and early maturing and give a higher grain and fodder yield than Kalinga III. Both varieties mature in less than 100 days and are suitable for cultivation in uplands.

Impact Assessment

Methods

The two new rice varieties, Ashoka 200F and Ashoka 228, were tested by:

- The All India Co-ordinated Rice Improvement Project of the Indian Council of Agricultural Research,
- Birsa Agricultural University (BAU),
- Farmers in a GVT-led PVS programme, in both eastern and western India.

Self-help groups of farmers in villages in Orissa produced seed in the 2001 - 2002 off-season. The majority of this seed was procured by GVT and distributed to farmers in more than 600

villages (Table 1) and to other agencies in the *kharif* (rainy season) 2002. It was also distributed to NGOs and state department of agriculture working in the Jharkhand, Orissa and W. Bengal states.

State	Ashoka 228	Ashoka 200F
Orissa	29	11
Jharkhand	26	11
West Bengal	3	-
Total	58	22

Table 1. Seed distribution (tonnes) by GVT in the project villages in kharif 2002

The impact of the two rice varieties was studied in villages where seed had been distributed either directly or indirectly by GVT. About 15% of the households were randomly sampled from the 1000 that received seed from the GVT. There were 126 sample households[†] from the GVT villages and farmers from these households were interviewed using a semi-structured format.

Seed transactions

Farmers sold between 2 and 2000 kg of seed to farmers within the villages but also outside the villages up to a distance of 300 km (Table 2). The spread of seed was through relatives and friends. For example, from Haldikundi village, the seed spread as far as 60 km (Fig. 1).

Table 2. Range of amount of seed sold by farmers and range of distance of spread from the seed foci in *kharif* 2002.

Variety	Orissa		West Bengal		Jharkhand	
	kg	km	kg	km	kg	km
Ashoka 228	10-2000	12-300	2-30	1-15	10-120	0.5-3
Ashoka 200F	10- 900	11- 20	10-20	11-20	25-200	-
No. farmers	38		45		76	
sampled						

[†] 56 in Jharkhand, 29 in Orissa, and 41 in W. Bengal. Included 23 households from those who got seed through NGOs, and 10 from those who received seed through the state department of agriculture



Figure 1. Spread of seed of Ashoka 228 from Haldikundi village of Dhenkanal district, Orissa in *kharif* 2002. Values represent the distance (km) of spread from a total of 14 households.

Farmers' perceptions of the new varieties

In the surveys, the majority of farmers perceived that, compared with local cultivars, the new varieties were, higher yielding and more resistant to lodging, and had many other favourable traits (Fig 2). These slender-grained varieties were easier to market and fetched a higher grain price than the local, coarse-grained varieties.



Figure 2. Farmers' perception (expressed as % of farmers) for Ashoka 228 and Ashoka 200F rice varieties in comparison to the local cultivars. Based on a survey of 159 households sampled over all three states (Orissa, Jarkhand, West Bengal). December 2002.

An increasing trend in the area of cultivation of the two varieties was found (Fig. 3). Further increases in area are expected in 2003 and beyond. These increases will be much more substantial because of the acceptance of these varieties elsewhere in the country. The GVT Western India Rainfed Farming Project (GVT(W)) has tested the two new varieties in participatory trials in Gujarat, Rajasthan and western Madhya Pradesh along with a range of promising upland varieties from many sources. In all three states, the two Ashoka lines were the most preferred overall and Ashoka 200F was particularly liked. GVT(W) already has an active seed multiplication and distribution programme for these varieties.

It is of significance that the two new varieties performed very well in the extreme drought year of 2002. This means that adoption trends will be less affected by the most important external shock in the upland rice growing areas, namely drought. In many places, the surveys showed that the local cultivars had failed but the new varieties survived the drought. In some places such as Bhirbhum (W. Bengal), the seed crop of Ashoka 228 totally wilted due to drought. However, a little rainfall around the middle of August enabled it to recover and produce a bumper crop. In the worst drought hit area of Kalahandi district in Orissa the Deputy Director of Agriculture reported the outstanding performance of Ashoka 228 when the local varieties had failed.

This is not just an excellent new technology but it is also in demand as there is a large area of uplands presently under landraces. As a result of the superior performance of Ashoka 200F and Ashoka 228, there is now a recognised demand for seed of the new varieties. Community based organisations, small scale seed entrepreneurs, GVT, BAU and State Departments of Agriculture are all involved in multiplication of the seed.



Figure 3. Increase in cultivated area of the new rice varieties for 2001 to 2002 and projected area for 2003. Based on surveys in three states; Orissa (N=24), West Bengal (N=46) and Jarkhand (N=33). December 2002.

Effect on livelihoods

The new varieties had a significant effect on the household income (Table 3). The tiny impacts will be in part, at least, to the small area of upland rice growing area available to some households, and to a low proportion of that land presently being devoted to the new varieties. Further impact assessment work will look in detail at the influence of landholding size. The majority of farmers indicated small or large effects of the new varieties on the overall income of the households. Thus the new PPB varieties are expected to contribute significantly to the improvement of livelihoods of poor farmers.

Size of	Ashoka 228 (%, of 103	Ashoka 200F	
overall	interviewed	interviewed	
income	farmers)	farmers)	
Tiny	23	9	
Small	46	56	
Large	29	34	

Table 3. Impact of new varieties on overall income based on surveys in three states (Orissa, Jharkhand and West Bengal). December 2002.

Quantifying the impact

The population of people living below the poverty line in India is greatest in the eastern states. Rice is the most important crop in the region, and the majority of this rice is cultivated in upland, or medium upland to which the Ashoka varieties are adapted.

It is remarkable how well accepted the Ashoka varieties are compared to the traditional landraces or other modern varieties, and their superior performance under drought as well as in better conditions greatly reduces the uncertainty of the forecasts on their impact.

A preliminary financial analysis has been made of the benefits that these varieties, in just three states (Jharkhand, Orissa and West Bengal), can bring (Fig. 4) using the conservative assumptions in the box below. The benefits are large and anticipated cumulative benefits from this project by 2010 will be greater than the total expenditure of £19.5 million on the Plant Sciences Research Programme 1995-2005.

The benefit/cost ratio of this research is very favourable, even assuming a higher than actual annual cost of research of $\pm 100,000$. The benefits of this research have to be shared between the NR Strategy and the DFID India desk, as donors, and between CAZS, GVT and BAU as the project implementers. The benefits are sufficiently substantial for credit sharing.

Assumptions

- Rate of spread of 2.5 times in Jharkhand, 2.0 times in Orissa, and 1.5 times in West Bengal.
- An adoption ceiling of 20% of the upland rice area.
- An increased benefit per hectare from Ashoka 200F and Ashoka 228 of £33 per hectare (500 kg additional yield at £0.09 kg⁻¹).
- Projects supplies seed sufficient to sow 1600 ha in the first two years (the actual amount for 2002 and the planned amount for 2003). In 2004 this halves to 800 ha, in 2005 it halves again to 400 ha and remains constant until 2010 when seed supply is assumed to stop.
- An annual cost of £100,000 for research and development.



Figure 4. NPV and IRR over time from the new rice varieties using the assumptions described in the box above.

Moreover, if less conservative (and hence probably more realistic) assumptions are made, the benefits increase greatly. If it is assumed that the project continues to supply seed to farmers in the same amounts as 2002 and 2003, the adoption percentage is assumed to reach 40% (and this is likely when the varieties are greatly preferred to landraces) and the rate of spread is 2.5 times in all three states (not just in Jharkhand) then benefits rise to £188 million by 2012 with a 5% discount. Even this scenario ignores:

- adoption in western India that will be substantial
- the likely partial replacement of Ashoka 200F and Ashoka 228 with superior varieties that are emerging from the participatory plant breeding programme in eastern India.