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Benefits of Improved Groundnut Technologies to Resource-poor Farmers: A Participatory Approach[1]

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Abstract

Considering that non-adoption of improved groundnut technologies by the small and resource-poor farmers is due to non-availability of quality seeds, poor knowledge, inappropriateness of technologies, etc., in the current study, improved groundnut technologies have been implemented through participatory mode so as to generate awareness about improved technologies among them. The participatory approach could make the farmers to learn, adopt and spread new technologies. The economic indicators have shown that a net return of Rs 7104 per ha was realized by adopting improved varieties and integrated crop management (ICM) package during *kharif* season, and it is higher than the returns realized by growing local variety (AK-12-24) with local practice (Rs 2010/ha). The cost of production has been found to be Rs 11.04/kg and 13.98/kg among the improved practice and farmers' practice, respectively. A similar trend of higher net returns (Rs 13820/ha) and lower cost of production (Rs 8.86 per/kg) has been observed with improved practice during the *rabi* season, compared to the lower net returns (Rs 6309/ha) and higher cost of production (Rs 11.34 per/kg) with farmers' practice. The informal seed supply system implemented through seed bank operation in a participatory mode has increased the improved groundnut seed availability at the village level. The seed multiplication programme could increase the spread of improved varieties from 32 ha to 69 ha in the adopted villages and from 15.9 ha to 85 ha in the neighbouring villages within a period of three years. It will help increase productivity levels of crops and income of farmers. The informal seed supply system implemented through seed bank operation has been found very successful in the faster technology spread. Hence, this model may be replicated in other areas to provide improved seeds to small and marginal farmers. It will also help in achieving self-sufficiency in improved varietal needs at the village level.

Introduction

Groundnut (*Arachis hypogaea* L) is an annual legume crop grown in semi-arid regions of the world. It is the world's fourth most important source of edible oil and third most important source of vegetable protein. In India, groundnut is the principal oilseed crop, occupying an area of 6.4 million hectares with a production level of nearly 6.7 million tonnes of nuts-in-shell. It accounts for 33.5 per cent of the total area under oilseeds and 36.3 per cent of total oilseeds production. It is one of the important oilseed crops grown in the Orissa state of India, and accounts for 25 per cent of the total oilseed crop area of 0.77 lakh ha in the state (2003-04). The crop is mainly grown under three situations, viz. *kharif, rabi/summer* and residual moisture conditions on riverbeds (Satish kumar *et al*. 2004).

The advances in agricultural technology have contributed to increased production and productivity of many crops at research level. However, it appears from several socio-economic studies that the same has not been reflected in the raises in income levels and improvement in socio-economic status of the farmers

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in general and marginal farmers in particular (Mann *et al.,* 2001). This situation is not different in the Orissa where crop productivity is very low and 47.5 per cent of the population belongs to the 'Below Poverty Line' (BPL) category (Planning Commission, 1999). Although groundnut is an important oilseed crop in Orissa, its productivity level is very low (980 kg/ha) due to non-adoption of improved practices. The non-adoption of improved groundnut technologies by small and resource-poor farmers is mainly due to non-availability of quality seeds, high seed cost (Nigam *et al.*, 2004), poor knowledge and inappropriateness of the technologies to these farmers.

The appropriateness of technologies to small and resource-poor farmers may be improved by employing innovative approaches like 'Farmer Participatory Research' (FPR), which involves encouraging of farmers to engage experiments in their own fields so that they can learn, adopt new technologies and spread them to other farmers. Because of low (6.15 per cent) seed replacement rate (Tiwari, 2002) in groundnut, the FPR approach [Farmers Participatory Varietal Selection (FPVS)] was followed in the study area to increase the availability of farmers' preferred quality seed and thereby to generate more income to the small and resource-poor farmers. The current study was a part of the project on "Farmers' Participatory Improvement of Grain Legumes in Rainfed Asia", funded by International Fund for Agricultural Development (IFAD) and implemented by National Research Centre for Groundnut (NRCG) in collaboration with International Crop Research Institute for Semi-Arid Tropics (ICRISAT) at Dhenkanal district, Orissa during 2004-06.

Methodology

The Orissa state was purposively selected considering the resource-poor farmers and potential of improvement in groundnut production and thereby the income and standard of living of farmers. The Dhenkanal Sadar block of Dhenkanal district was purposively selected based on the highest area under groundnut. The majority of farmers in the study area were marginal and resource-poor with low risk-bearing ability. Four villages, viz. Barda, Badagilla, Gunadei and Genghutia were randomly selected for implementing the project activities**.** Before initiation of the project, scientists from ICRISAT, NRCG, Orissa University of Agriculture & Technology (OUA&T) and Orissa State Agriculture Department officials had discussions with the farmers of these villages. The problems identified by farmers in consultation with scientists were prioritized and appropriate interventions were identified for addressing the problems in groundnut cultivation (Annexure I). The on-farm trials were conducted in 50 farmers' fields selected by proportionate random sampling from the four villages. The farmers' inclusion in the programme was exclusively based on their interest in participatory evaluation of improved groundnut technologies. Percentage analysis and economic indicators like net return, cost of production, and benefit cost ratio (BCR) were used to elicit the economic impact of groundnut technology intervention.

Results and Discussion

The results of the different interventions implemented through participatory mode are discussed below.

Farmers' Participatory Varietal Selection (FPVS) and Integrated Crop Management (ICM) Technology Intervention

In general, farmers in the study area were unaware about the improved groundnut varieties and for the past several years they have been growing low-yielding, age-old AK-12-24 (released during 1940) groundnut variety. Hence, to make farmers acquaint with the recently released improved groundnut varieties and also to evaluate the benefit of participatory technology, FPVS programme was implemented. Under FPVS, farmers cultivated five improved varieties along with the local variety AK-12-24 on the same field to evaluate and select the best suited variety. Among the five varieties, *ICGS 76* gave highest yield (1782 kg/ha), followed by *Smruti* (1449 kg/ha) and *Dh-86* (1449 kg/ha) (Table 1). Though all the varieties were superior over the local variety, the feedback revealed that 79 per cent of farmers preferred ICGS 76 for its high yield and better crop and 21 per cent preferred Smruti (OG 52-1) due to its bold kernel and attractive red testa colour. Among the varieties evaluated during the *rabi* season, 82 per cent farmers preferred ICGS 44 due to its high yield (2215 kg/ha) and good taste, if fresh seed/boiled kernels were consumed. About 18 per cent farmers preferred TAG 24 due to its early maturity, though it was slightly less yielding (1855 kg/ha) than

Table 1. Yield and farmers' preference of improved varieties during *kharif* season

Improved variety	Yield (kg/ha)	Yield increase due to adoption of improved variety, %	Farmers' preference, No.
TAG 24	1278	27	-
ICGV 91114	1212	21	-
Smruti	1449	45	11 (21)
ICGS 76	1782	78	39 (79)
Dh-86	1449	45	-
Average yield from farmers' variety (AK-12-24), kg/ha		999.5	
Sample size (N)		50	50 (100)

Note: Figures within the parentheses represent percentage of farmers' preference for a particular variety

Table 2. Yield and farmers' preference for improved varieties during *rabi* season

Improved variety	Yield (kg/ha)	Yield increase due to adoption of improved variety, %	Farmers' preference, No.
TAG 24	1855	36	9 (18)
ICGS 76	1700	25	-
DRG 12	2120	56	-
ICGS 44	2215	63	41 (82)
ICGV 86590	1827	34	-
Average yield from farmers' variety (AK-12-24), kg/ha		1355	
Sample size (N)	50	50 (100)	

Note: Figures within the parentheses represent percentage of farmers' preference for a particular variety

ICGS 44. Hence, it can be concluded that the farmers' preference of improved varieties depend not solely on the yield but also on other attributes. The economic indicators showed that a net return of Rs 7104/ha was realized by adopting improved varieties and ICM package, which was higher than the returns realized by growing the local variety (Rs 2010/ha). The cost of production was Rs 11.04/kg under improved practice and 13.98/kg under farmers' practice. A similar trend of higher net returns (Rs 13820/ha) and lower cost of production (Rs 8.86//kg) was observed with improved practice during the *rabi* season compared to the lower net returns (Rs 6309/ha) and higher cost of production (Rs 11.34/kg) with farmers' practice. The B-C ratio of 1.44 and 1.80 was achieved through adoption of improved varieties during *kharif* and *rabi* seasons, respectively (Table 3).

Seed Bank Operation

A sustained increase in agricultural production and productivity has thus become dependent on the development of new and improved varieties of crops and supply of quality seeds to farmers (Annon., 1997). Since there was no formal seed supply system in the study area to provide improved varieties and most of the farmers were small and marginal with poor resource-capacity to purchase seeds from the market, an informal seed supply system, viz. "seed bank" was established in all the four IFAD programme implemented villages to increase the area under improved groundnut (*see* Annexure II). The participatory seed production reduced the "seed route" (Vijayalakshmi *et al*., 2003). The seed bank, created after discussions with the farmers, was managed by a committee comprised of marginal and small farmers in each of the study villages. After three years of seed bank operation through IFAD-ICRISAT-NRCG project, more than 76 per cent of the small and marginal farmers had received improved groundnut varieties; the village-wise details are given in Table 4. It shows that seed bank was successful in satisfying the improved varietal needs of the small and marginal farmers. If this model is replicated in other resource-poor regions, the access of resource-poor farmers to improved varieties can be increased, resulting in high seed replacement rate and thereby productivity of many crops.

Varietal Spread

The survey conducted after three years of IFAD project implementation in the IFAD-adopted and neighbouring villages revealed a big jump in area under improved groundnut varieties cultivation, from 32 ha to 69 ha in the adopted villages and from 15.9 ha to 85 ha in the neighbouring villages. The increase in area under improved groundnut variety in the IFAD-adopted villages was 68.7 per cent in the second year over the first year, and 27.7 per cent in the third year over second

Table 3. Cost and returns structure of improved practice vs farmers' practice across seasons

Economic Indicators	*Khaif* season		*Rabi* season	
	Improved practice	Farmers' practice	Improved practice	Farmers' practice
Cost of cultivation, Rs/ha	15840	13982	17229	15371
Gross returns @ Rs 1600/q, Rs/ha	22944	15992	31049	21680
Net returns, Rs/ha	7104	2010	13820	6309
Cost of production, Rs/kg	11.04	13.98	8.86	11.34
B-C ratio	1.44	1.14	1.80	1.41

year. The hike in improved groundnut area was observed more in the neighbouring (IFAD non-adopted) villages (Table 5). The number of resource-poor farmers who benefited due to implementation of IFAD programme also increased proportionately (Table 5).

Table 4. Impact of seed bank operation in IFAD project implemented villages

Villages	Farmers	
	Total number of small and marginal farmers	Number of farmers who received improved varieties through IFAD seed bank operation at the end of 3rd year
Barda	27	23 (85.1)
Badagilla	52	40 (76.9)
Gunadei	48	32 (66.7)
Genghutia	38	31 (81.6)
Total	165	126 (76.4)

Note: Figures within parentheses indicate percentages of farmers who received improved varieties

Intercropping of Improved Groundnut with Pigeon Pea

To mitigate the negative effects of end of season drought and to enhance the risk-bearing capacity of the resource-poor farmers, groundnut + pigeon pea (ICPL 87051) intercropping intervention was implemented with the active participation of the farmers. The required amount of pigeon pea seed for intercropping was also met through seed bank operation. There was 110 per cent increase in yield in intercropping over the sole cropping system practised in the study area (Table 5). The 65 per cent yield increase was due to adoption of improved groundnut variety and 45 per cent was due to intercropping of pigeon pea (Table 6). The economic indicators showed that a net return of Rs 14535/ha was realized by adopting intercropping technology with improved technologies which was higher than that in the sole cropping with traditional variety (Rs 2010/ha). The cost of production was also lower in intercropping system (Rs 8.08/kg) than sole cropping (Rs13.98/kg). A benefit

Table 5. Spread in groundnut area under improved varieties in the IFAD adopted and non-adopted villages

Area	First year	Second year	Third year	Increase in area in second year over first year, %	Increase in area in third year over second year, %
IFAD Programme implemented villages	32 (106)	54 (152)	69 (165)	68.7	27.7
Non-adopted neighbouring villages	-	15.9 (46)	85 (220)	-	434

Note: Figures within the parentheses depict the number of farmers who cultivated improved groundnut varieties over the years

Table 6. Yield levels under groundnut + pigeon pea (6:2) intercropping vs sole cropping (local variety)

Sole groundnut yield (Local variety AK-12-24) (kg/ha)	Improved groundnut yield (kg/ha)	Pigeon pea yield in groundnut equivalents (kg/ha)*	Total increase over local variety (%)
999.5	1653 (65%)	448 (45%)	110

Note: *Groundnut equivalent was calculated as [Pigeonpea yield (per ha) × Price of pigeonpea]/[Price of groundnut per kg]

Table 7. Cost and returns structure of improved groundnut+ pigeon pea intercropping vs sole cropping

Economic indicators	*Kharif* season	
	IC	SG
Cost of cultivation, Rs/ha	16980	13982
Gross returns @ 1600/q, Rs/ha	31515	15992
Net returns, Rs/ha	14535	2010
Cost of production, Rs/kg	8.08	13.98
Benefit-cost ratio	1.85	1.14

Note: IC = Improved practice comprising improved groundnut + pigeon pea (ICPL 87051),
SG = Farmers' practice (sole cropping with AK-12-24 variety)

cost ratio (BCR) of 1.85 was realized among intercropping technology implemented by the farmers (Table 7).

Conclusions

In the current study, the farmers have themselves selected the best-suited variety based on the soil and climatic conditions in their locality, individual farmer's resource availability, preference and socio-economic conditions. Accordingly, farmers preferred ICGS 76 and Smruti (OG-52-1) for the *kharif* season and ICGS 44 for the *rabi* season. This implies that though many improved varieties were developed by research Institutes and made available to the farmers, they preferred only a few varieties. Hence, to make technology adoption wider and sustainable, the farmers' participation should be ensured in all stages of technology development like problem identification, technology selection, implementation and revalidation. It will help increase productivity levels of crops and income of farmers. The informal seed supply system implemented through seed bank operation has been found very successful in the faster technology spread. Hence, this model may be replicated in other areas to provide improved seeds to small and marginal farmers. It will also help in achieving self-sufficiency in improved varietal needs at the village level.

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Annexure I. Problems perceived by farmers in the study area

- Lack of knowledge about improved varieties, crop production and protection technologies
- Non-availability of improved groundnut seeds
- Low risk-bearing capacity, especially if monsoon recedes early.

The appropriate interventions identified by experts were:

(i) **Farmers Participatory Varietal Selection (FPVS) and Integrated Crop Management (ICM) Technologies:** Five improved varieties, viz. TAG 24, ICGV 91114, Smruti (OG-52-1), ICGS 76 and Dh-86 were supplied to farmers during the *kharif* season, 2004. The *rabi* season specific varieties, viz. TAG 24, ICGS 44, ICGV 86590, ICGS 76 and DRG 12 were supplied to the farmers along with the Integrated Crop Management (ICM) practices. The ICM package included seed treatment with Carbendazim @ 1.5 g/kg; 20:40:40 kg of N, P_2O_5 and K_2O per ha; Gypsum application @ 250 kg/ha at the time of peak flowering, followed by hoeing and need-based plant protection measures.

(ii) The formal seed supply system was non-existent in the study area and hence informal seed bank operation at the village level was introduced to increase the seed availability to the non-project participating resource-poor farmers.

(iii) Improved Groundnut + Pigeon pea (ICPL 87051) intercropping (6: 2 ratio) intervention was introduced to mitigate the drought effects and to enhance the risk-bearing capacity of the resource-poor farmers in the study area.

Annexure II. Seed bank model implemented under IFAD project, Dhenkanal, Orissa