

Sustainable Improvement in Pulses Productivity in Hamirpur District of Uttar Pradesh : An Approach of Farmer Participatory Varietal Evaluation

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ABSTRACT

A study was conducted among 300 farmers of the three villages namely Amirta, Kalauli Tir and Helapur in Hamirpur district of Uttar Pradesh where a project on farmer participatory improvement of grain legumes in rainfed Asia (IFAD TAG-532, ICRISAT) was implemented during October 2002 to June 2006. Out of 300, there were 75, 42, 125 and 58 farmers who actively participated in the on-farm varietal selection trials (OFVST) for pigeonpea, urdbean, chickpea and lentil, respectively. Four pattern analysis viz., space, time line, flow and decision making were done by using PRA tools to identify agro-ecological situations and major farming situations. It was revealed that three predominant situations namely: mono-cropped, rainfed clay and clay loam soil where lentil, chickpea, linseed were the major crops grown as mixed or intercrop; double-cropped partial irrigated clay loam soil where urdbean, sesamum, chickpea, lentil, linseed, wheat, mustard were main crops and mono-cropped rainfed loam and sandy loam soil with mild slope wherein pigeonpea + sorghum is grown as mixed or intercrop prevailed in the selected villages. The findings of the above study helped to choose JG 315 and DCP 92-3 as the most suitable chickpea varieties appropriate for clay (Mar) and clay loam (Kabar) soils-rainfed mono-cropping situation and clay loam (Kabar) and loam (Parwa) soils-double cropping situations, respectively. Similarly, DPL 62 was found suitable variety of lentil under rainfed mono-cropping situation. Inclusion of short duration YMV free variety of urdbean (IPU 94-1) was found to shift 20 percent monocropped area into double cropped area in the villages. The concept of pulse seed village which was initiated in the project is a success story.

Keywords : *On-farm varietal selection trials (OFVST); Farmer participatory varietal evaluation; Pulse seed village;*

The growing demand of about 20 million tonnes of pulses by 2012 and 28 million tonnes by 2025 can be realized only by adopting increasingly more productive technologies along with sustained developmental efforts and favourable Government policies (Anonymous, 2007). Moreover, identification and use of farming situation specific crop varieties shall have greater implications in enhancing crop productivity (Mukherjee, 2003). This is particularly applicable in case of pulses production.

Farmer participation in agricultural research is a systematic dialogue between farmers and scientists to solve problems related to agriculture and ultimately increase the impact of agricultural research. By responding closely to farmers' concerns and conditions, researchers can develop technologies that are adopted more widely and that respond to important social issues such as equity and sustainability (Das and Willey, 1991).

Development and identification of situation specific

appropriate pulses varieties is an important factor for augmenting total as well as per unit pulse production in India. Farmers have their own indicators and criteria to choose a variety which may fit well in their production circumstances. Farmers' participatory varietal evaluation, therefore, is an important tool to identify the most suitable variety from a set of varieties as per farmers' criteria.

It was in the above context that a project on Farmer Participatory Improvement of Grain Legumes in Rainfed Asia (IFAD TAG-532, ICRISAT Project) was implemented across the partner countries of China, India, Nepal and Vietnam. Indian Institute of Pulses Research, Kanpur executed the project in the state of Uttar Pradesh during October 2002 to June 2006 with following specific objectives:

- (i) To evaluate better adopted pulse varieties in various situations for sustainable intensification of rainfed cropping systems through farmers participatory approach

- (ii) To identify, promote and upscale farmers' preferred pulses varieties

METHODOLOGY

Project was implemented during October 2002 to June 2006 among 300 farmers of the three villages namely Amirta, Kalauli Tir and Helapur in Hamirpur district of Uttar Pradesh. Out of 300, there were 75, 42, 125 and 58 farmers who participated in the on-farm varietal selection trials (OFVST) for pigeonpea, urdbean, chickpea and lentil, respectively.

Participatory Rural Appraisal (PRA) techniques were utilized for conducting diagnostic survey. Series of participatory tools and techniques were used either singly or in combination and these were triangulated whenever required in order to have more reliable and valid information. These were grouped into three categories *viz.*, visualized analysis, interviewing and sampling methods, and groups and team dynamics methods. Since methods and sequence overlap, they were listed by using the categories and terms in common use namely, Analysis of secondary sources of data, Mapping and modeling for social composition, soil types, surface hydrology, enterprises with their spread, Transact walks, Analysis of time lines and trends and changes, Seasonal calendars, Daily time use analysis, Livelihood analysis, Matrix scoring and ranking of crops /varieties /practices, etc. Venn or *Chapati diagram*, well being and/or wealth grouping and ranking, Analysis of differences especially by gender, social group, wealth / poverty, occupation, age, etc. and focused group discussions / interviews.

The above exercises resulted in the identification of micro-farming situations, identification of problems of existing production systems in each micro-farming situation, problem prioritisation and problem-cause relationships of each problem and identification of intervention points along with details of interventions and families involvement in each intervention, etc. All categories of farmers were actively involved in identification of micro-farming situations.

Further, on-farm participatory trials with the potential varieties of chickpea, pigeonpea, lentil and urdbean were laid out under farmer managed situations. Partner farmers were motivated, encouraged and asked to evaluate those varieties by utilizing their own indicators/criteria. Extent of adoption of farmers' preferred varieties was also ascertained. Consequently, a success story on pulse seed village was emanated which is also reported in this paper.

RESULTS AND DISCUSSION

(i) *Prevailing Bio-physical circumstances in the project villages* : The climate of the area was dry and the summer months were characterised by intense heat. The maximum temperature recorded was 46°C (in May/June) and minimum 10°C (in December/January). The annual rainfall of the area varied from 800 to 950 mm. Most of the rainfall occurred in the months of July, August and early September.

Total geographical area of Helapur, Amirta and Kalauli Tir villages are 573 ha, 430ha, 1260 ha, respectively. Mainly two types of soils were found in both the villages *viz.*, i) Parwa (loam) and ii) Kabar (clay loam). Mar (clay) soil was also seen in a few patches. Parwa soil was coarse textured at the surface and got heavier in the sub-soil. Kabar soil was heavy textured with a marked illuviation of calcium carbonate down the profile while Mar soil was very deep, swells on wetting and shrinks on extended drying. Soil was poor in organic matter.

There was a canal, which passes through the villages but most of the time it remain dry. Under this micro-farming situation, most of the area comes under mono-cropping. Pigeonpea + sorghum was mainly grown during *kharif* season in loam and sandy loam soils with a mild slope. Chickpea, chickpea + linseed and lentil were the major crops grown during *rabi* season on clay loam soils without irrigation. Under irrigated double-cropping system, urdbean, sesamum, mungbean and groundnut were the major *kharif* crops and chickpea, wheat and mustard the main *rabi* crops. Tomato and some other vegetables were also grown in some patches. Pulses were pre-dominant crops grown in the project villages by all categories of farmers. Among pulses, pigeonpea and urdbean were the important crops of *Kharif* season and chickpea and lentil of the *rabi* season both under rainfed and irrigated conditions.

More than 60 per cent farmers belonged to smallholder category (<2 ha). Only 16 farmers were classified as medium and large categories having 2-5 ha cultivated land. A majority of the farmers were from backward class followed by scheduled caste families. Eleven per cent farmers were landless agricultural labourers and they fell below poverty line. It was found that mainly three farming situations prevailed in the project area.

- (i) Mono-cropped, rainfed clay and clay loam soil (Lentil, chickpea, linseed were the major crops grown as mixed or intercrop)

- (ii) Double-cropped partial irrigated clay loam soil (Urdbean, sesamum, chickpea, lentil, linseed, wheat, mustard were main crops)
- (iii) Mono-cropped rainfed loam and sandy loam soil with mild slope (Pigeonpea + sorghum is grown as mixed or intercrop)

(ii) *Implementation and evaluation of Farmer Participatory Varietal Selection Trial (FPVST)*

(a) *Chickpea* : Chickpea was the major pulse crop of rabi season grown in nearly 30 per cent of total cultivable area in rainfed and partial irrigated situations in the project villages. The productivity of chickpea (600-900 Kg/ha) was low mainly due to incidence of wilt, infestation of pod borer, no use of bio-control and less quantity of chemical fertilizer, terminal drought and high temperature during February and March. In order to harness synergy among technologies to increase productivity under limited resources, farmer participatory varietal selection was carried out.

Chickpea variety JG 315 performed well under rainfed mono-cropping situation (Table 1). It recorded 46% increase in yield over the check and the benefit/cost ratio was also very high (2.47:1). Whereas, under double cropping situation, (crop sown with pre-planting irrigation), DCP 92-3 variety performed very well. Fifty one per cent yield increases was recorded over the local check.

Farmers ranked JG 315 as the best followed by DCP 92-3 and BG 256. DCP 92-3 was preferred for better market price due to bright yellowish seed colour. Farmers also viewed that there was less infestation of pod borer in DCP 92-3 in comparison to the others (Table 2). JG 315 and DCP 92-3 have been fully accepted and widely adopted in project villages and neighbouring area of Hamirpur district.

(b) *Lentil* : Lentil, a *rabi* crop, was cultivated in rainfed condition. Nearly 60 per cent of the total area was under intercropping system (Lentil + Linseed). The productivity of lentil was 700-900 Kg/ha in the project villages. There was preference for large seeded variety among farmers. Farmers rated lentil as first among the *rabi* pulse crops from the profitability point of view and asserted that area under lentil could increase if disease resistant varieties were available. Three varieties were assessed under FPVST during 2002-03 to 2004-05. Comparative performance is given in Table 1.

JL-1 variety performed very well in rainfed mono-cropping where the soil is mostly heavy clay to clay loam. The variety showed 42% yield increase over the

local check. But variety DPL 62 had premium price due to its large seed which led to higher benefit/cost ratio (3.1:1). Consequently DPL 62 became most popular among the farmers of the project and neighbouring villages.

Table 1. Farmer Participatory Assessment of various kharif and rabi pulse varieties under different farming situations

Variety	Average Yield (Kg/ha)	Increase over Control (%)	Net Return (Rs./ha)	B:C ratio
Crop: Chickpea				
Farming Situation I: Clay (Mar) and clay loam (Kabar) soils– Rainfed mono-cropping				
Local variety	1002	-	6800	2.1
DCP 92 -3	1386	38.3	11269	2.4
JG 315	1462	45.9	11965	2.5
BG 256	1174	17.1	7719.0	2.0
Farming Situation II: Clay loam (Kabar) and Loam (Parwa) soils– Sown with pre-sowing irrigation, double cropping				
Local variety	991	-	6448	2.0
DCP 92 -3	1504	51.7	12259	2.5
JG 315	1429	44.1	11580	2.4
BG 256	1239	25.0	8310	2.0
Crop: Lentil				
Farming Situation: Clay (Mar) and clay loam (Kabar) soils– Rainfed mono-cropping				
Local variety	1060	-	8673	2.4
DPL 62	1495	41.0	15216	3.1
DPL 15	1290	21.7	12133	2.7
JL 1	1505	42.0	13258	2.8
Crop: Pigeonpea				
Farming Situation: Clay (Mar) and clay loam (Kabar) soils– Rainfed mono-cropping				
Local variety	980	-	12618	4.1
NA 1	1250	27.6	16648	4.6
Bahar	1100	12.2	14089	4.1
Amar	1160	18.4	15101	4.3
MAL 13	1070	9.2	13545	4.0
Crop: Urdbean				
Farming Situation: Clay (Mar) and clay loam (Kabar) soils– Rainfed mono-cropping				
Local variety	240	-	196	1.1
IPU 94-1	507	111.3	1048	1.2
Shekhar	482	100.8	773	1.2
Azad	455	89.6	476	1.1

The varieties were assessed and ranked by the farmers with respect to different traits. DPL 62 was at the top followed by JL 1, local and DPL 15. DPL 62 was found more appropriate and suitable in farmers' perspective. JL 1 was preferred due to high yield and less infestation of aphids (Table 2).

(c) *Pigeonpea* : Farmers generally cultivated long duration pigeonpea during kharif season. More than 40

per cent area was covered under pigeonpea and sorghum mixed cropping. The major reasons identified for low yield of pigeonpea was incidence of wilt, unavailability of seed of wilt resistant variety, infestation of pod borer, negligible nutrient application, weed infestation and erratic rainfall. Mixed cropping was also responsible for low production because of the difficulty in carrying out inter culture operations in mixed cropping.

Though pigeonpea was profitable than other crops grown in kharif season, area expansion under pigeonpea was restricted due to high variability in yield as well as non-availability of seed of improved varieties. Improved varieties of pigeonpea viz., Narendra Arhar (NA) 1,

Bahar, Amar and MAL 13 alongwith local variety were assessed under farmers' real prevailing situation to obtain preferential response of farmers. Overall performance of FPVST is given in Table 1.

In overall assessment, variety NA 1 was the best followed by Bahar. Local variety got high score in terms of taste and drought tolerance. MAL-13 was preferred more in terms of short duration where as Amar scored high as there was less attack of pod borer. Because of large seed size and attractive seed colour, Bahar was also preferred by the farmers. NA 1 variety was found to be resistant to wilt disease and could withstand water logging (Table 2).

Table 2. Farmers' assessment and preferences of different pulse varieties under various criteria

Crop/ Varieties	Criteria								Total score	Overall Rank
	More grain yield	Short duration	High market price	Disease resistance	Better taste	Drought tolerance	Less effect of frost	Less attack of insect pest		
Pigeonpea										
Narendra Arhar-1	8.5	6.5	7.8	8.3	8.0	7.8	8.0	6.0	60.8	I
Amar	7.0	7.4	7.5	7.0	6.5	7.5	6.0	7.5	56.6	III
Bahar	7.5	7.5	7.9	6.8	7.8	7.7	6.3	7.2	58.0	II
Mal 13	6.5	8.0	7.9	7.5	7.0	7.2	4.0	7.3	55.3	IV
Local	6.4	7.0	6.8	5.5	8.0	8.0	3.0	7.0	51.7	V
Urdbean										
IPU 94-1	8.8	7.5	5.5	9.5	6.5	7.5	—	8.0	54.3	I
Shekhar Urd 2	7.5	7.3	7.0	6.3	7.0	7.2	—	7.0	49.2	II
Local	6.4	4.5	8.9	5.5	8.0	6.0	—	6.5	45.8	III
Chickpea										
DCP 92-3	8.2	8.0	9.5	8.4	7.2	6.5	9.0	8.0	64.8	II
JG 315	8.5	8.3	8.0	8.5	7.9	7.7	9.0	7.5	65.4	I
BG 256	9.0	6.5	8.5	5.5	8.3	6.0	8.0	6.0	57.8	IV
KWR 108	7.5	6.0	6.5	9.0	7.0	7.5	8.5	6.5	58.5	III
Local	6.6	8.0	6.4	5.0	8.0	8.0	6.0	6.9	54.9	V
Lentil										
DPL 62	8.5	6.0	9.5	9.0	8.6	8.0	8.5	7.5	65.6	I
DPL 15	7.8	5.7	8.0	7.4	8.0	6.6	8.0	7.5	58.9	IV
JL 1	8.6	8.9	7.0	8.5	7.5	8.0	8.3	7.7	64.5	II
Local	7.0	9.0	9.0	5.0	8.8	8.2	8.0	7.5	62.5	III

Scoring is done on a 1 to 10 scale, where 1=lowest score and 10 = highest score

(d) *Urdbean* : The productivity level of urdbean was 400-500 Kg/ha. The major factors responsible for low yield were no use of fertiliser, incidence of Yellow Mosaic virus, use of old seed, incidence of weeds and erratic rainfall. As wheat followed urdbean, there was a need to introduce short duration variety of urdbean. Average performance of urdbean varieties is given in Table 1.

The IPU 94-1 was rated first in terms of grain yield, disease resistance, drought tolerance and duration. Introduction of IPU 94-1 has shifted 20 per cent mono-cropped area to double-cropping. Green coloured local

variety of urdbean scored high for taste and price in the local market (Table 2).

(iii) *Rate of adoption as well as increase in area under improved varieties* : The follow-up study and participatory surveys were held to assess the extent of adoption of farmers' preferred pulse varieties in the project partner and nearby villages over a given period of time. All categories of farmers were interviewed under participatory survey.

Three hundred and ten farmers in project villages used improved chickpea varieties (DCP 92-3 and JG 315) in 280 ha (Table 3). In case of pigeonpea, 80 per

cent area (190 ha) was covered with improved variety NA 1. A total of 218 farmers of project villages grew this variety during 2005 *kharif* season. In adjoining areas (about 24 villages) more than 200 farmers adopted NA 1 in 25 percent pigeonpea area. JG 315 and DCP 92-3 varieties of chickpea were adopted in 65 per cent

area (280 ha) in project villages and in 45 per cent in nearby villages during 2002-06 *rabi* season by 265 farmers. In lentil 72 per cent area (210 ha) was covered under DPL 62 variety during 2002-06 by 348 farmers in project villages. More than 185 farmers procured seed of DPL 62 and cultivated in 40 per cent area of 16 villages of Hamirpur district.

Table 3. Extent of adoption of farmers' preferred pulses varieties in Hamirpur during 2002-06

Crop	Adoption by partner farmers		Adoption by non-partner farmers in project villages		Adoption in nearby villages	
	No. of farmers	Area (ha)	No. of farmers	Area (ha)	No. of farmers	Area (ha)
Chickpea						
DCP 92-3	170	180.0	140	100.0	265	130.0
JG 315	140	100.0	-	-	-	-
Lentil (DPL 62)	348	210.0	106	42.0	185	170.0
Pigeonpea (NA1)	170	138.0	48	52.0	200	136.0

Table 4. Increase in Area under Improved Varieties of pulses

Crop and Variety	2002		2006	
	Total area (ha)	Area under improved variety (ha)	Total area (ha)	Area under improved variety (ha)
Pigeonpea (NA 1)	160	20	220	140
Chickpea (DCP 92-3 and JG 315)	395	140	370	280
Lentil (DPL 62)	350	85	375	210

Since last 3-4 years, improved varieties of chickpea, lentil and pigeonpea have replaced almost 75 per cent of local seed and had been expected to cover 90 per cent area in couple of years. It is also interesting to note that over 3-4 years period (2002-06), farmers increased the adoption level. During 2002-03, about 10 per cent farmers adopted full package technology of chickpea but two years later, 45 % farmers showed positive response towards full package technology in project villages. The rate of adoption of full technology in pigeonpea, chickpea, lentil and urdbean during 2002-2006 was 28, 45, 30 and 15%, respectively (Table 4).

In Hamirpur, Jalaun, Banda, Mahoba and Chitrakoot districts in Bundelkhand region of Uttar Pradesh, more than 1500 farmers have benefited from the technologies developed under the project with collaboration of Krishi Vigyan Kendra, Krishi Gyan Kendra and extension personnel of Agriculture Department.

(iv) *Pulse Seed Village : A Success Story emanated from the study* : Considering the initial success in

FPVST and identification of farmers' preferred varieties, it was conceived that the concept of pulse seed village may be initiated and evaluated. Consequently, an attempt was made to promote this concept in the project area with the objective of ensuring quality seeds of improved varieties for increasing productivity and creating income generating opportunities for better livelihood of the villagers.

Chickpea and lentil were the major pulses of *rabi* season and were grown in about 58 per cent of total cultivated area in the project villages in rainfed mono-cropping and partial irrigated double-cropping situation. Pigeonpea is also important *kharif* season pulse crop of these villages. After ascertaining farmers' preference for chickpea varieties, DCP 92-3 and JG 315, lentil cv. DPL 62 and pigeonpea cv. Narendra Arhar 1 and demand of seed in the project as well as neighbouring villages, four groups of farmers, (10 farmers in each group), were identified for quality seed production in 2003-2004. Groups were trained in quality seed production technologies at different stages of the crops. Capacity building (trainings on cleaning, grading, storage and quality of seeds) was done to improve the skills of the farmers involved in seed production. Total 180 q seed of chickpea (DCP 92-3 and JG 315), 88 q lentil (DPL 62) and 36 q pigeonpea (NA 1) were produced by groups during 2003-2004. Observing the performance of improved varieties over local seed, farmers from the neighbouring villages purchased 65 q seed of DCP 92-3, 32 q DPL 62 and 4.6 q NA 1 for planting in 2004 *kharif* season and 2004-2005 *rabi* season. The informal seed production gained further momentum as groups

produced 210 q chickpea, 265 q lentil and 76 q pigeonpea during 2004-2005. Farmers not only met the seed requirement of project villages but also sold more than 110 q chickpea, 130 q lentil and 12 q pigeonpea in 24 villages of Hamirpur and other villages of adjoining districts viz., Banda, Jalaun and Kanpur Nagar.

This approach can be adopted to ensure the timely availability of quality seeds of rabi pulse crops grown in rainfed environment. Majority of farmers obtained net return of Rs. 9850/ha from pigeonpea, Rs. 9500/ha from chickpea and Rs. 10400/ha from lentil. Under informal seed production programme farmers were getting Rs. 600-700 per quintal additional return in comparison to prevailing market rate of grains. Farmers opined that initial benefit in the form of higher profits and income were invested in order to obtain long term benefits and to stabilise the farming system.

CONCLUSION

Farmer participatory varietal evaluation trial is an important approach to identify the situation specific and farmers' preferred cultivar. The findings of the above study helped to identify JG 315 and DCP 92-3 as the most suitable chickpea varieties appropriate for clay (Mar) and clay loam (Kabar) soils-rainfed mono-cropping situation and clay loam (Kabar) and loam (Parwa) soils-double cropping situations, respectively. Similarly, DPL 62 and IPU 94-1 were found suitable varieties of lentil and urdbean respectively under rainfed mono-cropping situation. NA-1 was found suitable pigeonpea variety for rainfed monocropping situation. The concept of pulse seed village which was initiated to promote informal seed production in the project area is a success story.

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