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Experimenting with Farmers' Capacity and Social Institutions Building for ensuring Village Level Seed Sufficiency: A Case of Chickpea (*Cicer arietinum* L) in India

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ABSTRACT

Building farmers' capacity to experiment with the recommended technologies and at the same time facilitating them for institutionalizing their efforts requires constant validation, consolidation and upscaling. An action research was conducted to empirically probe how the recommended and improved seed varieties may appear if looked with farmers' lens and how to a large extent the farmers' preferred varieties may reach, while using the interventions of institutional backstopping, capacity building, hand holding and enabling. Chickpea is a major pulse crop of India. However, its productivity is restricted around 896 kg/ha, over the past several decades. Local landraces and varietal admixture are influencing the chickpea cultivation in the country. One of the major reasons for low productivity of chickpea is the non-availability of quality seed of improved varieties among the farmers. In the present paper, the experiences of farmer-participatory chickpea seed production in districts of Fatehpur and Kanpur Dehat in Uttar Pradesh state of India have been shared. Through farmer-participatory varietal selection trials, farmers identified DCP 92-3 and JG 16 varieties, as their preferred choices. These varieties were preferred because of its high yield, attractive seed size, seed color, better taste and cooking quality. Farmers were organized to form cooperative societies to undertake seed production, processing and marketing at the local level. They were also linked with the public sector seed producing agencies to participate in the formal seed production program. The B:C ratio of seed production of DCP 92-3 and JG 16 variety was 2.94 and 3.18 as compared to 2.15 of the local chickpea variety sold as grain. Village level seed production not only addressed the issue of shortage of quality seeds but also brought higher incomes to farmers leading to their improved livelihood.

Keywords: Participatory approach, Institutional linkages, Seed delivery, Farmer association

INTRODUCTION

Despite the fact that farmers in developing countries being much interested in testing and acquiring new crop varieties to respond to the ever changing production situations (Rubyogo *et al.*, 2007), they continue to grow local varieties, particularly in pulse crops, for various reasons. Some of these reasons include inadequate exposure to new cultivars, new varieties failing to meet farmers' aspirations, non-availability of seed of improved varieties and lack of resources with small holder farmers to invest in seeds, among others. The need of participatory breeding (Nigam, 2009) and farmer-participatory varietal selection (Singh *et al*, 2008; Singh *et al*, 2013) in legume has been aptly envisaged in the Indian context to promote adoption of improved varieties of pulses to raise their productivity. If adoption rates are to be improved, farmers need to try a wide range of novel cultivars in their fields through their involvement in Farmers' Participate Varieties selection (FPVS) programs. In the present FPVS trials, only released varieties were included. In the event of any one of these varieties being selected by the farmers, the large-scale provision of seed will be easier through formal and informal seed sectors (Witcombe *et al,* 1996). In case a farmer-preferred variety is not released by the state/national authorities, the formal seed sector will not include it in its seed production program.

Good seed is the foundation of good agriculture. The quality seed of improved, farmer-preferred varieties contributes to the improved agricultural productivity as it responds to farmers' needs and situations (Pelmer, 2005). Sperling and Cooper (2003) conceptualized farmer level seed security as the situation in which a farmer has access to the sufficient quantities of seeds of their preferred varieties with desired physical qualities. They further reiterated that as majority of small scale farmers operate in low input system; their seed security is guaranteed when they produce enough food and put some in reserve to be used as seed for the next season. However, many a time, farmers are forced to sell their total produce in the market due to immediate cash requirement to clear debt and attend to other social obligations. The own-saved seed is akin to blocking that much capital for the next 6-8 months which becomes uneconomical to farmers as they have immediate cash requirement. Small scale farmers,

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however, are encountered with manifold challenges of biotic and abiotic stresses putting, thereby, the village level seed sufficiency at stake (Rubyogo *et al*, 2005). To ensure seed sufficiency at village level, not only the cultivation and multiplication of farmer-preferred varieties is important, formation of producers' association and developing their capacity to initiate seed based micro-enterprises is equally important (Penrrose-Buckley, 2007). Jones *et al* (2001) empirically reported that farmer-to-farmer informal dissemination of preferred seed was quicker through such associations and farmers' group particularly in pigeonpea in semi-arid regions of Kenya.

The productivity of pulses in India has remained stagnant over the past several decades. In case of chickpea, which is a major pulse crop of the country (area 9.21 million ha and production 8.25 million tonnes; http:// dacnet.nic.in / eands/At_A_Glance_2011/4.13 (a), (b).xls), the per unit production is hovering around 786 kg/ha for the last five decades (Rao *et al.,* 2010). Non-availability of quality seeds of improved varieties, poor crop management practices followed by the farmers, damage by insect pests and diseases, drought and frost are some of the factors responsible for low pulses productivity in India. Uttar Pradesh (UP) ranks sixth in terms of chickpea area in the country after Madhya Pradesh (MP), Maharashtra, Karnataka, Rajasthan and Andhra Pradesh (AP) and also holds same rank in production after MP, Maharashtra, AP, Karnataka and Rajasthanwith an average productivity of 824 kg/ha. Statistically, chickpea is grown on 0.62 million ha area with a total production of 0.51 million tonnes in the state of UP The major biotic constraints to chickpea production in the state include heavy damage by pod borer (*Helicoverpa armigera* L.) among the insect. A constraint analysis of low productivity of rainfed chickpea in India by Maruthi Shankar *et al.* (2004) identified shortage of quality seed as one of the major factors limiting chickpea production in the country. Genetically pure seed alone can increase productivity of the crop by 10-15 per cent (Saxena, 2006). However, despite release of several improved varieties of chickpea, local landraces and varietal mixture dominate the cultivation of this crop in the country. Most of the farmers procure their chickpea seed from local traders else they rely on their 'own-saved' or 'neighbor's saved' seed, which in most cases are unspecified. Private seed sector showed little interest in production and marketing of chickpea seed due to several reasons. On the other hand, public sector seed producing agencies have not been very effective in meeting the seed requirement of pulse crops. Thus, there is a need to evolve innovative approaches to address the issue of non-availability of quality seed of chickpea at farmers' level.

The present paper analyzes the experiences gained in on-farm chickpea seed production with community participation in the districts of Fatehpur and Kanpur Dehat in Uttar Pradesh state of India. Experiments also emanated how farmers can participate in on-farm experimentation for assessing the new varieties on their own preferred traits and how effective could farmers' interest group in ensuring seed sufficiency at the community level if they are adequate facilitated and capacitated.

METHODOLOGY

The action research was conducted in two districts, Fatehpur and Kanpur Dehat, in UP, state India for three years during 2007-08 to 2009-10. These two districts represented partially irrigated and fully irrigated production situations, respectively. These two distinct agro-ecologies allowed us to undertake farmer-participatory research on chickpea in the identified districts. Six villages in Kanpur Dehat and seven villages in Fatehpur, which were traditional chickpea-growing villages in the past, were selected. Before actually initiating the project, a baseline survey was conducted in partner villages of Fatehpur and Kanpur Dehat districts to appraise chickpea situation from production to marketing. Data were collected using a semi-structured personal interview schedule devised for the purpose. This was triangulated with participatory observation, group discussion, farmers' feedback, etc. Collected data were analyzed using the descriptive and inferential statistics. The major interventions in terms of on-farm participatory varietal selection (FPVS) trials, capacity building, forging partnership, strengthening farmers' organizations, etc were implemented in the project villages. Farmer-participatory varietal selection (FPVS) trial were conducted using five improved varieties DCP 92-3, KWR 108, JG 16, BG 256, JG 315 and two local varieties large seeded and small seeded were laid out under two micro farming situation was constituted to identify farmer-preferred variety (ies). Ten such FPVS trials (non-replicated, with full set of varieties) each in the 2007-08*Rabi* (post rainy) season were conducted in 10 farmers' fields in Godharauli village in Fatehpur and Barhapur and KuitKheda villages in Kanpur Dehat. Each farmer was assigned one trial with 100 sq m plot size for each variety. The varieties were evaluated for grain yield and other economic parameters besides taking into consideration the farmer's perception on their performance using a 10-point rating scale, where 1 is the lowest and 9 the highest for preference. Farmers' groups were alo formed with proper intuitional structures and they were facilitated to hold the responsibilities of input management, production management and marketing

management. The association were linked with Indian Institute of Pulses Research (IIPR) as well as the Uttar Pradesh (UP) State Seed Certification Agency (UPSSCA) for seed certification and the public sector seed agencies such as National Seeds Corporation Ltd. (NSC Ltd.), State Farm Corporation of India (SFCI) and Uttar Pradesh Seed Development Corporation (UPSDC) for supplementing with formal seed sector for pulses seed production. The promotional activities such as diagnostic field visits, field days and participatory evaluation visits, which were organized on a regular basis to develop functional linkages. Data were generated on agro-ecosystem related parameters, production parameters, preference indicators and economic indices. The collected data were analyzed using descriptive statistics and inter-relational approaches of case study were utilized to draw meaningful conclusions.

RESULTS AND DISCUSSION

Agro-ecosystem analysis of the project areas

Further, with particular respect to chickpea cultivation in Fatehpur and Kanpur Dehat districts of Uttar Pradesh, India where the present study was conducted, it is a matter of fact that before irrigation became available through canals and bore wells in 1975, the cropping systems in these two districts were highly diversified with legumes occupying a prominent place. After 1975, the farmers shifted mainly to rice (in rainy season) and wheat (post rainy season) cultivation. Pulses now occupy only 16-23 per cent of the total arable area in these districts (Fatehpur - 3,99,367 ha and Kanpur Dehat - 3,14,984 ha). Chickpea is grown in 18-20% of the pulses area. Chickpea is the important rabi pulse crop grown in about 46662 ha of area in Fatehpur and 25 071 ha in Kanpur Dehat with productivity of 979 and 1201 Kg ha^{-1}. Farmers mainly cultivate chickpea either in kharif fallow or after harvesting of *Til* and paddy in the project villages. However, the chickpea productivity in both the districts is much higher than the average productivity in U.P. and at the national level. The average yield of chickpea in Fatehpur is 1201 kg ha^{-1} and in Kanpur Dehat it is 1309 kg ha^{-1}.

The average annual rainfall in Fatehpur is about 760 mm and the farmers grow pulses in clay loam, loam and sandy loam soils. In Kanpur Dehat, the average annual rainfall is 630 mm and the pulses are grown in loam and sandy loam soils. Almost 87 - 90 per cent arable area in both the districts has access to full or partial irrigation. Most of the chickpea growers in these two districts normally grow local varieties of unspecified pedigrees, which are genetically inferior, usually a mixture of many varieties, susceptible to diseases and insect pests and have low productivity potential.

Performance of varieties in FPVS trials

The results of Farmer Participatory Varietal Selection (FPVS) have been presented in Table 1. Average performance of five improved chickpea varieties, DCP 92-3, KWR 108, JG 16, BG 256, JG 315 and two local varieties (large seeded and small seeded) were laid out under two micro farming situations. Under clay loam and loam soils having partially irrigated double cropping system included in the FPVS trials in Fatehpur district, results are given in Table 1. Of the five improved chickpea varieties along with two local varieties evaluated on ten farmers' fields, DCP 92-3 produced the highest (Range: 2030 and 1765 kg/ha) seed yield followed by JG 16 (1895 and 1635 kg/ha), KWR 108 (1795 and 1585kg/ha), local large seeded (1395 and 1145 kg/ha) JG 315 (1320 and 1050 kg/ha). The yield of local small seeded was 1020 and 845 kg/ha under both the micro-farming situation.

Table 1: Average performance of chickpea varieties included in FPVS trials in Fatehpur districts

Variety	Grain yield (kg ha^{-1})					
	Micro-farming situation I*			Micro-farming situation II**		
	Max	Min	Average	Max	Min	Average
DCP 92-3	2030	1500	1765	1765	1395	1580
JG 16	1895	1450	1672	1635	1292	1463
KWR 108	1795	1350	1572	1585	1245	1415
JG 315	1320	1000	1155	1050	865	945
BG 256	1520	1235	1377	1292	1050	1171
Local (Large seeded)	1395	1100	1200	1145	900	1025
Local (Small seeded)	1020	650	835	845	500	672

*Clay loam and loam soil, partially irrigated, double cropping system (sown 15th Oct. to 10th Nov.)
**Loam soil, double cropping system and full-irrigated condition
(Average of 10 non-replicated trials with 100 m^2 plot size for each variety.)

Ten on-farm participatory varietal selection trials involving six improved varieties *viz*., KWR108, JG 16, DCP 92-3, KGD 1168, PG 186 and JKG 1(Kabuli) along with local varieties in Kanpur Dehat district under two micro farming situations. On the basis of yield data of FPVS trials of six improved varieties along with two local varieties, it was revealed that DCP 92-3 produced the highest seed yield (2960 kg/ha) followed by JG 16 (2630 kg/ha), KWR 108 (2130 kg/ha), PG186 (1910 kg/ha), Local large seeded (1890 kg/ha), JKG 1 (1600kg/ha) , KGD 1168 (1460 kg/ha) and local small seeded (1160 kg/ha) under clay loam and double cropping System.

Under loam soil with full irrigation facility and double-cropped situation same improved varieties along with two local varieties were evaluated at farmer's field. DCP 92-3 had been rated as highest yielder (2770kg/ha) followed by JG 16 (2580kg/ha), PG 186 (2510 kg/ha), KGD 1168

(2320kg/ha) and KWR 108 (1860 kg/ha). Overall assessment indicates that farmers preferred DCP 92-3 and JG 16 for their high yield and its yellowish color and adaptability to the late sowing (last week of November) condition. Variety wise performance is given in Table 2.

Table 2: Average performance of chickpea varieties included in FPVS trials in Kanpur Dehat districts

Variety	Grain yield (kg ha^{-1})					
	Micro-farming situation I*			Micro-farming situation II**		
	Maximum	Minimum	Average	Maximum	Minimum	Average
DCP 92-3	2960	2740	2850	2770	2200	2490
JG 16	2630	2460	2550	2580	2140	2360
KWR 108	2130	1790	2010	1860	1410	1640
PG 186	1910	1600	1750	2510	1980	2250
KGD 1168	1460	1210	1340	2320	1740	2030
JKG 1	1600	1280	1440	980	780	880
Local (Large seeded)	1890	1340	1620	1580	1200	1390
Local (Small seeded)	1160	940	1050	1170	790	980

*Clay loam and loam soil, partially irrigated, double cropping system (sown 15th Oct. to 10th Nov.)
**Loam soil, double cropping system and full-irrigated condition
(Average of 10 non-replicated trials with 100 m^2 plot sizefor each variety.)

In addition to grain yield, farmers also evaluated these varieties for the following traits: duration, resistance to diseases and insect pests, tolerance to drought, seed size and color, taste and potential for high market price (Table 3). Based on the aforementioned traits, the farmers in both the districts unequivocally selected DCP 92-3 and JG 16 for large-scale seed production and popularization.

Table 3: Farmers' assessment of chickpea varieties for various traits and their over all rank.

Variety	Average trait score[a]								Total score	Over all rank
	Grain yield	Short-duration	Market price[b]	Taste	Disease resistance[c]	Drought toleranced	Frost tolerance	Tolerance of insect pests[c]		
DCP 92-3	8.2	8.0	9.5	8.4	7.2	6.5	9.0	8.0	64.8	I
KWR 108	8.8	6.5	7.9	8.4	8.2	7.6	8.2	5.9	61.5	III
JG 16	8.8	7.8	7.9	8.4	8.2	7.6	8.2	5.9	62.8	II
PG 186	7.6	7.5	8.2	7.8	7.9	6.2	7.5	7.3	60.0	IV
KGD 1168	6.2	6.8	7.0	8.0	5.4	4.4	7.1	7.6	52.5	VIII
JKG 1	6.9	7.5	7.5	6.2	7.0	7.2	6.1	7.2	55.6	VI
JG 315	6.2	6.8	7.0	8.0	5.6	3.4	7.1	7.6	51.7	IX
BG 256	6.5	8.0	7.9	7.1	7.0	4.5	6.5	7.1	54.6	VII
Local (small seeded)	7.1	7.3	7.8	6.4	7.0	7.6	6.2	7.4	56.8	V
Local (large seeded)	6.2	6.8	7.2	7.1	5.8	4.1	6.0	7.0	50.2	X

a=Scored on a 1 - 10 scale, where 1 = the lowest, and 10 = the highest for preference;
b= scored based on seed size and color preferred by growers, traders and millers;
c= assessed at initiation of secondary branches and flowering and at pod formation stage;
d= assessed at flower initiation stage, and e= assessed at flowering and pod formation stage.

Farmers' feedback and market demand favored DCP 92-3 over JG 16 because of the better taste and yellow grain color. Yield is not always the paramount consideration in farmers' choice of a variety (Joshi and Witcombe, 1996). This clearly brought the need of production system's perspective while developing new varieties and technologies in agriculture. Farmers' participation in trials and their evaluation process generated a lot of enthusiasm among them and many farmers have started conducting their own simple experiments before accepting any new variety/ technology in different crops. For a large scale adoption of a variety, it must be owned by the farmers. Active participation and a role in decision making while evaluating overall performance of varieties in FPVS trials, give farmers' a sense of ownership of the selected variety.

Farmer-participatory varietal selection provides an effective vehicle to identify farmer-preferred variety (ies) and hastens the process of varietal replacement (Witcombe *et al,* 1996). Sometimes farmer-participatory varietal selection and associated data can come in handy to get a better performing advanced breeding line released through fast track bypassing the formal variety release protocol (Ref: ICGV 91114 groundnut variety in Andhra Pradesh, Karnataka and Orissa; SN Nigam personnel communication).

Seed production and its marketing

With enhanced knowledge and skills in ICM and seed production technology through training, farmers were well prepared to take up quality seed production. In addition to monetary benefits, farmers also developed a culture to 'work together' through the formation of cooperative societies. While the FPVS trials were in progress, seed production of potential chickpea varieties, DCP 92-3 and JG 16 in Fatehpur and Kanpur Dehat, was simultaneously initiated. Over a period of four years (2006/07-2009/10), a total of 3,18,590 kg seed of DCP 92-3 and JG 16 was produced from 210.31 ha involving 855 member and non-member farmers in both the districts (Table 4).

Table 4: Year-wise seed production and disposal pattern of chickpea variety (DCP 92-3 & JG 16) in Fatehpur and Kanpur Dehat districts, U.P.

Particulars	2006-07	2007-08		2008-09		2009-10	
	Fatehpur	Fatehpur	Kanpur Dehat	Fatehpur	Kanpur Dehat	Fatehpur	Kanpur Dehat
No. of village	06	07	05	08	06	12	06
No. of farmers	93	96	113	192	123	148	90
Area (ha)	18.6	22	18	40.88	27.1	48.0	35.73
Production (kg)	16 200*	36 990	16 000#	84870	47 430	62 100	55 000
Procurement by NSC (kg)	5 000**	20 590	10 200##	40 030	26080	37 800	30 500
Quantity sold in the market as a seed (kg)	-	5 200	2000	2 810	850	600	500
Quantity sold as grain in market (kg)	3 000	1280	2 000	18 850	13 350	2 500	10 000
Saved for 'Own use' (kg)	5 200	4430	1 000	4 730	3150	8 550	7 000
Kept for next year distribution (kg)	3 000	4 000	800	20 000	4 000	8 550	7 000

*[D.C.P. 92-3 (6 100 kg) + J.G. 16 (5 000 kg) + K.W.R. 108 (5100 kg)]
**[D.C.P. 92-3 (2 000 kg) + J.G. 16 (2 000 kg) + K.W.R. 108 (1 000 kg) procurement by IIPR, Kanpur
- 4000kg of quality seed of chickpea (2 000 kg DCP 92-3 and 2 000 kg J. G. 16) was purchased by IIPR, Kanpur during 2009-10
#[D.C.P. 92-3 (4 200 kg) + J.G. 16 (3 800 kg) + K.W.R. 108 (6200 kg) + P.G. 186 (1800 kg)]
##[D.C.P. 92-3 (3 000 kg) + J.G. 16 (2200 kg) + K.W.R. 108 (4 000 kg) + P.G. 186 (1 000 kg)]

i. Cost of seed production

The cost of production of chickpea was worked out ₹ 15 450/ ha (Table 6). In case of certified seed production plots, the additional costs also incurred which included registration fee (₹ 28/), inspection fee (₹ 337/ ha) and seed testing fee (₹169/ sample).

Table 6: Cost of seed production of chickpea

Operation/Activity	Expenditure (₹ ha^{-1})	Percent share
Land preparation	2320	14.87
Seed and sowing*	2500	16.02
Fertilizers	0580	03.71
Interculture	1880	12.05
Irrigation	3360	21.54
Insecticide	2460	15.76
Harvesting, threshing, winnowing, packaging etc.	2500	16.05
Total	15 600	-

* Chickpea seed rate 8-10 kg ha^{-1}.

ii. Economic analysis of seed production

Instead of growing chickpea for food use and selling it as grains, growing it for seed use was highly remunerative. The C:B ratio for seed crop was 2.94 and 3.18 as compared to 2.15 of the commercial crop (Table 7).

Table 7: Economics of seed production of chickpea variety (2009-10)

Indicator	Variety		
	Local	DCP 92-3	JG 16
Average seed yield (kg ha^{-})	1475	2050	2175
Increase in yield over control (%)	-	28.05	32.18
Cost of cultivation (₹ ha^{1})	10 300	15 600	15 600
Prevailing market price (₹ t^{-1})	2 200	3 000	3 000
Gross income (₹ha^{-1})	32 450	61 500	65 250
Net income (₹ ha^{-1})	22 150*	45 900**	49 650
C:B ratio	1:2.15	1:2.94	1:3.18

*prevailing market grain price, **NSC procurement rate

iii. Marketing of seed

Out of the total quantity of seed (63% in Fatehpur and 37% in Kanpur Dehat) of DCP 92-3 and JG 16 produced in different years, about 18 per cent in Fatehpur and 10 per cent in Kanpur Dehat were retained by the farmers for sowing the crop in the next season.

On an overall basis, about 21per cent of the seed produced by farmers was retained by them as indicated in Table 4. A large proportion of farmers preferred to save their own seed rather than buying new seed each year. This highlighted the need for safe seed storage practices at the household level.

Table 5: Details of seed production of DCP 92-3 and JG 16 chickpea varieties by farmers' cooperative societies ('*samitis*') in Fatehpur and Kanpur Dehat districts, U.P.

Particular	*Chaudgra Kisan Sewa Samiti (CKSS),* Chaudgra, Fatehpur				*Krishak Beej Vikas Samiti (KBVS),* Kuit Kheda, Kanpur Dehat			
Year	2008/09		2009/10		2008/09		2009/10	
Variety	DCP 92-3	JG 16	DCP 92-3	JG 16	DCP 92-3	JG 16	DCP 92-3	JG 16
Area (ha)	32.32	8.56	39.82	8.00	23.40	3.70	28.63	7.10
Production (t)	61 540	23 330	48 050	14 050	31 100	16 330	42 900	12 100

Both institutional and non-institutional marketing channels were utilized to dispose off the produce. National Seed Corporation (NSC) was the main institutional stakeholder in purchasing the chickpea seed produced at farmers' level. The non-institutional channels included local traders and neighboring and other farmers who were instrumental in diffusion the quality chickpea seed on larger areas. As farmers' cooperative societies came up later, the mechanism of seed marketing became more systematic. The details of seed produced and disposed by these farmers' cooperative societies are furnished in Table 5. A total of 2,49,400 kg seed was produced from 151.53 ha.

CONCLUSION

Based on the findings and experiences of the study, a functional 'seed system model' depicting roles of various stakeholders, related institutional linkages and anticipated outcomes has been evolved which is depicted as in Fig 1. The model highlights how the farmers, their village based local bodies, research institutions and Government institutions may converge for the specific purpose of on-farm technological backstopping, capacity building, on-farm assessment of the improved varieties, seed production, marketing and profit sharing and thus leading overall economic empowerment.

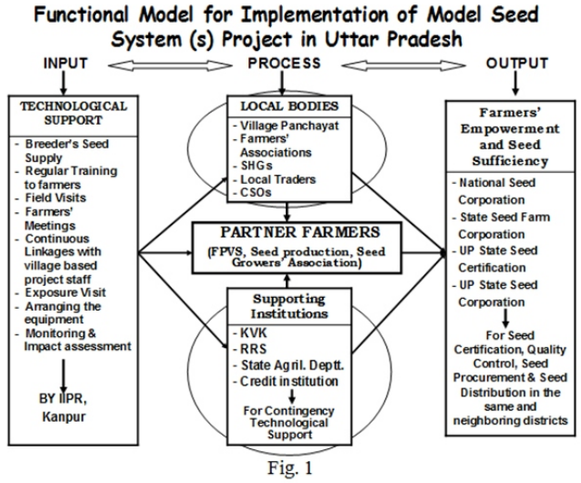

Fig. 1

Fig1: Empirical model of community-led seed sufficiency in rural India

The experiences have far reaching implications for extension education researches in terms of identifying the newer area, methodologies and indicators for executing more meaningful on-farm researches with validated methodologies. Also, the successful experiment on farmers' institution building in farm sector as deliberated as above may build the confidence of extension professionals in very fabric of extension education philosophy and action.

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REFERENCES

Ali M. (2004). Role of pulses in crop diversification in India.In *Role of legumes in crop diversification and poverty reduction in Asia*, 42-56 (Eds. CLL Gowda and S Pande). Proceedings of the Joint CLAN Steering Meeting, 10-12 Nov 2003, Patancheru, India: International Crops Research Institute for the Semi-Arid Tropics.

Almekinders CJM, Thiele G and Daniel DL. (2007). Can cultivars from participatory plant breeding improve seed provision to small scale farmers? *Euphytica,* 153, PP: 363-3372.

David S and Sperling L. (1999). Improving the technology delivery mechanisms: Lessons from bean seed system research in east and central Africa. *Agriculture and Human values,* 16, PP: 381-388.

Dhar V, Singh NB, Singh F and Majumdar N D. (2002.) Pigeonpea: Package of practices. Indian Institute of Pulses Research, Kanpur.

Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Govt. of India. 2010. Area, production and yield of chickpea during 2007/08 and 2008/09 in major producing states along with coverage under irrigation. http://dacnet.nic.in/eands/At_Glance_2014/4.14(B).xls

Jones R B, Audi P A and Tripp R. (2001). The role of informal seed systems in disseminating modern varieties: example of pigeonpea in semi-arid areas of Kenya. *Experimental Agriculture*, 37, PP: 539-548.

Joshi A and Witcombe JR. (1996). Farmer participatory crop improvement. II. Participatory varietal selection, a case study in India. *Experimental Agriculture*, 32, PP: 461-477.

Maruthi Shankar GR, Yadav IPS, Dharmraj PS, Gupta GP, Antkar VN, Ghajbiye KS, Thyagaraju CR, Girija A, Vittal KPR and Chary GR. (2004). Constraint analysis of low productivity of rainfed chickpea and pigeonpea in India. *Indian Journal of Pulses Research,* 17 (2), PP: 162-166.

Nigam S N. (2009). Designing farmer-participatory varietal selection in legumes.*In Legumes for Ecological Sustainability*, 519-528 (Ed. M. Ali, S. Gupta, P. S. Basu and Naimuddin). Proceedings of the national symposium on legumes for ecological sustainability: emerging challenges and opportunities, 3-5 Nov 2007, IIPR, Kanpur. Indian Society of Pulses Research and Development.

Parthasarathi Rao P, Birthal PS, Bhagavatula S and Bantilan MCS. (20100. Chickpea and pigeonpea economies in Asia: Facts, trends and outlook. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Pelmer DP. (2005). Agriculture in the developing world: Connecting innovations in plant breeding research to down stream applications. *PNAS* 102 (44) 15739-15746.

Penrrose-Buckley C. (2007). Producer organization: A guide to developing collective rural enterprises. Oxfam GB, Oxford, UK.

Ravinder Reddy Ch, Nigam SN, Parthasarathy Rao P, Ahmed S, Ratnakar R, Ashok A, Ashok Kumar A, Reddy BVS and Gowda CLL. (2010). Village seed banks: An integrated seed system for improved seed production and supply A case study. Information Bulletin No. 87. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Rubyogo J C, Remington T and Jones R. (2005). Seed systems for reaching a broad range of users quickly and efficiently. Proceeding of the Harvest Plus Reaching End Users Meeting, 5-7 May 2004, Rome, Italy (IPGRI-Macaresse).

Rubyogo J C, Sperling, L and Assefa T. 2007. A new approach for facilitating farmers' access to bean seed. *LEISA Magazine,* 23 (2), PP: 27-29.

Saxena KB. (2006). Seed production systems in pigeonpea. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Singh SK, Kumar Shantanu, Singh AK and Sah Uma.

(2008). Sustainable improvement in pulses productivity in Hamirpur district of Uttar Pradesh: An approach of farmer participatory varietal evaluation. *Indian Research Journal of Extension Education* 8 (2&3), PP: 32-37.

S. K. Singh, S. K. Dubey , M. Ali, S. N. Nigam, R. K. Srivastava, K. B. Saxena, A. S. Yadav & A. Kumar (2013). Development and Promotion of an Informal and Formal Seed System through Farmer Participatory Seed Production of Pigeonpea (*Cajanus cajan* L.) in Uttar Pradesh, India. *Agroecology and Sustainable Food Systems*, 37:5; PP:531-549

.

Sperling L and Cooper HD. (2003). Understanding seed systems in seed security.In *Improving the effectiveness and sustainability of seed relief*. Proceedings of a stakeholders' workshop in Rome 26-28 May 2003: Food and Agricultural Organization.

Witcombe JR, Joshi A, Joshi K D and Sthapit B R. (1996). Farmer participatory crop improvement. I. Varietal selection and breeding methods and their impact on biodiversity. *Experimental Agriculture* 32, PP: 445-460.