Putting farmers first in chickpea selection in Bangladesh

RIU

Validated RNRRS Output.

In Bangladesh, new crops are already tested on farms as well as on research stations. Even so, farmers often don't get what they want or need. Now, farmers themselves decide what works best for them on their farms under normal farming conditions. Involving farmers in selecting and testing improved varieties, known as 'participatory varietal selection', has proven successful with chickpea in Bangladesh's High Barind Tract. Here chickpea is becoming popular but yields are often less than a quarter of what they could be. Farmers who tested and adopted new varieties already harvest more grain. Plus, they can get an extra crop from land that previously just lay fallow after the annual rice crop. Involving farmers in selecting varieties has great potential, so efforts need to be focused on making this approach more widely accepted in Bangladesh.

Project Ref: **PSP11:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **CAZS-NR, UK**
Source: **Plant Sciences Programme**

Document Contents:

Description

Research into Use
NR International
Park House
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UK

Geographical regions included:

Bangladesh,

Target Audiences for this content:

Crop farmers,

PSP11

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Participatory Varietal Selection (PVS) of chickpea in Bangladesh

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Plant Sciences Research Programme (PSP)

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R8269

UK
CAZS Natural Resources, Bangor UK (Dr Dave Harris)

Bangladesh
PROVA, Rajshahi, Bangladesh (Mr A. M. Musa)
Pulses Research Centre (PRC), BARI, Ishurdi

India
ICRISAT, Patancheru, AP, India (Dr J.V.D.K. Kumar Rao)

*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

Chickpea is becoming a popular and profitable crop to replace fallow in the High Barind Tract (HBT) of **Bangladesh** following the harvest of rainfed *aman* rice. The potential yield of chickpea, with minimal biotic and abiotic constraints, in the HBT is >2.5 t ha^{-1} but farmers' yields are usually in the range of 0.5-1.0 t ha^{-1}. A series of Mother Trials and Baby Trials was conducted in 2003-04 and 2004-05 to compare the performance of, and obtain farmer feedback on, a range of chickpea genotypes under farmer-managed conditions in farmers' fields and to assess whether varietal and trait preferences varied across the HBT.

Using feedback from farmers, it was possible to assemble a farmer-researcher **ideotype** for chickpea improvement in the HBT. Ideotypes, or ideal plant types, have previously been used by plant breeders and physiologists to summarize breeding objectives, and to specify the traits that need to incorporated into existing varieties in order to breed superior varieties. Use of **Participatory Varietal Selection** (PVS) broadens the ideotype concept by also incorporating the ideas of the major clients, the farmers. Thus, to improve upon BARI chola 5 (the current most popular improved variety grown in the HBT), the following characteristics are needed:

- Shorter duration, to escape terminal drought and heat stress that occurs from early March, but without reduced yield potential;
- Cold tolerance to permit earlier flowering and pod set, and hence earlier maturity;
- Improved ability for seedlings to establish at low seedbed moisture;
- Deep rooting to capture moisture;
- Greater resistance to collar rot (*Sclerotium rolfsii*) and fusarium wilt (*Fusarium oxysporum*);
- Greater resistance to *Helicoverpa* pod borer; and
- Grain characteristics resembling the old variety Nabin (BARI chola 1).

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
x			x		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

Chickpea is the main commodity in this dossier, but the PVS methodology is applicable to all crops.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	***High potential***	***Hillsides***	***Forest-Agriculture***	***Peri-urban***	***Land water***	***Tropical moist forest***	***Cross-cutting***
x							

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	***Irrigated***	***Wetland rice based***	***Smallholder rainfed highland***	***Smallholder rainfed dry/cold***	***Dualistic***	***Coastal artisanal fishing***

x		x				

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

This output could be clustered with any crop genetic improvement projects, and projects involving farmer participation in improvement of agronomy, such as:

CPP, Chickpea ICM, R8427, R8366, R7885
CPP, Cost effective weed management packages for lowland rice in Bangladesh, R8412, R8234, R7471
PSP, Chickpea varieties for Western India, Prog. Dev.
PSP, Rice fallow rabi cropping systems, R8098, R8221

A client oriented breeding (COB) approach (e.g. PSP, Concepts and approaches of COB; PSP, COB horsegram and chickpea, Eastern India,) is recommended for further improvement of chickpea varieties for the HBT with:

- farmer involvement in selection of entries and segregants;
- on-farm, rather than research station, evaluation of entries and progeny;
- environmentally targeted to variations within HBT, including geographical (north, south) and location on the toposequence;
- continuous farmer interaction and feedback from parent selection to varietal release.

Validation

B. Validation of the research output(s)

*10**. How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

It has been argued, and demonstrated for several crops, that adequate consideration of client-orientation is necessary for efficient and effective identification of improved crop varieties that will be adopted by resource poor

farmers (Stirling and Witcombe, 2004; Witcombe et al, 2005). We thus used participatory varietal selection (PVS) techniques to guide chickpea introduction and breeding programmes appropriate for the HBT. The prime aim was to determine farmers' preferences for traits and varieties to ensure client orientation.

PVS of chickpea in the HBT of Bangladesh was validated by an NGO, PROVA, with collaboration of BARI and DAE. In Mother Trials, sets of varieties were sown in farmers' fields in 8-12 dispersed replications. Measurements included farmer assessment of varietal and trait preferences both pre- and post-harvest, and recording of yields. Baby Trials (77 in 2003-2004 and 50 in 2004-2005) involved disbursement of seed lots (2.5 kg) of improved chickpea varieties for farmers to test against the "local" variety they would normally use, in operational scale plots using farmers' own inputs. Data collected included post harvest assessment of farmer preferences for traits and varieties, and recording of farmer-measured yields. Data obtained over space and time were assembled by PROVA to formulate "ideal" plant types to guide future plant introduction and breeding programmes that would target all chickpea growers of the HBT.

In 2003-04 (Table 1) BARI chola 4, 5 and 7 were most preferred for pre-harvest traits, followed by BARI chola 2 and Annigeri, with BARI chola 8 and Local least preferred. For post-harvest traits, BARI chola 2, 4, 5, and 7 were equally preferred, with Annigeri intermediate and BARI chola 8 and Local least preferred. Similar information was obtained in 2004-05 and the farmers' expectations of yield in both seasons corresponded with the actual plot yields measured

Table 1. Pre-harvest and post-harvest assessment of chickpea Mother Trials in the HBT, 2003-04 ("1" = worst; "7" = best).

Trait	Chickpea variety							Signif [1]
	BARI chola					Anni-geri	Local	
	2	4	5	7	8			
Pre-harvest								
Seedling establishment	4.0	5.9	7.0	7.0	1.4	3.6	3.2	***
Seedling disease resistance	3.9	5.8	7.0	6.7	2.8	3.9	1.9	***
Growth habit	4.0	6.6	6.8	6.7	1.9	4.8	2.1	***
Wilt resistance	4.8	6.2	7.0	6.3	2.6	4.4	2.0	***
Pod borer tolerance	3.8	6.2	6.8	6.7	1.6	4.4	4.0	***
Expected yield	4.6	6.2	7.0	6.8	2.2	3.7	1.8	***
Post-harvest								
Grain size	6.8	6.3	6.9	5.8	2.7	5.4	2.3	***
Grain colour	7.0	6.6	6.9	6.6	3.2	6.0	2.9	***
Grain shape	6.7	6.6	7.0	7.0	2.3	5.8	3.7	***
Cooking quality	6.9	6.9	6.9	6.9	4.1	6.4	5.0	***
Taste	7.0	7.0	7.0	7.0	3.2	7.0	5.3	***
Market price	6.9	6.9	6.9	6.9	3.1	6.3	3.4	***

[1] Differences between varieties significant at P<0.001 for each trait

In Baby Trials, farmers showed an overwhelming preference for the improved variety over “Local” or Nabin for most traits. Table 2 presents an example, for the comparison between BARI chola 2 and farmers’ ‘local’ in 2003-04. In 2004-05, when a test variety (BARI chola 7 or Annigeri) was compared with BARI chola 5, farmers ascertained little difference in ranking between varieties.

Table 2. Preferences of 21 farmers who evaluated BARI chola 2 in Baby Trials in the HBT in 2003-04.

Trait	BARI chola 2 preferred	Both varieties equally preferred	“Local” preferred
Establishment	20	1	-
Time to maturity	3	18	-
Grain yield	20	-	1
Grain quality	14	7	-
Market price	15	6	-
Grow next season?	21	-	-
Overall preference	17	4	-

*11. **Where and when** have the output(s) been validated?*

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

The output was validated in the HBT of Bangladesh over two *rabi* seasons, from 2003-04 to 2004-05, in the rainfed rice-chickpea cropping system (semi-arid, wetland rice based, smallholder dry in Q7 and Q8).

Current Situation

C. Current situation

*12. **How and by whom** are the outputs currently being used? Please give a brief description **(max. 250 words**).*

Although improved varieties of chickpea (e.g. Bari chola 2, 5) are being grown, and seed saved, by farmers in the HBT as part of an ongoing initiative to promote double cropping (see PSP, Rice fallow *rabi* cropping systems), the ideotype itself is not currently being used because PROVA is not proceeding with chickpea breeding and introduction programmes and the Pulses Research Centre (PRC), BARI, does not appear ready or willing to adopt the methodology.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

Neither the output nor the PVS methodology is currently being used for chickpea in the HBT due to lack of resources of the NGO. More exposure of PRC personnel to PVS is necessary before GOs in Bangladesh are likely to adopt the approach.

*14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading **(max 250 words).***

Use of the PVS methodology for chickpea has been suspended until a project that will support follow-up chickpea introduction and breeding using PVS techniques is identified.

*15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? **(max 350 words).***

In Bangladesh, on-farm trials are called farmer field variety trials and demonstrations and minikit trials. In all these programmes, run at the district and village level, farmers are given seed of new varieties to test under a package of practices. All these activities can be modified to accomodate PVS if capacity is strengthened in more farmer-oriented techniques. We have found in the linear research to extension system that it is extensionists i.e. the DAE who have assisted the most. The key factors in success of PVS elsewhere have been in demonstratijng that PVS works and communication of these results in carefully targeted workshops.

Policies are unhelpful for the adoption of PVS as release proposals give such a high emphasis to research station trials. Active lobbying with policymakers for changes in policy is required so that on-farm participatory trials have equal status to research trials.

Current Promotion

D. Current promotion/uptake pathways

*16. **Where** is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion **(max 200 words).***

Promotion is currently under suspension.

*17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. **(max 200 words)**.*

The plant breeders currently responsible for producing new varieties of chickpea in the HBT are not sufficiently convinced that PVS is a valid approach for a) promoting new varieties by increasing farmers' choices and b) generating relevant data to guide the breeding of potentially better varieties in the future.

It must also be recognised that legume breeding and agronomy has a low priority for GoB, so few resources are available. However, given the recent success in promoting double cropping, largely based on chickpea, in the area it may be that new varieties of chickpea and other 'orphan' crops will have a higher profile and that PVS will become more attractive.

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues ***(max 200 words).***

Chickpea is an 'orphan' crop and seed can only be produced in the *rabi* season for the following *rabi* season so expensive seed, that is vulnerable to storage pests, has to be stored throughout the rainy season. It also has a low seed multiplication rate and the high value and high volume (bulk) of chickpea seed increases the investment and costs of seed storage. Nevertheless, it is a very popular and profitable crop to grow after rice when few other crops will grow.

Consequently, there is a need to strengthen the capacity of existing networks for raising awareness of the benefits of new chickpea varieties (and the PVS technology) in the following areas:

- Capacity building by training of GOs, NGOs and farmer groups.
- Creating awareness of the role of legumes in human and animal nutrition and cropping sequences for maintaining soil fertility.
- Creating awareness of the new varieties through meetings with stakeholders, demonstrations and publication of literature.

Finally, convincing data are required that can be used in sensitization and training programmes. This will entail an ongoing field-based PVS programme.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

Successful case studies and their widespread and attractive presentation to stakeholders is the key to achieving impact with large numbers of poor people.

Using Rogers' (2003) five categories to characterise diffusion of information as a framework for the lessons learnt:

1. The relative advantage of a technology compared to what it is replacing;
This is high. Replacement of chickpea landraces and indigenous varieties can increase grain yield and profitability and provide options for cultivating previously-fallow land (see PSP, Rice-fallow rabi cropping systems).

2. The compatibility of the technology with existing systems and ways of doing things, which is closely related to culture;
In the HBT, cultivation of chickpea is a relatively recent phenomenon, so compatibility of new varieties is medium/high, but becoming higher as farmers become more familiar with the crop. It is worth noting that PVS involves farmers actually growing the crop, thus automatically increasing familiarity.

3. The complexity of the technology in terms of what people need to learn to make it work;
The complexity is low/medium. For current growers, only replacement seed is necessary, without other management changes. Chickpea is becoming widespread in the HBT, partly because it needs few inputs and is thus relatively easy to grow, so new growers are likely to have been exposed to some degree and may be particularly receptive to additional extension efforts.

4. The observability of a technology in terms of how easy it is to demonstrate and observe performance;
The observability of the benefits of new varieties is very high when PVS is used because side-by-side comparisons are easily made in farmers' own fields.

5. The trialability of a technology in terms of how easy it is to test it before deciding to adopt.
The trialability is very easy as long as seed is available.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

It is too early for impact analysis of the benefits of new chickpea varieties in relation to those currently grown in the HBT. However, assuming that input costs are approximately similar for old and new varieties, the fact that e. g., Bari chola 5 outyields 'local' by almost 35% means that appropriate new varieties are likely to be more profitable. Even where the cost of seed of the new variety is more than the local, extra yield and more market-friendly characteristics (resulting in a higher sale price) can result in better net returns from the new one (Table 3, data from PSP dossier, Rice fallow rabi cropping systems).

Table 3. Comparison of returns from a short-duration chickpea variety ICCV 2 and a local variety (Data from CRS, Satna, M.P., India).

Variety	Cost of seed (Rs. kg^{-1})	Sale price (Rs. kg^{-1})	Net returns (Rs ha^{-1})
ICCV 2	45	25	21330
Local	22	15	9530

(1 US$ = Rs. 45.5 approximately)

Two studies of the impact of chickpea as a new crop, but without explicit consideration of varietal effects, in the HBT are available:

Saha, A.K. (2002). Impact assessment study for the DFID-funded project R7540 '*Promotion of Chickpea following Rainfed Rice in the Barind Area of Bangladesh*'. CAZS Natural Resources, University of Wales, Bangor, UK.

Socioconsult (2006). Report on Impact Assessment Study of Chickpea in the High Barind Tract (HBT). Socioconsult Ltd., SEL Centre, 29 West Panthapath, Dhanmondi, Dhaka.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

Chickpea itself is the most consistently profitable crop that can be grown without irrigation after rice in the HBT (Saha, 2002; Socioconsult, 2006; Table 4 below). Evidence from elsewhere (Joshi and Witcombe, 1996) has shown that there can be large increases in total productivity and other advantages for resource-poor chickpea farmers who adopt new varieties through PVS. Participatory identification of ideotypes that inform successful breeding of additional new varieties (e.g. PSP dossier, COB horsegram and chickpea, eastern India) can lead to a virtuous cycle of PVS-COB-PVS that can impact positively on the livelihoods of poor people.

Table 4. Input costs and profitability (Taka/ha) calculated for mean and maximum yields of rainfed *rabi* crops in the HBT in the 2003-04 and 2004-05 seasons.

Crop	Input cost in both seasons	2003-04 season		2004-05 season	
		Profitability (mean yield)	Profitability (maximum yield)	Profitability (mean yield)	Profitability (maximum yield)
Wheat	17,545	39	23,202	9,338	21,849
Barley	18,571	5,324	31,649	-4,023	7,349
Mustard	12,029	13,051	29,683	907	11,731
Linseed	10,216	41	6,879	-617	3,855
Coriander	13,383	12,713	21,413	4,015	27,553
Chickpea	11,800	14,850	52,570	15,260	23,460

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

Use of PVS techniques that lead to higher and more stable chickpea yields would encourage further chickpea cultivation and the environmental benefits thereof, through increased “legume effects” such as longer-duration ground cover to minimise soil erosion, better soil health and increased fertility. Extra, nutritious fodder from chickpea could reduce pressure on common grazing areas.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

No adverse environmental impacts envisaged.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Lack of choice in life is a defining characteristic of poverty. The direct (higher yield, increased food security and income) and indirect (e.g., earlier harvest) benefits of better, more appropriate chickpea varieties give farmers and their families **more choices** and lead to more resilient livelihood strategies. In adition, regular use of PVS techniques would maximize chances of varietal adaptation to any climate change, thus permitting continued cultivation of chickpea and the benefits derived from that.

Annex

References

Joshi, A. & Witcombe, J.R. 1996. Farmer participatory crop improvement. II. Farmer participatory varietal selection in India. Experimental Agriculture 32:461-477.

Rogers, E.M. (2003). Diffusion of innovations. 5th Edition. New York: Free Press.

Stirling CM, Witcombe JR. 2004. Farmers and plant breeders in partnership. Second edition. Bangor (UK): Department for International Development (DFID), Plant Sciences Research Programme (PSP), Centre for Arid Zone Studies (CAZS), University of Wales. 38 pp.

Witcombe, J.R., Joshi, K.D., Gyawali, S., Musa, A. M., Johansen, C., Virk, D.S. & Sthapit B.R. (2005). Participatory Plant Breeding is Better Described as Highly Client-Oriented Plant Breeding. I. Four Indicators of Client-Orientation in Plant Breeding. Experimental Agriculture 41: 299-319.