Don’t neglect rainy season legumes in India

RIU

Validated RNRRS Output.

Blackgram and horsegram are important for poor indigenous farmers in eastern and western India. But they are largely ignored by officialdom. Even though there are recommended varieties, farmers can’t get seed. So they grow poor varieties that are prone to mildew and other diseases. Better varieties of horsegram have a huge potential for intercropping with maize in western India and rice in eastern India in the rainy season. They could provide additional food and fodder at little or no extra cost. But farmers can only abandon old varieties by saving seed of new varieties themselves. Others would also grow the better grams if they could get seed. Although there is major potential for grams to improve food and incomes, the only way to get seed at the moment is through a few schemes and NGOs.

Project Ref: **PSP08:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **CAZS-NR, UK**
Source: **Plant Sciences Programme**

Document Contents:

Description, Validation, Current Situation, Current Promotion, Impacts On Poverty, Environmental Impact, Annex,

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Description

Research into Use
NR International
Park House
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Geographical regions included:

India,

Target Audiences for this content:

Crop farmers,

PSP08

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 in rainy season legumes – improved agronomy and improved varieties for India.

Improved intercropping and improved varieties of blackgram (IU8-6) and horsegram (AK-42 and VLG 1)

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

Plant Sciences Research Programme. DFID India

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.

R8099, Programme development, Bilateral DFID India projects

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Dr M. Chakraborty, Dr J. Ghosh and Dr Y. Kumar

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.*

New varieties were tested with farmers in **participatory varietal selection** (**PVS**) that overcomes the limitations of traditional, on-station testing systems. A broader choice of **blackgram** and **horsegram** varieties was offered that were chosen to meet farmers' requirements for adaptation and quality. Methods of horsegram cultivation by intercropping with maize were tested with farmers. The outputs are:

Western India

- **IU8-6** blackgram (Telang et al., 2005; Joshi and Witcombe, 1988).
- **AK-42** horsegram (Witcombe et al., submitted).
- **Intercropping early-duration horsegram with maize**

Eastern India

- **VLG 1** horsegram suitable for late sowing for eastern India (Virk et al., 2006).

The research on blackgram with IU8-6 began in 1995 and it was released in MP in 2004.

The PVS with horsegram AK-42 began in 2002 and it was recommended in 2005 by the Central Variety Release Committee for Rajasthan, MP, Gujarat and Jharkhand. However, at the state level only Rajasthan has endorsed this recommendation.

Variety VLG 1 was tested in PVS from 2003 to 2005 in Jharkhand (it was already released for the Uttranchal hills in 1983) where, despite its superiority, it is yet to be recommended.

Table 1. List of outputs and primary characteristics (blackgram and horsegram varieties)

Output	**Special features**
Blackgram IU8-6 Western India	· Semi-spreading, medium in height · Early to mature (60-70 d) · Bold and shining grains (3.5 g per 100) · Moderately resistant to powdery mildew
Horsegram AK-42 (Pratap Kulthi) Western India	· Indeterminate type · Maturity 82-90 days · Brick red grains · Suitable for rainfed, undulated topography and for intercropping with maize
Horsegram VLG 1 (Viveknand Laboratory Gahat 1) Eastern India	· Determinate type · Maturity in 81 days · Seeds golden, shining and bold, 2.9 g per 100 · Suitable for late sowing under rainfed conditions.

In western India, resource poor, farmers of the indigenous tribes cultivate small areas of land in cleared forest in

drought-stressed, low-fertility fields. They grow blackgram as one of their most important legumes but grew only **low-yielding landraces** which were highly susceptible to powdery mildew disease (Joshi and Witcombe, 1998).

Horsegram is also grown but knowledge on its use is limited and it is only locally popular. Farmers only grew landraces that are very low yielding and late maturing. Given better varieties (earlier and higher yielding) horsegram has a huge potential in maize-based cropping systems where it can be **intercropped with maize** to help in **weed control**, **reduce labour demands**, and provide additional, nutritious, grain and additional **fodder** all at little or no extra cost.

In eastern India, poor farmers grow horsegram on sloping, degraded lands as a late rainy-season crop in the 'left over' fields where they could not sow any crop earlier. It provides additional nutritious food grain legume and quality fodder to the animals. Farmers only grow landraces that are very low yielding and late maturing because all released varieties mature late and hence are prone to end-of-season drought.

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*		*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

This output is focused on blackgram and horsegram but both are integral to maize-based farming systems in western India and both can help in increasing the profitability and sustainability of maize production.

In eastern India, the sole-crop cultivation of horsegram is by farmers who primarily follow a rice–based cereal cropping systems. As well as growing the crop in fields that were not sown earlier in the rainy season, it is also possible to grow horsegram as a relay crop in transplanted rice in medium and semi-deep rainfed lowlands.

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 fits completely with the new legume varieties produced by COB (PSP dossiers 14, 17) new maize varieties bred by COB (PSP dossier 15). It also fits well with new transplanted rice varieties identified by PVS and bred by COB (PSP dossiers 10 and 16).

The introduction of new varieties of legumes in the rainfed conditions can be linked with the rainfed *rabi* fallow projects (PSP dossier 35). It can be combines with seed priming (PSP dossiers 26 and 30).

In PVS, the new intervention is a crop variety which can combine with the testing of other interventions that are synergistic with new crop varieties, i.e., crop protection and improved crop agronomy interventions. Since farmers evaluate varieties for all traits including fodder quantity and quality then clustering with improved livestock nutrition would be synergistic.

PVS as a technique (PSP dossier 33) can be used for all crops in all farming systems and is an essential component of client-oriented breeding (PSP dossier 34).

Clustering can be done with the following RNRRS outputs:

CPP, Good seed initiative, R8480
CPP, Increasing food security and improving livelihoods through the promotion of integrated pest and soil management in lowland maize systems Phase II, R8452, R8215
CPP, Linking demand with supply of agricultural information, R8429, R8281
CPP, Strategies for feeding smallholder dairy cattle in intensive maize forage production systems and implications for integrated pest management, R7955
NRSP, Participatory Technology Development, R7412

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)****.*

In PVS, validation is always by the first end users of a new variety – farmers - in on-farm participatory trials with participatory evaluation (using many techniques e.g., matrix ranking, surveys,) of many traits important to farmers. The trials were always replicated to provide a test of statistical significance. Validation of yield increases of the blackgram and horsegram varieties was done by government organisations (State Agricultural Universities) in on-station trials. Agronomic trials followed similar methods to PVS and, indeed, horsegram-maize intercropping trials were more successful when combined with the testing of new maize and horsegram varieties.

The final step of PVS - the wider dissemination of farmer-preferred varieties - tests the acceptability of a variety on a much larger scale. Some wider dissemination of the three varieties has been done and this has confirmed their acceptability.

Validation was done by farmers working with researchers largely from the NGO, GVT, and State Agricultural Universities collaborating with GVT. In addition, state departments of Agriculture were involved to a limited extent as well as other NGOs. In western India, further validation is being undertaken by Madhya Pradesh Rural Livelihood Project (MPRLP) in MP and other NGOs such as Catholic Relief Services (CRS) in Rajasthan, Gujarat and MP; Action for Social Advancement (ASA) in MP, PRYAS, SARTHI, SEWA MANDER, DRDA; National Watershed Mission.

The target groups of male and female farmers were from all social groups representing resource rich, medium and poor farmers. Wealth categories (usually three) were determined through local informants using key proxies for wealth such as landholding size. Evaluation of PVS trials included participating farmers (with a representative proportion of women) and their neighbours, relatives and friends (this always included some women). The evaluation of the post-harvest traits always involved women. It should be noted that the wealth classes were relative within the village but when compared to other areas in India the vast majority of the participants, predominantly indigenous smallholder farmers, in Gujarat, MP, Rajasthan and Jharkhand would be classified as poor.

Substantial increases in productivity were achieved over the local and best modern cultivars in station and on-farm trials (Table 2). The benefits are more than simple grain yield increases because of the earlier maturity of the new varieties that has multiple benefits related to many aspects of the farming system (earlier harvest, reduced proneness to end-of-season drought, greater suitability for intercropping, greater suitability for late sowing). These benefits were recorded as perceptions in the on-farm trials (Table 3).

PVS methods usually involve the introduction of varieties from outside the state in which the trials take place. Some varieties exhibited great changes in the time of flowering in the local conditions. For example, VLG 1 horsegram variety matures in 125 to 130 days in Uttranchal hills but when tested in on-station and PVS trials it matured in 84 days in Jharkhand, one to two weeks earlier than Birsa Kulthi 1 (BK!) the modern check variety.

Table 2. Examples of yield increase of new varieties given in PVS trials

Crop	Where	When	Increase in grain yield (%)	Source
Blackgram IU8-6	Gujarat, MP, Rajasthan, India	2002-2005	20% over modern check variety in on-station trials.	Release proposal, JNKVV, 2004
Horsegram AK-42	Gujarat, MP, Rajasthan, India	2003-05	61% over local in farmers' fields (n=266)	Witcombe et al. (submitted) and reports
Horsegram VLG 1	Jharkhand, W. Bengal, Orissa, India	2002-2005	Up to 14% over modern check in station trials (n =9); preferred by farmers (n = 52)	Virk et al. (2006) and BAU reports
Horsegram/maize intercropping	Gujarat, MP, Rajasthan, India;	2003	69% farmers reported no loss in maize grain yield (n=22) so horsegram yield was a bonus	Witcombe et al. (submitted)

Table 3. Examples of improvement in traits other than grain yield

Crop	Improvement in traits other than grain yield
Blackgram	Grain quality (bold shiny grains) that fetch a higher market price), earlier maturity, resistance to powdery mildew
Horsegram	Earlier maturity, larger grain size and, for VLG 1, cream coloured seeds that are preferred over the colour of local alternatives

*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 work in western India has been centred on adjoining areas of three western Indian states; eastern Gujarat, southern Rajasthan and western Madhya Pradesh in the districts of Jhabua (MP), Panchmahals (Gujarat) and Banswara (Rajasthan). The region is the semi-arid tropics. These are hilly areas populated by very resource-poor farmers with land holdings that are small and fragmented. Maize is the main rainy season (*kharif*) crop of these areas and is grown as a rainfed crop by these farmers in low-fertility fields, often on sloping land that is vulnerable to soil erosion. Maize productivity is very low, averaging below 1 t ha^{-1}. Legumes form an important part of this maize-based farming system and in the *kharif* season these are blackgram and horsegram. Pigeonpea is also grown but it spans both the *kharif* and the post rainy season because of its very long duration.

In eastern India the research was in 13 districts of three states: Jharkhand (Ranchi, Palamu, Hazaribagh, West

Singhbhum, Kharsavan, Goda, Gumla, and Bukaro); Orissa (Dhenkanal, Keonjhar, Mayurbhanj); and West Bengal (Midnapur and Purulia). The on-farm validation primarily involved resource-poor farmers of the villages in which GVT was working. GVT east operates for the improvement of the livelihoods of 0.4 M people the majority of whom are smallholders (about 90% of farmers have < 2 ha), 40% of land is rainfed upland; 65% households live below the poverty line (BPL); livelihoods are based mainly on agriculture and migration for daily paid waged labour in big cities.

All testing was carried out under rainfed conditions in the semi-arid tropics in the years .

- 2002-2005 for blackgram IU8-6 in western India
- 2003-2005 for horsegram AK-42 in western India
- 2002-2005 for horsegram VLG 1 in eastern India
- 1995 to 2005 for horsegram-maize intercropping in western India.

Current Situation

C. Current situation

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

The outputs are being used by resource-poor farmers in the target areas described in detail in Q11. They have replaced their local landraces with the better varieties and have done so largely by seed saved from the previous harvest (farm-saved seed). Many of the adopters have obtained seed of the new varieties from their neighbours, relatives and friends. Blackgram is grown often as a cash crop so farmers are selling the grain of IU8-6 as a source of income. The market for horsegram is poorly developed so most of the grain is used by farmers for local consumption as *dhal.* In all cases, the stover from the crop is used as a fodder source for animals.

*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).***

See also question 11.

In western India, all adoption is in the semi-arid system. Blackgram is adapted to better environments than horsegram so the latter will be preferentially grown on the upper, more drought prone slopes. A small area (about 10%) of the total cultivated area is lowland with better soils and blackgram may be grown more in these areas as the crop responds more to better fertility. We have found that intercropping of maize with horsegram tends to be on the more marginal i.e., sloping lands where the provision of labour for weeding is more risky than in the better areas. Hence, farmers can benefit more from the reduction in weeding provided by this simple technology. In better areas, or areas that are too poor for maize, horsegram is grown as a sole crop.

In eastern India, all adoption is also in the semi-arid system. Horsegram is grown in the rainfed uplands of Jharkhand, Orissa, and W. Bengal. It is grown in fallow uplands where other rainy season crops could not be grown due to inadequate rains or late onset of rains or where the crop had failed due to lack of moisture. In the unirrigated uplands when rains are receding horsegram normally does not follow any crop and no winter season crop is grown after it. However, the variety identified has not spread because of little dissemination of either knowledge or seed. Horsegram in Jharkhand is grown on 29,000 ha with production of 22,000 t (0.75 t ha^{-1}).

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

Determining the scale of the current use of outputs is too early (particularly for horsegram) since large quantity of seed could not yet be produced and disseminated. The measurement of scale of use at an early stage requires considerable resources as it needs sampling of a large number of farmers to gain an accurate estimate. There have been no surveys that have adequately measured the rate of farmer-to-farmer seed spread although we have evidence that this is the case.

In western India 500 kg seed of blackgram variety IU8-6 has been distributed to about 100 farmers (Table 5). In horsegram, 690 kg seed of AK-42 was distributed to about 150 farmers. The target areas in western India are Jhabua district of MP, Dahod in Gujarat and Banswara in Rajasthan.

However, no seed of VLG 1 was distributed to farmers in eastern India except to the 20 farmers in the PVS trials. This is because no horsegram seed was produced by BAU or GVT.

Table 5. Quantity of seed (kg) of blackgram and horsegram varieties distributed to farmers by the GVT

Variety	2002 (kg)	2003 (kg)	2004 (kg)	2005 (kg)	Total quantity (kg)	No. of farmers
IU8-6 blackgram	250	250	-		500	100
AK-42 horsegram	-	150	540	100	790	152
		(Number)				
VLG 1 horsegram	12	3	5		-	20

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 factors of success? ***(max 350 words).***

The promotion of varieties in these poor parts of western India has been inefficient as the areas are remote, the purchasing capacity of the farmers is low, and the demand for seed unpredictable because it varies with the rains. Farmers also have limited access to the government extension services. They are supposed to visit the local farm science centre (KVK) but few farmers have the resources to do so. Front line demonstrations by Departments of Agriculture are few and conducted in more favourable agricultural environments. Hence, the main activities for

dissemination of seed have been through projects such as the western India rainfed farming (WIRFP) which has now completed. Ongoing projects include the Madhya Pradesh Rural Livelihoods Project (MPRLP) and District Poverty Initiative Programmes (DPIP), National Watershed Programme, Community Resource Centres under District Rural Development Agency. Also some NGOs such Action for Social Advancement (ASA), PRYAS, SAMARTHAN, that work in the area are interested in supplying seed of varieties that farmers prefer over the local landraces.

In eastern India the dissemination has been through the eastern India rainfed farming (EIRFP) which has now completed. Ongoing projects such as Western Orissa Rural Livelihood Project (WORLP) and programmes such as the Poorest Area Civil Society Programme (PACS) of Government of India and supported by DFID. The village Panchayats, Krishi Vigyan Kendras, National Agricultural Banking for Rural Development (NABARD), National Agricultural Marketing Federation (NAFAD), Council for Advancement of People's Action and Rural Technology (CAPART) exist in the area and can help in seed production and dissemination. The GOs such as the State Agricultural Universities and State Departments of Agriculture and several NGOs also have dissemination programmes. The GVT has collaboration with about 30 NGOs in Jharkhand, Orissa and West Bengal.

In eastern India, horsegram is a neglected crop and no agency is producing the seed. The seed is not available even for the recommended varieties. The BAU or other GOs do not produce seed of out of state varieties such as VLG 1. The only seed being multiplied is for validation in a modest number of trials. Also seed is not available with the originating institute (Vivekanand Institute of Hill Agriculture, Almora, and Uttranchal) for distributing to the farmers. Unless seed production is supported dissemination and scaling up of VLG 1 will be constrained and farmers will not benefit.

Clearly, there is a need for raising awareness of these new varieties and technology through existing networks. For promotion of adoption and capacity strengthening the following are required:

- Capacity building by training to GOs, GOs and farmer groups.
- Encouraging community-based seed production (see dossier 36).
- Creating awareness with the stakeholders through meetings, demonstrations and publication of literature for:
    - the new varieties
    - the intercropping of horsegram in maize and its use as a relay crop in transplanted rice
    - the role of legumes in human and animal nutrition and cropping sequence for maintaining soil fertility.

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).***

Several GOs and NGOs are promoting new seeds of various crops. However, little attention is given to the

promotion of minor food legumes such blackgram and horsegram. Organisations that are active in promoting new seeds are: bilaterally funded projects, KVKs, State Agricultural Universities, and State Departments of Agriculture.

In western India, promotion is currently taking place in 7 districts of MP, Gujarat and Rajasthan by GVT in conjunction with MPRLP and DPIP projects.

In eastern India GOs and other organisation such as Western Orissa Rural Livelihood Project (WORLP), Poorest Area Civil Society Programme (PACS) of Government of India and supported by DFID, KVKs are active.

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)****.*

A major problem has been a lack of continuity in the project-based approach to rural development in western and eastern India. DFID funded the WIRFP and EIRFP for many years but both have been completed. One possibility of replacing the role of these projects is an increased input from the private sector. However, for the formal private sector investments in more favourable agricultural areas are more profitable and this is exacerbated by the 'orphan' nature of crops such as blackgram and particularly horsegram where existing seed demand is low.

Working in a poverty-focused approach by establishing groups within villages to produce seed has been fraught with problems (low and erratic productivity. poor access to markets, poor infrastructure, and lack of training in the commercial - rather than the technical - aspects of seed production). There is a need to establishing groups in more favourable areas that are not too remote from the target areas and where emphasis is placed on training in commercial matters relating to the seed business.

Seed production by GOs is dependent on actual orders for seed (called indents) and the poor farmers cannot raise indents. GOs responsible for producing seed, such as the State Agricultural Universities, will not do so without an indent and the Department of Agriculture, and the extension system do not place indents for new varieties unless they are aware of them and know there is a demand for seed.

To influence the market by creating a demand a relatively large quantity of new variety needs to be produced. Fortunately the biology of these crops is favourable with low seed rates, high multiplication rates, and the ability to grow an off-season crop. This means that a large scale seed supply to farmers is required to bring sizeable area under its cultivation.

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).***

The most important factor to remove the barriers is to raise awareness of them at all levels (State Agricultural Universities, NGOs, Departments of Agriculture and the private sector). There is a lack of awareness of the new technologies, particularly because they are regarded as minor crops, but also a lack of awareness on the constraints to delivering them. Packaging the availability of all of the new, related technologies would be helpful (see for example Witcombe and Yadavendra, 2006).

There is one major remaining platform in western India, the MPRLP. Like all rural development programmes it is multifaceted and hence focus on important single issues such as the provision of new seed can be blurred. There is a need to raise awareness in this major platform of the possibilities presented by these new technologies.

Removing barriers is not as hard as it might appear from the limited current use of these varieties. There are several important advantages with these technologies in terms of their scaling up inherent in the biology of these small-grained legumes:

- Horsegram and blackgram can be multiplied in the dry i.e., summer season in western India. (VLG 1 is too photosensitive for off-season multiplication in Jharkhand but it is possible that this could be done in Orissa).
- There is hence little delay between seed production and seed sales.
- Two generations a year can be grown so seed production can be quickly geared up.
- The inherent rate of seed multiplication is high (100 fold).
- They are inbreeding crops so producing pure seed is straightforward.
- The amount of seed needed for sowing by farmers per hectare is low and even lower for intercropping.
- There are areas where these crops are locally popular and these can act as foci for the scaling up.

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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).***

Using Rogers (2003) 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 extremely high. The replacement of landraces in orphan crops such as blackgram and horsegram produces spectacular increases in grain yield. These yield increases add immensely to the attractiveness of a new cropping system such as horsegram/maize.

2. The compatibility of the technology with existing systems and ways of doing things, which is closely related to culture;
The compatibility of these technologies is extremely high and allows people to continue with there traditional farming systems.

3. The complexity of the technology in terms of what people need to learn to make it work;
The complexity is very low. For blackgram and sole-cropped horsegram the only change required is replacing the seed. Intercropping of various forms is already a common practice.

4. The observability of a technology in terms of how easy it is to demonstrate and observe performance;
The observability is high.

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.

Hence provision of a sustainable seed supply is the most important factor in getting this research into use.

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.

There are two papers on horsegram, one published and one submitted, that include descriptions of impact.

Virk, D.S., Chakraborty, M., Ghosh, J. and Harris, D. 2006. Participatory evaluation of horsegram (*Macrotyloma uniflorum* Lam Verdc.) varieties and their on-station response to on-farm seed priming in eastern India. Experimental Agriculture 42: in press.

Witcombe, J.R., Patel, N.B., Billore, M., Singhal, H.C., Saini, D.P., Meratia, P.S., Sharma, L.K., Tikka, S.B.S., Tomar, H.K., Yadav. S. and Yadvendra. J.P. 2006. Improving the nutritional security of low-resource farmers: Introducing horsegram into maize-based cropping systems. Experimental Agriculture (submitted)

These include impact at the level of individual farmers. They indicate high increases in total productivity with related advantages to the livelihoods of the resource poor farmers that are adopting them.

Financial analysis: Area and production for blackgram and horsegram are not available for most of states and districts. We illustrate the potential financial gains for only one district of MP (Jhabua) and for Jharkhand state (Table 8). For Jhabua district alone there will be a total gain of £0.86 million per year from the new varieties of the two crops. Farmers of Jharkhand state alone will accrue additional gains of £0.3 million per year. This analysis is based on very conservative assumption of 20% area under the new varieties and an increase of 30% in yield over landrace varieties. The added cost of cultivating the new varieties (the grain will initially be more expensive to purchase) is so small that it has been disregarded and is more than offset by other benefits such as more fodder and the higher grain quality (and hence market price) of the new varieties. .

Extrapolation of these analyses to all districts in western India will produce huge economic gains to the farmers in terms of enhanced returns. There will be additional benefits in western India if the horsegram is intercropped with maize in terms of increase in food grains per unit area, reduced expenditure on weeding, and improvement in soil fertility. In eastern India additional gains come from an increased area of cropping as the variety can be sown over a longer period of time (as early as alternatives as well as later in the season if there are late rains).

Table 8. Financial analysis for blackgram and horse gram for Jhabua district of MP and for horsegram for

Jharkhand state

Crop (place)	Area (000 ha)	Production (000 t)	Yield (t ha^{-1})	Additional production†† (t)	Economic benefit† (£)
Blackgram (Jhabua district)	81	58	0.71	3480	£0.8 million
Horsegram (Jhabua district)	11	4.4	0.39	263	£0.06 million
Horsegram (Jharkhand state)	29	22	0.75	1320	£0.3 million

††assuming 30% increased yield on 20% area of the area
† At a value of £241 t^{-1} (£ =Rs 83) and Rs 29,000 t^{-1}

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*

The provision of cheaper proteins improves the nutrition of poor farmers who can more often have a nutritious *dhal* with the daily meal of maize *roti* or rice.

The impact of intercropping of horsegram in maize was studied and it was found that it reduced the need of agricultural operations. In Rajasthan, where weedings were done more often in the sole crop, 9 out of the 10 farmers reported fewer weedings in the intercrop. In both Rajasthan and MP the frequency of intercultivation, was reduced particularly in MP (Table 6). Most farmers reported that intercropping with horsegram had not affected the yield of maize (Table 7).

In both states, farmers sold most of the grain of AK-42 in the market followed by home consumption and resowing with the smallest proportion being used as animal feed (Table 7). Less green fodder from weeds was produced in Rajasthan where the number of weedings was reduced. Most farmers reported that fodder availability was not reduced because they got nutritive fodder from the horsegram stover; all farmers used horsegram as a dry fodder after threshing of seed and none reported harvesting before grain production for fodder.

Table 6. Farmers reports on frequency of cultural operations, 22 farmers Rajasthan (Raj) and MP, rainy

season 2003.

Operation	Sole crop (number)		Intercrop (number)		Proportion with reduction (%)	
	Raj	MP	Raj	MP	Raj	MP
Ploughing	1.7	1.0	1.7	1.0	0	0
Weeding	2.3	1.0	1.2	1.0	90	0
Intercultivation	2.1	2.2	1.5	0.3	50	100

Table 7. Perception of ten farmers regarding use of horsegram seed and the effect of horsegram on main crop yield, two villages in Rajasthan, rainy season 2003.

State	Seed use (%)				Reduces maize yield (%)		Fodder reduced by less weeding (%)	
	Resowing	Sold	Consumed	Feed	Yes	No	Yes	No
Raj	29	38	24	9	30	70	20	80
MP	10	52	33	<1	33	67	0	100

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.

Direct and indirect benefits:

- The wide scale adoption of the PVS process will reduce national wastage associated with the breeding and testing of varieties that farmers would ultimately reject.
- Increased productivity per unit area without the use of additional external inputs especially pesticides is environmentally beneficial. The new varieties fix nitrogen and reduce the demands for inorganic N that is an important pollutant and its synthetic production is a significant contributor to global warming.
- Increased productivity will reduce the pressure to increase the area under cultivation (Evenson and Gollin, 2003).
- Varietal diversification will help reduce crop loss due to pests and diseases and thereby reduce the

use of pesticides. Introduction of new varieties has always increased on-farm diversity and in this case the diversity will be at the level of the crop if horsegram and blackgram increase in popularity and are grown in areas where previously there was a cereal monoculture.

- The better disease and pest resistance of the new varieties can reduce the use of water and soil polluting agro-chemicals. Reduced use of pesticides and insecticides will also reduce the risk to human life and will help in creation of a balanced pest-predator cycle.
- Horsegram is an ideal crop for reducing soil erosion. It covers bare soil when intercropped with maize, and can be grown on erosion-prone, upland, sloping soils.

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

Any adverse environmental impact is unlikely in the present case as the new varieties are scale neutral and do not require any special cultural, management and production input.

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)***

Earlier maturing varieties have increased the resilience of farmers by escaping end-of-season drought.

Varietal diversification is a means of coping with climate change. Intercropping reduces the risks from natural disasters such as diseases and pests and natural calamities as different crops have different susceptibilities to such stresses. The new varieties do well under drought-stress but respond to better conditions. This increases the capability of farmers to cope with natural risks. If PVS increases the number of varieties in a farmers' portfolio then this can reduce risk and increase options.

Horsegram is ideally suited to really harsh upland conditions where it reduces soil erosion and provides much higher biomass under harsh conditions than any other annual crop.

Annex

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