RAINFED AGRICULTURE IMPACT ASSESSMENT CLUSTER STUDY SYNTHESIS REPORT: 5 November 2009

by Czech Conroy

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Acknowledgements

This report draws on the seven individual case study reports that preceded it, and hence everyone who contributed to those has also contributed indirectly, if not directly, to this one. Those reports in turn were the products of survey work undertaken by local partner organizations: PROVA in Bangladesh; GVT, CRS and JDSSS in India; and FORWARD and LI-BIRD in Nepal. We are grateful to everyone who was involved in the fieldwork, including the hundreds of farmers who gave freely of their time. Staff of Bangor University's CAZS NR unit worked hard to clean and analyse data from the structured surveys and convert them into meaningful findings; while Dr Marlene Buchy played a similar role in synthesizing information from the qualitative fieldwork. Dr Sheelagh O'Reilly of IOD provided ongoing support in guiding the cluster study process over a period of about two years, and her colleagues at IOD also provided specialist support from time to time, as required. Others who have contributed valuable thoughts and time at various points in the process are: Michael Flint, Dr Roger Edmonds, Dr Carlos Barahona and Martin Whiteside. We are grateful to them all.

Abbreviations

ASA	Action for Social Advancement
BI	Bioversity International
CAZS NR	CAZS-Natural Resources
CBO	Community-based organisation
CBSPD	Community Based Seed Production and Distribution
CIMMYT	International Maize and Wheat Improvement Center
COB	Client-oriented breeding
CRS	Catholic Relief Services
DADO	District Agriculture Development Office
DoA	Department of Agriculture
DFID	Department for International Development
EIRFP	Eastern India Rainfed Farming Project
FORWARD	Forum for Rural Welfare and Agriculture Reform for Development
GVT	Gramin Vikas Trust
IARC	International Agricultural Research Centre
IOD	International Organisation Development
IRD	Informal research and development
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
NGO	Non-governmental organisation
PCI	Participatory crop improvement
PPB	Participatory plant breeding
PSP	Plant Sciences Research Programme
PVS	Participatory varietal selection
RIUP	Research into Use Programme
RNRRS	Renewable Natural Resources Research Strategy
SAU	State Agricultural University
WIRFP	Western India Rainfed Farming Project

Contents

EXECUTIVE SUMMARY

This study on Rain-Fed Agriculture is one of two studies that were undertaken as part of the Impact Evaluation Component of DFID's Research into Use Programme (RIU). The objective of this Component was to produce high quality evaluation evidence that significantly increases understanding of how 'research into use' can best contribute to poverty reduction and economic growth.

The study summarises the findings of seven case studies of the impact of agricultural innovations, which were undertaken in south Asia in 2008-2009. All of the case studies were related to research that was funded by DFID's Plant Sciences Research Programme (PSP). The case studies are seen as a cluster because they are closely related to each other: they are all entirely or primarily concerned with rainfed agriculture, and all focus on crop research (and development) undertaken in south Asia – 3 in India, 3 in Nepal and 1 in Bangladesh.

Within the cluster there are two sub-sets of case studies: one sub-set focused on new crop varieties (primarily rice varieties for cultivation during *kharif,* the monsoon season) and the processes (broadly termed participatory crop improvement) by which these were developed or identified; and another sub-set (called 'rainfed rabi cropping') concerned with work on facilitating and improving the growth of a second crop in the winter (*rabi*) season.

The seven case studies have been produced and submitted to RIU and this cluster study report provides a summary and synthesis of the main findings from them. Five of the case studies were on technological innovations and two of them on process (institutional) innovations, as shown in the following Table.

Table Summary of the Innovations Studied, by Country

Country	Technology case studies	Processes case studies
India	1.Improved rice varieties* 2. Rainfed rabi cropping	Participatory varietal selection & Client-oriented (plant) breeding
Nepal	1.Improved rice varieties* 2. Rainfed rabi cropping	Participatory varietal selection & Client-oriented (plant) breeding
Bangladesh	1.Improved rice varieties*	

* derived from processes in 2nd column

Improved rice (Ashoka) varieties in India

Two similar rice varieties – Ashoka 200F and Ashoka 228 – were developed through COB. The study was carried out in 5 districts (of 4 states) in which Ashoka seed had been distributed in 2002/3. Almost all of the 200 users of the Ashoka varieties interviewed were found to be poor, and a majority were tribals. The varieties appear to be very well suited to the needs and limited resources of resource-poor farmers. Half of the users interviewed had not received Ashoka seed directly from development projects: they had chosen to grow Ashoka varieties and had managed to acquire the necessary seed independently. The other half had continued to grow Ashoka for several years after they had received it from two development projects.

Better quality grain was the benefit ranked highest by most farmers, followed by earlier harvest and then better quality fodder. In addition, about half of the farmers identified ‘more rice’ (i.e. higher yield) as a benefit. The vast majority of Ashoka grain was kept for home consumption. Ashoka growers experienced a mean increase in rice self-sufficiency of almost one month, or 17%, and this was reflected in the higher reported grain yield of the Ashoka varieties.

Anecdotal evidence suggests that the shorter duration of the Ashoka varieties compared to others is associated with greater resistance to drought. The increase in grain self-sufficiency has resulted in a decrease in grain-related expenditure, which frees up households’ scarce cash for other uses (e.g. sending children to school).

In the study villages, 14 to 53% of households grew the Ashoka varieties on 2 to 24% of the total rice area, depending on the district and village. There has been high village-to-village spread of Ashoka seed by farmers. Extrapolating from the sample to the district and state levels, it was estimated that about 177,000 farmers were growing approximately 26,600 ha of Ashoka varieties in the five study districts. If farmers adopt the Ashoka varieties to a similar extent across the four states that were studied (Rajasthan, Jharkhand, Orissa, West Bengal) then about 420,000 ha would be devoted to them by the 2,800,000 households.

Several factors influencing the extent of use of the varieties were identified. These can be grouped into two categories: (a) those preventing or discouraging use, and (b) those leading farmers to choose other crop-related options. The former include difficulty in accessing seed and associated extension services. The latter include: agro-ecological conditions for which other rice varieties are more appropriate; and crop options that give better returns.

Rainfed rabi cropping in India

All users and non-users were poor: there were no significant differences between users and non-users. The target domain for the RRC technology package was zones in which there were extensive rice fallow areas during the rabi season, prio to any intervention. The 30 villages surveyed in this study were subsequently found not to be representative of the target domain, in that rabi cropping was already widely practised. Despite this, there was appreciable adoption of one of the RRC technologies, viz. short duration Kabuli chickpea (KC). User households grew it on an average of 0.19 hectares, which represents almost 30% of the land potentially suitable for chickpea. Amounts of chickpea grain produced per household were small, but there is evidence that households are saving enough seed to maintain this area of KC cultivation so adoption can be said to be sustainable. The two most important benefits of KC cited were ‘increased consumption of legumes’ and ‘better health’.

There was a positive interaction between growing Ashoka rice and being able to sow KC earlier. Previous research has shown that early-sown chickpea yields better than that sown later. Hence the promotion of Ashoka and KC together represents a positive synergy at the level of the overall cropping system. Elements of the RRC package other than KC (e.g. rapid minimum tillage, seed priming) were not adopted at all, implying a deficiency in the training programme.

Improved rice varieties in Nepal

The study focused primarily on the use of nine improved rice varieties (1 identified through PVS, 8 developed by COB). A high proportion of the 344 survey households using these varieties were poor, which suggests that at least most of the varieties are very well suited to the needs and limited resources of resource-poor farmers. Non-users were, on average, only slightly poorer than users, and were ethnically similar to them, which suggests that being poor is not a barrier to becoming a user and remaining one.

Farmers' reported benefits varied according to the variety and included: increased grain yield, increased straw yield, better grain quality, and earlier harvest. About 75% of farmers who were growing any improved variety reported an increase in rice grain sales (by an average of about 300 kg) or increased rice self sufficiency (by an average of about 2 months' supply); whereas non users did not. Many farmers have made a shift from only growing rice in the main (kharif) cropping season to growing rice in the spring season as well, due to the use of shorter duration varieties in the main season and the availability of a suitable variety for the spring season.

Eight (out of 11) COB varieties were found to be grown by at least 1% of all 2,222 households identified in the group discussions. The *overall* proportion of land devoted to these varieties among the users was 15%. A range of the varieties had been adopted for upland and lowland rice ecosystems by an average of 17% of all the households in the 36 study villages.

High rates of spread of seed and information were found, and current use of the eight varieties in the six study districts was 15 times higher than the amount of seed that had been supplied in these districts since 2002.

Rainfed rabi cropping in Nepal

Virtually 100% of the 287 users covered by the household survey were poor; and non-users were significantly poorer than users*.* The fact that a high proportion of the households users were poor implies that at least most of these technologies are well suited to the needs and limited resources of resource-poor farmers. However, the significant difference in poverty status between users and non-users suggests that some of the poorest farmers *might* be facing challenges in using or accessing some of the RRC technologies[1].

User households reported that household food grain self-sufficiency had increased by about three months since project crop varieties (rice, chickpea and mungbean) had first been used. This had resulted in a decrease in food-related expenditure. Many farmers said that their agricultural knowledge had also increased – e.g. in soil fertility management, including organic approaches and organic pesticides – thanks to the technical support of the local NGO partner, FORWARD.

Land suitable for growing the main rabi crops promoted by the project, *chickpea and mungbean,* was less than that which is suitable for rice cultivation, so production per household of these crops was low. The proportion of households growing *mungbean* in the survey villages in 2 of the 4 study districts has been steady at around 30-40%. Additional information about extent of use of other RRC technologies in the survey districts can be found in sub-section 3.5.4 of this report. This study did not estimate use levels beyond these four districts.

A limited amount of information suggests that for all three crops (rice, mungbean, chickpea) the number of households using new varieties, and the area of land that each household sows, are at least being maintained and may be increasing.

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[1] There are other possible explanations for this difference, which are discussed in the main body of the report.

Improved rice varieties in Bangladesh

A rapid impact assessment was done in the High Barind Tract on the use and benefits of three short-to-medium duration rice varieties bred in RNRRS projects in Nepal using client-oriented breeding. The study was implemented in 24 villages (of 3 districts) in which seed of the varieties had been distributed, using semi-structured group discussions.

Of the three varieties studied, two were being grown during two seasons, *t. aman* and *boro* - one on upland and medium lands and the other on medium and lowland. These use patterns were mainly determined by the crop duration of a particular variety fitting to a particular domain. Use of the third variety had been declining as it lacked any obvious advantage over the existing farmers' varieties or the other two COB ones.

In around one third of the group discussions, the participants reported increases in rice yield of about 30%. Increased availability of food was reported in almost all the discussions, and in most group discussions participants also mentioned better nutrition as a benefit. Participants in about a quarter of the group discussions reported that increased integration of *rabi* crops, made possible by the introduction of short duration rice varieties, had contributed to a 100% increase in cropping intensity in more than 50% of previously fallow land.

Participatory Crop Improvement Processes in India and Nepal

These studies looked at two process innovations developed and promoted by Bangor University's CAZS NR unit with PSP funding: Participatory Varietal Selection (PVS) and Client-Oriented Breeding (COB), the latter being more commonly known as participatory plant breeding (PPB). Surveys of PVS and COB use were undertaken in India and Nepal.

Participatory Varietal Selection PVS involves: finding and experimenting with a number of potentially suitable cultivars (identified by farmers and researchers) in farmers' fields under farmers' input and management conditions, and then disseminating the farmer-preferred one(s) more widely.

PVS has been extensively used in India by CAZS NR's NGO partners, GVT and ASA; and also by three state government projects in Madhya Pradesh and Bihar. GVT estimates that it has involved at least 110,000 farmers in trials on cereal crops, while for legume trials (on nine crops) the GVT estimate is at least 112,500 farmers in total. Corresponding ASA estimates are about 6,500 farmers on cereals and 7,000 on legumes.

In Nepal PVS has been used in at least 45 of its 75 districts, by six government agencies and six NGOs.During the period 1995-2008, nearly 45,000 farmers were directly involved in PVS/COB processes with the organisations covered by the study, on a wide range of crops. About 2/3 of these farmers were engaged by the NGO LI-BIRD, a partner of CAZS NR. Most farmers were involved in testing varieties of rice (19,658) and maize (11,717). Nearly all of the rice farmers (18,772) were engaged by LI-BIRD: this figure is conservative and a different approach to calculating the number gives a total of 72,061 farmers.

PVS has been significantly institutionalised in Madhya Pradesh and Nepal, including within the public sector.

Client-oriented breeding can build on the results of PVS as it can identify suitable parental varieties for crossing. It involves: (i) breeding new varieties of a crop, involving farmers and other clients at appropriate stages, that have the combination of traits desired by the client farmers, by crossing parent cultivars that have the potential to produce the desired combination; (ii) carrying out the selection of them under agro-ecological and management conditions closely matching those of the client farmers; and (iii) testing the resultant new varieties for various traits in PVS trials with client farmers.

GVT is the only Indian NGO that has been involved in COB/PPB. This work has been done primarily in collaboration with SAUs. GVT's COB/PPB has covered seven crops, while the SAUs have applied it to five crops between them. In Nepal, only two of the six public sector organisations involved in PVS have also been undertaking COB/PPB, covering three crops. Three NGOs have been conducting COB/PPB, also covering three crops between them.

Use of COB/PPB by public sector agencies (NARIs, universities) to develop new varieties has virtually stopped in both countries and the two studies analyse the reasons for this. These include:

- Lack of acceptance of its scientific credentials vis-à-vis conventional plant breeding
- Perception that it has higher **costs** than conventional plant breeding
- Scepticism and perceived lack of quantified evidence about likely size of **benefits** of PPB, in terms of number of users of a variety.

Lessons and Insights from Institutional Innovation Case Studies

PVS has been implemented and institutionalised to a far greater extent than PPB. The main reasons seem to be that PVS:

- has lower costs
- has lower skill requirements
- produces visible benefits much more quickly
- is less subject to government regulations and hence more open to NGO involvement
- appears to be less threatening to/competitive with existing practices.

Lessons and Insights from Technology Innovation Case Studies

The development and dissemination of the Ashoka rice varieties was made possible by contributions (financial and in-kind) from three sources: DFID bilateral development projects; supplementary funding from PSP programme development (PD) funds; and PSP project funding. The level of impact shown in this case study could not have been achieved solely with the level of funds typically provided for a RNRRS research project; nor in the period of time for which RNRRS funding was typically provided.

The widespread use and quite rapid rate of spread of the Ashoka varieties (bred using COB) provides evidence that COB/PPB is capable of producing crop varieties suitable for marginal environments, something that conventional breeding has failed to do in India; and that it can be an effective replacement of conventional plant breeding for such agro-ecological conditions. A wider use of the COB/PPB approach for these conditions is needed for poverty alleviation, and perhaps now for climate adaptation too.

However, to influence policy additional evidence is needed, at least in India. It would be desirable, therefore, for RIU to commission a further study on another COB/PPB variety – for example, on the impact of GM 6 maize. Evidence from the two case studies (Ashoka and a second) could provide the basis for a thorough comparative cost/benefit analysis of COB/PPB and conventional breeding.

General Lessons for Research and Innovation

Issues related to RNRRS funding for agricultural research

Separating research from extension and dissemination The division between RNRRS research funding and development funding makes it more difficult to achieve development impact. In India the PSP rice research was able to link up with the DFID-supported WIRFP and EIRFP – but such linkages were not possible in Nepal or with the RRC work in India.

Most of the seed dissemination work in Nepal, India and Bangladesh was not funded by RNRRS projects; but in a couple of cases RNRRS rules were 'bent' to facilitate dissemination.

RNRRS marginalisation of capacity building was a significant constraint for most of the PSP research on rainfed agriculture reviewed in these studies. The consequences are particularly apparent in relation to the non-sustainability of COB/PPB in public sector research organisations in India and Nepal.

Projects versus programmes Each RNRRS programme funded quite a large number of relatively small (budget of say £100,000 – 200,000) research projects on specific topics, whose typical duration was quite short - about three years. Thus, no one project on its own was likely to have a significant and lasting effect. One of the reasons why the PCI and RRC research has tended to be relatively successful is that the PSP Manager: (a) increased the duration of research, by funding *successive* projects; and (b) supplemented the *project funding* with *programme funding* that was more flexible.

Factors contributing to the impact of PSP research outputs

The important contribution of non-project funding Much of the impact of the innovations studied in the various case studies is to a large extent due to non-project funding, which enabled the researchers to overcome constraints imposed by RNRRS regulations. The non-project funding came from (a) PSP programme funds and (b) bilateral development funds, and more recently from the Rockefeller Foundation.

Going beyond research Despite the lack of institutionalisation of COB/PPB, it is evident that the PVS and COB/PPB projects funded by DFID's RNRRS programme have had a substantial impact in India and Nepal. The fact that they were able to do so (directly or indirectly) is quite remarkable. However, in future research programmes (as in the RIUP) that attach priority to achieving impact there should be an explicit recognition and acceptance that influencing and improving the innovation system within which research projects function is a legitimate and important activity for those projects.

The importance of flexibility and opportunism In some PSP projects in Nepal important actions/initiatives were taken that were not envisaged in the original project logframe. A key lesson here is the need for flexibility on the part of project staff and programme managers to respond to new insights and circumstances.

Benefitting the poor through agricultural innovation

The very poorest people, such as the landless and those with disabilities, do not benefit directly from crop production interventions, although they may benefit indirectly from increased agricultural labour or lower food prices. The technologies studied here have mainly benefitted resource-poor farmers (RPFs). It is clear from the studies that there are no silver bullets – no technological panaceas – in RPF agriculture. For RPFs with limited arable land, even quite large relative benefits from crop-based interventions will not be large enough in absolute terms to make much of an impact on poverty. RPFs, with their diversified livelihood strategies, will also need non-agricultural improvements to enable them to move out of poverty.

Nevertheless, this set of case studies has shown that demand-led crop-based and other agricultural improvements can make a significant impact on household food security.

1. INTRODUCTION AND OVERVIEW

1.1 DFID Research into Use Programme

1.1.1 Rationale for the RIU

The RIU programme was commissioned by DFID in 2006 to capitalise upon the achievements of DFID's past and current research in renewable natural resources. Whilst there have been some high profile success stories under the RNRRS, the full impact potential of many more research outputs has yet to be realised.

The RIU aims to draw upon a rich legacy of technologies, policies and processes developed by the previous agricultural and natural resources research programmes funded under the RNRRS which ran between 1995 and 2006. The RNRRS was organised as a number of subject-based research programmes (e.g. crop protection, forestry livestock) covering the needs of people dependent on natural resources (agriculture, forests, livestock, water resources) for their livelihoods. The breadth of the strategy reflected the wide variety of environments in which poor people live in poorer countries and the multiple routes by which research can reduce poverty. Whilst the RNRRS provides a rich dataset from which to draw, the RIU recognises that natural resources research from other sources is also likely to add value to its work.

1.1.2 Objectives of the RIU

The RIU purpose is two-fold: "to maximise the poverty-reducing impact of the RNRRS and other research, and by so doing, to increase understanding of how the promotion and widespread use of research can contribute to poverty reduction and economic growth". This would be linked particularly to delivery of Millennium Development Goal (MDG) one (eradicating poverty and hunger), MDG three (promote gender equality and empower women), MDG seven (ensuring environmental sustainability) and MDG eight (delivering a global partnership for development).

The core hypothesis of the RIU is that "an innovations systems approach will prove more effective than linear approaches at getting research outputs into use for the benefit of the poor."

RIU's emphasis on impact assessment and learning has two main origins: first, the need to know more about why natural resources research has not been more used and useful, and how a focus on use can speed up adoption and spread the benefits for the poor; and second, the limited available evidence of the impact on poverty of past research programmes.

RIU seeks to address both these gaps. The programme's purpose includes the ambition that RIU will 'increase understanding of how the promotion and widespread use of research outputs can contribute to poverty reduction and economic growth'. Between 2007 and 2009 RIU had three Outputs, with the first focusing on achieving 'significant use' of research outputs, the second focusing on monitoring, impact and learning and the third on wider dissemination.

The RIU Programme foresaw an opportunity for work understanding scale up and impact based on RNRRS activities which could take place alongside the operationalisation of RIU

Programme activities. This ‘impact evaluation activity’ was designed to provide the major part of the evidence needed to add significantly to research-into-use understanding. It addressed specific evaluation questions, and was based on consistent, comparable and rigorous studies in DFID PSA countries. While its primary focus was expected to be on RIU initiatives and RNRRS outcomes, some work on non-DFID research-into-use efforts, and related work on sectors other than natural resources, may be included. The aim is to produce and maintain an evolving research-into-use ‘evidence output’ based on RIU and other evaluations. Assessing the different impacts of research outputs on different groups is a key objective of part of the work.

1.1.3 Development of the Impact Evaluation Component

The objective of the Impact Evaluation Component was to produce high quality evaluation evidence that significantly increases understanding of how ‘research into use’ can best contribute to poverty reduction and economic growth. The impact evaluation component sought to answer the following questions:

- For an intervention (technology, process, communication instrument etc) the key questions are **what worked, where, for whom and why (or how)**? [2]

- Understanding this, through a robust comparative analysis, can then lead to developing approaches that answer the question **‘Will it work here?**’ i.e. what pre-conditions are necessary, and can they be put in place to enable other locations (countries, villages, communities, individuals) to assess whether a successful innovation elsewhere can be adopted/adapted to suit local conditions.

In the early stages of the RIU programme all previous RNRRS programme managers were asked to complete a ‘proforma’ around those projects within their programme that were likely to have the most significant ‘pro-poor impact’. These proformas (almost 300) formed the basis of the RIU database on natural resource knowledge. The impact evaluation team decided that this would provide an initial set of projects to use for a stronger evaluation process which would lead to the selection of at least two key impact studies (Balogun, 2007). This process involved filtering the 278 research outputs, which were reviewed against 2 broad criteria - pro-poor impact and whether the work was in the RIU target area, i.e. sub Saharan Africa, South and South-East Asia.

Six outputs/clusters were identified as feasible for the first phase of case studies, taking into account the quality of secondary data and the level of activity / cooperation from key stakeholders. (A further 9 outputs / clusters were also recommended for consideration during a second phase of case studies.) From these 6 clusters two were selected for detailed work because they:

- Offered an opportunity to undertake work with teams that were ‘intact’ in country and where work was continuing from other sources thus facilitating the impact study directly;
- Offered, in the case of one study (Stamp out Sleeping Sickness) to contribute to a ‘real time’ monitoring and evaluation whilst understanding the detailed historical and institutional setting that enabled the work to proceed.
- Provided very different subject matter and situations in which the work was being scaled out.

Further details about the two case studies selected are given in Table 1.1.

[2] One of the key items to a realist approach to evaluation put forward by R. Pawson (2006).

Table 1.1 Details of the Two Studies

Issue	Rain Fed Agriculture	Stamp out Sleeping Sickness
Active and engaged UK partners	CAZS NR at Bangor University	Edinburgh University
Ongoing activities with active partners	Yes – NGO partners in India, Bangladesh and Nepal with work continuing especially around the seed supply system	Yes – University and Government linked with through MOUs for a public private partnership
Extended timeframe	Yes work had been undertaken over a 20+ year period	Yes work had been undertaken over a 15+ year period directly in Uganda.
Pro-poor impact	Identified generally and in India through the identified target group i.e. tribal communities.	Sleeping sickness outbreaks were occurring in areas with high levels of poverty in a country with high poverty levels (Uganda)
Area of operation	Linking plant breeding using Participatory Varietal Selection and Client Oriented Breeding leading to new rice varieties (India and Nepal) with, where appropriate, changes in farming system including introduction of rain-fed rabi cropping and other measures to increase productivity.	Development of diagnostic approaches leading to greater understanding of the role of the cattle reservoir in Human Acquired Trypanosomiasis. Focus on control of an acute outbreak with implications for management through combination of block and restricted application of drugs with a public/private sector delivery mechanism.
Data available	Extensive archive of material which was drawn together during scoping phase. Could be linked to wider institutional studies	Extensive material available which could be linked to institutional studies.

In designing the management of the individual studies there was a balance between (a) independence and (b) ensuring that there was significant input from those stakeholders who retained high levels of tacit or codified knowledge. The approach taken was to recruit an independent case study management team who then worked with a key informant team in the UK (Edinburgh or Bangor University). The key parameters for each case study were as follows:

1. **Each study comprised four sets of actors**:
   - Study management team
   - Key informant team – UK
   - Key informant team - in-country partners
   - Other inputs/consultants for specialised support and studies.

2. **Each study was expected to deliver (deliverable areas) on the following areas**:
   - **PRO-POOR IMPACT:** Disaggregated (where possible) pro-poor impact assessment and analysis including issues of stability of gains made;
   - **INNOVATION SYSTEM ANALYSIS**: An analysis of the innovation system and the areas that supported/hindered etc the development and introduction of the innovation;

- **INSTITUTIONAL ANALYSIS:** An historical institutional analysis covering the time line of the research to research into use to (if appropriate) mainstreaming of the innovation.

1.2 Rain Fed Agriculture Cluster Study

This cluster study summarises the findings of seven case studies of the impact of agricultural innovations, which were undertaken in south Asia in 2008-2009. All of the case studies were related to research that was funded by DFID's Plant Sciences Research Programme (PSP), one of the 10 RNRRS programmes. The PSP's Programme Manager was Professor John Witcombe of Bangor University's CAZS NR.

The case studies are seen as a cluster because they are closely related to each other: they are all entirely or primarily concerned with rainfed agriculture, and all focus on crop research (and development) undertaken in south Asia – 3 in India, 3 in Nepal and 1 in Bangladesh. Within the cluster there are two sub-sets of case studies: one sub-set focused on new crop varieties (primarily for cultivation during *kharif,* the monsoon season) and the processes (broadly termed participatory crop improvement) by which these were developed or identified; and another sub-set concerned with work on facilitating and improving the growth of a second crop in the winter (*rabi*) season. The two sub-sets are related, however, as crop varieties from sub-set one are generally short duration ones, which itself facilitates the growing of a *rabi* crop since it enables the farmer to plant the second crop earlier when there is more residual moisture in the soil from the monsoon season.

This Cluster Study (and the other case - Stamp out Sleeping Sickness) was managed on behalf of RIU by International Organisation Development (IOD). IOD contracted inputs from the following partners:

Study management team: (Czech Conroy, manager; Dr Marlene Buchy, advisor on qualitative methods);

Key informant team – UK: CAZS-NR, Bangor University (Prof John Witcombe, Dr David Harris, Dr Daljit Virk, Dr Krishna Joshi);

Key informant team – in-country partners (sub-contracted by CAZS NR): (India: Gramin Vikas Trust and Catholic Relief Services (and one CRS local NGO partner); Nepal: LI-BIRD and FORWARD; Bangladesh, PROVA);

Other (local) consultants were recruited in India and Nepal, including two Local Field Coordinators (LFCs) and two consultants for the institutional innovations survey work. Statistical advice was contracted from two UK-based statisticians.

Table 1.2 Summary of the Innovations

Country	Technology case studies	Processes case studies
India	1.Improved rice varieties* 2. Rainfed rabi cropping	Participatory varietal selection & Client-oriented (plant) breeding
Nepal	1.Improved rice varieties* 2. Rainfed rabi cropping	Participatory varietal selection & Client-oriented (plant) breeding
Bangladesh	1.Improved rice varieties*	

* derived from processes in 2nd column

1.2.1 The Innovations

Five of the case studies were on technological innovations and two of them on process (institutional) innovations (see Table 1.2). The seven case studies have been produced and submitted to RIU and this cluster study report provides a summary and synthesis of the main findings from them. The case study titles are shown in Table 1.3.

Table 1.3 Rainfed Agriculture Impact Assessment Case Studies

Number	Title
1	New Upland Rice Varieties for India
2	New Rice Varieties for Nepal: Outcomes of Client-Oriented Breeding or Identified by Participatory Varietal Selection
3	New Rice Varieties for Bangladesh from Client-Oriented Breeding
4	Rainfed Rabi Cropping in Rice-fallows of Nepal
5	Institutional Innovations and India's Crop Improvement System
6	Institutional Innovations in Nepal's Crop Improvement System
7	Rainfed Rabi Cropping in India

The Technological Innovations In the studies on improved rice varieties the precise nature of the varieties varied from country to country. There were also some inter-country differences in the RRC technologies. (See Table 1.4 for details.)

Table 1.4 Details of the Technologies in Each Case Study

Country	Technology case studies	Details of Technologies
India	1.Improved rice varieties	*COB varieties*: (i) Ashoka 200F (ii) Ashoka 228
India	2. Rainfed rabi cropping	• New, short duration (Kabuli) chickpea varieties; • Rapid, minimum tillage; • 'On-farm' seed priming; • Ashoka rice varieties
Nepal	1.Improved rice varieties	*COB varieties*: Barkhe 1027, Barkhe 2014, Barkhe 3004, Judi 572, Barkhe 2001, Barkhe 2024, Sugandha 1 and Sunaulo Sugandha. *PVS variety*: BG 1442
Nepal	2. Rainfed rabi cropping	Many technologies were involved, and can be grouped as follows: • new rice varieties, often the products of client-oriented breeding produced in sister projects; • new chickpea varieties; • new mungbean varieties; • 'on-farm' seed priming; • Improved composting; • Integrated Pest Management (IPM); • Integrated Plant Nutrient Management (IPNM).
Bangladesh	1.Improved rice varieties	*COB varieties*: (i) Judi 567 (ii) Judi 582 (iii) Barkhe 3004

1.2.2 The Institutional Innovations

Research undertaken by Bangor University's CAZS-NR and its partners in India and Nepal, funded by DFID's Plant Sciences Research Programme, utilised and promoted participatory varietal selection (PVS) and client-oriented breeding (COB) (more commonly known as participatory plant breeding (PPB)) to identify crop varieties that scored highly against farmers' criteria and were suitable for farmer conditions, particularly those of resource-poor farmers.

As defined here, PVS involves finding and experimenting with a number of potentially suitable cultivars in farmers' fields under farmers' input and management conditions, before disseminating the farmer-preferred one(s) more widely. Thus, it can be done independently of PPB, or as an integral part of PPB[3]. PPB involves:

- breeding new varieties of a crop, involving farmers and other clients at appropriate stages, that have the combination of traits desired by the client farmers, by crossing parent cultivars that have the potential to produce the desired combination;
- carrying out the selection of them under agro-ecological and management conditions closely matching those of the client farmers; and
- testing the resultant new varieties for various traits (e.g. grain quality, organoleptic testing) in PVS trials with client farmers.

In Nepal CAZS NR's main local partners were two NGOs, LI-BIRD and FORWARD. DFID funded research on participatory crop improvement (PCI)[4] in high potential production systems during the period 1996-2003; and then two research projects on PPB (1998-2005), the second of which also involved the Nepal Agricultural Research Council (NARC) and Department of Agriculture (DoA) as partners. Some PCI work had already been done before 1996, particularly at Lumle Agricultural Research Centre. (For further details see Conroy and Adhikari, 2009.)

In India CAZS NR had two main local partners for its PVS and PPB work, both of which were NGOs, namely Gramin Vikas Trust (GVT) and Action for Social Advancement (ASA). GVT was the implementation agency for two major DFID-supported rural development projects, namely the Western India Rainfed Farming Project (WIRFP) and the Eastern India Rainfed Farming Project (EIRFP). WIRFP operated in a number of contiguous districts of three states, namely Gujarat, Madhya Pradesh and Rajasthan; whereas EIRFP operated in various districts of Jharkhand, Orissa and West Bengal. The EIRFP collaborated with Birsa Agricultural University; Ranchi, while in western India GVT's main partners in this work were four State Agricultural Universities:

- Anand Agricultural University (AAU), Gujarat
- Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Madhya Pradesh
- Maharana Pratap University of Agriculture and Technology (MPUAT), Rajasthan
- Sardar Krishinagar Dantiwada Agricultural University (SDAU), Gujarat.

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[3] Some people define PVS in such a way that it cannot be done independently of PPB – i.e. as "a component process within PPB" (Walker, 2007).

[4] PCI includes PVS and PPB and also other participatory approaches to crop improvement, such as Informal Research and Development.

1.3 The Cluster Study Questions

The Rainfed Agriculture cluster study aimed to obtain information about the above-mentioned innovations that would provide answers to the questions listed below.

Extent of use of innovations To what area of land are individual farmers applying the innovation, and in which season(s)? How many farmers (or other innovators) are using the innovation – in a given village, administrative block, district etc?

Who is using the innovation and who is not Who (by type – e.g. poverty status, gender, main socially excluded group) has innovated? Who has not? What is the difference between users and non-users?

Impact of innovations What are the impacts (i.e. the positive and negative changes attributable to the innovation) for each sub-category of the population? (e.g. changes in consumption, income or employment).

Factors explaining extent of innovation (factors influencing adoption/use) What explains the extent of innovation; and who the innovators are? What are the factors that enabled/hindered the use of the innovation?

Factors explaining differential impact among potential users/innovators If some groups are experiencing greater impact from the innovation than others, what are the reasons for this?

Sustainability of use of innovations by farmers Has the innovation been used by specific individuals or groups for a sustained period of time? If not, what factors have resulted in its use being discontinued?

Lessons for policy and practice What can governments and development agencies do to make innovation work better for the poor?

In 2001, Robert Tripp assessed the state of knowledge then in relation to participatory plant breeding as follows:

> “Most of the efforts at decentralised plant breeding are less than a decade old and it is difficult to present any firm conclusions about their performance … No matter how successful decentralised plant breeding may be in identifying useful new varieties, a number of questions still remain to be answered. As yet we have little information on whether participatory plant breeding for many isolated and presumably distinct environments will yield a significant number of varieties with superior productivity. And, even if the results are positive, it is not clear how such processes can be scaled up to meet the needs of hundreds of other environments.. In addition, the identification of a new variety is of little use unless there is a mechanism for seed diffusion… [whether] farmer-to-farmer movement of seed … is capable of providing effective access to, and information about, location-specific varieties from participatory programmes is much in doubt. These questions will not be answered, however, until there is documentation on the adoption of varieties developed through these techniques and analysis of their costs” (Tripp, 2001).

The reader is invited to consider to what extent the findings of the rainfed agriculture studies summarised in this report have contributed to filling the gaps and answering the questions that Tripp identified.

2. STUDY METHODOLOGY

2.1 Impact Assessments of Technologies

2.1.1 Data collection

A range of survey methods was used to collect information about the impact of the technological innovations: these are summarized in Table 2.1. Most of the methods used were be common to all of the technology surveys albeit with small differences between them. Details of the methods used in each case study can be found in the individual case study reports.

Table 2.1 Methods to be Used in Technological Innovation Surveys

Methods	To Assess/Measure
Village-level survey (Group Discussion)	Extent – Level of use within primary villages
Seed supply chains (Group Discussion)	Extent – Level of use, numbers of villages to which seed has been supplied from primary villages
Structured interviews of individual current users & non-users	Factors influencing use
Structured interviews of individual current users	Benefits
Semi-structured 'qualitative' interviews or discussions (individual and group)	In-depth and nuanced understanding of benefits and impact

Substantial numbers of villages and farmers were covered in the India and Nepal technology case studies (see Table 2.2). The numbers were determined primarily by two considerations, and a balance had to be struck between them:

- What was the minimum number of farmers that needed to be surveyed to obtain data necessary to answer the survey questions? and
- What was the maximum number of farmers (and villages, districts) that could be surveyed at a reasonable level of quality, given the resources (time, people, funds) available?

2.1.2 Data entry and analysis

Structured survey methods CAZS-NR prepared data entry templates using Excel spreadsheets into which the survey data were entered. *Local partners* performed initial data quality control and were requested to enter data on a village-by-village basis as the study progressed.

CAZS-NR staff had the primary responsibility for analysing the data: Dr D.S.Virk and Prof. J. Witcombe on the India Ashoka rice varieties survey; Prof. J. Witcombe on the Nepal rice varieties; Dr D. Harris on the two RRC surveys; and Dr K. Joshi on the Bangladesh rice varieties study. The Cluster Study Team Manager (CSTM), Czech Conroy, was also be involved in the analysis and interpretation of the data, with particular reference to ensuring that the study's basic issues and questions were addressed.

Semi-structured (qualitative) survey methods The LFCs had the main responsibility for analysing information collected by the qualitative survey and writing up the results. Dr Buchy assisted in this process, edited reports and provided quality control. This part of the survey work covered a much smaller number of villages. For three of the four technology studies undertaken in India and Nepal the survey information and analysis took the form of a set of village survey reports plus a comparative analysis that synthesized and summarised the findings from these. (For the India RRC fieldwork the comparative analysis was not prepared.)

Table 2.2 Numbers of Villages and Farmers Surveyed Using Structured Methods

Technology	Country	Number of districts	No. of Villages (villages per District)	Individual interviews	
				Users**	Non-users
Ashoka Rice Varieties -	India	5	20* (4)	200	100
Rainfed Rabi Cropping	India	3	30 (varied by district)	178	180
Improved rice varieties	Nepal	6	36 (6)	344	139
Rainfed Rabi Cropping	Nepal	4	24 (6)	287	96
Improved rice varieties	Bangladesh	3	24 (varied by district)	N/A***	N/A***

* In this study some group-based survey work was also done in 'secondary' villages to which seed had been supplied by one of the 20 'primary' villages covered by the structured survey.
** The terms 'current users' and 'current non-users' were used by the cluster study team to describe farmers currently using and not using the technologies: some 'current non-users' may have been users in the past.
*** The Bangladesh study was a preliminary one and only involved group discussions.

2.1.3 Quality control

The structured fieldwork for the technology innovation studies was done primarily by NGOs that had been involved in the RNRRS PSP projects that had developed the technologies. They had a comparative advantage in terms of their familiarity with the villages where the initial work was done, and some of the farmers involved, and their understanding of the technologies and the history of their development. However, they had disadvantages in terms of: (a) potential bias – a possible vested interest in demonstrating/exaggerating impact and extent; and (b) less than ideal competence in undertaking surveys to a high level of reliability.

The RA Case Study team sought to ensure good quality, and to minimise the local partners' disadvantages, through the following measures:

- holding a 10-day methodology capacity building workshop for local partners prior to the fieldwork
- insisting that the local partners only use their most capable staff
- piloting the survey work in at least one village in each location, with CAZS-NR and the CSTM providing feedback on the work done in the pilot village(s) before work was undertaken in the other villages

- local partners to use the same team in each location, where possible, so that lessons from the first were carried forward into subsequent locations
- visits by CAZS NR staff, particularly at the piloting stage
- periodic field visits by the LFC to identify any emerging methodological issues.

Due to difficulties in recruiting and retaining LFCs in India and Nepal, the last measure was only implemented once (on the RRC survey in India).

It was anticipated that quality challenges, in terms of local partner bias and competence, would be greatest in relation to the use of qualitative survey methods. Thus, these were to be led by the LFC in each country, who had had no previous involvement with the related RNRRS PSP projects. This was done for the two India studies. In Nepal, however, the LFC resigned just before the work was due to begin; so here Dr Buchy, the study's adviser on qualitative methods, undertook some of the work, and closely supervised the rest, together with the local NGO partners. Dr Buchy was also involved in piloting the qualitative methods in both countries and providing training to local members of the survey team.

2.2 Studies of PCI Processes

The methods used in the studies were:

- reviews of secondary literature;
- a questionnaire-based survey undertaken in 2008;
- a group discussion at a workshop[5] in Nepal, in January 2009, involving key informants from India, Nepal, Bangladesh, UK and USA; and
- individual interviews with key informants in India (12) and Nepal (7) in early 2009.

A questionnaire-based survey was undertaken to identify all organisations in India and Nepal that have adopted PVS and COB, and to obtain a preliminary estimate of the crops involved and the number and nature of farmers benefitting from the work of each organisation. This study was primarily concerned with measuring *extent* in terms of: (a) how widely the process innovations have been adopted by other organisations in these countries; and (b) the numbers of farmers benefitting from technologies developed through the use of these processes.

Questionnaires were sent to different organisations involved in PVS and COB, following a 2-stage process. A general questionnaire, designed to provide a general overview of the organisation's involvement in PVS/COB, was sent to each organisation. A second questionnaire, designed to obtain information about the costs and benefits of individual crop varieties, was sent to a much smaller number of organizations that had responded in detail to the first one. In Nepal, 12 organisations (6 public sector and 6 NGOs) completed and returned the first questionnaire; in India only three organisations (1 public sector and 2 NGOs) returned it. Three other public sector agencies (state agricultural universities – SAUs) that had been involved in PPB did not return it.

[5] The RIU Programme Rain Fed Agriculture Cluster Study Review Workshop. The author facilitated a group discussion that involved: Dr K Joshi (CAZS-NR Nepal office), Narayan Khanal (FORWARD), Dr D S Virk (CAZS-NR), Prof John Witcombe (CAZS-NR), Prof Carl Pray (Rutgers University) and Dr J P Yadavendra (GVT India)

2.3 Poverty Measurement and Classification

In India there was the option of collecting data from farmers as to whether they were officially classified by the government as below the poverty line (BPL); but in Nepal and Bangladesh there is no official equivalent to the Indian BPL classification. In any case, the process by which households are categorised as BPL or not is abused, with better off households sometimes acquiring BPL status, because being BPL provides certain entitlements such as access to basic goods at reduced prices.

Thus, in order to be able to obtain relatively reliable information about whether users and non-users of innovations were poor, the cluster study team developed a set of poverty indicators (and associated survey questions) that could be used for this purpose, and an associated scoring system. The indicators (and scoring system) were used in all four surveys in India and Nepal and were selected on the basis of one or more of the following criteria: (a) easy to use; (b) directly relevant to the IA; (c) not particularly sensitive or intrusive; and (d) likely to be reliable. Information about income was not collected as it was considered to be sensitive and hence likely to be unreliable. The indicators used were:

- Livestock units
- Total quantity of all food grains produced in the season 07-08 per capita
- Roof type
- Number of jobholders in household who provide income
- Ownership of a tractor
- Extent of unskilled labour migration.

Further information about these indicators and how they were selected and applied is given in Annex 1. For the purposes of triangulation, data about BPL status were collected in India, and all Indian respondents who said they were BPL were asked to show the enumerators their BPL card so that this could be verified. The Indian studies also collected data as to whether respondents held a card provided in association with the National Rural Employment Guarantee Act (NREGA), which guarantees 100 days of employment to a local rural household if it is willing to do unskilled manual work. NREGA is intended to benefit poor households, and a job card is required to participate, so this is another possible indicator of poverty. In practice, the scheme is subject to corruption, which reduces the value of this as a poverty indicator.

2.4 Gender

It was decided to take account of possible gender differences in the surveys in relation to: (a) gender-differentiated impact, and (b) gender differences in perceptions regarding the various benefits of the innovations and their relative importance. Two approaches to obtaining gender-differentiated information were used (see Table 2.4).

Particular emphasis was given to investigating gender differences in relation to the India RRC study. This was because RRC was seen as a new practice there (but not in the Nepal survey area) that was thought to have a significant effect on women’s workload, in terms of agricultural practices and social/human fencing. The India and Nepal rice studies focused on new varieties of an existing crop, which were not expected to affect labour requirements significantly (although the Ashoka varieties in India were found to have a beneficial effect on women’s workload).

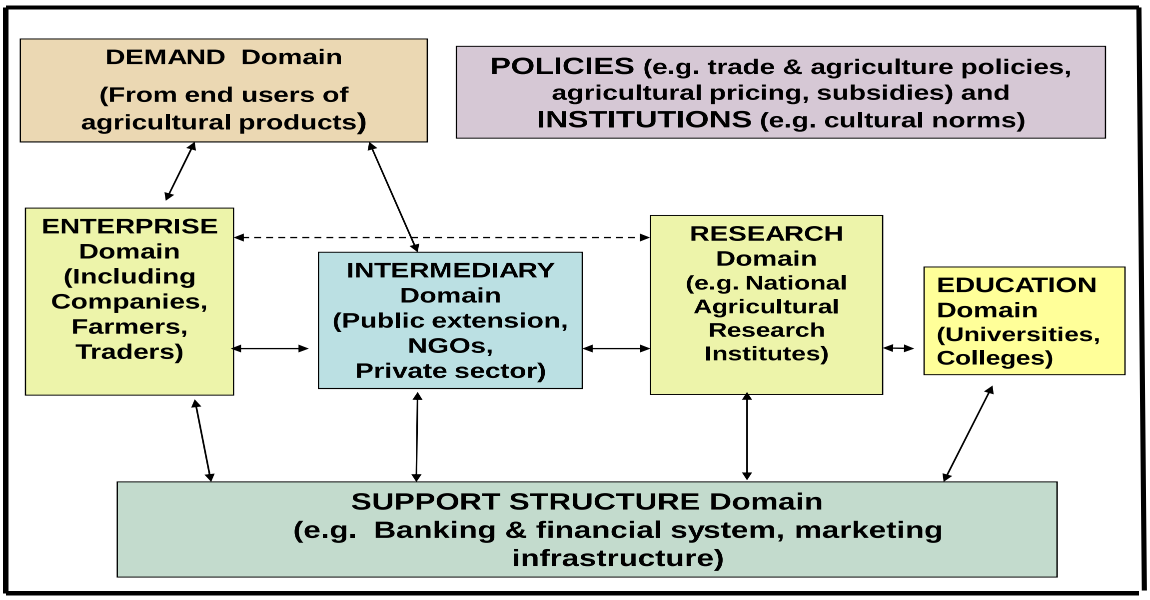
Table 2.4 Obtaining Gender-differentiated Information about Impact

Approach	India		Nepal	
	Rice varieties	RRC	Rice varieties	RRC
Do individual **structured** interviews with women & men, and incorporate relevant Qs in questionnaire		X (50/50)		
Consider gender-sensitive issues in qualitative survey work; interview men and women separately in groups and/or individually	X	X	X	X

2.5 Analyses of Agricultural Innovation Systems in India and Nepal

The studies of the process innovations (PVS and COB/PPB) examined their use and institutionalisation in each country through the lens of the respective national innovation systems (IS), using the diagram shown below. Information about each IS domain was obtained primarily through: (a) reviews of relevant papers, reports and articles; and (b) interviews with key informants. Key informants included people from: NGOs (India, Nepal), agricultural universities (India), national agricultural research agencies (India, Nepal), one IARC (CIMMYT) and government extension services (Nepal).

Figure 2.1 Agricultural Innovation System Domains



Source: This diagram is a substantially modified version of Arnold and Bell's innovation system framework (Arnold and Bell, 2001).

3. CLUSTER STUDY FINDINGS - Technological Innovations

Key findings in this chapter are summarised in bold at the start of each sub-section.

3.1 Who were the Innovators in India?

The RNRRS aimed to improve the livelihoods of poor people (see section 1.1.1); and the RIU programme aims "to increase understanding of how the promotion and widespread use of research can contribute to poverty reduction" (see section 1.1.2). Much agricultural research, however, has not been relevant to, and has not benefitted, resource-poor farmers (McIntyre *et al* [eds], 2009). Thus, a key aspect of these studies was to determine to what extent poor households have benefitted from using the technologies; and whether there are any differences between poor households and others in being able to access, use and benefit from them. The maximum value for the poverty index (PI) in India was 25 - the higher the score, the less poor households are. Any user household with a score of 12.5 or less was considered to be poor.

3.1.1 Ashoka rice study

The Ashoka varieties are very well suited to the needs and limited resources of resource-poor farmers; and being poor is not a barrier to becoming a user and remaining one.

There was no significant difference in the poverty status of users and non users of the Ashoka varieties when they were compared using the poverty index developed for the study[6]. Of the 200 respondents in the household survey, 198 (99%) had total scores below the threshold value of 12.5: the highest score of any household was 14. (The qualitative survey also identified some Ashoka users who would probably have been classified as better off if they had been scored against the poverty index.) Using other poverty indicators (see methodology section), i.e. BPL status and NREGA card holder, the majority (more than two-thirds) of users would be classified as poor (see Table 3.1.1). The majority of users belonged to scheduled tribes (see Table 3.1.1), and the other major group was 'other backward castes'.

Table 3.1.1 Poverty status of users of Ashoka varieties and non-users

Characteristic	Users	Non-Users
Poverty index	6.54	6.33
Below poverty line (%)	68	54
NREGA card holder (%)	82	76
Tribal (%)	63	74

Non-users of the Ashoka varieties were slightly poorer than users, on average, using the PI measure; but smaller percentages of them were poor on the basis of the BPL and NREGA card holder indicators (Table 3.1.1). A higher proportion of users than non-users belonged to 'other backward castes', and a smaller proportion to scheduled tribes.

Overall, the study findings suggest that the Ashoka varieties are very well suited to the needs and limited resources of resource-poor farmers. Half of the users interviewed had not

[6] This was not surprising given that the villages to which the seed was distributed were all selected by GVT (in the DFID-supported EIRFP and WIRFP bilateral projects) on the basis of being very poor.

received Ashoka seed directly from WIRFP or EIRFP: they had chosen to grow Ashoka varieties and had managed to acquire the necessary seed independently. The other half had continued to grow Ashoka for several years after they had received it from the projects. The fact that there were no major socio-economic differences between users and non-users suggests that being poor is not a barrier to becoming a user and remaining one.

3.1.2 Rainfed rabi cropping study

The targeted users in this study were poor, and just as poor as non-users in the same villages.

The findings of this study were broadly similar to those of the Ashoka study. The vast majority of users (and non-users) were poor, and the mean PI score of non-users was slightly lower than that of users. Differences between users and non-users in relation to BPL status and possession of an NREGA card were minimal – see Table 3.1.2.

Table 3.1.2 Poverty status of users and non-users in RRC Study

Characteristic	Users	Non-Users
Poverty index	6.58	6.42
Below poverty line (%)	66.8	65.0
NREGA card holder (%)	97.7	98.3

The vast majority of users (see Table 3.1.3) were from Scheduled Tribes, primarily Gonds, and the remainder almost all belonged to 'Other backward castes'. The breakdown was almost identical for non-users.

Table 3.1.3 Ethnicity of Users and non-Users in RRC Study (percent)

Study	Scheduled tribes	Other backward castes	Scheduled castes	Others
Users	86	13.5	0.5	0
Non-users	84	15	0	0.5

Overall RRC users and non-users have very similar characteristics. However, all of the users in this study were 'targeted' users who had received technical support directly from the research project's partners; and that support was provided relatively recently (from 2004/5). Thus, it is too early to know whether other farmers will choose to use the RRC varieties and technologies, and be able to acquire them; or whether targeted users will continue use the technologies well beyond the termination of project support. What we can conclude from the survey data is that the targeted users are poor, and just as poor as non-users in the same villages.

3.2 Who were the Innovators in Nepal?

3.2.1 Rice study

A high proportion of the households using COB/PVS rice varieties are poor, which suggests that at least most of these varieties are very well suited to the needs and limited resources of resource-poor farmers. It seems that being poor is not a barrier to becoming a user and remaining one.

The maximum value for the poverty index in Nepal was 23, and any user household with a score of 12 or less was considered to be poor. In the *rice study* the mean total poverty score of users was 6.96; and there was a small but statistically significant ($p < 0.05$) difference in the mean total poverty scores of users and non-users – see Table 3.2.1. (Higher mean scores for users were found in all districts except Nawalparasi, but these differences were only significant in two districts.) This overall difference stemmed from significant differences for two of the PI indicators, namely food grain production per capita and livestock units, with users having higher average quantities of each.

Table 3.2.1 Poverty Status of Users and Non-Users in the 2 Nepal Studies (mean PI)

Study	Users	Non-Users
Improved rice	6.96	6.37
RRC	5.84	4.18

Of the four ethnic groups represented in the survey, Tribals and Dalits are probably the most disadvantaged, and between them they account for 58% of the users (see Table 3.2.2). The ethnic composition of users and non-users was broadly similar.

Table 3.2.2 Ethnicity of Users and non-Users in Improved Rice Study (percent)

	Brahmin/Chhetri/ Newar	Terai group	Dalit	Tribal
Users	38	4	6	52
Non-users	35	4	11	50

A high proportion of the households using COB/PVS rice varieties are poor, which suggests that at least most of these varieties are very well suited to the needs and limited resources of resource-poor farmers. Non-users are, on average, only slightly poorer than users and are ethnically similar to them, which suggests that being poor is not a barrier to becoming a user and remaining one.

3.2.2 Rainfed rabi cropping study

A high proportion of the households using RRC technologies were poor implying that at least most of these technologies are well suited to the needs and limited resources of resource-poor farmers. However, non-users were significantly poorer than users.

Virtually 100% of the 287 users covered by the household survey were poor as defined by the PI. This is not surprising, given that the original selection by FORWARD of target communities and households was highly poverty-focused.

Non-users were significantly poorer than users, as in the rice study*,* but here the mean difference between them was much larger (see Table 3.2.1). However, this difference is one of *relative* poverty: 380 out of the total 383 (99.2%) households had a PI less than 12.5 (the exceptions scored only 12.5, 13 and 13.5); and the RRC users were significantly poorer, on average, than the rice users. The PI indicators for which users and non-users had significant differences were the same ones as in the *rice study*. Users produced significantly more food per capita (80% more) than non-users, owned 30% more livestock units and were less likely to have a thatched roof. Other components of the Poverty Index did not differ between users and non-users.

The ethnic composition of households surveyed was rather different from that in the rice study. There were no tribals interviewed in this study; and here, there was a much higher representation of households belonging to the Terai group (35.9%) and also a substantial minority of Janjatis. Brahmins/Chhetris were the best-represented ethnic group among both users and non-users, but made up a higher proportion of the users (50% versus 38%):

whereas more non-user households were Janjatis (Table 3.2.3). These ethnic differences between users and non-users might be linked to the different mean PI scores for these two groups. However, the fact that the PI of users in this study was less than that of users and non-users in the rice study implies that ethnicity is not a good indicator of poverty status.

Table 3.2.3 Ethnicity of Users and non-Users in RRC Study (percent)

	Brahmin/Chhetri	Janjati	Terai group	Dalit
Users	50.5	5.2	35.9	8.4
Non-users	38.5	13.5	37.5	10.4

The fact that a high proportion of the households using RRC technologies are poor implies that at least most of these technologies are well suited to the needs and limited resources of resource-poor farmers. However, there was a significant difference in poverty status between users and non-users.

The reason(s) for the significant difference in poverty status between users and non-users is not known. It could be that some of the poorest farmers are facing challenges in using or accessing some of the RRC technologies. Or the difference could stem from the local partner selecting households to work with on the PSP project that were somewhat better off than those not selected. The selection of 'users' and 'non-users' for the household survey was supposed to be a random one, so this *per se* should not have resulted in differences between the two groups.

3.3 Impact of Technologies on User Households in India

Farmers who had used any of the technologies whose impact was being studied were asked in the household survey what the benefits were. The question was open-ended, so whether a benefit was mentioned or not was an indicator of its importance. In addition farmers were asked to give a rank order to each of the benefits they mentioned (with 1 being the most important).

3.3.1 Benefits and impacts of Ashoka rice

The Ashoka varieties have provided users with better quality grain, higher yields, increased rice self-sufficiency and an earlier harvest. This has resulted in a decrease in grain-related expenditure, which has freed up scarce household funds for other uses.

Benefits The household survey found that better quality grain was the benefit ranked highest by most farmers: there was a consistent high ranking of grain quality in all districts. This was followed by earlier harvest and then better quality fodder, both of which were also frequently mentioned in the qualitative survey. In addition, about half of the farmers identified 'more rice' (i.e. higher yield) as a benefit.

The vast majority of Ashoka grain was kept for home consumption, apparently due to:

1. the perceived high quality of Ashoka grain; and
2. because the early harvesting of the Ashoka grain takes place at a time when households are short of food grains generally.

The higher quality of Ashoka grain should, in principle, be reflected in a higher price, which would provide an incentive to sell it. However, some value chain analysis work carried out by OXFAM in eastern India has found that Ashoka grain does not command a higher market price, because the variety does not yet have a brand name - and will not get one until more is sold on the market (J.R. Witcombe, *pers. comm*.).

In the household survey 83% of Ashoka users reported increases in rice availability, with a mean increase in rice self-sufficiency of almost one month, or 17%. The findings of the qualitative survey were similar:

> "The direct positive result of the introduction of Ashoka is an increase in grain production which extends the grain self-sufficiency of the household by 2 weeks to 1 month in Banswara district, for example ; and for up to 2 months even for marginalized farmers in Hazaribagh district, depending on the size of the land available".

The higher food availability reported by the majority of the farmers was reflected in the higher reported grain yield of the Ashoka varieties compared with popular local ones: this varied by district, ranging from 10 to 21%. In the questionnaire-based household survey farmers were only able to make this comparison for a *typical* growing year. They were not able to make the comparison for a *drought* year, as they had not experienced one (the last one was 2002) since they started growing Ashoka varieties.

The yield advantage of Ashoka varieties would probably be greater in a drought year, due to their shorter growing period. In the qualitative survey villages in Hazaribagh farmers *were* able to make this comparison. There was less rainfall here in 2006 and a drought was declared in the area. In Kherika village all crops were affected, and only those farmers who grew Ashoka got some paddy, which at least could be used as seed for the next season: but for other rice varieties there was no harvest. This village also experienced lower rainfall than usual in 2008: farmers reported that Ashoka's production was not affected, whereas production was less than usual for other varieties.

The qualitative survey identified the short duration and the resistance to drought of the Ashoka varieties as two positive factors mentioned by all groups in the five districts. This survey also identified some other commonly perceived benefits of Ashoka varieties that were not picked up in the household survey, including:

- Earlier maturity enables growing of a second crop
- Requires less fertiliser
- Requires less water
- Requires less labour
- Easier to cook and needs less fuel.

Impacts The increase in yield, and hence grain self-sufficiency, has resulted in a decrease in grain related expenditure: this frees up funds for other uses. For example, one woman (in Kud village, Hazaribagh district) reported that this had enabled her to continue sending her children to school.

One positive impact women mentioned is that, as Ashoka matures earlier than other varieties, the harvesting and threshing of rice (presumably where a household cultivates a combination of varieties) takes place over a longer period: hence women reported that it is less intensive and they felt less under pressure. Women in one village (Bhuyan Tola, Katkamsandi block) also reported that there had been an increase of agricultural wage labour by 15-20 days due to the longer duration of the rice harvest.

Improved nutritional status was also reported in some villages. However, it would be difficult to establish whether any such improvement was due to growing Ashoka rice, and having more rice to consume, or to other factors – such as any general increase in incomes in recent years.

3.3.2 Benefits of RRC technologies

Users of the RRC technologies reported having increased their consumption of legumes and many also said they were healthier.

Almost all (95%) user households cited 'increased consumption of legumes' as a benefit and, of those, 78% ranked it as the most important benefit. The second most important benefit cited was 'better health'. Thirty-four households (19%) saw KC as a 'source of cash' but only 20 of those (59%) ranked that as number 1. Although 'increased soil fertility' and 'increased fodder for livestock' were mentioned, neither was considered to be particularly important. 'Reduce or avoid migration' was mentioned by only two people.

Six of the 178 user households reported making money by selling KC as green pods (snacks). Four of these households were in the same Block (Bichya) of Mandla District and three of those in the same village (Mudiyarichka).

Forty percent of user households reported that they had grown Ashoka rice and 93% of those had followed it with chickpea. All reported that they had been able to sow the chickpea earlier as a result of using short duration rice. Previous research has shown that early sowing increases the yield of chickpea, but the survey was not able to determine if that was the case in this instance.

Perceptions of the problems associated with growing KC were the same for users and non-users. 'Lack of water', 'pests' and 'diseases' were the most important constraints cited. 'Lack of seeds' was mentioned by only 3% of the user households; and 'reduced grazing from fallows' was not mentioned by anyone – which was not unexpected as there was very little fallow land in these villages prior to the interventions.

3.3.3 Differential impact among potential users/innovators and explanatory factors

Ashoka case study Neither poverty/wealth status nor ethnicity have a differential effect on a household's capacity to grow the Ashoka varieties. The extent to which a household can benefit from them seems to depend primarily on the area of suitable land that it has for cultivating them; and also perhaps on the prevailing agro-ecological conditions, which may affect the yield.

RRC case study The small minority of users that was selling green pods of Kabuli chickpea as a snack was deriving greater benefit from the crop. This phenomenon was highly localised and the practice seems to be dependent on having good access to a suitable market for the product.

3.4 Impact of Technologies on User Households in Nepal

As in India, farmers who had used any of the technologies were asked in the household survey what the benefits were, and were asked to rank them in importance.

3.4.1 Rice Study: Benefits of COB and PVS rice varieties

Benefits to farmers from improved rice varieties varied according to the variety and included: increased grain yield, increased straw yield, better grain quality, and earlier

harvest. About three quarters of farmers growing any of the improved varieties reported an increase in rice grain sales or increased rice self sufficiency. **Use of new varieties has also enabled many farmers to grow rice in two seasons rather than the previous one, generating increased income and employment.**

The qualitative survey found that there has been a general improvement in rural livelihoods in the terai during the last few years, due to various factors such as electrification and better access to health and education services. In this survey it was not possible to separate the impacts of the new rice varieties from those of other changes that had been taking place.

In the structured household survey farmers reported benefits that varied according to the variety: these included increased grain yield, increased straw yield, better grain quality, and earlier harvest. About three quarters of farmers who were growing any COB or PVS variety reported an increase in rice grain sales (by an average of about 300 kg) or increased rice self sufficiency (by an average of about 2 months' supply).

The qualitative survey also found that users of COB/PVS varieties had experienced an increase (of 2-4 months) in their rice self-sufficiency; but they attributed this change to a combination of factors – the new varieties, fertiliser use (better or more) and irrigation (better or more). The qualitative survey found that rice self-sufficiency had also increased in villages where use of the COB/PVS varieties was considered to be low. Nevertheless, throughout the survey villages COB/PVS users identified the new varieties as an important factor.

The qualitative survey findings raise the question of whether the increases in rice self-sufficiency reported by COB/PVS users in the structured household survey were entirely or largely due to the use of new varieties. It appears that they were because: (i) non users in the structured survey did not report increases; and (ii) analysis of the survey data found that users' reported increases in grain were consistent with their planted area under PVS/COB varieties and yield increases of these varieties recorded in trials. The findings from the two surveys are not inconsistent: the qualitative survey reported increases of 2-4 months in self-sufficiency due to a combination of factors, whereas the structured survey recorded an *average* increase of 2 months due to improved varieties alone.

A major change in agriculture identified in the qualitative survey was a shift from growing rice only in the main cropping season to growing rice in the spring season as well, due to the use of shorter duration varieties in the main season and the availability of a suitable variety for the spring season. For example, in one village of Rautahat district:

> "Five to ten years ago, villagers only grew one crop of rice during the main season as well as wheat and maize. The land remained fallow during the spring season but now they grow one spring season rice – BG1442 which is the main source of income for the villagers. Some of the villagers repeated that the introduction of BG1442 in the village not only increased yields but also provided jobs for the villagers during what used to be the fallow period".

3.4.2 Rainfed rabi cropping study:

The food grain self-sufficiency of households using project crop varieties had increased by 29%; and this has resulted in a decrease in food-related expenditure, freeing up scarce cash for other uses, such as children's education.

Benefits of technologies and new varieties In the *household survey* User households reported that mean household food grain self-sufficiency had increased from 10.2 months to

13.2 months (29%) since project crop varieties[7] had been adopted. Reported change was greatest in Jhapa (63%), where BG1442 was adopted widely on relatively large areas of land per household. In districts where legume adoption was significant (Kapilvastu and Saptari) they were grown on small areas of land and contributed less, in absolute terms, to household food grain self-sufficiency. The *qualitative survey* also found that household food grain self-sufficiency had improved by 2 to 4 months per year, and in all groups people reported that this had resulted in a decrease in food-related expenditure.

All the groups involved in the *qualitative study* mentioned that their agricultural knowledge had increased – e.g. in soil fertility management, including organic approaches and organic pesticides – which they attributed to FORWARD's technical support. Even though some farmers may not have been growing some of the initially distributed rice or chick pea varieties anymore, they were now more likely to choose short duration varieties of rice.

Limitations and constraints of technologies and new varieties*.* Overall, in the *household survey* the two most important problems cited by users of the new varieties (of rice, chickpea and mungbean) were pests and diseases. However, it should be noted that these are also the most important problems in general for these crops, irrespective of variety. These constraints were also identified in the *qualitative survey*.

The other important constraints cited in the *household survey* were: lack of seed and inputs; lack of irrigation; and theft or damage from stray animals (in relation to legumes, particularly mungbean). Inadequate technical know-how was also considered important by users of legumes, particularly in Saptari and Siraha. Again, the findings from the *qualitative survey* were quite similar.

Farmers involved in the qualitative survey identified insufficient water and lack of irrigation as another major constraint on mung bean and chickpea production. They also reported that Kabuli chick pea is not grown intensively as it is prone to pest damage and sensitive to moisture. It also requires more frequent weeding then local varieties. The threat of stray cattle was given as another factor discouraging mungbean cultivation; and the absence of good markets was mentioned as a deterrent to investing in large scale mungbean cultivation.

The current lack of clarity on land tenure policy is a more generic factor hindering risk taking for farmers.

Impact The qualitative survey found that there has been a general improvement in rural livelihoods in the terai during the last few years, due to various factors: for example, electrification and roads construction were mentioned by farmers as factors of change. It is very difficult to separate the impacts of the new technologies and crop varieties from those of other changes that have been taking place.

Farmers in Kapilvastu reported that the increased availability of home grown lentils had resulted in an increased consumption of lentils; and they perceived a link between this and other dietary improvements and their children becoming 'stronger'. Farmers in Kapilvastu also reported that the increase in food grain production had resulted in better education for children; and that the introduction of winter crops had created more job opportunities for the landless and small holders.

In Jhapa the reduction of fallows had in turn reduced green fodder availability. In all the groups farmers reported a decrease in livestock numbers because the increase in the growing period had reduced the area available for grazing.

[7] It should be noted that the survey question did not mention other RRC technologies such as seed priming, IPM, etc.

3.4.3 Differential impact among potential users/innovators, and explanatory factors

In both Nepal studies the benefits from the technologies experienced by the poorest farmers were less in absolute terms than those of less poor farmers who had more land on which to grow crops.

Rice study Farmers who reported *only* an increase in food self sufficiency sold no grain. They had experienced an average increase in rice self sufficiency of over 2 months (amounting to an increase of nearly 25%): this, on average, brought them into approximate rice grain self sufficiency (i.e. 12 months of rice).

On average those farmers that reported an increase in grain sales were better off farmers: they had a grain surplus for sale and had twice as much cultivated rice land. Hence, on average they already had a rice harvest sufficient to last 22 months and this increased by 4 months or 18%. Their mean increase in grain sales was about 300 kg – or 12%.

RRC Study The *poorest farmers* were less likely to be users; and even if they were users they would tend to benefit from the technologies less then *poor farmers* with more land. Nevertheless, even the latter are poor - around 99% of all households sampled had a PI <12.5.

Only a small number of farmers in Saptari and Siraha used seed priming; whereas a lot of farmers in Kapilvastu did use it. The increase in food grain self sufficiency was greatest in Jhapa (63%) where mean food grain self-sufficiency was already the highest. The majority of households reported a change in food self-sufficiency in Saptari, Siraha and Jhapa but only 40% of the households in Kapilvastu reported a change. This may be related to level of uptake of rice cvs., but that is not immediately obvious. The area sown to new rice cvs and the production per household was lowest in Kapilvastu.

3.5 Extent of Use of Technologies in the Survey Areas

3.5.1 Ashoka varieties in India

The Ashoka varieties are now widely used in the originally targeted (primary) villages and their use has spread from those villages to other connected villages (primary to secondary to tertiary villages). Farmers in primary and secondary villages are growing Ashoka rice on an appreciable proportion of their land. If similar use levels prevailed throughout the five study districts, about 177,000 farmers would be growing about 26,600 ha of Ashoka varieties.

Within a household's rice-growing area The household survey found that farmers who grew the varieties adopted them on a high proportion of their suitable land (on average 75% of their upland and over 50% of their medium land). In contrast, the qualitative survey authors concluded that: " ..though the number of farmers who grow Ashoka has increased, the proportion of the potentially suitable land allocated by households to growing Ashoka remains small. In Kud (Hazaribagh district) for example only 25% of the suitable land is under Ashoka and in Benjara (Ranchi district) it is 20%". This study found that in all the FGDs across the 5 districts, farmers maintained that they will continue to grow their local *Desi* rice varieties along with the Ashoka one(s). This is because they want to spread risks by maintaining varietal diversity and also because *Desi* rice (local land races) still has some qualities valued by local people.

Within and between survey villages In the primary and secondary villages, 14 to 53% of households grew the Ashoka varieties on 2 to 24% of the total rice area, depending on the district and village. In the survey of individual farmers, over one third of those who grew an Ashoka variety distributed seed to other households from the 2007 harvest. In the structured group discussions farmers reported that, on average, farmers in every primary village had distributed seed to about two new villages (secondary villages). This process extended further as farmers had distributed seed to new (tertiary) villages from these secondary villages. The primary and secondary villages had more or less equivalent levels of use despite there having been no formal seed supply to the latter.

Within survey districts Given that there was high village-to-village spread and a large number of villages had been supplied with seed by NGOs and other organisations, use levels were extrapolated from the sample to the district and state levels. It was estimated that about 177,000 farmers were growing about 26,600 ha of Ashoka varieties in the five study districts.

3.5.2 RRC in India

During the 2007/08 *rabi* season, KC was grown by user households on an average of 0.19 hectares. On the assumption that only medium land is suitable for growing chickpea, that represents almost 30% of the 0.7 hectares of medium land cultivated by user households. Given that 165 (93%) of the user households said that the *rabi* area cropped had not changed, it seems reasonable to assume that KC was being grown at the expense of one or more other crops.

Adoption of other elements of the RRC 'package' was zero and represents a serious failure in the quality of training provided.

3.5.3 Improved rice varieties in Nepal

The percentage of households in the study villages using COB varieties was estimated to be 10% (from group discussions) and 17% (from the household survey). Overall, users devoted about 15% of their land that to COB varieties. High rates of spread of seed and information were found, and current use of COB varieties in the six study districts was 15 times higher than the amount of seed that had been supplied since 2002.

Over all six districts, eight COB varieties were found to be grown by at least 1% of all 2,222 households identified in the group discussions. Three other COB varieties were used by less than 1% of households and were excluded from the analysis to reduce its complexity. Sunaulo Sugandha, one of the two released COB varieties was the most widely grown (by 7.5% of all 2,222 households) among all of the varieties. Barkhe 3004 (2.4%), the other released variety, did not have the higher use that might be expected from its official release and greater promotion (more seed of it had been supplied than of other varieties). It was about as widely grown as three unreleased varieties i.e., Barkhe 1027 (2.8%), Judi 572 (2.4%) and Barkhe 2014 (2.0%).

Within a household's rice-growing area The area on which the varieties were grown was small and averaged about 0.17 ha per household per variety - about 15% of the rice area. This could not be explained by land availability as there was no correlation at all between the area a household devoted to COB varieties and the area of rice that a household cultivated.

Apart from two exceptions, *individual* COB varieties were grown on an average of at least 0.1 ha – or 12.5% of the land used for rice production. Barkhe 3004 had the highest average area of any variety (more than one third of a hectare) and accounted for 27% of the total rice area of the households that grew this variety. The *overall* proportion of land devoted to COB varieties among the users was somewhat higher, at 15%, as 17% of COB user households grew two or more COB varieties.

Within survey villages By 2008, a range of COB varieties had been adopted for upland and lowland rice ecosystems: estimates of the mean percentage of households adopting them in the 36 study villages were 10% (from group discussions) and 17% (from household survey).

PVS varieties were more widely used than COB varieties. This is probably related to the longer time in which PVS varieties were available: the research project started with PVS and first seed distribution took place in 1998; whereas the first COB varieties were not distributed until 2001 and then in only small quantities.

Within survey districts High rates of spread of seed and information were found, and current use of COB varieties in the six study districts was 15 times higher than the amount of seed that had been supplied since 2002.

3.5.4 RRC in Nepal

There were major inter-district differences in the use rates of RRC project varieties of rice, mungbean and chickpea and RRC agronomic practices, with use rates of each ranging from high (>30%) in some districts to low (<15%) in others.

Use on survey household land New *rice varieties* were grown on an average of 0.1 to 0.23 ha (9% to 24% of household land) except for Barkhe 2014 in Saptari where it was grown on 43% of users' land. The other major rice success story was that of BG 1442 in Jhapa where 82 households (99% of the households sampled) grew it as a spring (*Chaite*) crop on an average of 0.46 ha.

As land suitable for growing *chickpea* is scarcer than that which is suitable for rice cultivation, mean area per household growing chickpea was only around 0.05 ha to 0.15 ha. Although yields per unit area were often reasonable (given the low levels of inputs used) amounts of chickpea grown per household were small. The land area sown to *mungbean* per household was low so production per household was also low.

Use in survey villages The proportion of households growing *mungbean* in the Jhapa and Kapilvastu survey villages has been steady at around 30-40%. The household survey results suggest that *seed priming* has been adopted, on average, by around 50% of those households initially trained to do it. On average, the rate of adoption of *improved composting* was around 40% of those households initially trained.

Extent of use in and between survey districts Surrounding non-project villages were not surveyed and accurate information on the spread of the new varieties elsewhere in the districts is not available. However, seeds of new varieties had been re-distributed by relatively few households, which is not surprising given the short timescale since their initial distribution.

Rice Use levels of new rice varieties varied by district and by variety. In Siraha, adoption of PVS rice varieties was low (only 4%) because the RRC project mostly tested (through PVS) short duration varieties that proved to be unsuitable for the project villages. Adoption of rice varieties bred from COB was highest in Saptari (63%) which was mainly due to the rapid uptake of Barkhe 2014 that was particularly preferred as a very good replacement for Kanchhi Masuli, the most popular local variety. Adoption of COB varieties (short to medium duration) was lowest in Jhapa and Siraha (2%). It appears that medium- to longer duration varieties are preferred here, perhaps due to greater availability of irrigation.

Table 3.5.1 Extent of Use of the RRC Varieties and Technologies by District

Technology	Jhapa	Kapilvastu	Saptari	Siraha
Crop varieties				
Rice - COB	Low	Medium	High	Low
Rice - PVS	High	Medium	Low	Low
Chickpea	Low (0)	Medium	High	Low
Mungbean	Medium	Medium	High	High
RRC technologies				
Seed priming	High	High	Low	Low
Composting	High	High	Medium	Low
IPM	High	Medium	Low	Low
IPNM	High	Low	High	High

Note: High = >30%; medium = 15-30%; low = <15%.

Chickpea was not adopted in Jhapa where soils are deficient in boron and where disease pressure for chickpea is very high, particularly from Botrytis Grey Mould. Adoption of chickpea cvs Awarodhi and Tara was substantial in Kapilvastu and Saptari.

Mungbean, particularly cvs Kalyan and Prateeksha, was grown in all four districts on very small areas, ranging from 0.03 – 0.14 ha, and was particularly popular in Siraha.

Improved composting, IPM and *IPNM* were all quite popular in Jhapa but less so in the other three districts, the only exception being IPNM in Siraha and, possibly, improved composting in Kapilvastu. These relatively high values for adoption of these three technologies in Jhapa are due to high rates of adoption in rice and in mungbean but not in chickpea (which is not grown).

Table 3.5.1 summarises the extent to which different technologies were found to be used in each district.

3.6 Estimated Extent of Use Beyond the Survey Areas

3.6.1 Ashoka varieties in India

If farmers adopt the Ashoka varieties, at the levels found in the survey area, across the four states that were studied then about 420,000 ha would be devoted to them by almost 3 million households.

If farmers adopt the Ashoka varieties to a similar extent across the four states that were studied (Rajasthan, Jharkhand, Orissa, West Bengal) then about 420,000 ha would be devoted to them by the 2,800,000 households. Moreover, the varieties have already been widely distributed in the states of Madhya Pradesh, Gujarat, Chhattisgarh, and Uttar Pradesh; and they will almost certainly have spread across borders to neighbouring states with important upland rice growing areas such as Bihar.

3.6.2 RRC in India

The methodology did not include the collection of information beyond the surveyed project villages, because it was considered that the survey was taking place too soon after initial implementation of project activities for any significant spread of varieties/technologies to other villages to have taken place. The sample of villages covered by the survey had all been served by the same one (of many) of CRS's local partners, and in that respect may not be representative. Furthermore, it was discovered after the survey had been completed that the districts and villages surveyed were not representative of the kind of zones in which the RRC project was supposed to have been operating, i.e. zones in which there was a large amount of rice fallow land where rabi cropping was not widely practised. For these reasons, it would not be appropriate to estimate use of the RRC technologies beyond the survey area.

Nevertheless, it is worth noting that farmer-to-farmer spread of Kabuli chickpea was already taking place: 28 user households (16% of the sample) gave seed to 32 new households in 2007/2008.

3.6.3 Improved rice varieties in Nepal

If 2008 use levels in the survey districts were to be extrapolated to all the terai districts, then 15,000 – 25,000 ha would have been devoted to COB varieties and grown by more than 150,000 households.

If current use in the survey districts (estimated from the group discussions and household survey and from the opinions of DADO staff) were to be extrapolated to all the terai districts, then by 2008 a range of 1.5 to 2.4% of the rice area (15,000 – 25,000 ha) would have been devoted to COB varieties and grown by more than 150,000 households. By 2010 to 2011, assuming that rates of spread found in the study continue, then up to 100,000 ha could be occupied by COB varieties.

BG 1442 (Hardinath 1) was found to be used more extensively than any of the individual COB varieties. Hence, the level of use would be expected to exceed substantially 100,000 ha under COB and PVS varieties combined and 150,000 households by 2010 or 2011.

The **scoping study** identified more COB varieties than the household survey as it was done for all of the terai districts and not just six. It identified Barkhe 3004 as the most widely grown COB variety. The scoping study identified a similar number of COB varieties to the household survey in the six survey districts. However, there was very poor agreement across the two methods. This is not surprising, given that the use of individual COB varieties varied greatly across villages, and only six villages were sampled per district in the structured survey: whereas in the scoping study expert opinion was based on the entire district.

3.6.4 RRC in Nepal

This study focused only on villages where FORWARD had conducted training and distributed seeds, so there is no information available concerning spread of any technologies beyond those villages. Substantial adoption of some varieties (albeit often in 'niches') and reasonable adoption (from 30% to 50% of those households initially trained) of agronomic technologies suggest that similar project activities in other villages would have impact. Evidence from the rice study suggests that farmer-to-farmer spread of crop varieties would increase that impact.

3.7 Factors Influencing Extent of Use of Innovation

3.7.1 Ashoka rice in India

Several factors influenced the extent of use of the varieties, some preventing or discouraging use, and others leading farmers to choose alternative crop-related

options. These included: difficulty in accessing seed; lack of access to extension services; agro-ecological conditions for which other rice varieties are more appropriate; and crop options that give better returns.

Several factors influencing the extent of use of the varieties were identified. These can be grouped into two categories: (a) those preventing or discouraging use, and (b) those leading farmers to choose other crop-related options. The former include difficulty in accessing seed and lack of access to extension services. The latter include: agro-ecological conditions for which other rice varieties are more appropriate; and crop options that give better returns. Each of these will now be discussed.

Access to seed Ashoka seed spread in the survey villages was almost entirely farmer to farmer and there was no commercial marketing of the seed. Farmers with Ashoka seed apparently gave it primarily to relatives, rather than to neighbours or friends. Thus, in the short-term at least, these factors may have prevented some farmers in survey blocks from obtaining seed.

Lack of access to extension The study found that there has been considerable spread of Ashoka use during the last few years, and this took place despite a general absence of extension work by development agencies. Nevertheless, there is reason to believe that Ashoka use could have been more widespread by now if seed distribution had been accompanied by, or followed up with, an extension campaign. This issue is discussed further in sections 3.8.1 and 5.2.1.

Agro-ecological conditions The household survey found that in one district, West Midnapur, Ashoka varieties were not grown in the **medium lands**. This appears to be because farmers had better alternative rice varieties for this situation. In the **uplands** of this district Ashoka was widely used, but the fact that other modern varieties (MVs) were also widely grown here may have discouraged even wider use. The growth of other MVs in West Midnapur was apparently due to the fact that it is possible to grow longer-duration, medium-land varieties in this situation as the duration of the monsoon is longer. There are five months of significant rainfall here compared with 3 to 4 months in Jharkhand and other more westerly districts.

Alternative crop options In the study districts of Rajasthan and Orissa, where the structured group discussions had revealed that there was no upland rice, the Ashoka varieties would only be grown if they replaced other crops. These were reported to be: predominantly maize in Rajasthan; mainly Sabai grass, *Ischaemum augustifolium*, grown for paper making, in Orissa; and, in Hazaribag, a wide variety of crops, with Niger *(Guizotia abyssinica)* the most important. The qualitative study found that in Jaria village (Ranchi district) an NGO has been supporting different livelihoods activities, such as flower growing, which provided further opportunities; vegetable farming has been developed on upland plots in the kharif season as well. In Hutkona village (Hazaribagh district) people reported stopping growing Ashoka rice because growing vegetables upland was more profitable and provided a longer stream of income. However, this would rarely be an option as it needs irrigation water and very few villages have irrigated upland. In Baripada block (Orissa) many farmers use their upland to grow sabai grass for rope making (also found in the structured survey), which secures a good market price, and Ashoka is not competitive.

3.7.2 RRC in India

There were no major socioeconomic differences between users and non-users of Kabuli Chickpea; but on average users harvested around 70% more *rabi* grains per household than non-users. Cause and effect is not clear in this case, and it is difficult to determine what factors lead to some farmers becoming users and others not.

As noted above, the characteristics of the villages surveyed did not match the recommendation domain of the RRC technology package, which was designed to target fallow land – there was very little fallow land in these villages. In addition, the majority of the users had only grown the new varieties for 1-2 years rather than the 3-4 years envisaged. Given these constraints it is notable that users were found to be growing KC on almost 0.2 hectares per household – a significant proportion of the land suitable for chickpea.

Although there were differences between the three survey districts in some socioeconomic variables (e.g., in livestock units per household, NREGA months worked, area of lowland held and cultivated, area of irrigated medium land, total amount of grains harvested per household) there were no major socioeconomic differences between users and non-users of KC. However, on average, users harvested around 70% more *rabi* grains per household than non-users. Cause and effect is not clear in this case. Rabi cropping may be more important to user households and so they may have been better disposed to a *rabi*-specific technology; or adoption of RRC technologies may have boosted *rabi* production to significantly different levels. The same problems and benefits (and the same relative importance of problems and benefits) of growing KC were reported by both users and non-users. The decision to grow or not grow KC might depend on intangibles such as “mindset” or “propensity to innovate” or “willingness to take risks” or other aspects of “personality”. Questions related to these attributes were not included in the structured survey.

3.7.3 Rice varieties in Nepal

Users grew COB varieties on only a small proportion of rice land: the reasons for this are unclear but different possible explanations are considered. In a third of survey villages COB varieties were not grown at all, and the most likely reason is lack of access to seed and perhaps also information about COB varieties.

Within a household’s rice-growing area There are different possible explanations for the small proportion of rice land on which COB varieties were grown. *One* is that the low areas per farmer may partly be because this is an early stage in the innovation process - hence the use of the COB varieties could be limited by seed availability as well as a desire by some farmers to try the variety for more years before taking the risk of growing it on a larger area. However, no meaningful test of this explanation was possible as many farmers were not able to say when they first got access to seed; and because the sample size for earlier years was very low as at that time only small quantities of seed were distributed.

A *second* explanation is that all of these varieties (with the possible exception of Barkhe 3004) are niche varieties that will be grown by many farmers but on relatively small proportions of total rice land. However, the breeding programme was not targeted at producing niche varieties and the wide use of some of the varieties across districts would make this seem unlikely. A *third* possible explanation is that farmers may prefer to grow a number of varieties to spread risk; or to meet a range of different needs that require different traits. Other varieties may have specific advantageous traits not possessed by the COB varieties available to farmers in a given location, as was revealed by the qualitative survey which asked farmers to compare some of the COB and PVS varieties with other commonly used ones.

Within and between survey villages In 12 of the 36 villages COB varieties were not grown at all, while in some others over 70% of the households grew them. The most likely reason why none were grown in some villages is lack of access to seed (and perhaps also information about COB varieties), given the very small quantities of seed that were distributed at a district level compared with the rice area. If this access were to improve then the use of COB varieties could increase in villages where use is currently low.

Users of particular varieties The agro-ecological niche of a particular variety could be one of the factors influencing the nature and number of farmers using it. Some varieties may require relatively good growing conditions, while others may be well adapted to the less favourable conditions more likely to characterise the landholdings of poorer farmers. In the Nepal rice study an analysis was made of the difference between users and non-users of the *Sunaulo Sugandha* variety. There were 53 users of this variety in the three districts where it had the highest use. On average the farmers that adopted Sunaulo Sugandha had more medium land and significantly more grain production. It appears that the differences between the users and non-users are a reflection of *the adaptation of Sunaulo Sugandha for fertile medium and lowland conditions*. Conversely, the qualitative study found that poorer farmers in one village were disinclined to grow Sunaulo Sugandha because it has a lower yield than the Sabitri and Mansuli varieties and they prioritised quantity rather than quality and market price.

3.7.4 RRC in Nepal

RRC users cultivated 60% more land than non-users and had more than twice as much irrigated land, which may have made adoption/use easier for them. The reasons for this are not known, but different possible explanations are considered. There were clear niches for particular crops/varieties in particular districts, due to agro-ecological (and perhaps other) differences.

The most obvious difference between user households and non-user households is that users owned 51% more total land and cultivated 60% more land than non-users. Users also had more than twice as much (130%) irrigated land. Although the absolute amounts of land involved are small in relative terms (for example 0.35 ha of irrigated land versus 0.15 ha) the relative difference is large. Since the technologies available are all crop-based, additional land would give users more options. Under those circumstances, adoption/use may have been easier for this category of households. On the other hand, these relatively 'land rich' households may have been inadvertently targeted by FORWARD when choosing collaborators for the PSP project.

Another consideration is that users were chosen for the purposes of this survey solely on the criterion that they were growing a new variety (adoption of an agronomic technology was not considered). That might have biased the selection of users even more towards those with additional land, but we do not know whether that was the case.

There were clear niches for particular crops/varieties in particular districts: widespread adoption of BG 1442 rice as a spring (*Chaite*) crop in Jhapa; Barkhe 2014 rice grown in Saptari on a high proportion of household land; eventual discontinuation of chickpea production in Jhapa due to pest and disease pressure and boron deficiency; substantial adoption of chickpea cvs Awarodhi and Tara in Kapilvastu and Saptari; widespread use of mungbean, cvs Kalyan and Prateeksha, particularly in Siraha. It can be concluded that the PVS approach was successful in fitting crops/varieties to their appropriate domains and matching them to farmers' needs.

3.8 Sustainability of use of innovations by farmers

3.8.1 Ashoka rice in India

The household survey found that the Ashoka varieties were still being grown by 95% of the farmers who were first given seed 4-6 years earlier. Lack of access to seed was

a major reason for discontinuing use of Ashoka rice, and lack of appropriate extension support was another.

The household survey found that the Ashoka varieties were still being grown by the great majority of farmers (95%) who were first given seed 4 to 6 years earlier. This was despite little, or no, subsequent outside interventions (extension or further seed supply) for these varieties in their villages. Similarly, farmers who obtained seed from other farmers continued to grow the varieties once they had gained access to the seed.

The household survey found that the great majority of farmers who discontinued their use of Ashoka rice said it was because of lack of access to seed. This constraint was confirmed by the qualitative study. For example, in Bahja and Huktona villages (Hazaribagh district), farmers reported losing all their seeds after the drought in 2006. Not all farmers kept seeds for the following year, consuming what they had; and when they ran out there was no alternative seed supply.

The qualitative survey identified many cases of discontinuers and several other factors as being responsible. These included *Bad early experience due to inappropriate practice,* which led some farmers to stop growing Ashoka rice. In *primary villages* this happened because technical advice from GVT on the cultivation of Ashoka was limited: furthermore, some of the GVT staff employed for this work were non-agriculturists, hence they may not have always given appropriate advice. Farmers in *secondary villages* sometimes planted the seeds on the wrong type of land or followed inappropriate practices, leading to failure of the crop.

Other reasons given by farmers for ceasing to grow Ashoka varieties, included:

- damage by elephants, which prefer Ashoka varieties to all others
- prone to *Gandhi bug*, said to be a type of grain borer that destroys crops.

According to farmers in Hulsi, Ranchi district, possible reasons why elephants prefer Ashoka varieties and why Ashoka fields tend to be the first point of attack by the elephants were:

a) as the plants are tall they find them easier to remove with their trunks
b) softness and taste of the fodder and grains
c) sweet smell from the matured plants.

3.8.2 RRC in India

During the limited period of time that project villages have had access to Kabuli chickpea, the number of users has risen steadily and the mean area sown per household has been fairly constant. User households have been saving enough seed to sustain the area sown.

Most of the users in the surveyed villages had only been growing KC for 1-2 years so firm conclusions on continued adoption and sustainability of KC are not possible. However, during the four *rabi* seasons between 2004/05 and 2007/08 when the number of farmers growing KC rose steadily (15, 38, 127, 178) the mean area sown per household remained quite steady at 0.12 ha to 0.19 ha. This suggests that the adoption ‘ceiling’ per user HH has been reached (constrained by availability of suitable land or, possibly, some other factor) and would be maintained if seed were available. The survey showed that all user households saved, on average, 11.7 kg seed in 2006/07 and 70% of users saved 10.3 kg seed in 2007/08. These amounts are enough to plant around 0.2 ha at the recommended sowing rate.

3.8.3 Rice varieties in Nepal

The study findings do not shed much light on sustainability of use of COB/PVS varieties. This is partly because many of the farmers surveyed only started using COB varieties relatively recently, and partly because of the complexity involved in obtaining this kind of information for nine different rice varieties.

3.8.4 RRC in Nepal

There is evidence that for all three crops (rice, mungbean, chickpea) the overall number of households using new varieties, and the area of land that each household sows, are at least being maintained and may be increasing.

A limited amount of information suggests that for all three crops (rice, mungbean, chickpea) the number of households using new varieties, and the area of land that each household sows, are at least being maintained and may be increasing. Averaged over all four districts, the percentage of sampled households growing new *rice* varieties, the area grown per household and the production per household all increased steadily between 2004 and 2008, although the time course of adoption varied between districts. The mean production per hectare remained relatively constant over this period at between 3 and 4 t ha^{-1}.

In the case of *chickpea and mungbean* the proportion of households in Kapilvastu that grew *chickpea* was high during all four years; and the proportion growing *mungbean* in Jhapa and Kapilvastu remained fairly steady during the four years at around 30-40%. In contrast, adoption by households in Saptari and Siraha increased steadily over the four years and areas sown were also larger in these two districts.

In the household survey findings the one major exception to continued use was *chickpea* growers in Jhapa, where the number of user households declined steadily over the four years, down to zero in 2008: this was due to disease pressure and boron deficiency. The qualitative study, however, found that *mungbean* use had also declined among some farmers due to various factors such as the higher labour requirements and lack of access to markets. The increase in the area of land under Chaite (spring) rice could also have contributed to a decline in mungbean cultivation, as both crops are grown in the same season and in terms of crop agronomy chaite rice is much easier to grow. Alternatively, the decline in mungbean cultivation may have been limited to a small minority of more commercially-oriented farmers; whereas farmers interviewed in the household survey, whose mungbean production was fairly constant over time, would have been a more representative sample.

3.9 Grassroots Innovation Processes

3.9.1 Ashoka rice in India

Farmer to farmer spread As was noted earlier, the use of Ashoka rice has spread well beyond the initial set of targeted (*primary*) villages – to *secondary* villages and sometimes from these to *tertiary* villages. This process has been almost entirely due to seed and information being passed on from one farmer to another – the same process whereby new varieties and new crops have become more widely used since humans first engaged in agriculture. Nevertheless, the survey work on seed spread found that a large proportion of villages in the vicinity of any given primary village had **not** yet become secondary villages. This suggests that the spontaneous farmer-to-farmer process could be made more effective and comprehensive if it was supported or complemented by extension and seed supply services.

Gender dimension The qualitative study found that both men and women have been involved in innovating Ashoka varieties in their households and villages. In a number of the *primary* villages the seeds were distributed by GVT through women's self-help groups. In each of two *secondary* villages in Banswara district, the seeds were initially introduced through a woman. The two women both initially got seeds from relatives and after their first harvest distributed some seeds through their SHG. Another woman (in Kud, Hazaribagh district) convinced her in-laws of the benefits of Ashoka and they had been growing it since 2003; she said this success had improved her status within the family.

Growing Ashoka as a summer crop Farmers sometimes modify technological 'inventions' and come up with a different innovation, and this is one example. The qualitative survey brought to light the fact that some farmers were growing Ashoka rice as a summer crop (as well as a *kharif* crop), planting it in February - whereas the two varieties were developed by the plant breeders purely as a *kharif* crop. The structured household survey also found cases of summer cultivation of Ashoka rice in the survey districts in Orissa and W. Bengal.

3.9.2 Rice varieties in Nepal

Seed spread of COB variety Barkhe 2014 from village to village To obtain a better understanding of the process of the spread of seed from village to villages an additional group discussion was held in Malhanama village in Saptari district in May 2009 by staff from FORWARD. This focused on the distribution of seed of Barkhe 2014 by farmers. A group of farmers was asked to identify all of the transactions relating to Barkhe 2014 from a single harvest. The total of 18 farmers that distributed seed did so to farmers in 13 new villages, indicating a very high spread from village to village. On average, villages were situated 16 km away from Malhanama.

4. CLUSTER STUDY FINDINGS – Institutional Innovations

4.1 PVS

4.1.1 Use of PVS in India

Both ASA and GVT have done a large amount of work on a wide range of crops, details of which are given in Table 4.1.1. GVT began work on PVS in 1992. Its programme area for this work includes poorer areas of western (southern Rajasthan, eastern Gujarat, western Madhya Pradesh) and eastern (Jharkhand) India - across the central belt of the country, which is predominantly tribal. ASA has been implementing PVS since early 2000 and is currently working in 11 districts of Madhya Pradesh (MP) and three districts in Bihar. ASA's programme area can be categorised as marginal with a high percentage of small farmers (average holding size 1 ha. per household).

Table 4.1.1 PVS in India by Crop and Development Agency

Agency	Staples	Legumes
ASA	4	5
GVT	3	9
MPRLP	2	3

In MP PVS has also been implemented by two projects of the state government. One is MPRLP, which sees it as a very good tool for promoting varieties at the field level (Khanwalkar, pers comm). However, implementation has been far from satisfactory, with limited farmer participation and a tendency not to carry out an initial needs assessment (Khanwalkar). PVS has also been implemented (with technical support from ASA) in 14 districts by another MP state government project, the District Poverty Initiatives Project (DPIP), which is funded by the World Bank.

GVT has worked closely with state agricultural universities (SAUs) on PVS and PPB. Their involvement in PVS in relation to crops is summarised in Table 4.1.2.

Table 4.1.2 Indian State Agricultural University Involvement in PVS, by Crop

SAU	Staples	Legumes
AAU (Gujarat)	2	0
JNKVV* (MP)	2	4
MPUAT** (Rajasthan)	2	3
SDAU (Gujarat)	0	1
BAU** (Jharkhand)	2	0

* The relevant part of JNKVV (located in Indore) was recently transferred to Gwalior University.
** No data received *directly* from this university

Outside of MP, Gujarat and Rajasthan there appear to be very few states in which organisations are implementing PVS. Bihar is one, where there is another World Bank funded project on livelihood development of poor (called Bihar Rural Livelihood Project) implementing PVS in three districts with technical support by ASA (this project has followed a similar process of legitimisation to that which occurred in MP). There is also one in Jharkhand, where ASA has trained three NGOs in PVS, which is being implemented as part of a UNDP project.

Numbers of farmers Information on numbers of farmers that are using different PVS or COB varieties is not available. However, data are available on the numbers of farmers who have been involved in PVS trials conducted by ASA and GVT, which give an indication of the initial scale of coverage: large numbers of farmers have been involved in PVS and/or COB trials.

GVT estimates that it has involved at least 110,000 farmers in trials on cereal crops, disaggregated as follows: maize, 20,000; rice, 40,000; and wheat 50,000. While for legume trials (on nine crops) the GVT estimate is at least 112,500 farmers in total – primarily on: soybean, 75,000; chickpea, 10,000; and black/green grams, 10,000. Corresponding ASA estimates are about 6,500 farmers on cereals, primarily rice and wheat; and 7,000 on legumes, primarily soybean (3399), black/green grams (2250) and moong bean (1109).

4.1.2 Use of PVS in Nepal

PVS processes have been taken up in various parts of the *Nepal Agricultural Research Council* (NARC). The NARC component organisations shown in brackets and italics in Figure 2 of Section 2.6 have all been involved in PVS; so has the DoA's Crop Development Directorate, working with many district agricultural development offices (DADOs).

The crops on which these various components of NARC have applied PVS are summarised in Table 4.1.3. The DoA's CDD has been collaborating with CIMMYT on maize PVS under the Hill Maize Research Project (HMRP).

Table 4.1.3 Public Sector Organisations Involved in PVS in Nepal, by Crop

Division/Institute	Staples	Others
Agricultural Botany Division	2	
Outreach Research Division	2	
RARS Lumle*	4	1 (tori – brassica)
ARS Pakhribas	2	1 (lentil)
National Wheat Research Program	1	
Crop Development Directorate, Department of Agriculture	1	

* Lumle may have also applied PVS to barley, peas,potato and other crops – but this was not reported in their questionnaire

Two major NGOs in PVS work have been LI-BIRD and FORWARD. Both of these NGOs were established by former staff of research stations at Lumle and Pakhribas that had been funded by the UK government, when funding for these stations was ended in the 1990s and they were transferred to NARC. They came into existence in the 1990s when some of the researchers left Lumle and Pakhribas.

Table 4.1.4 NGOs involved in PVS in Nepal, by Crop

NGOs	Staples	Others
IPGRI/BI	3	0
FORWARD	4	4
LI-BIRD	4	4
CEAPRED	1	0
SUPPORT Foundation	1	0
TTRI	2	0

* LI-BIRD may have also done PVS on two other staples - Barley and Buckwheat – but this was not reported in their questionnaire

Numbers of users NGOs, CBOs and government agencies have been involved in distributing seeds for PVS and/or COB varieties to farmers. Once the seed is available in a given area, farmer-preferred varieties spread spontaneously through informal farmer-to-farmer distribution and exchange mechanisms. As a result, it is difficult to know how widely a variety has been adopted unless a survey is carried out to obtain such information. The study, therefore, was only able to document the numbers of farmers involved in PVS and/or COB trials for each crop.

During the period 1995-2008, nearly 45,000 farmers were directly involved in PVS/COB processes with the organisations covered by the study, on a wide range of crops. About 2/3 of these farmers were engaged by LI-BIRD. Most farmers were testing varieties of rice (19,658) and maize (11,717), and large numbers were also involved with wheat (4,826) and moong/kidney beans (3,866).

Nearly all of the rice farmers (18,772) were engaged by LI-BIRD. This figure is conservative as it was arrived at by taking the highest *annual* number of farmers for main season and *chaite* (spring) rice respectively and combining them, whereas for other crops the totals are based on the total number of farmers *over time*. Using the latter method for LI-BIRD rice farmers gives a total of 72061.

4.1.3 Community-based seed production and distribution in Nepal

Limited availability of, and access to, farmer-preferred varieties can be a major constraint on their adoption and spread. It would be impossible for the state's National Seed Company (NSC) alone to supply a substantial amount of farmer-preferred PVS or COB varieties to farmers. The PCI team saw the establishment of effective community-based seed production and distribution (CBSPD) groups as essential to ensuring the supply of seed of PVS/COB varieties and hence their widespread use.

They established three seed producer groups in Chitwan district, after reviewing previous attempts at establishing sustainable seed producer groups. Taking into account lessons from the review they emphasized strengthening managerial and marketing capabilities of the groups rather than concentrating on technical issues such as seed quality control. The PCI team believes it has avoided the common pitfalls of previous initiatives and that their groups are well on their way to becoming sustainable. The groups were able, after only a few years, to produce and sell large quantities of seed: the rice seed production of the three newly established groups compared favourably with the total rice production of the NSC.

4.2 COB/PPB

GVT is the only Indian NGO that has been involved in COB/PPB. This work has been done primarily in collaboration with SAUs. The Coordinator of GVT's crops research, Dr J P Yadavendra, previously worked for 30 years as a plant breeder at Gujarat Agricultural University; and GVT employs five plant breeders altogether. GVT's COB/PPB has covered seven crops, while the SAUs have applied it to five crops between them (Table 4.2.1).

Table 4.2.1 Organisations that have been Involved in COB/PPB in India

Institute	Crops
Public sector	
AAU	Upland rice, Maize
JNKVV	Blackgram, Horsegram, Upland rice, Maize
MPUAT	Chickpea, Upland rice
SDAU	Black gram
BAU	Upland rice
NGOs	
GVT	Maize, Rice, Chickpea, Blackgram, Horsegram, Niger, Ricebean

In Nepal, only two of the six public sector organisations involved in PVS have also been undertaking COB/PPB, covering three crops (Table 4.2.2). Three NGOs have been conducting COB/PPB, also covering three crops between them – 1 is a CGIAR centre and the others are the NGOs that were established by former research scientists.

Table 4.2.2 Organisations that have been Involved in COB/PPB in Nepal*

Institute	Crops (years)
Public sector	
RARS Lumle	Rice (1996); Maize (1999); Wheat (2001)
Agricultural Botany Division	Wheat (2002-08)
NGOs	

FORWARD, Chitwan	Mung bean** (2006)
IPGRI/BI Pokhra	Rice (since 1985); Maize (since 1997)
LI-BIRD	Rice (since 1998); Maize (since 1998)

* A reviewer has questioned some of the information in this table, (a) expressing doubt as to whether RARS Lumle has worked on maize and wheat PPB; stating that (b) the IPGRI/BI Pokhara office was only established in 1997, and that they never worked on maize in Nepal; and (c) LI-BIRD rice research began in 1997. **In collaboration with AVRDC, which chose the parent varieties.

4.3 General

4.3.1 Institutionalisation of PVS and COB/PPB

India is an extremely large country compared to Nepal, and as was noted earlier the use of PVS has been highly skewed geographically and limited to a few states. Thus, the study focused on institutionalisation of PVS in one Indian state, Madhya Pradesh, in which PVS use is most widespread (Table 4.3.1).

Table 4.3.1 Institutionalisation of PVS at Higher Levels in Nepal and Madhya Pradesh

Levels	Nepal	Madhya Pradesh
1a. National (or state) policies and procedures		
Favourable government policies		National Indian policy framework for agricultural extension 2003 recognises farmer participatory approaches & advocates NGO participation in extension
Government recognises PVS in extension-related procedure(s)	DoA implements PVS	PVS protocol adopted and published by MP state government.
Government extension services distribute farmer-preferred non-released varieties	No	No
1b. National breadth & depth of use		
* geographical coverage by government agencies (no. or % of districts)	25 (33%)	MPRLP 5+, DPIP 14 (23%+)
* no. of crops covered by government extension agencies or projects	1 (maize)	MPRLP 7, DPIP ?
* geographical coverage by NGOs (number of districts)	>45 (CIMMYT 45, LI-BIRD 42 FORWARD 12)	>11 (ASA 11, GVT 5)
* geographical coverage by NGOs (% of districts)	> 60%	>23%
* no. of crops covered by NGOs	54 (LI-BIRD 44, FORWARD 17)	15
* No. of NGOs using PVS	6	2

Government agencies in both locations recognise that PVS is a valid and desirable component of agricultural extension and are involved in implementing it. Geographical coverage by government agencies or projects, as measured by the percentage of districts in which PVS is implemented, is quite similar. The number of crops covered as part of a project or scheme involving government agencies is currently only one in Nepal (according to DoA), as opposed to several (7+) in MP: although, as mentioned earlier, individual DADOs may also be collaborating with NGOs on other crops. The number of crops covered by NGOs is about three times higher in Nepal, as is the number of NGOs involved. Overall, the degree of institutionalisation appears to be somewhat higher in Nepal.

4.3.2 Institutionalisation of PPB

Overall, there seems to be a slightly higher level of institutionalisation of COB/ PPB in Nepal, particularly in relation to policies and procedures; but the level is very low in both countries (Table 4.3.2). In Nepal, NGOs can make submissions to the varietal release committee, and are continuing to do so; but there is still some reluctance from public sector plant breeders to accept evidence in support of release that is based on participatory trials. In India NGOs are not allowed to apply for release of a variety and hence are dependent on collaborating with SAUs.

Table 4.3.2 Institutionalisation of COB/PPB at National and Organisational Levels

Levels	**Nepal**	**India**
1a. National (or state) policies and procedures		
Favourable government policies		
Government recognises COB/PPB in varietal selection procedure(s)	Yes (but see text)	Yes at state level No at central/national level
1b. National breadth & depth of use		
* Number of public sector agencies or divisions currently using PPB	1 (was 6)	0 (was 4)
* No. of crops covered by public sector PPB	3 (Rice, wheat, maize)	5 (maize, upland rice, black gram, horsegram, chickpea)
* Number of NGOs using PPB	3	1 (GVT)
* No. of crops covered by NGOs in PPB	5 or 6?	7
* No. of PPB varieties released or under consideration (& No. of crops)	8 (2)	8(5)
2. Organisation (Public sector)		
* supportive structures and procedures	No	No
* appropriate incentives & organisational culture	No	No

COB/PPB involving public sector agencies has either stopped (India) or reduced to a very low level (Nepal). In India, the SAU work ended with the cessation of funding from international donors. In Nepal, various factors may be responsible. The National Wheat Research Program stated that it was not “doing any more COB/PPB work due to lack of resources… it is more costly” (survey questionnaire). The reasons for this situation are analysed in section 5.1.1 and the relevant case studies (Conroy, 2009; Conroy and Adhikari, 2009).

4.3.3 Community-based Seed Production and Distribution

The more farmers who are aware of and have access to PVS/COB varieties, the greater their impact will be – hence the fact that “wider dissemination of farmer-preferred cultivars” is seen as an important final phase of the PVS process (Stirling and Witcombe, 2004). Limited availability of, and access to, farmer-preferred varieties tends to be the major constraint on their use and spread.

National seed supply agencies account for only a small proportion of the total seed sown in a country. Thus, it would be impossible (in Nepal, for example) for the national agency alone to supply a substantial amount of seed of farmer-preferred PVS or COB varieties to farmers. Furthermore, state seed supply and extension agencies in Nepal and India will only supply and promote seed of officially released varieties. Thus, PVS/COB proponents in India (ASA, GVT) and Nepal (CAZS NR, FORWARD, LI-BIRD) believe that it is an urgent priority to strengthen and improve community-based seed production and distribution (CBSPD).

The need for a decentralised seed production system in Nepal to complement the centralised NSC system has long been recognised by both the government and donors. Nepal has had several small-scale seed projects since the early 1980s.

Small-scale seed projects have tended to ignore the importance of transaction costs associated with seed multiplication and marketing - particularly in poor, marginal areas where demand for purchased seed may be low (Wiggins and Cromwell, 1995). Another common type of weakness is that the development agencies fail to develop the capacity of the CBOs to deal effectively with intermediaries – in sourcing seed, arranging external quality control and/or marketing the seed – instead, taking on these roles themselves. Seed marketing has been a particularly glaring weakness in most projects (Tripp, 2001).

The PCI project in Nepal facilitated several seed producer groups to address the COB/PVS seed supply constraint, with which its NGO partners LI-BIRD and FORWARD have been working. Before facilitating seed producer groups itself the team reviewed the outcomes of past attempts at establishing sustainable seed producer groups, such as those described above. They then took steps to establish sustainable seed producer groups in Chitwan district. Taking into account lessons from their review, they emphasised strengthening managerial and marketing capabilities of the groups rather than concentrating on technical issues such as seed quality control. Another distinctive feature of the CAZS-NR approach was that it advocated ‘truthfully labelled (TL)’ seeds as the type of seed to be produced and marketed by the groups, rather than the phase-wise certified seeds (Joshi, *pers. comm*.).

When PCI started to facilitate seed producer groups there was only one established group in Chitwan district, called *Bij Bridhi Krishak Samuha Phituwa*. The PCI initiated and supported another three producer groups in Chitwan, by working with farmer groups that had already been established by the DADOs for other purposes (e.g. dairy production). By 2005 the rice seed production of the three newly established groups compared favourably with the total rice production of Nepal’s National Seed Company.

The PCI team believes it avoided the common pitfalls of previous initiatives and that their groups are well on their way to becoming sustainable. It remains to be seen whether CBSPD producer groups will be able to function profitability without external support and nurturing, but the signs so far are promising. The promotion of commercially oriented CBSPD groups has been described as “one of the most important institutional innovations” promoted by PCI (Joshi *et al*., 2005).

4.3.4 Attribution of impact

The impacts of PVS and COB/PPB summarised above are not all directly due to the work funded by DFID’s RNRRS. In the case of ***PVS***, although the PSP NGO partners in both countries have obtained funding from a variety of sources to support their PVS work, the PSP funding that they received was one of their main sources during the period when this was being provided; and the technical support they received from the CAZS NR staff has been very important. During the last few years CIMMYT has also been a major implementer of PVS, which it is currently applying to maize in its HMRP.

There has been very little other funding for **COB/PPB** in India and Nepal. The CGIAR has a Systemwide Program on Participatory Research & Gender Analysis (PRGA), of which PPB has been a central focus for over a decade. One of the key outcomes that the PPB component is aiming to achieve is “Widespread application of PPB in national programs and in the CGIAR Centers”. Crop-focused CGIAR centres working in India include ICRISAT, which has a campus outside Hyderabad, and CIMMYT, which has a South Asia office in Kathmandu, Nepal. CIMMYT collaborated with CAZS NR on a PCI (PVS and PPB) project in South Asia, which was funded from DFID’s Competitive Research Facility.

Is it possible, therefore, that the CGIAR, and in particular the PRGA’s PPB component, has had a positive influence on PPB in India and Nepal? That possibility can be ruled out, as nearly all of the CGIAR centres appear not to be implementing COB/PPB themselves. (A senior plant breeder in CIMMYT’s Kathmandu office told the author that the only CGIAR centre in the world practising PPB was ICARDA, which is based in Syria and does not operate in India and Nepal. Another exception appears to be Bioversity International, which has been doing some PPB in Nepal.) If anything, the CGIAR centres may have had an inhibitory effect on COB/PPB in India and Nepal.

5. LESSONS, INSIGHTS AND CONCLUSIONS

5.1 Lessons and Insights from Institutional Innovation Case Studies

5.1.1 Institutionalisation of the Crop Improvement Innovations

PVS has been significantly institutionalised in MP and Nepal, including within the public sector. According to Ashis Mondal, ASA's Director, in MP nobody questions the efficacy of PVS nowadays. In both places this appears to be largely due to the fact that the principal NGOs (and CAZS NR in Nepal – Joshi *et al*., 2005) have been implementing and promoting PVS for many years, and key individuals in these organisations have acted as 'process champions'.

It is evident that PVS has been implemented and institutionalised to a far greater extent than PPB. The main reasons seem to be that PVS:

- has lower costs
- has lower skill requirements
- produces visible benefits much more quickly
- is less subject to government regulations and hence more open to NGO involvement
- appears to be less threatening to/competitive with existing practices.

Both institutional innovations require a major paradigm shift, away from the 'transfer of technology' paradigm towards one in which a number of different stakeholders, and farmers in particular, are recognised as having an important role to play in technology development. While the ToT paradigm has gradually become less dominant among civil society organisations and agricultural extension agencies in general, it appears to remain the dominant paradigm in some areas of public research and among some plant breeders in particular. In Nepal this has been attributed partly to "the long-term connections with plant breeders from the international centres for the major food crops grown in Nepal: rice, wheat and maize" (Biggs and Matsaert, 2004). Some key informants in Nepal argued that the fact that the CGIAR centres generally practise conventional breeding methods has reinforced the validity of these methods in the minds of some national plant breeders and their colleagues and made them less receptive to COB/PPB.

The relative lack of institutionalisation of COB/PPB is consistent with international experience, namely that "institutionalization of PPB has been slow" (Walker, 2007). Factors identified by key informants as hindering the take up and institutionalisation of PPB are summarised in Table 5.1.1. Factors 7 and 8 appear to be related to each other: COB/PPB tends to require more funds (up to 20% more – Yadavendra, *pers. comm.*) in the early stages (but may require the same or less funds over the whole plant breeding process) than conventional breeding to cover the costs of on-farm trials. Current budgeting norms may be inadequate to cover these costs, and this aspect of institutionalisation may not have been addressed in India. In Nepal, funding can be a constraint for any kind of plant breeding, due to a general freeze on research funding and the fact that plant breeding is funded on a project basis rather than as a broader long-term programme (Sherchan, *pers. comm.*).

Table 5.1.1 Factors Identified as Hindering the Institutionalisation of PPB

Inhibiting Factors	Sources[1]		
	India	Nepal[2]	Int'l
1. Public sector monopoly on central varietal release system	✓		
Attitudes and perceptions about the science			
2. Lack of acceptance by *senior management* of its scientific credentials vis-à-vis conventional plant breeding	✓		✓
3. Lack of acceptance by *some plant breeders* of its scientific credentials vis-à-vis conventional plant breeding; sometimes combined with perception of farmers as passive 'dumb receivers'	✓	✓	✓
4. Perception that existing system produces satisfactory results in terms of farmer-preferred varieties for rainfed/marginal areas	✓		
5. Those in public sector implementing conventional approach feel threatened by NGO PPB activities & become defensive			✓
6. Some managers and plant breeders prioritise 'high tech' research and perceive PPB for marginal areas as unattractive			✓
Costs and benefits (perceived and actual)			
7. Perceived to have higher costs than conventional plant breeding	✓	✓[3]	
8. Insufficient financial and other resources for fieldwork		✓	✓
9. Scepticism and perceived lack of quantified evidence about likely size of benefits of PPB, in terms of number of users of a variety	✓		✓
Disincentives			
10. Greater time and effort required by plant breeders to conduct PPB fieldwork & establish partnerships	✓		
11. Research organisations reward 'paper release' of varieties, & scientific publications, not benefit to farmers	✓		✓

[1]Information in first two columns is from individual interviews in the respective countries. Information in the third comes from the international group discussion held in 2009
[2] The fact that only three factors were identified as applying specifically to Nepal does not mean the others are absent: the Nepalis in the international group presumably saw all the factors in the final column as applying to their country, and there may have been a lack of interviews with sceptics in Nepal.
[3] In Nepal the key informant perceived PPB as being more costly in the early stages, but not overall

Research on policy change has identified five key conditions that need to be satisfied if change is to take place (J. Ashby, *pers comm*., 2009). These conditions are listed in Table 5.1.2, together with a subjective assessment (based on the findings of the two institutional innovation case studies) of the extent to which they have been satisfied in relation to PVS and COB/PPB in India and Nepal.

Regarding the first condition (convincing evidence), policy shapers in India – i.e. senior ICAR research managers – suggested that evidence of the benefits of COB/PPB was lacking: this was arguably true, as there had not been any studies of the extent of use of COB/PPB varieties prior to the RIU ones. It is more difficult for COB/PPB than PVS to satisfy the *fifth* condition, as PVS produces visible results much more quickly, i.e. within one crop season.

Table 5.1.2: Satisfying Conditions for Achieving Change – PVS and COB/PPB

	PVS		**COB/PPB**	
	Madhya Pradesh	*Nepal*	*MP and India*	*Nepal*
1.Providing **convincing** evidence to policy-makers (and policy shapers)	✓	✓	No	partially
2.There must be political demand for change on an important issue and you must offer an attractive solution	?	?	?	?
3.Proactive champions are required to get the message across	✓	✓	Limited (GVT)	✓ (LI-BIRD, FORWARD CAZS-NR)
4.Frontline professionals need sustained relations with policy makers.	✓	✓	Limited (GVT)	✓
5.Beneficiary groups must testify and demonstrate that proposed solutions to the problem actually work	✓	✓	?	?

The *second* condition refers to political demand for change, which has generally been absent in relation to crop improvement, particularly from resource-poor farmers operating in rainfed and marginal environments. NGOs have demanded change on their behalf, but more effective crop improvement has hardly become a political issue around which people have mobilised. The government research system, at least in India, has tended to give priority to developing new varieties for relatively favourable agronomic conditions: this suits most researchers, as well as better-off and more powerful farmers, as these conditions are consistent with the use of more high-tech and scientifically cutting-edge crop improvement techniques. In addition, there has been a focus on achieving *national* food self-sufficiency, and a reliance on redistribution to deficit areas and households as and when necessary.

Table 5.1.3 Clash of paradigms and values in agricultural research and plant breeding

Conventional approach	**Participatory** approach
Has been learned & internalised by breeders.	Is different & requires un-learning & re-learning.
Prioritises and rewards scientific knowledge.	Prioritises development impact esp. poverty reduction.
Success measured by numbers of: - scientific papers - varieties released - patents	Success measured by numbers of: - poor farmers using & benefitting from variety
Associated with: - *controlled* research under researcher conditions - Farmer knowledge & views NOT valued	Associated with: - Research (less controlled) under farmer conditions - Farmer knowledge & views highly valued

The last point highlights a factor not fully captured in Table 5.1.2, namely the importance of research paradigms and personal values. There tend to be important differences in these between conventional plant breeding and COB/PPB, as elaborated in Table 5.1.3. Some researchers (particularly younger ones) undergo a paradigm shift after being exposed to COB/PPB, but many do not. Senior researchers and managers tend to retain the conventional approach and paradigm; and in hierarchical (if not authoritarian) cultures, such as India's, the conventional persists.

5.1.2 Insights on changing the seed supply systems

The experience of the seed producer groups suggests that initial start-up support to these new enterprises was important but imparting business skills to the groups to allow them to build capital was crucial for making them sustainable enterprises (Witcombe *et al*., EA).

The type of varieties produced by the groups initially have generally tended to be different from what was envisaged, i.e. PVS or COB varieties. The situation arose because the seed producer groups were responding to demands from local Agrovet-dealers who, in turn, were responding to the demands of their client farmers. Since the farmers were unaware of the new varieties they did not demand them: so demand would not increase unless farmers could try the seed and seed would not be produced unless there was demand (Witcombe *et al*., 2009).

More recent CAZS NR/LI-BIRD initiatives aim to address this challenge by passing demand for seed of new varieties via a local development agency to the seed producer groups, even when they knew that the groups had no seed available (ibid). Although this would not result in an immediate supply it could give them the confidence to include COB/PPB varieties in their future plans for seed production. CAZS NR and its Nepali partners are also holding stakeholder meetings of seed producer groups, Agrovets, farmer groups, DADO extensionists, rice millers, traders and other NGOs – all of the major players in the rice innovation system – to explain the growing characteristics and qualities of the new varieties to stimulate demand and increase knowledge of the new varieties.

It is interesting to note, that work on CBSPD "was not envisioned in the project design" for PCI (Joshi *et al*., 2005). This omission may have been due to researchers thinking that this kind of activity was beyond the scope of RNRRS research projects.

5.1.3 The contribution of individuals to institutional change

This study has focused on policies, organisations and broader social processes. However, individuals can and do exert a significant influence, whether they work in NGOs and civil society generally or in the public sector. In India, for example, large organisations like ICAR and the SAUs are not necessarily monolithic, although they may appear like that to outsiders, and at a senior level individual staff can make a difference.

The current status of crop improvement in India and Nepal has been strongly influenced by various *champions* of PCI processes, including: Dr JP Yadavendra of GVT and Mr Ashis Mondal of ASA in India; and a number of leading advocates of PCI processes in PSP's local partner organisations in Nepal - LI-BIRD, FORWARD; and staff of Bangor University's CAZS-NR (Dr John R Witcombe - and Dr D S Virk in India and Dr Krishna Joshi in Nepal).

5.2 Lessons and Insights from Technology Innovation Case Studies

5.2.1 Ashoka rice India

The innovation process The development and dissemination of the Ashoka varieties was made possible primarily by the contributions (financial and in-kind) made by DFID bilateral development projects; and subsequently by supplementary funding from PSP programme development (PD) funds. The contribution of RNRRS funded research projects was quite limited.

Participatory rice breeding in India began (in 1998) under the auspices of the EIRFP and WIRFP, with CAZS-NR researchers (Dr Virk and Professor Witcombe) working as consultants to the projects. In a sense the involvement of Dr Virk and Professor Witcombe as consultants to the projects was fortuitous – it stemmed from the fact that Bangor University's CAZS was part of a consortium that managed the technical inputs to the first phases(s) of the WIRFP, starting in 1993. Subsequently, DFID awarded the contract for this work to a different consortium led by WS Atkins: nevertheless, CAZS inputs continued to be funded by this consortium until the project ended in 2005.

The development of the varieties and their distribution to the 'primary' villages surveyed in the IA study was done during the period up to and including 2003; but it was only in 1999 that a related and fully funded PSP research project started, combining participatory breeding with the use of molecular markers.

The level of impact shown in this case study could not have been achieved with the level of funds (e.g. £150,000-200,000) typically provided for a RNRRS research project; nor in the period of time for which RNRRS funding was typically provided, i.e. three years, with possible extensions of 1-3 years.

The PD funds were available to the CAZS-NR researchers because Professor John Witcombe was the manager of the PSP and therefore had considerable discretion over what these funds were used for. Such funds would not necessarily have been available to other researchers, working on other PSP-funded projects - who would not necessarily know of the existence of such funds and who would have had to apply to the programme manager for them.

Seed dissemination and extension New varieties of an existing crop are probably the easiest new technology for farmers to start using – provided they do not require any major modifications to previous practices (e.g. increases in agricultural inputs). There are many cases of new varieties spreading from farmer to farmer without any official extension campaign, and sometimes without them having been officially released. This case study has provided another example, documenting quite extensive and rapid farmer-to-farmer spread of Ashoka varieties.

Nevertheless, the fact that some farmers grew Ashoka varieties on inappropriate lands and had problems growing Ashoka rice points to weaknesses in the way in which seeds of the Ashoka varieties were disseminated - or conversely ways in which it could have been strengthened. GVT staff did not always give proper instructions to farmers while giving the seed for testing in the early (PVS) stages. This is partly/largely because the GVT was mostly targeting social issues in the EIRFP and WIRFP and most of its community workers (who distributed the seed to the farmers) had a social science background. There was a lack of literature with the Ashoka variety seed in the latter stages when dissemination started. Several farmers or groups of farmers interviewed in the qualitative survey, including ones positive about Ashoka, argued that Ashoka use could have been more widespread and/or faster if seed distribution had been accompanied by, or followed up with, an extension campaign.

The nature of the benefits Conventional plant breeding tends to attach greater weight to increased yield than to any other crop trait. It is interesting, therefore, that, although Ashoka has this trait, the majority of Ashoka growers ranked other traits, particularly grain quality and taste, more highly. It is also interesting that Ashoka users identified many other positive characteristics of these varieties. This reinforces the case made repeatedly by advocates of COB/PPB that plant breeding should take account of multiple farmer-preferred crop traits.

Inter-district differences There were substantial differences in Ashoka use patterns between the different study districts. For example, in three districts a higher percentage of households grew Ashoka rice on medium land (with none growing it on upland in two of them); and in the other two districts a higher percentage grew it on upland, (with no primary village households growing it on lowland in one of them). This reflects inter-district differences in cropping systems due to differences in agro-ecological conditions, crop markets etc; and highlights the diversity in farming systems and the inappropriateness of blanket assumptions about how and whether a new variety will fit into the farming systems of resource-poor farmers.

Upland rice focus In its first stages the Ashoka work in eastern India focused on *upland* – yet most of the rice is grown on *medium and lowland*. (In the later stages there was also work on medium and lowland rice.) This was because EIRFP prioritised upland agriculture, which it believed to be particularly important for the poorer farmers. Conversely, maize, horsegram and groundnut - which had already been covered in western India and which **are** grown on upland in these locations - were not selected as a focus for dissemination work. Dr Virk had been funded to work on rice through a PSP 'R' project, and pushed rice with EIRFP – but there was no 'R' project for the other three crops.

Professor Witcombe attributes the focus on upland rice (as opposed to other, more important upland crops) to: (a) a lack of baseline and background information about farming and cropping systems in the EIRFP programme area; and (b) the local partners (GVT and BAU) being very weak (J. Witcombe, *pers. comm*.).

Lesson The widespread use and quite rapid rate of spread of the Ashoka varieties provides evidence that COB/PPB is capable of producing crop varieties suitable for marginal environments, something that conventional breeding has failed to do in India; and that it can be an effective replacement of conventional plant breeding for such agro-ecological conditions. A wider use of the COB/PPB approach for these conditions is needed for poverty alleviation, and perhaps now for climate adaptation too.

However, to influence policy in India additional evidence is needed, including a thorough comparative cost/benefit analysis of COB/PPB and conventional breeding. Better evidence is needed on the costs and benefits of COB/PPB vis-à-vis conventional breeding, including:

- The costs of PPB compared with those of CB
- Actual numbers of adopters of PPB varieties (a key dimension of the benefits)
- Actual numbers/proportions of adopters of conventional Vs for particular crop(s) in particular districts/regions, with reference to the numbers of Vs of the crop produced through conventional breeding.

One of the arguments against technologies developed with resource-poor farmers using a participatory approach to technology development has been that the unit costs are high, but the number of beneficiaries (the recommendation domain) is likely to be low. The same argument is being used in India by COB/PPB sceptics/opponents. It is important, therefore, to gather evidence on actual or likely number of users of COB/PPB varieties, as the RIU Rainfed Agriculture technology studies have. Although the study on the impact of Ashoka rice varieties should be a valuable contribution to the debate, sceptics are likely to argue that one example is not sufficient evidence on which to base policy change. It would be desirable, therefore for RIU to commission a further study on another COB/PPB variety – for example, on the impact of GM 6 maize. This was released in Gujarat and neighbouring states several years ago and has had sufficient time to enter widespread use.

5.2.2 RRC in India

The fact that none of the farmers interviewed in the household survey was using any of the elements (seed priming etc.) covered in the training package raises fundamental questions about the way in which the training was provided. It appears that CRS's local partners (who trained the participating farmers) had only a limited understanding of the technologies they were promoting.

The highly diffuse structure of the relationship between CRS and its various layers of partners makes it unusually susceptible to a sort of 'chinese whispers' phenomenon. That, coupled with the general lack of any appropriate technical background of operating partner's (OP's) staff (generally focussed on social welfare activities) made detailed, consistent training very difficult. CAZS NR was attracted to CRS and its OPs as partners, because of their close linkages with farmers, but the trade-off was the poor quality of those linkages for imparting technical information.

The limited resources available to a research project to provide training (and follow up) may also have been a factor. The project monitoring appears to have been deficient, as the complete lack of use of the technology elements revealed by this case study was unexpected. **Lesson** Better monitoring could have highlighted this, and in principle follow-up actions could have been taken to address the issue.

One of the conclusions made by the study's lead author is that there are fundamental constraints on making much of an impact per household with Kabuli chickpea (KC), i.e. tiny land areas per household and low productivity. In the context of one of the main perceived advantages of Kabuli chickpea – it is a minimal input crop - measures to improve productivity may well be subject to rapidly diminishing returns. Only where selling green pods of KC is possible is the impact likely to be significant.

5.2.3 Improved rice varieties in Nepal

The study's finding that BG 1442 (Hardinath 1) is now in widespread use provides an illustration of the value of PVS in identifying varieties that farmers like and will adopt. It is also the latest of many examples of farmer-suitable crop varieties that remain 'in the locker' of national research organisations. This variety was introduced into Nepal about 20 years ago by the National Rice Research Program but had not been released prior to the PVS trials.

The early use of eight COB varieties by surveyed farmers provides strong evidence that the breeding methods that were used, although highly simplified and potentially cheaper than conventional ones, can produce successful varieties.

The fact that COB varieties were not grown at all in a third of the 36 villages surveyed appears to be due, at least primarily, to the limited availability of seed and perhaps also a lack of information about them. The quantities of COB seed supplied by the PSP projects were small, and the implication is that if larger quantities of seed had been available the rate of spread could have been more rapid. Being research projects they were not able to supply large quantities, and this suggests that an alternative funding source would have been desirable once the value of the research outputs (the COB varieties) had been demonstrated. The CAZS NR team did seek funds from various sources - including DFID Nepal - but with no success.

The limited use of COB varieties in some villages suggests that it may have been unduly early for an assessment of their impact to be undertaken. The study was done only 3 to 5 years after the varieties were first tested with farmers and only 1-3 years after any significant scaling up was done. BG 1442 (released under the name of Hardinath 1), on the other hand, was first tested (by the PCI project) in 1998, and its seed was distributed on a large scale in 2001; so this variety had had a substantially longer period to enter into widespread use.

Three different methods were used in this study to obtain information about the extent of use – the structured group discussions, the household survey and the scoping study. This was desirable for the purposes of triangulation – cross-checking – of findings; but there was some inconsistency between them in the results obtained, and it appears that no one method was entirely satisfactory.

5.2.4 RRC in Nepal

The RRC project was highly complex. It used a community-development type approach in which many different technologies, and combinations of technologies, were made available to farming households. The technologies themselves were: plant-based ones (new varieties) that could be readily tested by farmers without much additional project involvement; and knowledge-based (e.g. seed priming, improved composting) interventions that required varying degrees of farmer training. It was perhaps inevitable, then, that the impact of individual technologies would be difficult to determine.

The striking differences between districts in use levels of different technologies serve as a reminder of the complexity and variability of farming systems, even within one recognisable region like the terai. The case study findings provide yet another example of the inappropriateness of a one-size-fits-all approach to technology generation and dissemination; which has broader implications for agricultural research and development. They highlight the importance of developing a wide range of technologies such as crop varieties (as in the Nepal RRC and rice projects).

The need for a PVS approach in order to match varieties to farmers' needs for particular situations was confirmed. For example, in at least one of the districts where the RRC project tested short duration rice varieties it became apparent through the PVS process that most farmers were interested in medium and long duration varieties; and in Jhapa district it became apparent that the agro-ecological conditions were not conducive to chickpea production.

Availability of land is a key issue for projects that seek to improve livelihoods by increasing agricultural productivity. Average land holding per household is very small in the project villages and hence even very large relative increases in crop production are not large in absolute terms.

The focus of the PSP projects was on technological *research* rather than supportive *extension* approaches. The RNRRS programme relied on spontaneous spread of effective technologies by farmers; or on research project managers linking up with extension-oriented programmes. However, the latter was not available in this case, and the former is often inadequate. **Lesson** The absence of a funding mechanism to promote promising research outputs was a generic weakness of the RNRRS programme: this is now being addressed for some technologies through DFID's RIU programme.

A methodological learning from this study is that group discussions tended to (a) underestimate the level of use within a village of varieties that are relatively rare; and (b) overestimate the more popular varieties. This throws into question the accuracy of results from group discussions, particularly those at which the entire village is not represented. It also suggests that group discussions are particularly poor for estimating the early adoption of new varieties when they are likely to occur at a low frequency in a village.

5.3 General Lessons for Research and Innovation

5.3.1 Issues related to RNRRS funding for agricultural research

Some of the issues identified in this cluster study are generic to the whole RNRRS, and were identified in an evaluation of the RNRRS that was undertaken in 2005. Where this is the case, reference is made to relevant parts of the evaluation report.

Separating research from extension and dissemination "In 1994, DFID field projects and programmes were an important, but not exclusive, provider of support to wider uptake and capacity building activities, thus aiding directly the securing of impact for the identified ultimate beneficiaries. With the changes in aid delivery policy, notably the 1997 White Paper, this has changed with progressively greater reliance being placed on others, including national governments, to secure the delivery of uptake and impact" (RNRRS Evaluation, 2005). In India the PSP rice research was able to link up with the DFID-supported WIRFP and EIRFP – but such linkages were not possible in Nepal or with the RRC work in India.

"Once DFID moved away from the extensive field based programmes noted in the Yellow Brick as a major (but not exclusive) user of the findings, a conundrum was created for Programme Managers. Funding could never allow any significant uptake activity much beyond the preparation of material and promulgation of workshops. Furthermore, capacity building was specifically excluded from Programme Managers' TORs" (RNRRS Evaluation, 2005). This was a significant constraint for most of the PSP research on rainfed agriculture reviewed in these studies.

Most of the seed dissemination work in Nepal and India was not funded by RNRRS projects (with 'R' codes): there were no RNRRS mechanisms to facilitate scale-up. (However, the rules were softened somewhat in the later stages of the RNRRS (J R Witcombe, pers. comm.) In Nepal, dissemination activities, including purchase of seed, were funded by the PSP as an 'underground' activity using programme development funds: in effect, the RNRRS rules were 'bent' to facilitate dissemination. (One consequence of this situation, however, was that there were insufficient resources to document the process in any detail.)

RNRRS neglect of capacity building "Capacity building incentives were excluded in the first 8 years" of the RNRRS (RNRRS Evaluation, 2005). However, "If research is to deliver impact and to be sustained, then capacity building is required for policy and delivery institutions and actors, as well as for research institutions, which also need support in improving their strategic level planning and management of research" (ibid). For this reason, the RNRRS Evaluation made the following recommendation: "Capacity building at 3 levels needs to be built into future work: professional development of researchers; policy makers, decision makers and extension workers; and, institutional strengthening". This recommendation is supported by the findings of this cluster study.

The consequences of the RNRRS's marginalisation of capacity development are particularly apparent in relation to non-sustainability of COB/PPB in public sector research organisations in India and Nepal. It appears that the PSP did not supply any funds directly to the Indian SAUs or to Nepal's NARC (J.R. Witcombe, *pers. comm.* 29 Sept 2009). Apart from the issue of capacity development not being recognised as a legitimate and priority activity by the RNRRS, the PSP may not have had sufficient funds to support this kind of work (J.R. Witcombe, *pers. comm.* 29 Sept 2009).

In India funds were made available to the SAUs from the DFID-supported bilateral projects (EIRFP and WIRFP) to implement this process innovation, which was a form of capacity building (learning by doing). However, this was not sufficient to enable the innovation to become institutionalised in any of the SAUs, which stopped using it around the time when the funding ended. This suggests there are higher level constraints (as discussed in section 5.1.1) that may not have been identified and addressed when the bilateral funding of the SAUs was established and implemented. The short duration of the funding may have also been a factor.

Projects versus programmes DFID RNRRS funding was structured and channelled through 10 programmes, of which Plant Sciences Research was one. Each programme funded quite a large number of relatively small (budget of say £100,000 – 200,000) research projects on specific topics whose typical duration was quite short - about three years. Thus, no one project on its own was likely to have a significant and lasting effect. One of the reasons why the PCI and RRC research (whose impact has been studied in this set of case studies) has tended to be relatively successful is that the PSP Manager: (a) increased the duration of research, by funding *successive* projects; and (b) supplemented the *project funding* with *programme funding* that was more flexible.

5.3.2 Factors contributing to the impact of PSP research outputs

The important contribution of non-project funding Much of the impact of the innovations studied in the various case studies is to a large extent due to non-project funding, which enabled the researchers to overcome constraints imposed by RNRRS regulations. The non-project funding was of two kinds:

- PSP programme funds and
- Bilateral development funds.

In India there were no 'R' projects to begin with, and the work was funded and documented through DFID bilaterally funded agriculture projects (EIRFP, WIRFP). Dr Virk did PCI work as a consultant to GVT on the EIRFP, and Professor Witcombe made related visits, funded by PSP programme development (PD) funds. (There was some blurring at times re which funding source was funding particular activities.) PD funds were very useful in providing this kind of flexibility.

Going beyond research Despite the lack of institutionalisation of COB/PPB, it is evident that the PVS and COB/PPB projects funded by DFID's RNRRS programme have had a substantial impact in India and Nepal. The fact that they were able to (directly or indirectly) (a) benefit substantial numbers of poor farmers, (b) develop local capacity for PCI processes and (c) influence the enabling environment and policy despite the constraints of the RNRRS rules is quite remarkable. It reflects a strong commitment on the part of PSP Programme Manager and his CAZS NR colleagues to achieving impact, and a willingness to bend the rules where necessary in order to do so. However, in future research programmes (as in the RIUP) that attach priority to achieving impact there should be an explicit recognition and acceptance that influencing and improving the innovation system within which research projects function is a legitimate and important activity for those projects.

The importance of flexibility and opportunism In some PSP projects in Nepal important actions/initiatives were taken that were not envisaged in the original project logframe. For example, "influencing formal extension policy and institutionalisation of the partnership with the government line agency was not envisioned as one of the outputs in the original project log frame"; and nor was promotion of CBSPD (Joshi *et al.,* 2005). A key lesson here is the need for flexibility on the part of project staff and programme managers to respond to new insights and circumstances.

5.3.3 Benefitting the poor through agricultural innovation

The very poorest people, such as the landless and those with disabilities, do not benefit directly from crop production interventions, although they may benefit indirectly from increased agricultural labour or lower food prices. The technologies studied in these impact assessments have mainly benefitted resource-poor farmers (RPFs). It is clear from the studies that there are no silver bullets – no technological panaceas – in RPF agriculture. For RPFs with limited arable land, even quite large relative benefits from crop-based interventions will not be large enough in absolute terms to make much of an impact on poverty. RPFs, with their diversified livelihood strategies, will also need non-agricultural improvements to enable them to move out of poverty.

Nevertheless, this set of case studies has shown that demand-led crop-based and other agricultural improvements can make a significant impact on household food security. First, new varieties of one major staple crop (or a combination of RRC technologies) have been shown to increase poor farmers' food grain self-sufficiency by 1-3 months, and this can be a vital hunger-alleviating benefit for a poor family. Second, while the benefits per household may be quite small, the rice studies have shown that the number of beneficiaries can be large. Third, a crop improvement system oriented towards satisfying the needs of RPFs can deliver new varieties and technologies that cover a range of crops, not just one. The fact that no one *technological innovation* is likely to have a transformational effect is one of the reasons why *institutional innovation* is essential.

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Annex 1 Poverty index

The purpose of the index

The poverty index was constructed to enable the study to distinguish wealthier households from the rest of the households among those surveyed. Its use will allow the study to assess the extent to what projects have worked with the poor in the areas of intervention.
The poverty index does not attempt to place households in relation to the poverty line established by the government of the State or country where the intervention took place. The data demands for such exercise are too big in relation to the resources and information needs of the projects.

Development of the index

In the meeting held in Ratlam, India, in June 2007 to discuss the methodology for data collection and the design of the questionnaires, a decision was made to include a number of questions chosen to capture information about indicators of human resources, dwelling, food self-sufficiency and assets. These indicators fall in line with the categories of indicators used by the Consultative Group to Assist the Poorest (CGAP) Poverty Assessment Tool (cited in Falkingham, J. and Ceema N., 2002), developed by the CGAP of the World Bank in collaboration with the International Food Policy Research Institute.

The detailed decisions made in Ratlam are documented in the Quarterly Report for April-June 2008 of the MIL RA Cluster Study.

The meeting held in Dhulikhel, Nepal, in January 2009, revised the index proposed in Ratlam and proposed changes to improve the ability of the index to distinguish the non-poor from the poor. The main changes include:

1. Decision to have an index that splits the households into two categories: poor and non-poor. This is in contrast with the three categories proposed in Ratlam.
2. Redefinition of the scores assigned to each indicator and with that, the weight for each indicator in the overall index.
3. As a consequence of the two items above, redefinition of the threshold for the non-poor category.
4. Inclusion of an extra indicator: tractor ownership.

The indicators

The indicators selected for the poverty index are:
1. Livestock units
2. Total quantity of all food grains produced in the season 07-08 per capita
3. Roof type
4. Number of jobholders in household who provide income
5. Ownership of a tractor
6. Extent of unskilled labour migration

The indicators

Livestock units

This is calculated by computing a weighted sum of all livestock owned by the household. The weights of the different types of animals are as follows:

Type of animal	Weight
Cows, Buffaloes, horses, donkeys	1
Goats, Sheep	0.1
Poultry	0.01
Pigeons	0.005

The number of animals owned of each type is multiplied by the corresponding weight and the products added up to obtain the "Livestock Units". Thresholds for this indicator index were derived from consultation of secondary sources (NSS Report No. 493(59/18.1/1), Maltsoglou, I and Taniguchi, K., 2004) and consultations with key informants from the partner organisations participating in the study.

Food production per capita

This is the total quantity of all food grains produced in the season 2007-2008 per capita. It includes the weight (kg) of grains (cereals and legumes) produced in the 2007-2008 season. It is important to highlight that the indicator includes grain that is produced for consumption as well as that that is produced for sale.

For the calculation of the indicator, the total production is divided by the number of adult equivalents per household. Adult equivalents per household are calculated as a weighted sum suing the following weights: Adults = 1 ; 10 – 17 years = 1; children under 10 = 0.1.

The contribution of this indicator to the overall index is based on a scale that increases in accordance to the increase of food production. At the lower end of the scale are those households with production less than 180kg grain per capita, roughly equivalent to 0.5 kg per day. Households with more than 730kg per capita (roughly 2kg per day per capita) are at the higher end of the scale.

Seasonal unskilled labour migration

This indicator behaves differently in India and Nepal. In the areas of intervention in India distressed migration is not uncommon and is used as a coping strategy by very poor households. In the areas of intervention in Nepal, seasonal migration of unskilled labour is uncommon and is less useful to discriminate levels of poverty. This is reflected in the different weights used for the computation of the index in each country.

Other indicators

The other indicators are derived directly from the corresponding questions included in the questionnaire and do not require specific calculations.

Scores for the poverty indexes of India and Nepal

India	Score							
	-1	0	1	2	3	4	5	6
Indicator								
Livestock units		<1	1-<3	3-<5	5-<10	>=10		
Food production per capita		<180	180-<365	365-<730		>=730		
Roof material		Thatch	Tile	Tin	Pucca/ concrete			
Jobholders in the family		No job		1 job		2 jobs		3 or more
Tractor ownership		No tractor					Own tractor	
Seasonal unskilled labour migration		Wife migrates	Husband migrates		Neither migrates			

Nepal	Score							
	-1	0	1	2	3	4	5	6
Indicator								
Livestock units		<1	1-<3	3-<5	5-<10	>=10		
Food production per capita		<180	180-<365	365-<730		>=730		
Roof material		Thatch	Tile	Tin	Pucca/ concrete			
Jobholders in the family		No job		1 job		2 jobs		3 or more
Tractor ownership		No tractor					Own tractor	
Seasonal unskilled labour migration	Migration		No migration					