INSTITUTIONAL INNOVATIONS IN NEPAL'S CROP IMPROVEMENT SYSTEM:

Rainfed Agriculture Impact Assessment Study No. 6

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Abbreviations

ABD	Agricultural Botany Division
ARS	Agricultural Research Station
AREP	Agricultural Research and Extension Project
ARPP	Agriculture Research and Production Project
BI	Bioversity International
CAZS NR	CAZS-Natural Resources
CBO	Community-based organisation
CBSPD	Community Based Seed Production and Distribution
CEAPRED	Centre for Environmental and Agricultural Policy Research and Development
CIMMYT	International Maize and Wheat Improvement Center
COB	Client-oriented breeding
CVT	Coordinated Varietal Trial
DADO	District Agriculture Development Office
DISSPRO	District Level Seed Production Sufficiency Program
DoA	Department of Agriculture
DFID	Department for International Development
FAT	Farmers' Acceptance Test
FFT	Farmers Field Trials
FORWARD	Forum for Rural Welfare and Agriculture Reform for Development
FSR	Farming Systems Research
FSRDD	Farming Systems Research and Development Division
GON	Government of Nepal
HMRP	Hill Maize Research Project
HPPS	High potential production systems
IARC	International Agricultural Research Centre
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
IVT	Initial Varietal Trials
LAC	Lumle Agricultural Centre
IRD	informal research and development
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
LoA	Letter of Agreement
MOAC	Ministry of Agriculture and Cooperatives
MV	Modern variety
NARC	Nepal Agricultural Research Council
NARI	National Agricultural Research Institute
NASRI	National Animal Science Research Institute
NGO	Non-governmental organisation
NMRP	National Maize Research Program
NRRP	National Rice Research Program
NSB	National Seed Board
NWRP	National Wheat Research Program
ORD	Outreach Research Division
PCI	Participatory crop improvement
PPB	Participatory plant breeding
PRA	Participatory rural appraisal
PSP	Plant Sciences Research Programme
PVS	Participatory varietal selection
RARS	Regional Agricultural Research Station
RIUP	Research into Use Programme

RNRRS	Renewable Natural Resources Research Strategy
SARO	CIMMYT's South Asia Regional Office
SERED	Socioeconomic Research and Extension Division
SQCC	Seed Quality Control Center
SSSP	Seed Sector Support Project
TTRI	Technical Training and Research Institute

EXECUTIVE SUMMARY

This study looked at the use and impact of Participatory Varietal Selection (PVS) and Client-oriented Breeding (COB)/Participatory Plant Breeding (PPB) in Nepal, methodological innovations to crop improvement processes that were partly developed and implemented through projects funded by DFID's Plant Sciences Research Programme (PSP). The projects were managed by Bangor University's CAZS Natural Resources (CAZS NR); and the main partners in Nepal were two NGOs – LI-BIRD and FORWARD. The PSP also supported community-based seed production and marketing to facilitate the supply of seed of PVS and COB varieties to farmers. The methods used in this study were:

- a review of secondary literature;
- a questionnaire-based survey undertaken in 2008;
- a group discussion at a workshop in Nepal, in January 2009; and
- individual interviews with 7 key informants in Nepal in early 2009.

Use of PVS In the public sector five divisions and research stations of the Nepal Agricultural Research Council (NARC) have been implementing PVS, applying it to at least six crops altogether. In addition, the Department of Agriculture's Crop Development Directorate has been collaborating with CIMMYT on maize PVS. Six NGOs have also been involved in PVS, of which the main two have been LI-BIRD and FORWARD: total numbers of crops to which these two NGOs have applied PVS are 44 and 17 respectively.

Use of COB/PPB Two of the six public sector organisations involved in PVS have also been undertaking COB/PPB, applying it to three crops. Three NGOs have been conducting PPB, also covering three crops between them – one is a CGIAR centre (IPGRI/BI) and the others are LI-BIRD AND FORWARD.

Impact of PVS and COB/PPB New varieties tested, developed and promoted through PVS and/or COB often have higher yields (and/or better prices) than the ones that farmers were previously growing - typically an increase of 20-40% - as well as other improved traits. The annual benefit to an average household of using one improved variety could be in the range NR 125-500, depending on the crop and the area planted.

Nearly 45,000 farmers were directly involved in PVS processes with the organisations covered by this study, during the period 1995 to 2008, on a wide range of crops. More farmers than this have benefitted from farmer-preferred PVS varieties: seed of these varieties has been distributed by NGOs and projects and there has also been farmer-to-farmer spread. Some COB varieties have also been widely distributed and are being used by significant numbers of farmers. (For some detailed estimates see studies 2 and 4 in this series.)

Availability of seed is essential for the spread and widespread use of PVS and COB/PPB varieties. To improve PVS/COB seed supply the PSP supported and pioneered the promotion of commercially oriented community-based seed production groups. These appear to have avoided the common pitfalls of previous initiatives and may be on their way to becoming sustainable; but they have not prioritised the supply of PVS/COB seed, and further measures are needed to address this issue.

Despite the lack of institutionalisation of COB/PPB (see below), it is evident that PVS and COB/PPB have had a substantial impact in Nepal. The PSP projects funded by

DFID's RNRRS programme have made a major contribution to this impact, particularly in the case of COB/PPB.

Acceptance and institutionalisation of PVS PVS has become mainstreamed in the work of LI-BIRD and FORWARD, and also in CIMMYT's work in Nepal. One indicator of this is the fact that each of these NGOs has been implementing PVS in a large number of districts. The total number of PVS districts covered by these organisations is 63: in 20 districts PVS has been applied to only one crop, and in the other 43 to more than one crop (often several).

The Department of Agriculture's Crop Development Directorate is planning to institutionalise PVS and CBSP in its regular extension programme, and scale out PVS to all 75 districts of Nepal; and to expand the number of crops covered. Some key informants were of the opinion that PVS has already been institutionalised to a significant degree in the DoA's extension system; and also within NARC as a standard part of the process for testing varieties.

Acceptance and institutionalisation of COB/PPB CAZS-NR played a significant role in bringing about changes in official variety release procedures that made them compatible with COB/PPB. Twelve PPB varieties have been released (and more are under consideration). The fact that a substantial number of COB/PPB varieties has been officially released in Nepal shows that its varietal release system does recognise the validity of developing varieties through this process. Nevertheless, currently COB/PPB is only being implemented on a limited scale. The three NGOs still have some involvement in COB/PPB, but there is very little COB/PPB being done in the public sector. Within NARC the COB/PPB process has not been institutionalised, and it has almost ceased in the absence of funding from international donors.

Possible Reasons why PVS has been institutionalised more than COB/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.

Factors hindering the institutionalisation of COB/PPB The study identified several inhibiting factors, which relate to: attitudes and perceptions about the scientific aspects of COB/PPB; the costs and benefits of COB/PPB as compared with conventional plant breeding; and certain disincentives to researchers using it. In addition, there is a potential clash between the paradigms and values that may be held by some plant breeders and their organisations, and those associated with COB/PPB advocates. This may be an important underlying influence on whether they are receptive to it.

1. INTRODUCTION

1.1 Purpose of Study

This is a report of a study on a suite of innovations that have been taking place during the last 15 years or so in Nepal's crop improvement system. They are innovations in the processes used to improve crops – in the ways that crop improvement and distribution of improved seeds are undertaken by both government agencies and NGOs. The innovations are the use of:

- Participatory Varietal Selection (PVS)
- Client-oriented Breeding (COB)/Participatory Plant Breeding (PPB) and
- Community Based Seed Production and Distribution (CBSPD).

These institutional innovations in Nepal's crop improvement system were developed to a large extent through projects funded by DFID's Plant Sciences Research Programme during the 1990s and early 2000s that were managed by the University of Bangor's CAZS-NR[1]. The study is part of a wider set of studies[2] that also covers India and Bangladesh, funded by DFID's Research Into Use programme, to assess the impact of DFID-funded research on rainfed agriculture in south Asia.

This study had two objectives. One was to find out how widely used these innovations are, to identify the organisations in Nepal that have adopted PVS and/or COB/PPB, and to obtain a preliminary estimate of the crops involved and the number of farmers benefitting from the work of each organisation. In addition, the study aimed to identify any influences of the innovation system on adoption (or not) of the institutional innovations by public sector and civil society organisations; and any changes that may have been required to the innovation system as a pre-requisite to more widespread adoption of the innovations.

1.2 The Innovations

By **PVS** we mean the process of working with farmers to identify which characteristics of a particular crop they regard as most important; and 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. It has been argued (Stirling and Witcombe, 2004) that a successful PVS programme has four phases:

1. participatory evaluation to identify farmers' needs in a cultivar
2. a search for suitable material to test with farmers
3. evaluation of its acceptability in farmers' fields and
4. wider dissemination of farmer-preferred cultivars.

By **COB/PPB** we mean:

- breeding new varieties of a crop, involving farmers and other clients at appropriate stages, that have the combination of traits desired by the client

[1] Until a few years ago this unit was known as the Centre for Arid Zone Studies, and is now known as CAZS-Natural Resources.

[2] The other studies include a parallel study to this one in India; and studies of technological innovations, particularly rice varieties tested and/or developed through PVS/COB processes and improved practices in rainfed rabi cropping. There will also be a more detailed report on CBSPD in Nepal.

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.

The term client-oriented breeding (COB) has been proposed as an alternative to the more widely used participatory plant breeding (PPB), because the purpose of involving farmers is to improve client orientation, and highly client-oriented breeding describes this purpose, while PPB describes an activity (Witcombe *et al*., 2005). However, the term PPB is still the more widely used and recognised one, so we use both terms in this report.

CBSPD is the production and distribution of seeds at the community level, with the participatory involvement of farmers' groups, to facilitate the multiplication and distribution of farmer-preferred varieties and the development of local seed markets.

PVS and COB/PPB have been developed and promoted because poorer farmers in marginal areas need varieties that are more relevant to their circumstances. They have often not benefitted from the modern varieties (MVs) developed through conventional breeding: instead, they tend to be still growing lower-yielding landraces or old varieties, and these are sometimes susceptible to pests and diseases. Major reasons for this are: (a) the fact that MVs have been bred primarily to maximise yield and often do not score well against farmers' criteria, which may include fodder potential, growing period, taste and many other factors; and (b) MVs' yields may be much lower under the management conditions (soils, inputs etc) of resource-poor farmers.

In the RNRRS-funded work undertaken by CAZS-NR and its partners the PPB/COB programmes exploited PVS by using PVS cultivars as parents of crosses. Where farmer-preferred cultivars had weaknesses they were crossed with varieties that had complementary traits, in order to eliminate those weaknesses. PPB/COB advocates argue that it is "more powerful than PVS as it creates new variability rather than relying on existing varieties" (Stirling and Witcombe, 2004).

Process innovations like these shape and influence the nature of technological innovations (e.g. their suitability for resource-poor farmers), including new crop varieties. They can have a profound effect, particularly if their promotion also influences the institutions and norms that govern the crop innovation system. There has been growing recognition in recent years that developing effective national and local capacity for agricultural innovation is more important in a way than the development and promotion of any particular technologies. This is because the 'recommendation domain' and 'useful life' of any individual technology is limited – so what is needed is an innovation system that can generate a wide range of technologies on a long-term basis, responding to changes in agricultural systems (e.g. new pests or diseases, changes in climate or changes in the relative scarcity of factors of production) as they occur. In the words of Hall *et al* (2008) "the capacity to respond to change by a process of continuous innovation assumes importance over specific technologies and is the result of the particular patterns of interaction of many players in a specific context".

This report examines, therefore, the extent to which these particular process innovations (PVS and COB) have been adopted and applied by organisations in Nepal's crop improvement system, and the extent to which they have been

institutionalised and have changed relevant institutions (formal and informal) of the crop innovation system.

1.3 Methodology Used

The methodology used in this study included the following four components:

- A review of some secondary literature on the nature of the plant breeding and varietal testing systems in Nepal
- A survey of the main organisations that have been involved in PVS and/or COB based on two questionnaires (reproduced as Annexes 1 and 2)
- A review of secondary literature on the use of PVS and/or COB in this country
- Interviews with key informants in NGOs and public sector organisations.

Questionnaires were sent to different organisations involved in PVS and COB, following a two-stage process. A general questionnaire, designed to provide a general overview of the organisation's involvement in PVS/COB, was sent to each organisation. Twelve (out of 14) different organisations (six GOs and six I/NGOs) completed and returned this questionnaire. A second questionnaire, designed to obtain information about the costs and benefits of individual crop varieties, was sent to four organisations, one of which (FORWARD) completed and returned it.

2. NEPAL'S CROP IMPROVEMENT INNOVATION SYSTEM

2.1 Background

Nepal is still a predominantly agricultural country, with more than 60% of the population depending on this sector (Kumar *et al*., 2003). About 33% of total GDP is generated by agriculture, which creates significant employment in Nepalese rural areas. The agricultural sector grew by about 3% p.a. during the decade 1993-2003 (Stads and Shrestha, 2006). The Terai (flat plain areas in the southern part of Nepal) is fertile and conducive to cereal (rice, wheat and maize) production, whereas the mid-hills are suitable for cereals, fruits and vegetable production. Rice is the main crop in the lower part of the country, maize in the hills, and wheat is grown in both the Terai and Himalayan valleys. The diverse climate and distinct agro-ecological zones provide an ample opportunity to produce diverse crops, fruits and vegetables. Farmers' preferences for crops and varieties will vary largely in such diverse situations.

Formal varietals improvement work in Nepal was started in 1951 with the introduction of some Japanese and Indian rice varieties. Beside this some local germplasm was collected from different parts of the country and evaluated at Parwanipur and Kathmandu. Parwanipur was considered as the representative site for the entire Terai - including lower elevation, river basin and valley - whereas Kathmandu was considered as representative for the hills. Though these varieties were introduced and tested for many years, they did not replace local varieties as they did not give satisfactory performance. However, Taiwanese varieties introduced in 1964 did spread rapidly in the mid-hills, especially in Kathmandu valley and similar areas.

A systematic crop research and breeding programme started after the inception of the Crop Commodity Research Program (rice, wheat, maize etc) in 1972, though formal agricultural research had started earlier. Subsequently, the formal and informal flows of germplasm from India and from International Organizations (IRRI, CIMMYT, ICRISAT etc) have been the major sources of new varieties and breeding materials.

Forty years ago the agricultural research and extension system in Nepal was dominated by the conventional top-down transfer of technology (ToT) approach, with dominance of small-plot researcher-designed and researcher-managed trials and with limited dissemination pathways (Gauchan, *et al*., 2003). This was partly due to the long-term connection of Nepal's NARC with the International Agricultural Research Centres (IARCs). This paradigm was heavily guided by the 'package of practices', an approach designed for a well managed crop with a high yield. In the research station trials 'low input' varietal screening had never been an established practice (Joshi *et al*., 2005).

In the mid 1980s the Department of Agriculture's USAID-supported Agriculture Research and Production Project (ARPP) initiated on-farm research with its on-farm sites. Local knowledge and landraces were used in evaluation process. Following the inception of the Farming System and Socioeconomic Research Division, which had a multidisciplinary approach, there was a lot of interaction with farmers as more participatory survey methods were introduced - Samuhik Bhraman, rapid rural appraisal (RRA) and participatory rural appraisal (PRA). Another significant international donor was the British Government's Overseas Development Administration (ODA), the precursor of DFID, which funded Agricultural Research

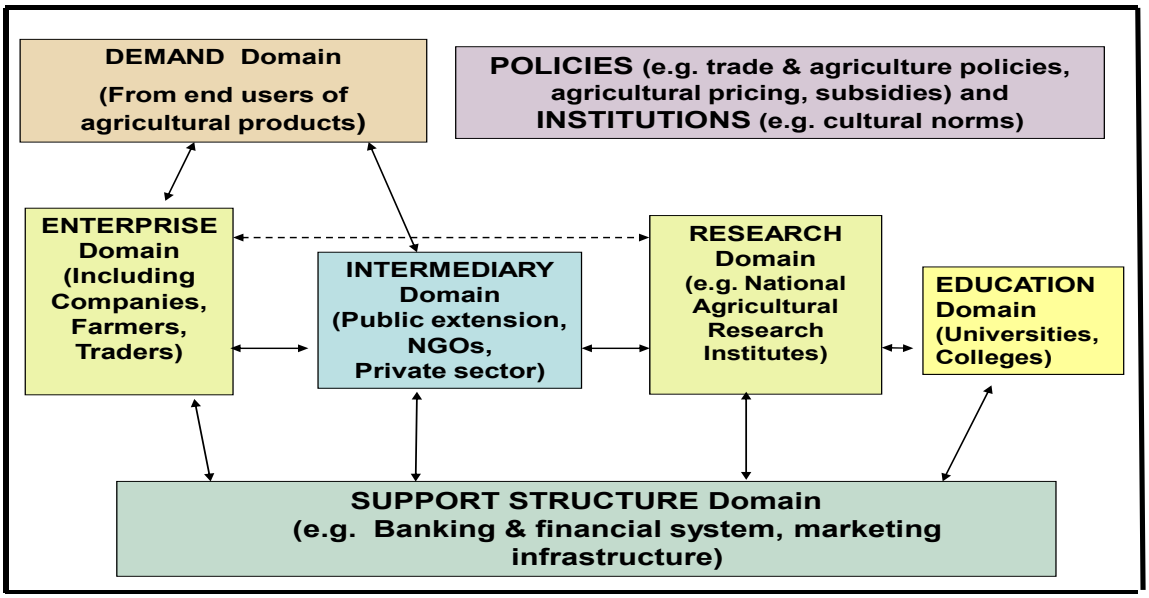
Centres at Lumle and Pakhribas that functioned independently of the government's agricultural research system until the mid-1990s.

2.2 Key Stakeholders in Nepal's Agricultural Innovation System

The ministry responsible for agriculture in Nepal is the Ministry of Agriculture and Cooperatives (MOAC). MOAC comprises four departments, three boards and a council: it also has five divisions and three centres. The most relevant parts of MOAC to this study are: the Department of Agriculture (DoA), the Nepal Agriculture Research Council (NARC), the Seed Promotion and Quality Control Center, and the National Seed Company Limited (NSC).

Figure 2.1 describes the principal components or domains of a national innovation system. Here we apply this framework to Nepal's agricultural innovation system and identify the key actors in the 'Research' and 'Intermediary' domains.

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).

2.2.1 Agricultural Research Domain

Public sector NARC is an autonomous body for agricultural research that was established in 1991. Within NARC there is a National Agricultural Research Institute (NARI) and National Animal Science Research Institute (NASRI), and within NARI there are seven disciplinary divisions. There are 15 Agricultural Research Stations (ARSs) in Nepal, each with its own command area or district, which come under four Regional Agricultural Research Stations (RARS). These are located at Lumle, Nepalgunj, Parwanipur and Tarahara; and are responsible for addressing the needs of the western, mid and far western, central and eastern regions respectively.

Agricultural R&D expenditure rose by an average 7.6 % p.a. during 1996-2003, primarily due to funding from the World Bank-financed Agricultural Research and Extension Project (AREP); and NARC was a major beneficiary of this funding (Stads and Shrestha, 2006). After AREP ended in 2002 expenditure contracted – from $42 million in 2001 to $28 million in 2003.

Civil society There are several strong NGOs, many of which are active in both the 'research' domain and the 'intermediate organisations' domain. The PSP's main NGO partner has been LI-BIRD, and another NGO, FORWARD, has also been a partner. Both of these NGOs were established by former staff of the 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. The NGOs came into existence in the 1990s when some of the researchers left Lumle and Pakhribas.

Local Initiatives for Biodiversity, Research and Development (LI-BIRD) is a nongovernmental organization (NGO) established in 1995. In the past ten years of partnership for development-oriented research in agriculture and natural resources management, LI-BIRD has contributed to the development of several innovative methodologies and approaches for participatory research and development, and has generated impacts that have enhanced the livelihoods of resource-poor farmers through appropriate technological and policy changes. LI-BIRD has been a pioneer organization in strengthening methodologies to use Participatory Plant Breeding (PPB) and Participatory Variety Selection (PVS) for crop improvement and community-based biodiversity management, and has played an instrumental role in institutionalizing these approaches in the national systems of Nepal.

Forum for Rural Welfare and Agriculture Reform for Development (FORWARD) was established in 1996 to improve the livelihoods of under-privileged rural communities using the principles of self help. FORWARD creates a forum of researchers, development professionals, rural people and funding organisations who are committed to working together for community empowerment, adaptive research and development. Its activities are mainly focused on the poverty-stricken communities in several hill and terai districts of Nepal. One of its programmes is sustainable intensification of cropping systems through integrated plant nutrient management, integrated pest management, participatory variety selection and other management options.

There are also two international agricultural research organisations with a strong presence in Nepal that have been involved in PVS and/or PPB, namely: CIMMYT – the International Maize and Wheat Research Centre; and Bioversity International, which is the operating name of the International Plant Genetic Resources Institute (IPGRI) and the International Network for Improvement of Banana and Plantain (INIBAP).

2.2.2 Intermediary domain

Public sector There are District Agriculture Development Offices (DADOs), one in each district across the country, which are responsible for planning and implementation of agricultural development activities, and are expected to maintain active linkages with RARS and ARSs and other stakeholders, including NGOs and private sector organisations. They carry out various extension activities, including field trials, and report to the Department of Agriculture (DoA) via five Regional Directorates of Agriculture (Manandhar, 2003)

During the last few years changes in government extension policies have included a shift from an individual contact to a group approach, with the extension services provided by the government (and many NGOs) increasingly channelled through groups (Kumar *et. al*., 2003); and this applies to many of the services provided by NGOs also. Thus, farmers who are not members of the groups are less likely to be served by the extension services unless the individual makes an effort to go to the service centre and consult with technicians. At the same time, with liberalisation of the economy many private entrepreneurs have entered the fray. Another policy reform has been the promotion of public-private partnerships, and partnership with beneficiary groups and community organisations (ibid). A participatory project planning process has been developed, and since FY 2001/02 extension activities in all 75 districts are meant to be based on local priorities identified in this way (ibid).

The National Seed Company, which is government-managed, plays a small but significant role in supplying seed to farmers.

Civil society comprises a range of not-for-profit organizations, most of which fall under the heading of either NGOs or community-based organisations (CBOs). ***NGOs*** In addition to LI-BIRD and FORWARD there are numerous NGOs providing agriculture-related support to farmers, a few of which have been involved in PVS. ***CBOs*** When it became mandatory to form groups to derive any benefit or seek advice from government extension services there was a surge in the number of groups registered. LI-BIRD worked closely with several CBOs, with which it had letters of agreement (LoAs), on varietal selection and COB-related activities and on scaling up outputs of the PSP-funded project that it was leading. DoA has supported the formation of about 125 ***seed producer groups***, through its District Level Seed Production Sufficiency Program (DISSPRO), with a view to the development of district seed systems. However, not all of these are still active.

Private sector The new seed policy encourages the private sector to be involved in crop breeding and the seed sector. However, the commercial seed sector is weak and underdeveloped, with seed production companies in the formal sector supplying less than 5% of the total seed demanded (Devkota *et al*., undated). Examples of private companies, both from Chitwan district (from Ojha and Morin, 2001) are:

- *Inter Nepal Agrovet (P) Limited*, which has contacts with national and international companies, and operates both as a retailer and as wholesaler to the other Agrovets. It deals with hybrid vegetable and cereal seeds (and also pesticides and veterinary medicines), and has direct links with Indian and other international companies from which it buys inputs that it sells wholesale to other Agrovets in Nepal.
- *Narayani Agrovet* is a much smaller and more typical retail company, a family-run shop managed by an agricultural graduate. It stocks hybrid vegetable seeds, veterinary medicines and insecticides.

2.2.3 Policy and institutions domain

In the crop improvement innovation system specifically, there are various laws, key standards and norms. These include: the procedures followed in the official plant breeding and varietal testing system and the varietal release system, which are described in sections 2.4 and 2.5; and those governing seed production and distribution.

2.3 DFID-Funded Research on Crop Improvement

The DFID-funded research involving more participatory approaches to varietal selection and plant breeding, which focused on rice, began in 1996. A timeline of important milestones in the evolution of rice and participatory research in Nepal, including items relating to work supported by DFID's Plant Sciences Research Programme, is given in Box 2.1; and a summary of the PSP projects is given in Table 2.0.

Table 2.0 Summary of Plant Science Research Programme Projects in Nepal

DFID ref. no.	Project title	Duration	Nepali Partner(s)	Cost* (£'000)
R6748	PCI in high potential production systems in India & Nepal	1997-1999	LI-BIRD	119
R7542	PCI in high potential production systems – piloting sustainable adoption of new technologies	2000-2003	LI-BIRD	178
R7122	PPB in high potential production systems	1998-2000	LI-BIRD	44
R8071	PPB in high potential production systems – an evaluation of products and methods	2001-2005	LI-BIRD, NARC, DoA	170
R7281	Participatory Crop Improvement for Maize-Millet Intercropping in the mid-hills of the Himalayan Region		ARS Pakhribas	

* Most of these projects were implemented in both Nepal and India

A participatory crop improvement (PCI) project was initiated in late 1996, with the purpose of developing and promoting processes and strategies for the introduction of new crop varieties and improved agronomic practices in high potential production systems (HPPS) of Nepal terai. The project worked on the following staple food crops, particularly rice: Chaite rice, main season rice, winter maize, spring maize, lentil and wheat. The project districts were Chitwan and Nawalparasi. The project aimed to demonstrate, in a range of socio-economic environments, that participatory methods are effective in HPPSs to increase cultivar diversity and variety replacement rates, and to improve agronomic practices. Rice varieties from various sources (e.g. the National Rice Research Program, Indian universities) were included in the PVS trials and subsequent dissemination, and farmers' popular varieties, e.g. Ekhattar and Lahure, were also included. In 1998, the PSP also initiated a client oriented breeding (COB) project, as the PVS varieties could not provide enough choice to the farmers (Joshi *et al*., 2005).

BOX 2.1 Timeline for Rice and Participatory Research in Nepal
(items in italics relate to outputs from CAZS-NR and the Plant Sciences Research Programme)

After 1951: Initiation of formal research: rice germplasm collection and evaluation at Parwanipur and Khumaltar
After mid 1950s: Introduction of exotic rice germplasm
1959: First release of exotic rice introduction
1967: Release of several exotic rice varieties for Kathmandu valley
1972: Establishment of National Rice Improvement Programme (NRIP), Parwanipur
1977: Cropping systems project, opening of six testing sites
After 1985: Samuhik Bhraman (multidisciplinary trek using PRA) by FSRDD, LAC and Pakribhas Agricultural Research Centre (PAC). * Decentralised breeding of rice variety Palung 2
After mid 1980s: Utilization of local landraces and local knowledge: Pokhereli Masino, Chhomrong Dhan, Khumal 4
1986: Agricultural Research and Production Project (ARPP) established by DoA with USAID funding
1987 * Establishment of Farming Systems Research and Development Division (FSRDD) and Socioeconomic Research and Extension Division (SERED). * Farming System Research (FSR) approaches, opening of FSR sites. * Lumle Agricultural Research Centre (LAC) mandated to develop cold tolerant rice
1991 Informal Research and Development (IRD) developed and institutionalised by LAC
1992 Closing down of FSRDD and SERED after the autonomy of NARC
After 1992 *COB on high altitude rice in outreach research by LAC supported PhD programme*
1994 * Start of Outreach research by NARC * Linkage between research and Agro entrepreneurs
1996 * *Release of Machhapuchhre-3 the first variety bred using COB. * Start of PCI project (**R6748**) in HPPS funded by DFID Plant Sciences Research Programme (PSP) - from 01 Oct 1996 to 30 Sep 1999.*
1998 * *Start of PPB project (**R7122**) in HPPS funded by PSP (01 March 1998 Feb 28 2001)*
* Start of community integrated pest management (IPM) Farmers Field School (FFS). * *Scaling up and out of PCI **R6748** outputs to GOs and NGOs, e.g. CARE, PLAN, and FORWARD*
Late 1990s Uptake of resource conservation technologies (RCTs)
2000 * *Signing Letter of Agreement (LoA) with DADO Chitwan for scaling up of PCI process (PVS) & outputs (identified varieties) of **R6748. *** LoA with three Community Based Organisations (CBOs) in Nawalparasi for scaling up of PCI outputs, community-based seed production and marketing. * LoA with Jeskelo Youth Club Chitwan to work on the process of COB (PPB), e.g. selection of segregating lines and for the organisation of organoleptic assessment of rice lines and varieties. * Second phase (**R7542**) of PCI project funded (01 Feb 2000 to 31 July 2003)*
2001 * *Stakeholders meeting and Formation of Working Groups for fund raising & revision of variety releasing procedures (initiated through PSP projects)*
* *AREP (World Bank) provided funds to scale up PCI outputs in four districts (initiated through PSP projects) * Signing LoA with Agricultural Research and Extension Project (AREP) funded by World Bank for scaling out and scaling up the process and outcomes of PCI project through four District Agriculture Development Offices, e.g. Dhanusha, Sarlahi, Bardiya and Kailali*
* *Second phase of PPB project (**R8071**) funded by PSP (01 Sep 2001 28 Feb 2006)*
2002 *NGO (LI-BIRD) signed LoA with Nepal Rice Research Programme (NRRP)*
2005 *Revision of variety release and registration procedure by MoAC on the recommendation of a Working Group, to accommodate participatory data*
2006 * *Release of Barkhe 3004 for the lowland areas of the Nepal terai * PSP funding ends*
2008 * *Release of aromatic variety Sunaulo Sugandha for the Nepal terai*

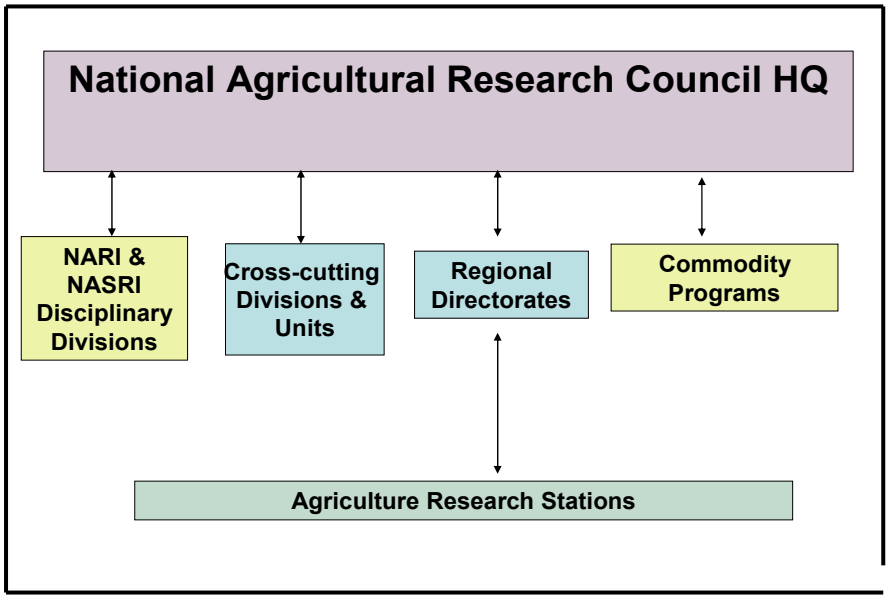
Source: CAZS NR

2.4 Plant Breeding and Varietal Testing System

A formal plant breeding programme was initiated after the crop commodity research programs were established in 1972. In the beginning most of the breeding materials were received either from India or from CGIAR centres. In late 1970s a cropping system program was established with the aim of strengthening the capacities of the commodity programme, including the breeding programme: this was supported by ICP project (a USAID-funded project).

The initial breeding programme (crossing, selection and advance testing) is done on station. Several varietal-testing procedures have been followed on the station before any testing is done in farmers' fields. Advanced Varietal Trials (AVT) and Initial Varietal Trials (IVT) are performed in on-station research by the concerned breeder: then these materials are sent for Coordinated Varietal Trial (CVT) in regional research station(s). Farmers Field Trials (FFT), Farmers' Acceptance Test (FAT) and Minikits approach were introduced in the early 1970s, with the inception of the commodity research program in 1972, as a part of varietal evaluation and promotion in different agro-ecological regions of the country. All varieties that performed well in station have been tested in on-farm research as FFT and minikits. Farmers have been given the opportunity to select the best varieties among the varieties tested and also their feedback has been taken into account before varieties were released.

Figure 2.2 Organogram of National Agricultural Research Council



The key stakeholders for verification and dissemination of these varieties through FFT and minikits are the Outreach Research Division, one of NARC's cross-cutting divisions (see Figure 2.2), the District Agriculture Development Offices (DADOs), and NGOs involved in agriculture research and development. All the stakeholders involved in varietal testing provide feedback to the breeder, which helps the breeder to evaluate the variety. Based on on-station and on-farm data/information the breeders submit the proposal for varietal release.

During the 1970s and 1980s the trial design, input levels and final decision on the selection of a variety or technology were mostly done by the researchers, even in FSR sites; and the set of activities and approaches used was also more or less the same as that of on-station trials, e.g. cropping pattern trials (CPTs) and FFTs. (Although Pre-Production Verification Trials and Minikits had relatively more farmer orientation.) The farmers participated in land preparation, intercultural operations, harvesting and subsequent operations, but only had limited participation in the technology evaluation and decision making process (ibid).

Orientation towards effective farmer participation came only after the association of Lumle Agricultural Centre (LAC) with CAZS-NR in 1991. LAC was already pioneering informal research and development (IRD), a farmer participatory approach to testing and disseminating new crop genetic materials in which evaluation, decision-making and dissemination rest with farmers and researchers/development workers. The PCI project helped to legitimise IRD: for example, the germplasm coming from informal sources, including farmer innovations and varieties from India, were included in the PCI's PVS trials. In addition, CAZS-NR introduced the concept of evaluating varieties or breeding lines in the farmers' fields, under their input level with their real participation and decision-making role. There was useful learning from CAZS-NR in terms of COB and PVS methodologies (Joshi *et al*., 2005).

Table 2.1 Organizations Involved in the Crop Improvement Innovation System

SN	Organization	Activities
1	Nepal Agricultural Research Council (NARC), NGOs	Plant Breeding (Breeder and foundation seed production)
2	National Seed Board	Variety release
3	DoA's Seed Quality Control Center	Seed certification and quality control
4	National Seed Company	Seed production/distribution
5	Department of Agriculture (DoA) District Agriculture Development Offices (DADOs)	Seed popularization
6	Private seed companies	Seed Production/distribution
7	CBOs (co-operatives, farmers' groups)	Seed Production/distribution
8	NGOs	PVS, PPB and support for CBSPD

2.5 Varietal Release and Popularisation System

Varietal release The responsible body is the 'Variety Approval, Release and Registration Sub-Committee', which comes under the National Seed Board: it makes decisions about the release of crop varieties, based on the information/data provided by the breeder. The breeder submits the proposal based on research data and information from on-station and on-farm research. The present legislation (see section 8.2) allows private organisations and NGOs, as well as government ones, to apply for varietal release with supportive documents. To obtain approval for release of a variety the researcher must submit a proposal with research information and data based on trials (on-farm and on station) conducted for several years. To release a variety from an NGO site, similar on-farm research information should be included.

Seed production and distribution NARC has prime responsibility for the production of breeder seed in Nepal, and its commodity programs produce breeder seed at their headquarters. NARC also produces foundation seed, and is the only agency providing source seed to various seed producing agencies (Devkota *et al*., undated). A registered seed company can also produce foundation seed. Seed production is only undertaken for the varieties approved for release by the varietal release

committee. The National Seed Company is government-owned, and primarily handles grain seed, both production and distribution. This company makes seed available to farmers through its regional and district offices. Though it is a government owned company, government involvement in seed supply has been declining and NSC has recently not even been able to supply 1 % of the total seed supplied (Devkota *et al*., undated). Since 1991 there has been a Seed Entrepreneurs' Association of Nepal (SEAN). Nevertheless, the commercial sector is poorly developed (Witcombe *et al*., 2009), and the proportion of seed supplied by the whole of the formal sector is also very small: in 2002-03 the percentages of seed supplied for cereals were rice (0.64), maize (1.83) and wheat (2.5) (SQCC, 2003, cited in Devkota *et al.*).

Civil society organisations and farmer to farmer systems supply the rest of the seed. A substantial number of cooperatives and CBOs are involved in seed production and popularisation; but the capacity of these CBOs is highly variable, and many of those established through DISSPRO are not functional. CBSPD is discussed further in sections 5 and 6.3.

Seed production, certification and distribution The Government of Nepal (GON) passed the seed regulation act in 1988. The objective of this act was to make available high quality seed to the public through an effective quality assurance system. As per the provision in seed act, GON constituted a National Seed Board (NSB), which formulates and executes national seed policy. Three sub committees under this board are:

- Variety approval, release and registration sub-committee,
- Planning, formulation and monitoring sub-committee,
- Quality-standards determination and management sub-committee.

Government seed quality control and certification laboratories exist in the centre and five different regions of the country. These laboratories are responsible for controlling the quality and certification of the seeds.

It is seed tagging - a kind of voluntary seed certification - that is compulsory, not independent certification. Any seed company, institute or person can produce and sell seed with their own inspection and laboratory test, or they can coordinate with central/regional seed laboratories for inspection, supervision, treatment and tagging. The packaging (e.g. bag, container) of such seeds should be tagged, i.e. should provide various kinds of information, such as varietal purity, germination rate, weed seeds, lot number. Such type of labelling is known as truthful labelling.

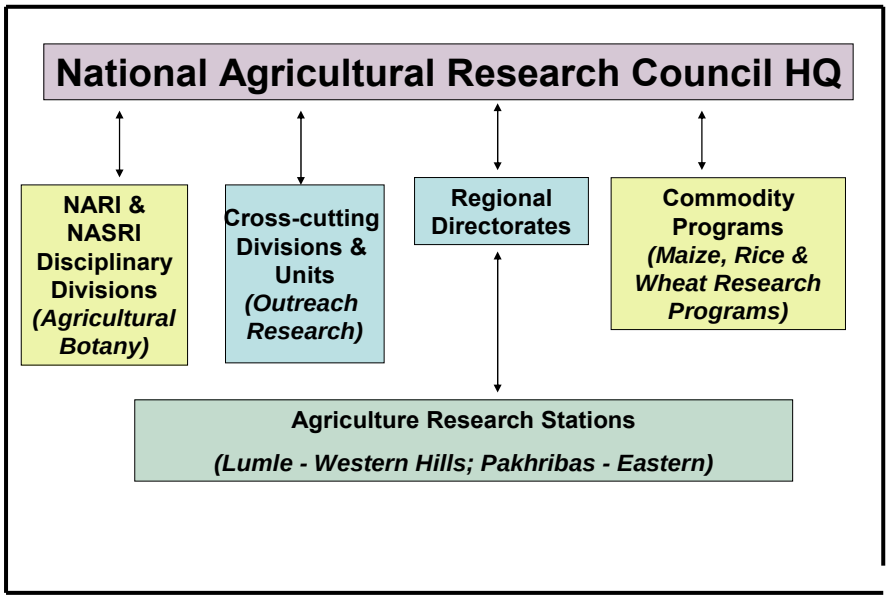
3. PROCESS INNOVATIONS AND THE PUBLIC SECTOR

3.1 Public Sector Organisations and PVS/COB

In 1990 Lumle Agricultural Research Station (LARC) – at that time funded by ODA - initiated an 'informal research and development' (IRD) program on varietals development, when it was recognised that the traditional system was not able to address the diverse needs and demands of hill farmers. This became more effective after the association with CAZS NR in 1991. Prior to the IRD programme FFT had been practised, which then became 'farmers acceptance test' (FAT), in which 5 to 7 promising varieties were included in a set and tested in farmers' fields to receive their feedback before release of varieties.

LI-BIRD, which has worked on PVS and COB since its inception in 1995, extended its collaboration to District Agriculture Development Offices (DADOs) at Chitwan and Nawalparasi. The DADO service centres provide production-oriented extension services to the farmers.

Figure 3.1 Organogram of NARC and Components Covered by Survey



Components of NARC (see Figure 3.1) exposed to PVS/COB have included:

- three of its commodity programs, the National Rice Research Program (NRRP), National Wheat Research Program (NWRP) and National Maize Research Program (NMRP);
- the Agricultural Botany Division (ABD), one of its disciplinary divisions;
- Outreach Research Division (ORD), one of its cross-cutting divisions; and
- Pakhribas Agriculture Research Station (PARS), another of its agriculture research stations.

Two international organizations working in Nepal, CIMMYT's South Asia Regional Office (SARO) and IPGRI/Bioversity International, have been involved in PVS and PPB, and both have staff who previously worked with CAZS NR partner

organisations. (For further details see section 4.3.2.) Dr T Tiwari, who worked on PSP project R7281 as an employee of ARS Pakhribas, subsequently joined CIMMYT to work on its HMRP. Dr Bhuwon R Sthapit, one of the founding members of LI-BIRD, CAZS NR's principal partner in Nepal, subsequently joined IPGRI/Bioversity International where he continues to work on both PVS and COB. CIMMYT has also collaborated with CAZS NR on a PVS and PPB research project that was funded by DFID through its Competitive Research Facility.

The main public sector partners of CAZS NR for PVS were various components of NARC, and the Department of Agriculture (DOA). As can be seen from Figure 3.1, PVS and/or COB processes have been taken up in various parts of NARC. The NARC component organisations shown in brackets and italics have all been involved in PVS. During the 1990s NARC's Maize and Wheat commodity programs were involved in PVS in collaboration with CIMMYT. Later the NRRP was also exposed to PVS in collaboration with LIBIRD and FORWARD. The DoA's Crop Development Directorate has also been involved in PVS, particularly through its involvement in CIMMYT's Hill Maize Research Project (HMRP).

3.2 Details of PVS and COB work undertaken by Public Sector Organisations

The PCI project worked with rice scientists from NRRP, and a LoA was signed between LI-BIRD and NRRP in 2002: "Disease screening of COB rice lines is done by NRRP while LI-BIRD are supporting NRRP in screening rice lines for quality traits including cooking, eating qualities, market acceptance etc." (Joshi *et al*., 2005). NARC has been gradually shifting its approach for varietal selection from FFT to PVS. Its commodity programs have collaborated with CIMMYT's South Asia Regional Office in wheat and maize PVS, and with IPGRI and LI-BIRD on rice COB (Sthapit *et al*., 2001). At least three of its commodity programs (maize, rice, and wheat) have been involved in PVS. Further details of public sector involvement in PVS are given in Table 3.2.

Table 3.2 Public Sector Organisations Involved in PVS, by Crop

Division/Institute	CROP					
	Rice	Maize	Wheat	Finger millet	Rapeseed	Lentil
Agricultural Botany Division		✓	✓			
Outreach Research Division		✓	✓			
RARS Lumle	✓	✓	✓	✓	✓	
RARS Pakhribas	✓	✓				✓
National Wheat Research Programme			✓			
Crop Development Directorate, Department of Agriculture		✓				

Public sector organisations' reasons for being involved in PVS In our survey we asked public sector agencies what their reasons were for getting involved in PVS: their answers are shown in Table 3.3. They can be summarised as being to accelerate the previously slow process of varietal selection and adoption; and to

increase crop productivity, by replacing inferior existing varieties, with the aim of improving farmers' food security and livelihoods.

Table 3.3 Public Sector Organisations' Reasons for Being Involved in PVS

Organisation	Reasons for being involved in PVS
Agricultural Botany Division	1. Farmer preferred genotypes identification, release, generated technology and knowledge transformation at fast rate. 2. To cope the existing problems on wheat crop: rusts, sterility, low production and productivity, old varieties etc
Outreach Research Division	To identify / verify the suitable technology (variety) which were generated by research stations with the active participation of the farmer. It helped to disseminate quickly and enhanced the production and productivity in cereals of the area which improve food security and livelihood of the farmers.
RARS Lumle	To accelerate the process of varietal selection.
RARS Pakhribas	Active participation of farmers, Variety adoption for larger period
National Wheat Research Programme	Slow variety replacement, poor seed replacement rate (less than 6%), low wheat yield
Crop Development Directorate, DoA	1. Focus on the resource poor farmers in food insecure district 2. Funding availability 3. Provision of training to the staffs

Only two of the six public sector organisations involved in PVS have also been undertaking COB. Information about their work is given in Table 3.4.

Table 3.4 Public Sector Organisations Involved in COB

Institute	Crops (years)	Who chose parents?	Number of crosses	Pop. Size in F_2 onwards	Reason for COB
RARS Lumle	Rice (1996) Maize (1999) Wheat (2001)	Jointly Researchers & farmers	Few	Large	GXL interaction between farmers' field and research stations eliminated and farmers can get the promising materials a bit earlier
Agricultural Botany Div.	Wheat (2002-08)	Breeders in consultation with farmers	Six crossings	>2000 plants	Overcome weaknesses of PVS varieties and produce high yield disease resistant genotype

RARS Lumle identified a number of differences they have experienced between COB/PPB and conventional breeding, as shown in Table 3.5.

Table 3.5 Differences between COB/PPB and conventional breeding

PPB	Conventional Breeding
1. Locally adapted cultivars were the parents for crossing 2. More replications across locations in early generation 3. Bulk pedigree method 4. Genotypes provided to farmers only after the screening of major diseases	1. Elite cultivars 2. Not replicated in early generations 3. Pedigree breeding 4. Screening of the diseases done as Multi-location testing

Source: RARS Lumle completed questionnaire

3.3 Scaling out Use of PVS and COB in the Public Sector

During the last few years, at least two projects supported by international donors also adopted PVS, namely: the Agriculture Research and Extension Project (AREP); and the Seed Sector Support Project. The PCI project had good linkages with AREP, which was the first project to adopt seed varieties and approaches developed by PCI.

Table 3.6 PCI links with Other Projects for Scaling Out

Project	Donor	Duration
Agriculture Research and Extension Project	World Bank	Mid/late 1990s – 2002
Seed Sector Support Project	DFID	1998-2004

4. PROCESS INNOVATIONS AND CIVIL SOCIETY

4.1 Use of PVS by NGOs

CAZS NR's main NGO partners in PVS have been LI-BIRD and FORWARD. FORWARD has collaborated with LI-BIRD since 2002 for PVS and scaling up of rice varieties identified by the PCI project or bred by COB in part of six districts (Khanal *et al*., 2004). The NGOs covered by this study that have been using PVS are:

- The Forum for Rural Welfare and Agricultural Reform for Development (FORWARD)
- Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
- Centre for Environmental and Agricultural Policy Research and Development (CEAPRED)
- Support Foundation
- Technical Training and Research Institute (TTRI) and
- International Plant Genetic Resource Institute (IPGRI/BI).

The crops they have been working on are primarily cereals, with only FORWARD having worked on non-cereals, as can be seen from Table 4.1.

Table 4.1 NGOs involved in PVS, by Crop

NGOs	CROPS								
	Rice	Maize	Wheat	Mung bean	Chickpea	Lentil	Tomato	Rape seed	Other
IPGRI/BI	✓	✓	✓						
FORWARD	✓	✓	✓	✓	✓	✓	✓	✓	
LIBIRD	✓	✓	✓			✓			Millet, Kidney bean, Cowpea, Ghaiya
CEAPRED			✓						
Support Foundation		✓							
TTRI	✓	✓							

Reasons for using PVS The reasons given by NGOs for becoming involved in PVS are shown in Table 4.2. The main reason was to enable farmers to select varieties that they preferred because they were well suited to their own conditions, particularly those found in remote areas and marginal environments. Another reason was to develop farmers' capacity and skills, particularly for local innovation.

Table 4.2 NGOs' Reasons for Being Involved in PVS

Organisation	Reasons for being involved in PVS
IPGRI/BI	To strengthen farmers' capacity for local innovation
FORWARD	FORWARD's focus is always on validating and promoting crop varieties that are well adapted in existing geophysical and socio-economic circumstances. FORWARD targets its program in remote areas and marginal environments where unavailability of farmers preferred crop varieties has been the key issue behind poor crop productivity. Varieties developed for good management condition by scientist without involving the farmers cannot be grown under the harsh environment either
LIBIRD	• To assess and provide the farmers with varietal options • To identify the parents for PPB/COB programme • To test the varieties generated from PPB/COB • To facilitate fast dissemination of new varieties through farmer-to-farmer networks
CEAPRED	Provided opportunity for farmers to select better varieties in their own conditions so that they could be benefited from wheat cultivation
Support Foundation	To select the farmers' preferred varieties for seed production
TTRI	1. Basically, our organization was established help to increase the income of farmers. 2. To enhance the capability of staff's skill and knowledge to conduct training programs and program implementation. 3. To serve the poor farmers to increase their knowledge and skills for improved farming with different approaches.

4.2 Use of COB by NGOs and CBOs

Only three NGOs have been involved in COB/PPB, one of which is a CGIAR centre. Details of their involvement are given in Table 4.3.

Table 4.3 Involvement of NGOs in Client Oriented Breeding

Organisation	Crops (years)	Who chose parents?	Number of crosses	Pop. Size in F_2 onwards	Reasons for COB
FORWARD, Chitwan	Mung bean (2006)	AVRDC	?	2000	* To develop varieties preferred by client * Outscaling process is more rapid
IPGRI/BI Pokhra	Rice (since 1985) Maize (since 1997)	Both farmers & researchers	Usually 2-8	8000 to 10000 F2-F3 for inbreeders	
LI-BIRD	Rice (since 1998) Maize (since 1998)	Researchers and farmers	2-4	> 10,000	To develop crop varieties that meet the needs of the clients involving important stakeholders in all the steps and processes of COB

4.3 Influence of DFID PSP on Use of PVS or COB by NGOs

4.3.1 Nepali NGOs

CAZS-NR, LI-BIRD and FORWARD have supported and collaborated with other local level NGOs and CBOs in PVS activities. For example, CAZS-NR staff member Dr Krishna Joshi provided guidance to Support Foundation when they were starting their PVS work.

4.3.2 International non-government organizations[3]

LI-BIRD has collaborated with international non-government organisations (INGOs), notably CARE and PLAN International. The PCI project also encouraged two CGIAR centres to adopt PVS and/or COB/PPB, details about which are given below.

IPGRI/BI The global project on *in situ* conservation of crop genetic resource, which started in 1997, adopted client oriented breeding (COB) as a technical strategy for the conservation of crop genetic resource *in situ*. This project was managed by IPGRI and implemented by NARC jointly with LI-BIRD, CBOs and DOA. This project was influenced by previous participatory research on PVS, COB (PPB), PCI in Nepal, India and elsewhere. This project built upon the past experience and also refined some of the process to make the COB more rigorous. A few members of the PCI team not only worked as thematic leader for the COB component of *in situ* crop conservation project but also provided logistics for creating diversity and advancing generation of the crosses made by the project for the Kaski site.

CIMMYT The PCI Project was also instrumental in influencing other CG centres particularly CIMMYT South Asia Regional Office (SARO) in adopting participatory approaches, particularly PVS, both on wheat and maize. The PVS approach was adopted by another project within CIMMYT SARO, i.e. the Hill Maize Research Project (HMRP) funded by Swiss Agency for Development and Cooperation (SDC).

The initial phase of the project was dominated by research-led on station testing and verification activities. However, after the recruitment of an agronomist, with overseas training from University of Wales/CAZS NR in participatory research, the entire orientation of the project was changed in the second phase. It adopted a more participatory approach, involving several NGOs, grassroots organizations and government line agencies, focusing on marginalized socially excluded *Dalit* in the activities. PVS and community based seed production and distribution (CBSPD) were initiated in several of the hill districts. CIMMYT, in turn, has also played a significant role in the initiation of PVS work by two of the NGOs covered by this study, namely CEAPRED and TTRI. However, COB/PPB has not been institutionalised within CIMMYT SARO and it is no longer conducting any (see section 8.3).

[3] Most of the material in this sub-section is from Joshi *et al*., 2005. CAZS Discussion Paper No. 8.

5. COMMUNITY-BASED SEED PRODUCTION AND DISTRIBUTION[4]

5.1 Background

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 can be a major constraint on their adoption and spread.

For most crops, sales by the National Seed Company account for only a small proportion of the total seed sown: for rice, Nepal's most important crop, it only produces about 2% of the seed (Witcombe *et al*., EA). The NSC's capacity to supply seed to farmers is limited in various ways:

> "Even with a fully fledged operation, it would be impossible for NSC to cater for the entire seed demand for food crops in Nepal considering their scale of operation, production and distribution approaches, rigidity in action, lack of competitive price and seed quality, absence of business motives and failure to respond to demands of the clients" (Joshi *et al*., 2005).

It would be impossible for NSC alone to supply a substantial amount of farmer-preferred PVS or COB varieties to farmers. Thus, PVS/COB proponents believe that it is an urgent priority to strengthen and improve community-based seed production and distribution (CBSPD).

5.2 COB/PVS Seed Production Support: Survey Results

Our questionnaire asked whether the responding organisation had been involved in supporting seed production activities by farmers or CBOs for PVS and/or COB/PPB varieties in various ways (see Annex 1). The responses we received are summarised in Table 5.2.

It is noteworthy that all of the organisations that answered these questions have:

- been involved in supporting seed production of PVS/COB varieties,
- supported production by CBOs (farmer or self-help groups) and
- linked such CBOs to potential seed purchasers.

Most of them have also contracted farmers to produce seed for sale.

Public sector NARC's Agricultural Botany Division informed us that:

"Farmers are producing seeds and supplying seeds to their relatives, neighbours and other farmers and NGOs, communities. Farmers are producing seeds by learning head to row system of selection and harvesting".

In the case of NWRP "BS [breeder seed] is produced at NWRP headquarter then [given] to seed companies and farmers' seed producers group".

[4] This chapter - primarily section 5.3 - makes substantial use of an as yet unpublished paper by Witcombe *et al*. that has been submitted to the journal *Experimental Agriculture*. This is referred to hereafter as Witcombe *et al*., EA.

Table 5.2 Production and Distribution of PVS/COB Varieties

SN	Institute	Involved in seed supply	Support CBO seed production	Farmers Contracted to Produce for sale	Act as intermediary for Production & Marketing
Public sector					
1	RARS Lumle, NARC	Yes	Yes	Yes	Yes
2	RARS Pakhribas, NARC	Yes	Yes	No	Yes
3	ABD , NARC	Yes	Yes	Yes	Yes
4	ORD, NARC	Yes	Yes	Yes	Yes
5	NWRP, NARC	Yes	Yes	Yes	Yes
6	CDD, DOA	-	-	-	-
NGO					
7	Support Foundation	Yes	Yes	Yes	Yes
8	CEAPRED, Lalitpur	-	-	-	-
9	TTRI, Lalitpur	Yes	Yes	Yes	Yes
10	FORWARD, Chitwan	Yes	Yes	No	Yes
11	LI-BIRD	Yes	Yes	Yes	Yes
12	IPGRI/BI Pokhra	Yes	Yes	Yes	Yes

NGOs FORWARD reported that it has been "facilitating community based seed production system by capacity building of farmers groups/ establishment of seed bank in hills and Terai districts". In the hills maize is the principal crop they have supported, whereas legumes and rice are the main ones in the Terai. FORWARD has also been providing technical services and source seed of Mungbean to some professional CBO seed production enterprises in Chitwan, namely Unnat seed production group and Pithuwa Seed Company. FORWARD has contracted farmers for seed production, but has been playing a facilitating role "between farmers groups and traders to develop functional linkage between these two parties".

5.3 Community-based Seed Production Initiatives and their Weaknesses

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. One of the more recent ones was SPIN (Special Programme in Nepal), which started in 1997. SPIN was established by FAO and was jointly implemented by DADOs and District Irrigation Offices to promote decentralised seed production with farmer groups.

The farmer training concentrated on increasing yield by the application of the recommended package of inputs and cultivation practices – there was no training in business skills and marketing. The application of the package was supported by the project, which fully or partially subsidised all of the inputs in the package - including seed, fertilizer, and chemical pesticides - as well as providing the necessary sprayers. This meant that farmers did not have to sell seed to make a profit, and

hence gained little if any experience in marketing quality seed at appropriate premium prices (Poudel *et al.,* 2003, cited by Witcombe *et al*., EA).

It was hardly surprising, therefore, that farmers reported discontinuing use of the package after the termination of the project when the subsidies had ended (ibid). Nor is it surprising that none of the groups surveyed after the project had ended was producing seeds for sale in an organised manner (ibid). SPIN was by no means unusual in experiencing these problems – they are fairly typical of international experience with local level seed projects.

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) – CBOs often fail to sell significant amounts of seed, have little experience/skills in promoting the seed and lack commercial contacts. Projects that have targeted their seed multiplication activities to the poorest sectors of the farming community "usually have not been successful, and have often been unable to make any useful improvement to local seed supply" (Tripp, 2001).

5.3.1 PSP Support for CBSPD

The PCI team saw the establishment of effective CBSPD groups as essential to ensuring the supply of seed of PVS/COB varieties and hence their widespread use. 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.

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). These groups were Unnat Seed, Shreeram and Devujjal; and, as can be seen from Table 5.1, the quantity of rice seed produced and sold by these groups rose rapidly during the first three years after their inception (Devkota *et al*., undated). By 2006-07 five groups, including these three, were producing 521 tonnes (Witcombe *et al*., 2009); and LI-BIRD and FORWARD were working with 11 functional groups in parts of several districts (Joshi *et al*., 2005). The rice seed production of the three newly established groups compared favourably with the total rice production of the NSC.

Table 5.3 Rice seed produced and sold by PCI seed producer groups

Seed producers group	Rice seed produced and sold (ton)		
	2002-03	*2003-04*	*2004-05*
Unnat	37	62	183
Shreeram	4	53	128
Devujjal	-	7	33

Source: Devkota *et al*., undated

The PCI team believes it 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. Their experience 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 promotion of commercially oriented CBSPD groups has been described as "one of the most important institutional innovations" promoted by PCI (Joshi *et al*., 2005). 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*.). It is interesting to note, however, that work on CBSPD "was not envisioned in the project design" for PCI (Joshi *et al*., 2005).

Although the team's intention in supporting these groups was to promote the scaling out of new COB or PVS varieties, most of the seed that was produced has been of obsolete varieties. This is because the groups made commercial decisions and produced seed of varieties that were in demand from their customers - i.e. seed of varieties that were already well-known and already popular. If this is to change, then policies to preferentially subsidise new varieties and to devote more resources to supplying information about new varieties are needed.

6. IMPACT OF PVS/COB ON FARMERS

6.1 Benefits per Household of Selected Varieties

6.1.1 Yield and price benefits of FORWARD-developed varieties

New varieties tested, developed and promoted through PVS and/or COB often have higher yields and/or better prices than the ones that farmers were previously growing. This can result in increased household income – or decreased expenditure on purchase of food grains, thereby freeing up cash for other uses. The effect on household incomes of new varieties of rice, mungbean and chickpea developed by FORWARD is shown in Table 6.1. Increases in family income can have various benefits, depending on how the money is spent: reported examples include life-saving health care (maternity care), improved schooling of children, meeting household requirements, social obligations (marriage) and farm improvements (Joshi *et al*., 2005).

Table 6.1 The Effect of New Varieties Developed by FORWARD on Average Household Income (NR p.a.)

Name of new variety	Crop	Yield of Old variety/ies (tons per Bigha)	Yield of New variety (tons per Bigha)	Yield advantage of new variety (tons per Bigha)	Price advantage of new variety♦ (Rs/Kg)	Planted area* (Bighas?)	Household Income benefit
8 varieties	rice	2.0-2.5	2.5-3.0	0.5	10	1.5 kattha**	375
4 varieties	Mung bean	0.5	1	0.5	20	1 kattha	500
3 varieties	chickpea	0.5	1	0.5	5	1 kattha	125

* The figures in this column refer to planted areas in PVS trials
**1 kattha = 1/20 of a bigha. ♦ This may apply only to aromatic variety

The kinds of yield increases shown in Table 6.1 have also been found by other agencies for preferred varieties tested and identified through PVS. Here are some examples.

6.1.2 Yield and price benefits of other PVS/COB varieties

PVS/COB varieties typically have substantial yield advantages over previously used varieties under farmer conditions, although price advantages are less common. Some examples are given below and these are summarised in Table 6.2, which shows yield improvements ranging from 22 to 40 percent..

Wheat According to NARC's Agricultural Botany Division: "As a result of PVS and its outstanding output "WK1204", there has been reported 30% of productivity of wheat has been increased at Kathmandu. WK1204 had yielded 6889 kg/ha on PVS research and now some farmers are harvesting approximately of 8 ton/ha".

Table 6.2 Yield and price benefits of other PVS/COB varieties

Name of new variety	Crop	Yield of old variety/ies (tons/ha)	Yield of new variety (tons/ha)	Yield advantage of new variety (percent)	Price advantage of new variety♦ (Rs/Kg)
WK 1204	wheat		7	30	0?
BG 1442	Rice (Chaite)	2.5-3.0	3.7	22-40	0.5-1
Barkhe 2014 (in medium land)	Rice	3.4	4.2	24	0?
Barkhe 2014 (in lower land)	Rice	?	3.7	37	0?
Swarna	Rice			50-100	-?

Rice There are two growing seasons for rice – the early or *Chaite* season, and the main or *Barkhe* season. In the PCI project the yield advantage of *Chaite* rice variety, e.g. BG 1442, over check variety was 22% (3.66 t ha^{-1} of 2.99 ha^{-1}) and over other varieties 40% (3,66 t ha^{-1} of 2.53 t ha^{-1}) In addition to yield advantage, a price advantage of Rupees 0.5 to 1 kg-1 ($ 7-14 ton-1) was also reported. For main season rice, the yield advantage from Barkhe 2014 in medium land was 24% (4.2 t ha^{-1} of 3.4 t ha^{-1}) and from Super 3004 in the lower lands 37% (3.7 t ha^{-1} of 3.7 t ha^{-1}). (Source: Joshi *et al*., 2005). According to farmers in some villages of Nawalparasi district, another project-identified variety, Swarna, yields 1.5 times to twice as much as Masuli, which was grown there previously, though it fetches slightly lower price than Masuli (ibid).

6.1.3 Other benefits

FORWARD varieties New crop varieties often have many other important kinds of benefits in addition to increased income: some common ones are shown in Table 6.3. Some of these benefits contribute to increased household *food security*, including: greater drought tolerance; greater resistance to pests or diseases; and shorter durations, which may enable farmers to harvest crops earlier in periods of peak food deficit. **Other varieties** Farmers told researchers that in most cases Swarna rice variety contributed to increasing food sufficiency from six to 12 months (Joshi *et al*., 2005).

Table 6.3 Other Benefits of New Varieties Tested and Promoted by FORWARD

Nature of Benefits	CROPS AND VARIETIES		
	Rice-Various	**Mungbean-various**	**Chickpea-various**
Higher yield in drought years (t/bigha)	0.5	0.5	0
Better quality of crop	Old Vs have no smell, but new Vs have sweet smell - both plant and while cooking	Old varieties have pungent smell while cooking – new Vs do not	0
Increased crop self sufficiency (months/year)	0	0	0
Better quality or more fodder	0	0	0
Earlier maturity/ harvest (days)	8-35	20	10
More food in hunger gap/shorter gap	Farmers can harvest early in peak food deficit period (Oct)	0	0
Greater resistance to pests/diseases	Old Vs susceptible to Blast, BLB and sheath blight: new ones tolerant to these disease	Old Vs susceptible to Yellow Mosaic Virus. New Vs have greater Resistance/tolerance	Greater tolerance to wilt, botrytis grey mould and yellow mosaic virus

6.2 Adoption Levels and Overall Financial Impact on Farmers

6.2.1 Extent of adoption of selected varieties

NGOs, CBOs and government agencies have been involved in distributing seeds for PVS and/or COB varieties to farmers. (All of the organisations involved in our survey may be involved in seed production and distribution - see section 5.) 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: hence this information is lacking for most crops, the exception being rice (see Box 6.1). Here, therefore, we have simply documented the numbers of farmers involved in PVS and/or COB trials for each crop, and the varieties of various crops that have been officially released.

Table 6.4 Numbers of Farmers Involved in PVS by Institute and Crop

Organisation	CROP									Total number of farmers
	Rice	Maize	Wheat	Rape seed	Finger millet	Moong (M)/ Kidney (K) bean	Chick -pea	Lentil	Other	
RARS Lumle	136	178	124	-	256	-	-	-	Tori 232	**926**
Agricultural Botany Div	-	>600	>1500	-	-	-	-	-	-	**>2100**
Outreach Research Div	50	30	30	-	-	-	-	-	Potato 25	**135**
NWRP	-	-	296	--	-	-	-	-	-	**296**
CDD, DOA	-	4800	-	-	-	-	-	-	-	**4800**
Support Foundation	-	290	-	-	-	-	-	-	-	**290**
CEAPRED	-	-	23	-	-	-	-	-	-	**23**
TTRI	-	2045	-	-	-	-	-	-	-	**2045**
FORWARD	700	-	250	1000	-	M-1000	600	100	Tomato 150	**3800**
LI-BIRD	18772 *	3494	3603		?	K-2866		1498	Cowpea 158 Ghaiya 409	**30800**
IPGRI/BI	-	-	-	-	-	-	-	-	-	**-**
Total	**19658**	**11707**	**4826**	**1000**	**256**	**3866**	**600**	**1598**	**974**	**44,485**

* This figure is arrived at by taking the highest *annual* number of farmers for main season and *chaite* 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.

Numbers of farmers involved in PVS/COB trials Nearly 45,000 farmers were directly involved in PVS/COB processes with the organisations covered by the study, from 1995 to 2008, on a wide range of crops. About 2/3 of these farmers were engaged by LI-BIRD; and more farmers were using varieties of rice and maize than other crops. (See Table 6.4 for details.)

BOX 6.1 Adoption Rates of PVS/COB Rice Varieties

Another RIU MIL impact assessment (IA) study is investigating the level of adoption of improved (PVS/COB) varieties of rice, and the results will be published in a separate study when they are available. A previous IA of rice varieties promoted by PCI project found that the adoption rate(s) of PCI project-identified and promoted rice varieties were 18% for the main season rice in Chitwan and Nawalparasi districts (Devkota *et al*., 2005).

Table 6.5 PVS/COB Varieties that have been Submitted for Release

Crop	Variety (COB unless stated otherwise)	Organisations Involved	Area/Domain	Year of release
Released varieties				
Wheat	WK 1204	ABD, NWRP	Mid and high hills	Release in 2007
Wheat	Gautam	NWRP	Terai/Lower Elevations	Release in 2004
Maize	Deuti (PVS)	ABD, TTRI, RARS Pakhribas	Mid hills	Release in 2007
Maize	Manakamana	RARS Pakhribas	Mid hills	Released
Maize	Shitala	TTRI, RARS Pakhribas	Mid hills	Release in 2006
Mungbean	Kalyan	FORWARD	Terai and foothills	Release in 2006
Mungbean	Prateeksha	FORWARD	Terai and foothills	Release in 2006
Chickpea	Avrodhi	FORWARD, NARC legumes	?	Release in 2008
Chickpea	Tara	FORWARD, NARC legumes	?	Release in 2008
Rice	Chomrong local (PVS?)	RARS Lumle	High Hills Cold water	Released 1991
Rice	Sunaulo Sugandha	LI-BIRD	Terai region	Release in 2008
Rice	Machapuchhre 3	RARS Lumle, IPGRI/BI	High Hills Cold water	Released in 1996
Rice	Barkhe 3004	LI-BIRD, IPGRI/BI	Terai region	Release in 2006
Rice	Pokhreli Jethobudo	LI-BIRD, IPGRI/BI	Kaski district Valley bottoms up to 900m	Release in 2006
Varieties under consideration				
Rice	Barkhe 3019	LI-BIRD	Terai belt	
Maize	Resunga Composite	LI-BIRD	Western mid hills	
Maize	Gulmi 2	LI-BIRD	Western mid hills	
Maize	Pop-45, HPW, HPY	RARS Pakhribas	Mid hills	
Varieties not released				
Rice	Lumle 2	RARS Lumle	High Hills Cold water	
Rice	Barkhe 2014	FORWARD	Terai/foot hills under partial irrigation & medium fertility	
Rapeseed	M 27	FORWARD		
Tomato	Manisha and To 848	FORWARD	Banke and	

PVS/COB varieties officially released Fourteen crop varieties developed by the organisations involved in our survey have been officially released, and this in turn encourages their dissemination through the official varietal popularisation and extension system. Information about varieties for which official release has been sought has been summarised in Table 6.5.

Adoption of varieties promoted by FORWARD The numbers of farmers estimated to have received seed developed by FORWARD are shown in Table 6.6. However, it is not known how many of these farmers have continued to grow these varieties.

Table 6.6 Numbers of Farmers Receiving Improved Seed Developed by FORWARD

Crop	No. of farmers receiving seed		
	From own organisation	From other organisations	Total
Rice	3000	5000	8000
Mungbean	2000	4000	6000
Chickpea	2500	2000	4500

6.2.2 Financial benefits

The total financial benefit to farmers using varieties tested/developed by FORWARD has been calculated, by multiplying the typical household income gain by the number of adopters, as shown in Table 6.7. Although the household income gain for rice, NR 375, is not as high as that for mungbean, NR 500, the total financial benefit from each (NR 3000,000) is about the same, as more farmers are using the new varieties of rice than are using the mungbean ones. The total financial benefit can be expected to increase markedly over the next 5-10 years as the seed becomes more widely available (see section 5) and the number of adopters increases.

Table 6.7 Total Income Benefit to Farmers Adopting New Varieties Developed by FORWARD

Name of new variety	Crop	Household Income benefit p.a. (NRs)	No. of farmers benefitting	Total income benefit p.a. (NRs)	Total income benefit p.a. (US$)
8 varieties	rice	375	8000	3000000	37,500
4 varieties	mungbean	500	6000	3000000	37,500
3 varieties	chickpea	50	4500	225000	2,812.5

An IA of the PCI project calculated the internal rate of return (IRR) and net present value (NPV) for the project (Witcombe *et al*., 2004). The authors estimated the IRR within the fifth year of trial was 43-126% while the NPV ranged from £2 to £29 million by 2010 and £4 to £52 million 2012. These calculations were based on various assumptions about the rate of spread of the rice varieties and the average area planted by the farmers.

6.3 Who Benefits from PVS and COB work?

Many of the organisations that have been involved in using PVS (and COB) have poverty reduction as one of their aims, and seek to work particularly with resource-poor farmers. (See also section 7.2.1). There is some evidence that they have been fulfilling this aim.

6.3.1 The PCI project

The PCI project focused on High Potential Production Systems (HPPS) and operated in Chitwan and Nawalparasi districts, which are respectively above and below average for Nepal on the UNDP's human development index (Witcombe *et al*., 2004). The site selection process deliberately focused on better-off environments within the districts (Rana *et al*., 2004). However, there was considerable variation in wealth status within the three project cluster areas, and the project decided to include farmers from all wealth categories (ibid).

According to another report, the project had a particular focus on food-deficit households and promoted a gender perspective (Joshi *et al*., 2005). It apparently contributed considerably to reducing poverty and addressing food and livelihood insecurity (Joshi et al., 2006, The outcomes and impact of COB and PVS on rice). Crop-based development interventions by their nature tend to benefit people with access to arable land; and, generally speaking, the more arable land a farmer has the more (s)he tends to benefit from the interventions. Landless rural people, such as those who making a living from wage labour, are unlikely to benefit, and that may have been the case with the PCI project. It has been recommended that greater attention be paid in future to bonded labourers and occupational castes (Joshi *et al*., 2005).

Nevertheless, an outcome assessment was undertaken, covering randomly sampled households in villages where PCI outputs had been scaled up: 350 households in seven villages for Chaite rice; and 906 households in 16 villages of Nawalparasi for main season rice. The survey found that >75% of respondents for Chaite rice were indigenous people and disadvantaged communities, while this percentage was 53% for main season rice (this info is from Joshi et al, 2005).

6.3.2 Other projects and organisations

In our survey some public sector agencies perceived PVS as involving and relevant to all farmers irrespective of "gender, caste, wealth so on" (RARS Pakhribas), and particularly "resource-poor" farmers (CDD, DoA) – see section 7.1.

Hill Maize Research Project In 2004 more women and disadvantaged ethnic communities participated in project activities than previously. Nearly 12,000 farmers (32% women) benefited directly from the project of which 75% were from food deficit categories. Based on ethnic composition 33% of them were *Dalits* (HMRP, 2005, cited by Joshi *et al*., 2005).

6.4 Seed Supply – a Potential Constraint on PVS/COB Impact on Farmers

6.3.1 Issues in CBSPD

Types and quantity Although seed production by the CBSPD groups established by the PCI project grew rapidly, as noted in section 5, the type of varieties produced have generally been different from what was envisaged, i.e. PVS or COB varieties:

> Around 80 per cent of the seed produced by the groups was of very old released varieties, and half the COB varieties produced were purchased by development programmes. By 2007, only 1 per cent of the total production was of COB varieties produced by the groups independently of development agency orders. However, since overall production had increased dramatically

> the absolute amounts sold were significant: in 2006-2007 this amounted to 119 t of seed of which 92 t was seed of PVS varieties and 27 t of seed of COB varieties (Witcombe *et al*., 2009).

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 (ibid).

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). Hence, on receiving a demand by a development organisation for 10 t of Barkhe 3004 rice, they asked *Unnat,* one of the producer groups, for seed. Although this could not result in an immediate supply it gave them the confidence to include Barkhe 3004 for seed production in their future plans. 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.

Sustainability It remains to be seen whether CBSPD producer groups will be able to function profitability without external support and nurturing.

7. BENEFITS AND CHALLENGES TO CROP IMPROVEMENT SERVICES

7.1 Benefits of Using PVS and COB

The system for crop breeding, varietal testing and release has been slow, with one phase following another. It takes 12-13 years or longer to propose a variety to the NSB's VARRSC for release; and a longer breeding cycle involves an economic cost, as farmers lose opportunities to grow better varieties earlier (Joshi *et al*., 2005). Advocates of PVS and COB/PPB see one of its main benefits as being an acceleration of this process, with concomitant economic benefits. We asked organisations involved in the survey what they saw the actual benefits as being.

Perceived benefits of PVS compared with FFT Although public sector agencies that adopted PVS anticipated that there would be benefits in doing so (see section 3.2), it does not necessarily follow that those benefits actually materialised. It is clear, however, from another question we asked that they did. Almost all public sector agencies that have been using PVS see it as having advantages over the Farmer Field Trials approach that they were using previously, as can be seen from Table 7.1. CDD noted that PVS leads to "higher adoption of varieties and technologies"; and RARS Lumle perceive it as being more effective, faster and more cost effective. The other benefit – from a poverty reduction perspective – is that PVS, unlike FFT, is seen as involving and relevant to all farmers irrespective of "gender, caste, wealth so on" (RARS Pakhribas), and particularly "resource-poor" farmers (CDD).

Table 7.1 Organisations' Perceived Benefits of PVS compared with FFT

Organisation	Benefits of PVS compared with FFT
Public sector	
Agricultural Botany Division	Many stakeholders participated in [PVS] implementation…. lead[ing to] more scientific output. Thus, the Client oriented PVS is well justified in the process of dissemination of newer technologies, knowledge identification and canalizing it
Outreach Research Div'n	(No differences were noted by ORD)
RARS Lumle	PVS involves more farmers, and is more effective, faster and more cost effective
RARS Pakhribas	PVS has good opportunity to all farmers in the village… It covers a large no. of [them]... considers gender, caste, wealth so on. FFT in limited farmers' fields does not consider much the socioeconomic class in the village
NWRP	In PVS, farmers and researchers both interact together during genotype selection and farmers' perception regarding genotype in question is important ,while in FFT only yields are taken into consideration and also researchers' inputs are used in case of FFT evaluation.
DoA's Crop Development Directorate	Resource poor [rather than resource-rich with FFT] farmers as beneficiary, less divide between researcher and farmers, higher adoption of varieties and technologies
NGOs	
FORWARD	See Table 7.1a
IPGRI/BI	FFT is on-farm research tool to test performance of elite materials under farmers' fields with decision on choice of entries and management practices decided by researchers. In contrast, PVS is both research and extension tool to compare a single variety with farmer's best under farmer own management system in a large area. The choice of variety is determined by need assessment and source of seed could be both released, advanced and farmer selected lines. Once variety liked by farmer and other neighbouring farmers there are sufficient seed locally available to spread farmer-to-farmer network. In FFT seed availability is limited because of small plot size and spread through informal seed system is very slow.
LIBIRD	* In the conventional plant breeding when the new lines/varieties developed performing better in IYT, CVT are then put under FFT. The inputs are as recommended by scientists although experimentation is done at farmers' field. * PVS is done to identify the parents for any breeding programme. Similarly, when the segregating generations get fixed at about 6th generation then the lines are ready for PVS. In PVS all the input and management is farmers practice.
Support Foundation	Almost same
CEAPRED, Lalitpur	FFT is decidedly the researcher Farmers and researcher decide PVS
TTRI, Lalitpur	1. In PVS, Mother and Baby trials helps to adopt this technology quickly due to their more involvement than FFT. 2. Participation of more number of female farmers also encourages quicker adoption of technology in the comparison with FFT. 3. Large no. of farmers' interaction and then selection make adoption quicker than FFT.

Table 7.1a Differences identified by FORWARD between PVS and FFT

Differences	PVS	FFT
1. Design and management	Farmers' design and farmers' manage, we only provide seed	Researchers' designs but farmers' manage
2. Decision making authority	Farmers decide which variety they have to promote	Researchers decide based on the information received from farmers
3. Scaling up/out	Rapid through farmers to farmers dissemination process	Slow

7.2 Challenges of Using PVS and COB

7.2.1 Challenges of Using PVS

Although virtually all public sector organisations believe that PVS has generated greater benefits than previous approaches, it has not been without costs and difficulties: these are shown in Table 7.2. Nevertheless, two NGOs (Support and CEAPRED) said that they had not experienced any difficulties at all in implementing PVS, and hence are not shown in the table. Two difficulties were mentioned by three or more organisations, namely:

- Availability of enough quality seed
- Farmer motivation to participate.

Farmer motivation was noted as particularly serious when PVS was being initiated and farmers were not yet aware of its value. FORWARD also noted that PVS involves some risk to farmers. They went on to recommend (a) "clear cut understanding on the purpose of experimentation and roles of both parties (researchers and farmers should be clear at the beginning); and (b) to be safe "choose medium level leader farmers to carry out PVS (mother trials)".

Farmer lack of technical knowledge was mentioned by one public sector agency, as was lack of funds by another. NARC's ABD observed that implementing mother-baby trials is very tedious, and LI-BIRD noted that collecting feedback requires substantial resources and commitment.

7.2.2 Challenges of Using COB

The most frequently cited difficulties (see Table 7.3) were:

- Funding constraints
- Farmer motivation to participate and
- Farmer lack of technical knowledge.

Funding constraints This was noted by two of the three NARC agencies/components; but it was not mentioned by any of the NGOs. NWRP is no longer "doing any more COB/PPB work due to lack of resources.. it is more costly". *Farmer motivation* was mentioned by four organisations and is a challenge partly because of the length of the COB/PPB process (NARC ABD), and because not all outputs of COB/PPB activities are positive (FORWARD). *Farmer lack of technical knowledge* was mentioned by two NARC agencies, ABD and NWRP, but not by the NGOs

Table 7.2 Difficulties Experienced in Using COB/PPB

Organisation	Funds /cost	Farmer participation AND/OR Farmer technical knowledge	Other
Public sector			
Agricultural Botany Division	Fund, vehicle	* Lack of innovative farmers * Incentive to collaborating farmer and researcher as COB is long running process * farmer's perception and understanding on sterility	* Reliable person to contact innovative farmers * Cooperation among the stakeholders including farmers * Lack of interest even of scientists, extension workers and other stakeholders
RARS Lumle		* Lack of full commitment among the collaborating farmers	
NWRP	More costly	* Farmers lack knowledge of selection practices during plant selection, more tedious	
NGOs			
IPGRI/BI			Resistance from public sector plant breeders
FORWARD		Some farmers may not be interested to participate unless they internalize the outcomes of the approach, as not all outputs of COB/PPB activities are positive	
LI-BIRD		Community mobilization during the initial phase of PPB/COB	Difficulties in releasing varieties generated from PPB/COB due to the nature of data recorded

Three factors in the 'Other' category may be inter-related. "Resistance from public sector plant breeders" is probably related to: "Difficulties in releasing varieties generated from PPB/COB due to the nature of data recorded", as these plant breeders tend to question some of the data generated by COB/PPB (see section 10.3); and may also be related to "lack of interest … of scientists".

Table 7.3 Difficulties Experienced in Using PVS

Organisation	Seed quality and/or amount	Farmer motivation to participate OR Farmer technical knowledge (FTK)	Other
Public sector			
Agricultural Botany Division	Seed availability at start-up stage	Maybe – lack of Cooperation and co-works among the stakeholders	* Lack of fund even to visit farmer's field often * Mother-Baby trial method is very tedious (more so than Mother-Daughter)
Outreach Research Division		Was really difficult to convince farmers to participate initially	
RARS Lumle		FTK about basics of plant and seed is major limiting factor	
RARS Pakhribas	Simply to get required amount of quality seeds		
NWRP		Always some difficulties working with farmers, but not much	
DoA's Crop DD			* Lack of orientation to the front line staffs **and** * Developing data base for mother baby trials
NGOs			
IPGRI/BI	* Access of elite varieties and information on their characteristics * Availability of enough quality seed		
FORWARD		Farmers' hesitation while selecting segregating lines (F 5-6). Some farmers may be less interested in participating due to risk factor.	
LIBIRD			*Private public partnership not yet strengthened and fully internalised by government organisations * Feed back collection requires resources and commitments
TTRI		Initially it was difficult to convince farmers to participate in PVS program. Small landholders are not much interested in maize farming and PVS program because of low volume of production	

8. CROP IMPROVEMENT SYSTEM DYNAMICS: AN OVERVIEW

This section and the following ones are concerned with the inter-relationships between the implementation of PCI processes, on the one hand, and the systems within which they have been implemented, on the other. The relationships are seen as dynamic and changing over time. Sections 9 and 10 focus on PVS and COB/PPB respectively. This section looks at broader aspects of collaboration between the organisations involved in the PSP-supported projects and the Department of Agriculture; and sets out a framework for analysing to what extent institutionalisation of PCI processes has taken place.

According to Biggs, the local staff of the PCI projects "helped bring about significant changes in agricultural research policy and the architecture of the formal national agricultural research and extension system" (Biggs, 2008). After an informal collaboration for over a year, a formal letter of agreement (LOA) was signed in 2000 between the authorities of DADO Chitwan and LI-BIRD, facilitated by CAZS-NR, with clearly agreed roles and responsibilities. The financial support for this partnership came from DFID's PSP: this formal partnership may have been one of the first examples of its kind in Nepal. The role of DADO Chitwan was to implement the joint activities through their district level network, and LI-BIRD was to provide technologies, technical support and agreed funds (Joshi *et al*., 2005). The then Regional Director of Agriculture for Central Region gave his approval to this arrangement. However, the collaboration only lasted for two years, at which point the DADO reverted to the normal way of operating (Joshi, *pers. comm*., January 2009).

Nevertheless, this case was one of several examples of local collaboration that motivated MOAC, DOA, Agricultural Research and Extension Project (AERP) and other projects to formulate policies for decentralization of agricultural extension functions (Joshi *et al*., 2005). DADO Chitwan and involved LI-BIRD professionals were invited to several meetings to share their practical experiences of managing this emerging partnership (ibid). Later, a policy was formulated by the MOAC that allowed all the DADO offices to collaborate with other service providers and agencies for generating extra funds, making agricultural service delivery timely and efficient. ….DOA appreciated partnership with NGO/INGO as a means of verification and dissemination of new crop varieties directly with the farmers' communities (Bhandari, 2002; Joshi *et al*., 2005). During 2009 the DoA has shown renewed interest in collaborating with civil society and the private sector and has hosted a number of meetings to explore possibilities for strengthening this.

8.1 Institutionalisation - a framework

A major aspect of the crop system dynamics is the extent to which the PCI processes have become institutionalised within Nepal's crop improvement system – or conversely stifled through inhibitory aspects of the traditional system. Institutionalisation is often thought of as something that relates specifically to organisations, but this report uses a broader definition, namely: "the process of making something (for example a concept, a social role, particular values and norms, or modes of behaviour) become embedded within an organization, social system, or society as an established custom or norm ..." (Wikipedia). In the case of PVS and PPB, for institutionalisation to take place fully it appears that changes are required at a number of levels within a given nation-state, as indicated in the *'Institutionalisation Framework'* in Table 8.1.

Using the Innovation System Framework (Figure 2.1), it is apparent that institutionalisation of PVS or COB/PPB can take place in a number of different domains. Both processes also tend to involve new forms of cooperation between various different stakeholders from at least three of the domains (research, intermediate organisations and 'demand', i.e. farmers).

Table 8.1 The Institutionalisation Framework and PCI Processes

Levels	*Domain*	*Indicators*
1a. National (or state) enabling environment - Government policies - Government procedures - Govt funding available? - Public sector courses available	*Policy and institutions* *Education*	* Policy supports or favours PPB or PVS * Varietal release system compatible with PPB or PVS * Plurality of organisations applying for release of PPB (or PVS) varieties * curriculum reform to incorporate PVS or PPB
1b. National breadth & depth of use - public sector research - public sector extension - NGOs - Farmer organisations	*Research* *Intermediary* *Enterprise*	* Numbers of PPB (or PVS) varieties released * Number of organisations using PVS or PPB * Plurality of organisations (including NGOs) applying for release of PPB (or PVS) varieties * Qty of seed produced annually (by public sector, CBOs) of PVS or PPB varieties * geographical coverage (no. or % of districts) * no. of crops covered by PVS or PPB
2. Organisation - supportive policy and strategy - supportive structures and procedures - appropriate incentives and organisational culture	*Research* *Intermediary* *Enterprise*	* organisation's procedures allow/support PPB or PVS (e.g. adequate funding for fieldwork) * % of plant breeders involved in PPB * plant breeders and extension workers feel that their PVS or COB/PPB work is valued by managers & peers
3. Human (Managers, researchers, extensionists) - skills - attitudes	*Research* *Intermediary* *Enterprise*	

At the **national and state levels** institutionalisation may be manifested in the form of supportive policies and/or procedures and in the allocation of funds for PVS or PPB. It may also be reflected in the breadth (geographical, numbers of crops, numbers of PPB/PVS varieties released) and depth (numbers of organisations or staff involved, quantity of PVS/PPB seed produced) of coverage. At the level of an individual **organisation** it may reflected in:

1. a supportive organisational policy and strategy
2. Building human capacity within an organisation to use PVS/PPB approaches effectively
3. Modified organisational structures and procedures to accommodate PVS/PPB
4. Realigning incentives and influencing organisational culture to foster PVS/PPB (adapted from Sutherland *et al*., 2001).

Cross-cutting the four dimensions at the organisational level is attitudinal change: even if all four of these are addressed, change may still be very slow if staff attitudes are overwhelmingly negative at one or more levels. In the next two sections the 'Institutionalisation Framework' is applied to PVS and COB/PPB respectively.

9. PVS and CROP IMPROVEMENT SYSTEM DYNAMICS

9.1 Has PVS become embedded in Nepal's Crop Improvement System?

PVS has become widely used in Nepal, by public sector research and extension agencies as well as NGOs. The PCI project helped legitimise informal research and development (IRD – a less structured variant of PVS) in the terai: for example, the germplasm coming from informal sources including farmers' innovations were included in the participatory varietal selection (PVS) trials of PCI project, and this enabled the formal system to accept and capitalise on the reality of the open border with India in terms of rice innovations (Joshi *et al*., 2005).

Public sector Several key informants in Nepal were of the opinion that PVS has been institutionalised to a significant degree in public sector organisations, i.e.:

- the DoA's extension system (personal communications from S Nepali, Director, DoA's CDD; Tiwari and Ortiz-Ferrara, CIMMYT) and
- NARC research (Sherchan, NARC; Tiwari and Ortiz-Ferrara, CIMMYT).

The *Department of Agriculture's Crop Development Directorate* has been collaborating with CIMMYT for five years in 25 districts on the Hill Maize Research Project (HRMP), a key element of which is PVS – using both researcher (NARC) and farmer varieties. They also have an oilseed seed production programme in six districts that is implementing some PVS activities. In addition, some individual DADOs may be involved in PVS at a local level in collaboration with NGOs.

Through this experience CDD have learned that PVS is beneficial and reasonably simple (initially front line staff are not familiar with the idea of 3 or 4 replications, but this is easily addressed); and it accelerates the process of adoption of better varieties of maize: they see PVS and extension going hand-in-hand. Consequently, they "are going to institutionalize PVS and CBSP in the regular program" (CDD, *pers. comm.* 2008): and intend to scale out PVS to all 75 districts of Nepal; and to expand gradually the number of crops covered, with rice and wheat probably being the next ones. NARC is also involved in HRMP, and DoA expects that NARC would be happy to collaborate with them in implementing PVS for other crops. They are developing guidelines and norms – this is currently at a very preliminary stage – for submission to the government (Nepali (CDD), *pers.comm*. 2009); and they envisage that it will be 2011 before scale-out of PVS will happen. They need to have discussions with NARC and its commodity programs about the cost of materials etc.

In the *National Agricultural Research Council (NARC)* PVS has become a standard part of the process for testing varieties, and mother/baby trials are carried out involving 6-8 varieties (Sherchan, *pers. comm*.). One set of trials is carried out at the Regional Research Stations and another set at the ARSs: there are also some on-farm trials.

The *National Agricultural Research and Development Fund (NARDF)* was established by the government in 2001 to administer short to medium-term projects, mostly on adaptive and action research, scaling up, market promotion etc. (Joshi *et al*., 2005). It has now been operating a competitive funding scheme for 6 years, based on an annual call for research proposals. For a proposal to be successful all three referees, representing a range of disciplines, must review it favourably. Most projects are led by NGOs and involve collaboration with researchers from public sector agencies. A significant number of projects funded – e.g. 3 out of 25 in 2003

(Joshi *et al*., 2005) - have involved PVS and 'mother/baby' trials. (The Support Foundation, one of the NGOs covered by this study, became involved in PVS in 2006 through a NARDF-funded maize project.) NARDF's Senior Programme Officer believes that this is clear evidence that PVS has become institutionalised in Nepal (Pant, *pers. comm*.).

Non-governmental organisations PVS has become mainstreamed in the work of LI-BIRD and FORWARD, and also in CIMMYT's work in Nepal. One indicator of this is the fact that each of these NGOs has been implementing PVS in a large number of districts. The total number of PVS districts covered by these organisations is 63: in 20 districts PVS has covered only one crop, and in the other 43 more than one crop (often several) - see Table 9.1.

Table 9.1 Number of Districts in which PVS has been Implemented by NGOs

Organisation	No. of districts		Districts that were 1 crop for > 1 agency for different crops (rice& maize) & hence become >1 crop districts	Combined total of LI-BIRD (30) & FORWARD (18) > 1 crop districts minus duplicates (9)	Total districts
	1 crop	>1 crop			
LI-BIRD	12	30			42
FORWARD	2	18			20
CIMMYT[1] (HMRP)	32	0			32
TOTAL	20[2]		4	39	63 (sum of row)

[1] The data for CIMMYT relate only to HMRP and hence may be underestimates.
[2] This is the total after subtracting districts that are 1 crop for a particular organisation, but where another organisation has worked on (an)other crop or crops – hence they are not 1 crop districts when all agencies' activities are taken into account.

The depth of NGO involvement in PVS is indicated by the number of crops to which they have applied the process. The information supplied by LI-BIRD and FORWARD in the questionnaires they returned is summarised in Table 9.2, but subsequent correspondence indicated that the full total numbers of crops covered by LI-BIRD and FORWARD are 44 and 17 respectively.

Table 9.2 Numbers of Crops of Different Types Involved in PVS by NGOs

NGO	Cereals	Vegetables	Legumes	Fodder	Others
FORWARD	3	4	5	-	1
LI-BIRD (extras)[1]	3	15	4	10	9
Total	**6**	**19**	**9**	**10**	**10**

[1] The data in this row are numbers of crops covered by LI-BIRD that are **not** covered by FORWARD.

The 'Institutionalisation Framework' described in Table 8.1 is applied specifically to PVS in Table 9.3. It would have been useful to include in this table the amount of seed of PVS varieties that is produced and distributed annually, since this is another important dimension of PVS; but this information was not available at the time of writing this report.

Table 9.3 Institutionalisation of PVS at the National Level

1a. National (or state) policies and procedures		
Favourable government policies	Informal support for GO-NGO collaboration & participatory approach	
Government recognises PVS in extension-related procedure(s)	DoA implements PVS – has a procedure?	
Government extension services distribute farmer-preferred non-released varieties	No	
1b. National breadth & depth of use		
* geographical coverage by government agencies (number and % of districts)	25 (33%)	
* no. of crops covered by government extension agencies or projects[1]	1 (maize)	
* geographical coverage by principal individual NGOs (number of districts)	1 crop	>1 crop
- FORWARD	2	18
- LI-BIRD	12	30
- CIMMYT (maize)[2]	32	-
* Aggregate geographical coverage by NGOs after eliminating duplicates (number of districts)	20	43
* geographical coverage by NGOs (% of districts)	84%	
* no. of crops covered by NGOs (FORWARD & LI-BIRD)	54	
* Number of NGOs using PVS	6	

[1] This is an underestimate as it does not include CDD's work on oilseed crops or any PVS activities of individual DADOs

[2] This is almost certainly an underestimate since it relates solely to HMRP

9.2 A Cautionary note

The extent of institutionalisation of PVS in Nepal is substantial and impressive. However, although DoA has said that it will formally incorporate PVS into its programmes and operationalise it across the country for a range of crop varieties, it remains to be seen whether these steps materialise and how soon. In addition, production and distribution of seed of farmer-preferred varieties identified through PVS may continue to be a serious constraint, particularly for varieties that have not been approved for release by the VRC. Seed of these varieties will have to be supplied entirely by CBSP groups and informal farmer-to-farmer processes, given that NARC does not produce seed for them.

10. COB/PPB and CROP IMPROVEMENT SYSTEM DYNAMICS

COB/PPB is continuing in Nepal, but only on a limited scale. Three NGOs still have some involvement in COB/PPB – LI-BIRD, FORWARD and IPGRI/BI. Two public sector organisations were involved in COB (covering three crops), but there is currently very little COB/PPB being done in the public sector. One plant breeder in the Agricultural Botany Division is still doing some, but otherwise NARC has stopped (Ortiz-Ferrara, *pers. comm.*). Within NARC PPB has not been sustained in the absence of funding from international donors.

10.1 Influence of COB/PPB Advocates on the Crop Improvement System

CAZS-NR played a significant role in bringing about changes in official variety release procedures. A new seed policy adopted by MOAC in 1999 stated "the function of variety development and promotion done only by public sector until now will also be open to NGOs and private sector" (MoAC, 1999, cited by Joshi *et al*., 2005). CAZS-NR and its partners LI-BIRD and IPGRI (now BI) were represented on a 7-member group set up to review variety release procedures to bring them into line with the new policy. A revised procedure, was formally endorsed by the government in 2005 (MoAC, 2005, cited by Joshi *et al*., 2005). The revised variety release format (developed jointly by representatives of NARC, the National Seed Board, LI-BIRD & CAZS-NR) recognises that data generated in farmers' fields using Mother Baby trails can be used to support the release of new varieties (Joshi, *pers. comm*.).

The procedures allow NGOs, as well as public sector agencies, to apply for the release of a new variety. Fourteen COB varieties have been released, whose development involved public sector agencies in 10 cases and NGOs in 11 and collaboration in most cases (see Table 6.5).

10.2 Lack of Institutionalisation of COB/PPB

The fact that a substantial number of COB/PPB varieties has been officially released in Nepal shows that its varietal release system does recognise the validity of developing varieties through this process. Nevertheless, it is clear that within NARC the COB/PPB process has not been institutionalised. Table 10.1 summarises the factors indicating the extent of institutionalisation of COB/PPB in Nepal.

Table 10.1 Institutionalisation of PPB at National and Organisational Levels

Levels	
1a. National (or state) policies and procedures	
Favourable government policies	?
Government recognises PPB in varietal selection procedure(s)	Yes (but see 8.1 text)
* Number of public sector agencies or divisions currently using PPB	1 (was 6)
* No. of crops covered by public sector COB/PPB	4 (chickpea, rice, wheat, maize)
* Number of NGOs using PPB	3
* No. of crops covered by NGOs in PPB	6 (rice, maize, mungbean, chickpea, rapeseed, tomato)
No. of COB/PPB varieties released (& No. of crops)	14 (5)
2. Organisation (Public sector)	
* supportive structures and procedures	No
* appropriate incentives & organisational culture	No[1]

[1]See point 8 Table 10.2.

The international experience is that "institutionalization of PPB has been slow" (Walker, 2007). Factors identified by key informants as hindering the take up and institutionalisation of COB/PPB are summarised in Table 10.2. 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. In addition, there may have been a lack of interviews with sceptics - no NARC plant breeders were interviewed. Nevertheless, as was mentioned earlier, a negative attitude on the part of plant breeders towards COB/PPB (Factor 2) was identified by several people. Factors 5 and 6 appear to be related to each other and to the fact that COB/PPB tends to require more funds than conventional breeding to cover the costs of on-farm trials.

Table 10.2 Factors Identified as Hindering the Institutionalisation of COB/PPB

Inhibiting Factors	Nepal[1]	Inter-national
Attitudes and perceptions about the science		
1. Lack of acceptance by *senior management* of its scientific credentials vis-à-vis conventional plant breeding		✓
2. 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'	✓	✓
3. Those in public sector implementing conventional approach feel threatened by NGO COB/PPB activities & become defensive		✓
4. Some managers and plant breeders prioritise 'high tech' research and perceive COB/PPB for marginal areas as unattractive		✓
Costs and benefits (perceived and actual)		
5. Perceived to have higher costs than conventional plant breeding in the early stages	✓	
6. Insufficient financial and other resources for fieldwork	✓	✓
7. Scepticism and lack of quantified evidence about likely size of benefits of COB/PPB, in terms of number of users of a variety		✓
Disincentives		
8. Research organisations reward 'paper release' of varieties, & scientific publications, not benefit to farmers		✓

[1]Information in Nepal column is from individual interviews; and information in the last column comes from an international group discussion held in 2009 (see Annex 3 for details).

There appear to be two main factors limiting the use of COB/PPB. The *first* factor is that COB/PPB tends to require more operational resources than conventional breeding in the early stages (Sherchan, *pers. comm*.); and current budgeting norms may be inadequate to cover these costs. In addition, funding is currently 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*.).

The *second* one is, in the words of IPGRI/BI, "Resistance from public sector plant breeders": this was also identified by NARC's Director of Crops and Horticulture (Sherchan, *pers. comm*.) and others. This resistance affects not only NARC itself, but also NGOs that are implementing COB. For example, LI-BIRD noted that it has had "Difficulties in releasing varieties generated from PPB/COB due to the nature of data recorded". This is apparently because, although the revised variety release format recognises that data generated in farmers' fields using Mother/Baby trails can be used to support varietal release, NARC staff often challenge, block or delay the release of varieties proposed by other organisations and this is one of the grounds on which they do so (K Joshi, *pers. comm*.). Some senior NARC staff, as well as currently practising plant breeders, may also have this negative attitude, and it was suggested by NGO staff that this is reinforced by exposure to CGIAR norms and attitudes at international conferences etc.

Table 10.3 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

This resistance from some NARC researchers may reflect a potential conflict between the scientific research paradigm and participatory approaches to technology development, as indicated in Table 10.3. In the former, enhancing scientific knowledge (through rigorously conducted research) is the primary aim, whereas the latter values achieving development impact. As was mentioned in Table 10.2, some managers and plant breeders may prioritise 'high tech' research and hence perceive COB/PPB for marginal areas as unattractive. Biotechnology has become increasingly important in agricultural research and may be perceived as a more attractive area in which to work. Ultimately, whether COB/PPB ever becomes mainstreamed in Nepal's agricultural research system and organisations may depend to a large extent on which narrative, research paradigm and set of values are most influential and dominant within that system.

11. LESSONS AND CONCLUDING OBSERVATIONS

11.1 Attribution of impact

The impacts of PVS and COB/PPB that have been summarised in this report are not all directly due to the work funded by DFID's RNRRS. In the case of ***PVS***, although LI-BIRD and FORWARD 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.

However, there has been very little other funding for **COB/PPB** in 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". Is it possible, therefore, that the CGIAR, and in particular the PRGA's PPB component, has had a positive influence on PPB in Nepal? That possibility can be ruled out, as the CGIAR centres themselves appear not to be implementing PPB. 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. If anything, the CGIAR centres have an inhibitory effect on COB/PPB in Nepal.

11.2 PVS versus COB/PPB

It is evident that PVS has been implemented and institutionalised to a far greater extent than COB/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 of NARC's plant breeders in particular. 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.

11.3 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 Nepal. It is noteworthy that this happened despite the fact that many important actions/initiatives taken 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, and a recognition and acceptance by them and donors that influencing and improving the innovation system within which research projects function is a legitimate and important activity for those projects.

11.4 The contribution of individuals

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. The current status of crop improvement in Nepal has been strongly influenced by various *champions* of PCI processes, including Dr Krishna Joshi and Dr John R Witcombe of Bangor University's CAZS-NR and a number of leading advocates in its local partner organisations - LI-BIRD, FORWARD and IPGRI/BI.

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ANNEX 1 Questionnaire Part A

'RESEARCH INTO USE' SURVEY OF PVS/COB USE IN NEPAL

This questionnaire has been developed to obtain information for a DFID-funded study on the use of Participatory Varietal Selection (PVS) and Client-oriented Breeding (COB)/Participatory Plant Breeding (PPB) in India, Nepal and Bangladesh. The study aims to find out how widely used these processes are and to get a very rough idea of how many farmers have benefited from them. The study is being managed by Czech Conroy who is Reader in Rural Livelihoods at the Natural Resources Institute, University of Greenwich, UK, with the support of Dr Chiranjibi Adhikari who is a consultant agronomist.

Please find the time to complete this questionnaire electronically and email it to us, preferably by 20 August 2008, at the following addresses:
cdadhikari@ntc.net.np and m.a.conroy@gre.ac.uk

If you have electronic versions of any publications describing your organisation's work on PVS and/or COB please also email them.

Definitions

By **PVS** we mean the process of working with farmers to identify which characteristics of a particular crop they regard as most important; and 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.

By **COB/PPB** we mean:

- 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.

1. Basic Information about Your Organisation

Name of organisation:	
Head office location:	
Programme area:	
Name of key contact person:	
Email address:	
Phone number:	

2. Involvement in Participatory Varietal Selection

2.1 When did your organisation first undertake PVS?

2.2 How did you know about PVS?

2.3 Who took the initiative to get involved in PVS and why?

2.4 From whom (if anyone) did you receive guidance on how to conduct PVS?

2.5 Please complete the following table, giving information about: crop(s) for which have you implemented PVS, in what years, numbers of farmers and input/management conditions (e.g. determined by farmers or researchers?). Add more rows if necessary.

Crop	Year(s)	Numbers of farmers	Input & management conditions

2.6 Who finally decides as to which variety is to be selected for seed production and dissemination? (Please place 'X' against the appropriate answer below.)

(a) Researchers ___ (b) farmers ___ (c) farmers and researchers ___

2.7 What are your/your organisation's reasons for being involved in PVS?

2.8 Have you experienced any difficulties in carrying out PVS?

2.9 Please name any important partners you have worked with in implementing PVS:

2.10 Have you influenced any other organisations or projects to take up PVS in their work? Yes ___ No ___

2.11 If 'Yes' please provide details:

2.12 What differences, if any, have you found between PVS and FFT?

3. Involvement in Client Oriented Breeding

3.1 Has your organisation done any COB/PPB? Yes ___ No ___

If you have then please answer the other questions on COB/PPB below. If not, then go to section 4.

3.2 How did you know about COB/PPB?

3.3 From whom (if anyone) did you receive guidance on how to conduct COB/PPB?

3.4 For which crop(s) have you implemented COB, and in what years?

Crop	Year(s)

3.5 Who chooses the parents?

3.6 Typically how many crosses do you do every year in any crop?

3.7 What is the typical population size in segregating generations, e.g. F_2 onwards?

3.8 What are your reasons for being involved in COB/PPB?

3.9 Have you experienced any difficulties in carrying out COB/PPB?

3.10 What differences, if any, have you found between COB/PPB and conventional breeding?

3.11 Please name any important partners you have worked with on COB/PPB:

4. Official release of varieties tested or developed through PVS or COB/PPB

4.1 Has your organisation been involved in any initiative to obtain official release of farmer-preferred varieties that were developed though PVS or COB/Plant Breeding? Yes ___ No ___

4.2 If 'No', why not?

4.3 If 'Yes' please provide details in the following table.

Crop	Variety	State(s) in which release is/was sought	Status/Outcome* (R/NR/UC)

* R = released. NR = not released. UC = under consideration. If a variety has been officially released, please give the year in which this happened.

5. Seed Supply

5.1 Has your organisation been involved in seed production of PVS and/or COB/PPB varieties? Yes ___ No ___

If you have then please answer the other questions on seed production below.

5.2 Have you:

(b) Supported see production by farmer or self-help groups? Yes ___ No ___

(c) Contracted farmers to produce PVS or COB seed for sale? Yes ___ No ___

(d) Acted as an intermediary for seed production and marketing, linking local seed producers to organisations or projects wanting to buy seed? Yes ___ No ___

6. Further information

If there is any other information that you would like to add about your organisation's involvement in PVS and/or COB please do so here.

Please indicate here whether you are attaching or will send an electronic file containing further information Yes ___ No ___

ANNEX 2 Questionnaire Part B

PART B INFORMATION ABOUT SPECIFIC CROPS

1. BACKGROUND INFORMATION

Name of organisation _____

Name of crop _____

Main growing season (Insert 'X'): Main season _____ Rabi _____ spring _____

Production system (Insert 'X'): Rainfed _____ Irrigated _____

Land type (Insert 'X'): Upland _____ Medium _____ Lowland _____

Where was the crop selection/breeding work carried out?
_____

Significance of crop in local farming system (e.g. main rabi crop):
_____

Main uses of crop locally: Place 'X' in appropriate rows of table below.

Home consumption	
Source of cash	
Residues/other parts used as fodder	
Green manure	
Other (specify)	

Nature of varieties grown before PVS (baseline situation):
Place 'X' in appropriate row of table below.

Only local landraces	
Nearly all (90% +) local landraces	
Some landraces, some improved cultivars	

2. PVS PROCESS

Socio-economic status of majority of farmers involved in PVS experimentation process: (a) Small/marginal farmer Yes ___ No ___ (Insert 'X')
(b) Dalit/disadvantaged farmer Yes ___ No ___ (Insert 'X')
(c) Any additional information on socio-economic status?

Please complete the following table about the cultivars used.

Cultivars tested	**Source ♦ (F/NARC/NGOs/O)**	**Status of cultivars *at time of PVS* (NR,PVStest,Re)***	**Selected? (Y=yes)**

♦ (F = farmer. NARC = Nepal Agriculture Research Council, O = other
* NR = not released. PVS test = tested in PVS trials.
Re = released

Numbers of farmers directly involved in PVS experimentation process: _____

Please fill in table on advantages of variety/ies selected over main baseline one(s).
If more than one variety has been selected, and they have different characteristics, please copy the table below and fill it in separately for each variety.

Benefits of new variety (give name)	**Insert ** Y or N or 0**	**Old variety/ies**	**New variety**	**Information about benefits**	
				Source ♦ (Insert Q,G,I, or A)	**Source document available?**
Higher yield (per Bigha)*					
Higher yield in drought years (kg)*					
Better price (Rs/Kg)*					
Better quality of crop					
Increased crop self sufficiency (months/year)*					
Better quality fodder or more fodder*					
Earlier maturity/harvest					
More food in hunger gap/shorter gap					
Greater resistance to pests/diseases					
Other (please name)					

* Where it exists please provide quantified information about these benefits in the columns headed 'Old variety/ies' and 'New variety'.
** Y = yes, new variety is better. N = no, new variety is worse. 0 = no difference between new and old
♦ Indicate what kind of evidence exists about the benefits, using the following 4 categories:

- **Q**uantified data from experiments/trials
- **G**roup discussions with farmers

- **I**ndividual structured (using questionnaire or list of topics) interviews with farmers
- **A**necdotal

What is the average planted area (in acres) of this crop among farmers with whom you have been doing PVS? _____

What is the average planted area (in Bigha) of this improved variety among farmers with whom you have been doing PVS? _____

3. DISSEMINATION OF FARMER-PREFERRED PVS/COB VARIETIES

Numbers of farmers receiving seed of selected varieties/y after experimentation phase:

from your organisation _____
from other organisation(s) _____

Any evidence of spontaneous spread of seed from farmer to farmer? Yes ___ No ___
If 'Yes', please provide further information here:

ANNEX 3 Key Informants on Institutionalisation

Date	Meetings with key informants
28/1, PM	• Group discussion involving: 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), Dr JP Yadavendra (GVT India)
30/1, AM	• Dr Dil Prasad Sherchan, Director Crops and Horticulture, NARC • Dr Krishna Pant, Senior Programme Officer, National Agricultural Research and Development Fund (NARDF)
30/1, PM	• Dr S B Nepali, Director, Crop Development Directorate, Department of Agriculture (+ Nitmal Gadal, agronomist; & Narain Gaire, seed laboratory, western region) • Dr Thakur Tiwari, Agronomist, Hill Maize Research Project, CIMMYT-South Asia • Dr G. Ortiz-Ferrara, Country Representative and NMRP Leader, CIMMYT-South Asia