INSTITUTIONAL INNOVATIONS IN INDIA'S CROP IMPROVEMENT SYSTEM:

Rainfed Agriculture Impact Assessment Study No. 5

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CONTENTS

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Abbreviations

AAU	Anand Agricultural University (Gujarat)
AICRP	All India Coordinated Research Project
AKIS	Agricultural Knowledge and Information Systems
ASA	Action for Social Advancement
ATMA	Agricultural Technology Management Agency
AVT	Advanced varietal trials
BAU	Birsa Agricultural University
CAZS NR	CAZS-Natural Resources
CBO	Community-based organisation
CIG	Common Interest Group
CIMMYT	International Maize and Wheat Improvement Center
COB	Client-oriented breeding
CRI	Central research institutes
CSC	Central Sub-Committee ***or*** Central Seed Committee
CVRC	Central Variety Release Committee
DARE	Department of Agricultural Research and Education
DASP	Diversified Agricultural Support Project
DPIP	District Poverty Initiatives Project
DPIC	District Project Implementation Committee
DFID	Department for International Development
EIRFP	Eastern India Rainfed Farming Projects
FPC	Farmer Producer Company
GAU	Gujarat Agricultural University
GOI	Government of India
GVT	Gramin Vikas Trust
ICAR	Indian Council for Agricultural Research
IA	Impact Assessment
IARI	Indian Agricultural Research Institute
IPR	Intellectual property rights
IRRI	International Rice Research Institute
JNKVV	Jawaharlal Nehru Krishi Vishwa Vidyalaya (Madhya Pradesh)
KVK	Krishi Vigyan Kendra
MP	Madhya Pradesh
MPUAT	Maharana Pratap University of Agriculture & Technology (Rajasthan)
MPRLP	Madhya Pradesh Rural Livelihoods Project
MV	Modern variety
NARI	National agricultural research institute
NATP	National Agricultural Technology Project
NCAP	National Centre for Agricultural Economics and Policy Research
NRC	National Research Centre
NSC	National Seed Corporation Limited
NSSO	National Sample Survey Organization
NGO	Non-governmental organisation
PEW	Para-extension worker
PPB	Participatory plant breeding
PSP	Plant Sciences Programme
PTD	Participatory technology development
PVS	Participatory varietal selection
PVSP	Participatory varietal selection and promotion
RIUP	Research into Use Programme
SAU	State Agricultural University

SDAU	Sardar Krishinagar Dantiwada Agricultural University (Gujarat)
SHG	Self-help groups
SFCI	State Farms Corporation of India
SSCA	State Seed Certification Agency
SSSC	State Seed Sub-Committee
SVRC	State Variety Release Committee
TDC	Tarai Development Corporation
T&V	Training and visit
VCU	value for cultivation and use
WIRFP	Western India Rainfed Farming Project

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 India, methodological innovations to crop improvement processes that were partly developed and implemented through projects funded by DFID's Plant Sciences Research Programme. The projects were managed by Bangor University's CAZS-Natural Resources (NR); and the Indian partners were two NGOs – GVT and ASA – and four state agricultural universities (SAUs) in Gujarat, Jharkhand, Madhya Pradesh and Rajasthan.

Use of PVS

The study found that between them ASA, GVT and the Madhya Pradesh Rural Livelihoods Project had applied PVS to 14 crops, of which 9 were legumes and the rest staples and coriander; while the SAUs have applied PVS to 5 crops. PVS has been practised in at least 11 of Madhya Pradesh's 50 districts, where three state government projects are using it to benefit farmers. It is also being used in state government projects in Bihar and a UNDP project in Jharkhand.

The yield advantages of crop varieties introduced through PVS over those being used by farmers are typically 15-40%. The numbers of farmers who have been involved in PVS trials are nearly 120,000 for staples and coriander and another 120,000 for legumes. It is likely that more farmers than this have benefitted from farmer-preferred PVS varieties: seed of these varieties has been distributed by NGOs and projects and there will also have been farmer-to-farmer spread.

Use of COB/PPB

COB/PPB has been practised by GVT and five SAUs. The SAUs have applied the process to five crops maize, upland rice, black gram, horsegram and chickpea, while GVT (largely in collaboration with SAUs) has applied it to seven crops altogether. Eight varieties developed through COB/PPB, belonging to five crops, have been officially released in one or more states or are being considered for release..

Acceptance and institutionalisation of PVS

PVS has been widely implemented and significantly institutionalised in the state of Madhya Pradesh. It has been implemented by two projects of the state government, MPRLP and DPIP, as well as by ASA and GVT. The involvement of government projects has been associated with official recognition of PVS as an appropriate research and extension activity by the state government. Similar recognition has also been given by the state government in Bihar, where PVS is being used in another state government project. PVS is also being used to some extent in Gujarat and Jharkhand.

Acceptance and institutionalisation of COB/PPB

All PPB varieties released have been at the state level – through the state varietal release committees - rather than at the national level: some have been released in more than one state. This is a reflection of the absence of acceptance of PPB at the central/national level. No COB/PPB is currently being done within public sector research organisations in India; not even in the SAUs where PPB was done with

DFID funding. ICAR recognises the merits of farmer participation in the technology development process for other technologies, but not in the case of plant breeding. The SAUs have not attempted to continue PPB in the absence of donor funding, and the plant breeders who were involved think that PPB cannot be implemented solely through their regular funding due, they say, to its higher costs.

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 narratives, 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 the use of Participatory Varietal Selection (PVS) and Client-oriented Breeding (COB)/Participatory Plant Breeding (PPB) in India. They are institutional innovations in the ways that crop improvement is undertaken by government agencies and NGOs.

These institutional innovations in India's crop improvement system were partly developed through projects funded by DFID's Plant Sciences Research Programme during the 1990s and early 2000s that were managed by Bangor University's CAZS-Natural Resources (NR)[1]. The study is part of a wider set of studies[2] that also covers Nepal 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 processes are, to identify all organisations in India 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 processes, particularly by NARIs/SAUs; and any changes that may have been required to the innovation system as a pre-requisite to adoption.

1.2 The Innovations

In the context of the present study, an institutional innovation is defined as a change in the institutions (rules of the game) through which a new technology is developed and becomes adopted by end-users (the farmers).

PVS refers to 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.

The term **COB/PPB** describes the process of:

- 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

[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 Nepal; and studies of technological innovations, particularly rice varieties tested and/or developed through PVS/COB and improved practices in rainfed rabi cropping .

- 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). (More strictly, it needs to be called *highly* client-oriented breeding as many plant breeders would argue that since all breeding programmes have some degree of client orientation: it is the extent that varies.) However, the term PPB is still the more widely used and recognised one, so both terms are used in this report.

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 have weaknesses they are crossed with varieties that have 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).

Methodological 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 they also influence 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 India's crop improvement system, and the extent to which they have been institutionalised and have changed relevant institutions (formal and informal) of the crop improvement system.

1.3 Methodology Used

Both primary and secondary data were collected for the purpose of the study. The methodology included the following four components:

- A review of some secondary literature on agricultural research and innovation in India , particularly the crop improvement system;
- A questionnaire-based survey of the main organisations that have been involved in PVS and/or COB (reproduced as Annex A);
- A review of secondary literature on the use of PVS and/or COB in this country and
- Interviews with key informants in NGOs and public sector organisations.

2. INDIA'S CROP IMPROVEMENT SYSTEM

2.1 Background

India is a very large country with a wide range of agro-ecological zones, ranging from the flat arid desert region of western Rajasthan to the high rainfall and hilly regions of states like Kerala in the south and Assam in the north-east. Nevertheless, quite a large proportion of the country can be described as dryland (arid or semi-arid) and dry sub-humid, with the former accounting for about 33 percent of the net sown area and the latter 35 percent (Paul, 1995). The Green Revolution that took place from the late 1960s onwards enabled India to achieve food self-sufficiency and security at the national level during the 1990s, harnessing new high-yielding varieties of cereal crops that were responsive to generous inputs of fertilisers and water, the latter coming largely from irrigation systems.

Annual growth in the agricultural sector continued to be quite high between 1980-81 and 1995-96, at 3.2 percent, but declined to under 2 percent subsequently and was 1.8 percent in 2006 (Mondal and Pastakia, 2007). Major regional imbalances developed, with some regions gaining far less from agricultural research and development efforts; and a large proportion of rural households have continued to experience food insecurity. A high percentage (40 percent of the total population – Paul, 1995) of rural households, including most of the poorer ones, tends to be primarily dependent on rainfed agriculture. Their limited access to irrigation meant that hey did not benefit significantly from the green revolution technologies.

There are various constraints which limit the productivity and profitability of the land holdings. These include:

- the small landholdings of most farmers
- lack of adequate region specific technologies
- poor seed replacement and poor quality of available seed, which are more than 15-20 years old
- prevalence of fake seeds and other agricultural inputs
- poor farmer access to knowledge and problem solving services and
- lack of market support services and institutional credit for agriculture.

2.1.1 Agricultural Research in India – A brief history

In India, efforts have been made towards establishing and consolidating agricultural research started in the last part of the 19th century. During this period, the Departments of Revenue, Agriculture and Commerce were established in the imperial and provincial councils of the British regime. Around 1905, the Imperial Agricultural Research Institute (IARI) was formed, which was renamed as Indian Agricultural Research Institute after India's independence. The Indian Council of Agricultural Research (ICAR) was formed in 1929 and was initially called Imperial Council of Agricultural Research. It was a semi-autonomous body which was established to promote, guide and coordinate agricultural research all over the country. Between 1921 and 1958, several central commodity committees were formed to develop commercial crops i.e., cotton, lac, jute, sugarcane, coconut, tobacco, oilseeds, areca nut, spices and cashews. In the initial days, these committees served the interests of the imperial government by providing revenue and ensuring raw materials for the industry.

One of the important organisational innovations in the Indian agricultural research was the formation of All India Coordinated Research Projects (AICRPs) in 1957. ICAR initiated AICRPs to promote multi-disciplinary and multi-institutional research. In 1965, ICAR was mandated to coordinate, direct, and promote agricultural research in India by overseeing all the research stations previously controlled by the commodity committees and government departments. Subsequently, the Department of Agricultural Research and Education (DARE) was created in the Ministry of Agriculture to facilitate linkages between ICAR and the central and state governments and with foreign research organisations.

The year 1960 was a landmark in the history of Indian agriculture which saw the establishment of the country's first State Agricultural University (SAU), at Pantnagar. This university and others formed later were based on the land grant pattern of the United States. The SAUs are semi-autonomous organisations co-funded by ICAR and the governments of the respective states which have a mandate to integrate education with research and frontline extension.

Various international agencies have played a critical role in funding agricultural research in India. Prominent among these are:

1. the Rockefeller Foundation, which supported the AICRPs
2. US Agency for International Development, which played a critical role in the formation of the SAUs
3. the World Bank, which has provided considerable support to agricultural research by way of funds for
    a. Research infrastructure and human resources in the initial days
    b. of late, funding for strategic research areas, priority research themes and institutional reforms.

2.1.2 DFID-Funded Research on Crop Improvement

Table 2.1 Summary of Plant Science Research Programme Projects in India

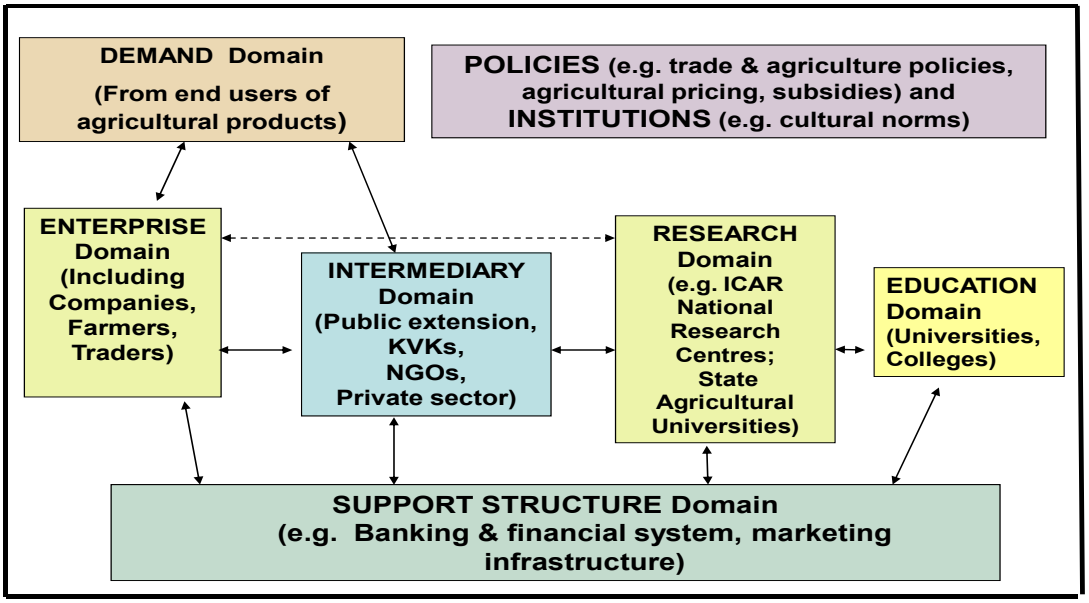
DFID ref. no.	Project title	Duration	Indian Partner(s)	Cost* (£'000)
R6748	PCI in high potential production systems in India & Nepal	1997-1999	GVT(W)	119
R7542	PCI in high potential production systems – piloting sustainable adoption of new technologies	2000-2003	ASA	178
R7122	PPB in high potential production systems	1998-2000	GVT(E)	44
R8099	PPB in rice and maize in eastern India	?	GVT(E), BAU	

* Most of these projects were implemented in both Nepal and India: the costs are those for both countries.

2.2 India's Agricultural Innovation System

Figure 2.1 describes the principal components or domains of India's national agricultural innovation system - particularly the 'Research', 'Intermediary' and 'Policy' domains.

Figure 2.1 India's 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 At least until the 1990s, agricultural research was the primary source of total factor productivity growth in India (Evenson and Rosegrant, 1993), which is famous for its 'Green Revolution'. The Indian Council for Agricultural Research (ICAR) is the major and overarching body for agricultural research in India. The Union Minister of Agriculture is the President of the ICAR. Its principal officer is the Director-General, who is also the Secretary to the Government of India in DARE. The General Body, the supreme authority of the ICAR, is headed by the Minister of Agriculture, Government of India. Its members include the Minister of Agriculture, Animal Husbandry and Fisheries and senior officers of the various state governments, representatives of the parliament, the agro-industries, scientific organisations and farmers.

The Governing Body is the chief executive and decision making authority of the ICAR. It is headed by the Director-General. The Director-General is assisted by eight Deputy Directors-General – including ones in charge of Crop Sciences, Natural Resource Management and Agricultural Extension. In administration, the Director General (DG) is assisted by the Secretary, ICAR, who is also the Additional Secretary to the DARE, Government of India.

The vast network of ICAR - which includes Central Research Institutes (CRIs), National Research Centres (NRCs) and Project Directorates - has about 30,000 personnel of whom nearly 7000 are engaged in active research and its management. The CRIs were established to meet agricultural research and education needs of the country in terms of pursuit of basic and strategic research in the concerned disciplines in a focussed area. They have a mandate for working on single or selected group of crops, animals or commodities; and include 24 crop science and 22 horticulture institutes. The 18 NRCs concentrate on selected topics with relevance to

resolving national problems in a particular animal, crop or commodity; and include ones on Weed Science and Integrated Crop Management.

Thirty eight State Agricultural Universities (SAUs) employ about 26,000 scientists (for teaching, research and extension education), of whom over 6000 scientists are employed in the ICAR supported coordinated projects. (Source: ICAR website).

Civil society The capacity of NGOs is small relative to India's 600,000 or so rural villages, as is reflected in the statistics quoted later on the percentage (0.6) of farming households that had accessed agricultural information from 'NGO/para-technician' or 'private agency'. Nevertheless, in some districts or blocks there are strong NGOs that are active in both the 'research' domain and the 'intermediary' domain, such as GVT and ASA.

2.2.2 Intermediary domain

Public sector In the past public sector extension services played an important role in promoting Green Revolution technologies. The Training and Visit (T&V) system, which ended in the early 1990s, proved effective in the areas of India affected by the Green Revolution; but it was less effective in the rainfed areas. In India's federal system, the states have the major responsibility for agriculture, including agricultural extension services. In addition to the state-funded extension services, ICAR supports Krishi Vigyan Kendras (Farmer Information and Advisory Centres) to act as intermediaries between ICAR research institutes and SAUs, on the one hand, and farmers. During the last few years the number of KVKs has expanded quite markedly, and the aim is to have one in each district of the country.

Civil society India has a vast number of NGOs working on rural development**,** of which a minority have specialist expertise and programmes in agricultural development. These include Gramin Vikas Trust (GVT) and Action for Social Advancement (ASA), both of which were involved in DFID PSP-funded research.
The weaknesses of public extension systems (see below) have prompted institutional innovations, including private sector initiatives and the promotion of 'para-extension workers' (PEWs). The latter has been supported by various NGOs (e.g. GVT and AKRSP), including the DFID-supported Western and Eastern India Rainfed Farming Projects. In principle, PEWs could and should strengthen the link between public extension services and local communities. There are uncertainties, however, about the financial sustainability of this model. The rainfed farming projects in India were both partners in RNRRS funded research on PVS and COB, and their pro-poor goals and their use of PEWs played a facilitative role in the implementation of demand-led and participatory research processes and the distribution of improved pro-poor varieties of maize, rice and other crops.

Various kinds of CBOs have been formed by NGOs and government development agencies, usually as part of a programme – e.g. on watershed development or joint forest management. Some agencies have facilitated the formation of farmer groups to strengthen the capacity of farmers to interact with private and public sector service providers. Perhaps the most common kind of CBO nowadays is the self-help groups (SHGs), most of which have an exclusively female membership and for which the main emphasis has been on provision of micro-finance services.

Private sector The commercial seed sector was quite weak, at least until recently. In the private sector there are about 500 seed companies with intra-state and inter-state

marketing among which more than 35 companies have collaboration with multinational companies.

2.2.3 Demand domain

This domain includes all end users of agricultural products. Farmers are often consumers in two ways: either as consumers of the food they produce, or as users of the seed (and other inputs) for the crops that they plant. They may acquire products from the enterprise (food) or intermediary domains (agricultural inputs).

2.2.4 Policy domain

India's 10th Five-Year Plan (2002–2007) emphasizes the need for "revamping and modernizing the extension systems and encouraging the private sector to take up extension services" (Government of India 2002, 528). The national Policy Framework for Agricultural Extension was developed in 2000 to serve as the basis for the central government's support to the states. (Birner and Anderson, 2007). In addition, each state has its own policies on agricultural extension and service provision.

2.3 Weaknesses in India's Agricultural Research and Extension System

2.3.1 Research

Agricultural research has given priority to high input, irrigated agriculture, with a view to maximising crop yields and total national production of crops and national food security. Rainfed agriculture has benefitted less than irrigated agriculture from research. In the rice sector, for example, of the modern varieties released during the period 1965-2000, the proportions developed for irrigated and rainfed conditions were 54 and 46% respectively; and within the latter only 19% were intended for rainfed uplands and the remaining 27% for rainfed lowlands (Janaiah *et al.,* 2006). Furthermore, there is no guarantee that even the minority of technologies intended for use in rainfed agriculture will actually be widely taken up by farmers.

The technologies developed by public sector research for rainfed agriculture "are based on the norms of irrigated agriculture" (Raina, 2006). Farmers operating under rainfed conditions "have gained little from the successes of the 'Green Revolution'" (Raina, 2009).

Some observers have identified resistance to institutional change within the public sector R&D system as a major problem (Sulaiman, 2009). Even the Government of India itself appears to be highly sceptical about the scope for institutional reform:

> It is necessary to take a comprehensive view of the functioning of the agricultural research system and make systemic changes in the course of the Eleventh Plan. Thus far, research has tended to focus mostly on increasing the yield potential by more intensive use of water and biochemical inputs. Far too little attention has been given to the long term environmental impact or on methods and practices for the efficient use of these inputs for sustainable agriculture. These features are widely known but efforts to correct them have not been adequate; at any rate they have not made much of a difference (Government of India, 2008, Vol. 3, pg. 13).

2.3.2 Extension

Since the T&V system ended there has been little donor support for extension, and reliance almost solely on state government funding. There is a general perception that, after T&V was phased out (in the 1990s), the extension system deteriorated (Birner and Anderson, 2007; Sulaiman, 2009); and the extension system of the 1990s has been described as "weak, ineffective and inefficient" (Raabe, 2008). Extension services are characterised by biases that result in them tending to neglect poor farmers, particularly women. There has been a wide range of chronic problems in the public provision of extension services to the poor, particularly in marginal and remote areas.

Different authors highlight different sets of factors. Birner and Anderson (2007) point to: high staff vacancy rates, low social status, low rank in the administrative system, lack of operational funds for effective fieldwork and high turnover. Sulaiman and Holt (2004) highlight structural problems, and the consequent inefficiencies in the delivery of research and extension services, which they argue resulted from the operation of: (1) a hierarchical, classical top-down, one-way communication system; and (2) a one-size-fits-all research and extension approach that centred on the institutional, agro-climatic, and socio-economic conditions of irrigated areas but bypassed those of rainfed areas. An NCAP report that focused on rainfed agriculture identified the "top priority problem facing the organisation of research" as being to "Enhance the willingness of research staff to identify and respond to clients' needs": this also "poses some of the most intractable challenges" (Farrington *et al*., 1998).

According to a more recent NCAP report (Pal and Byerlee, 2003), the weaknesses of the current system can be attributed to the following factors:

> (a) adaptive research and technology transfer is considered to be a less challenging task, and therefore, not many scientists are attracted to it; (b) scientists working for technology assessment and transfer are at a disadvantage since the number of publications dominates performance evaluation criteria; (c) most scientists lack skills to assess farmers' research needs and design appropriate technologies; and (d) scientists lack operating expenses for on-farm research. In addition, supply-driven extension approaches focused on the public sector in India are long overdue for drastic overhaul. Improved accountability to clients through incentive systems in the research system and piloting of more pluralistic and demand-driven extension systems are now being given higher priority as a way to speed technology transfer".

Table 2.2 Characteristics of ICAR and SAU Staff

Particulars	ICAR	SAUs
Average age (years)	43.8	45.7
Women 2001-02 (%)	11.9	11.3
Women 1975-76 (%)	5.3	4.9
Social scientists 2001-02 (%)	7.6	11.7

Source: Jha and Kumar, 2006

Certain characteristics in the staffing of Indian research organisations militate against pro-poor (especially pro women) research and innovation. These include only small percentages of staff who are women and social scientists, ageing staff and shrinking numbers (see Table 2.2). It can be seen that the proportion of women scientists has more than doubled over 25 years in both ICAR institutes and SAUs. The proportion of social scientists also increased in both, but only by 2.0 and 2.1% respectively.

The limited capacity of extension services to reach the poor is reflected in the data given below on farmers' sources of information. The 59th round of the Situation Assessment Survey of Farmers carried out by the National Sample Survey Organization (NSSO) in 2003 provides important information. Farmers were asked to identify which, if any, sources they had accessed during the previous 12 months to obtain information on modern agricultural technology. Nearly 60 percent of the farmers had not accessed any sources. When farmers did use sources, the input dealer was the second-most-used source, after other progressive farmers. Output buyers, food processors, and credit agencies also fall in this category, if the respective companies are private sector entities. The government extension worker ranked sixth, followed by the primary cooperative society. Less than 1 percent of Indian farmers accessed NGOs, private sector extension agencies, or para-technicians (Birner and Anderson 2007).

"Based on NSSO (59th round), only one-fourth of the farming households were observed to have access to at least any single source of information. Farmers' access to information was negligible for most of the sources.. e.g. KVK (0.15%), newspaper (2.07%), radio (4.09%) and TV (4.43%)…. In irrigated region, the access to extension worker was the lowest (1.64%), but it was partially substituted by access to input dealers (13.29%). In the case of hill and mountain region, the farmers greatly depend on mass media channels viz., TV (14.5%) and radio (21.49%)" (NCAP e-news, April-June 2007). Micro-level studies of farmers' Agricultural Knowledge and Information Systems (AKIS) have produced similar findings (e.g. Conroy *et al*., 2005).

Reforms to the system Major changes in the provision and financing of agricultural extension services materialized in the late 1990s (Raabe, 2008). Two of the most prominent research and extension reform initiatives in recent years were the World Bank funded 1998–2004 Diversified Agricultural Support Project (DASP) and the 1999–2005 National Agricultural Technology Project (NATP). The DASP initiative aimed (1) to increase agricultural productivity, (2) to promote private-sector development, (3) to improve rural infrastructure, and (4) to increase the income of farmers by supporting intensified and diversified agricultural production and farming systems. Principal objectives of the NATP initiative were: (1) to improve the efficiency of the organization and management systems of ICAR, (2) to strengthen the effectiveness of research programs and the capacity of scientists to respond to the technological needs of farmers, and (3) to increase the effectiveness and financial sustainability of the technology dissemination system with greater accountability to and participation by farming communities (ibid).

Under the DASP reform initiative, administrative decentralization included the transfer of managerial and technical decision making authority from the central to the district level. To this end, DASP operated two implementation mechanisms: the District Project Implementation Committee (DPIC) and the Agricultural Technology Management Agency (ATMA). Both mechanisms were designed to strengthen the co-ordination of the activities of different agencies and to improve the research–extension– farmer linkages (ibid).

2.3.3 Weak linkages of public sector in the innovation system

Linkages between farmers and public sector agencies are poor and farmer participation in the technology development processes of these agencies is very limited (Sulaiman, 2009). CSOs and the private sector have not been able to develop productive relationships with the public sector. Furthermore, within the public sector

there is collaboration between research and extension agencies is weak; and when recommended technologies are not used by farmers "research blames extension for poor results in the field, extension blames research for developing irrelevant technologies, and both research and extension blame policies for not creating the right conditions for technology uptake" (ibid). These weak linkages "constrain knowledge flows, and thereby, innovation" (ibid).

The CSOs have been relatively successful in providing broad-based support to farmers and promoting pro-poor innovation, although their geographical reach is quite limited. However, the public sector, which still dominates research and extension, "does not seem to be either learning from these experiences or responding effectively to these new challenges" (Sulaiman, 2009). "Any further delay in addressing institutional bottlenecks would further marginalize public sector research and extension. This will have serious implications for India's ability to tackle agriculture and rural development challenges and its strategy for an inclusive growth".

2.4 Plant Breeding and Varietal Testing System[3]

Public sector research organizations are responsible for varietal development and taking new varieties to the farmers via the extension agencies.

2.4.1 A brief history

Systemic efforts to build capacities in seed production and supply can be traced back to the pre-independence period. The Famine Enquiry Commission of 1945 had emphasized the need for multiplication and distribution of quality seed to the farmers. During the 1950s, the Department of Agriculture started seed farms in National Extension Service Blocks to multiply foundation seed of improved varieties particularly of food grains.

Regulation began to develop at about the same time as the first improved cultivars emerged from CIMMYT and IRRI. The GOI declared seeds as an essential commodity under the Essential Commodities Act, 1955; and in 1963 it established the National Seed Corporation Limited (NSC). This agency started with the production of foundation seed and hybrid seed of maize, sorghum, pearl millet and vegetables. It also took care of seed certification in the country. The first hybrid in the country, in the form of maize was released in 1961. The Tarai Development Corporation (TDC) and State Farms Corporation of India (SFCI) were started in 1969 with the objective of growing seeds on these farms. In 1967, the Government of India constituted a Seed Review Team to examine the issues related to seed production and marketing. The recommendations of this group were incorporated by the National Commission on Agriculture in 1976. It was during the Green Revolution that the Indian seed sector received major changes in the form of high yielding varieties and hybrids.

The introduction of the New Policy on Seed Development in 1988 changed the nature of actors who were involved in the seed sector in India. The new policy was aimed at enabling medium and large seed companies with foreign/technical collaboration to play an increasing role in development and marketing of high quality

[3] This section and the following one (2.5) draw heavily on the book *Seeds of Choice: Making the most of new varieties for small farmers* (Witcombe *et al*, eds, 1998).

seed varieties thereby boosting agricultural production. Many national and multinational seed companies entered seed production and marketing business post 1988. The Government of India had constituted a Seed Policy Review Group in 1995 to examine the changes in seed policy in the changing context. The group recommended the following:

- Compulsory registration of varieties
- Amalgamation of Seeds (Control) order with the provisions of Seed Act
- Self-certification by seed producing agencies
- Notification of seed testing laboratories and accreditation of private seed testing laboratories
- Establishment of National Seed Board in place of Central Seed Committee and Central Seed Certification Board
- Increase in penalties for offences
- Review of certification standards.

The growth of formal seed sector can be understood from the fact that the area under certified seed production increased from less than 500 hectares in 1962-63 to over 5 lakh hectares in 1999-2000. Table 2.3 gives details about the growth of the seed industry in India.

Table 2.3 Growth of seed distribution in India

Year	Quantity (in lakh* quintals)
1953-54	1.83
1970-71	5.16
1981-82	29.80
1990-91	57.10
1999-2000	100.00

Source: Seed Industry in Andhra Pradesh – a profile', Seedsmen Association of AP, 2002
* 1 lakh = 100,000

Practices and guidelines for plant breeding are strongly inter-related with regulations and procedures governing release. On-farm trials are not mandatory in the centralised/national system.

Table 2.4 Organisations involved in the Indian seed industry

Organisation	Activity
SAUs, ICAR institutes, international institutes, private companies	Plant breeding
SAUs, ICAR	Identification for release
Central Seed Sub-Committee & State Seed Sub-Committees	Release and notification
State Department of Agriculture, SAUs, NGOs, private companies	Popularisation
NSC, State Seed Corporations, SAUs, SFCI, private companies, farmers' organisations, NGOs	Seed production
State Seed Certification Agencies	Seed certification
NSC, SFCI, State Seed Corporations, SAUs, cooperatives, private companies, seed traders, farmers' associations	Distribution

Source: Seeds of Choice

2.4.2 All India Coordinated Crop Improvement Projects

Multi-locational trials in the All India Coordinated Crop Improvement Projects (AICCIPs) are used to test the new products from breeding programmes in the

country. They are used to establish which entries, if any, are superior to existing ones, and to measure the stability of performance across sites and years. The data are also used to establish the area of adaptation in which the cultivar will be recommended for cultivation.

The AICCIPs of the ICAR function as national bodies for developing crop cultivars and production and protection technologies that will benefit farmers. AICCIPs exist for all the major crops or groups of crops; and AICCIP trials follow a uniform testing procedure, which acts as a well-organised and powerful sieve to screen and recommend new varieties. The constitution of varietal trials and their conduct varies, with a 2-tier system used for some crops and a 3-tier one for others. In the 2-tier system, entries in the second and third years are tested in the same advanced varietal trials (AVTs), whereas in a 3-tier system they are tested in separate advanced trials (AVT I and AVT II).

"The AICCIPs are rooted in the GOI philosophy that superior technologies must be produced by the public sector and transferred to farmers for them to adopt as part of a recommended package or practices. Accordingly the trials must be conducted using this package" (Witcombe *et al*., (eds), 1998). However, the assumption that farmers should be able to use a package of practices is often incorrect, since this does not take account of limitations on farmers' resources and their aversion to risk. The package has been developed to maximise yield rather than maximise profit and minimise risk. Trials are conducted under high input conditions that do not represent the conditions in farmers' fields.

2.5 Varietal Release and Popularisation System

The official varietal release system came into existence in 1964 with: (a) the formation of the Central Variety Release Committee (CVRC) in ICAR at the national level; and (b) the State Variety Release Committees (SVRCs) at the state level. Responsibilities set out in the regulatory framework are executed through two parallel systems, which to some extent overlap, and should be complementary: the central systems and the system for states. Both are empowered to release varieties, but only the central system can notify varieties. The minutes of the CVRC report on released varieties and, from time to time, a list of released cultivars is published.

2.5.1 The central identification and release system

Once a variety has followed the established testing procedure for its value for cultivation and use (VCU), it can be proposed for identification and release. At the end of AVT II stage, the proposal for identification of a variety is submitted by the concerned breeder on a variety identification proforma specified by ICAR, which is used for both central and state releases. Each proposal is considered by the Variety Identification committee, which meets during each AICCIP workshop. Recommendations are made either for country-wide release or for a specific zone or states. Conditions for cultivating the variety are also specified, e.g. regarding time of sowing, or irrigated v. rainfed cultivation. The sponsoring research institute or agricultural university then submits the proposal for its release and notification to the Central Sub-Committee (CSC), with the support of the Project Director/Coordinator. If the CSC accepts the proposal, the variety/hybrid is released for the concerned states (often country-wide); and is simultaneously notified for certified seed production purposes, usually for the whole country. However, a state for which it is released usually requires the variety to be tested in Adaptive Trials within the state before it

can be formally recommended. The release proposal proforma requires the breeder to ensure availability of enough seed stock for seed multiplication on at least 10 ha.

The seed is made available for minikit trials to help popularise the variety and evaluate the response of farmers. Minikit trials are organised by the Directorate of Crop Development, Ministry of Agriculture and Cooperation, and are conducted by the State Departments of Agriculture. Minikit demonstrations and trials are conducted with both released and pre-release varieties at the AVT II trials stage. In the latter case this cuts overall testing time and can provide valuable information on how the variety performs on farmers' fields prior to its identification by the Variety Identification Committee.

A similar procedure applies to varieties produced by the private sector if they are intended to be officially released. However, it is not mandatory that a variety developed by the private sector be released centrally or by state committees, and private sector participation in the AICCIP trials is optional.

2.5.2 The state varietal identification and release system

The conventional way of developing a variety comprises of the following steps:

- Application with a formal variety release committee and variety registration, including a variety description
- Testing for the Value of Cultivation and Use (VCU) of the variety, involving a prescribed number of sites and seasons
- Testing for distinctiveness, Uniformity and Stability (DUS)
- Analysis of lab results by the committee, leading to the approval or rejection for formal release.

A state research organisation or a private seed company can apply to release a variety through the central or the state system; and their choice is likely to be influenced by indications as to how widely adapted the variety is. Although the state system is subject to national legislation and regulations there is considerable variation in implementation and practice between states: for example, in relation to the degree of farmer involvement in varietal testing.

Identification and testing of new varieties is usually mainly the responsibility of one or two agricultural universities; while popularisation is carried out by the Department of Agriculture and the agricultural universities, acting in collaboration and separately.
The State Seed Sub-Committee (SSSC) is responsible for the release of a variety in its own state on the basis of data generated by the SAU. The state breeders, along with scientists of other disciplines, generate research trial data (usually for a 3-year period) that provide the basis for establishing the VCU and other important features of the variety. In some states on-farm trial data are also collected by the extension agencies.

The SSSCs do not have authority to notify a variety for seed certification, even within the state. Thus, once approved by the SSSC for release in a state, the variety is required to be notified for seed production purposes by the CSC. For a state variety to be notified, it has to have been through the central system of trials. This means, in effect, that state releases must pass through a much more rigorous procedure than centrally released varieties: first, rigorous multi-locational testing within the state, and then testing across the country. The notification proforma specifically requires that the variety must have been tested in the AICCIP trials for at least one year, and

preferably recommended for release in the state by the AICCIP Varietal Identification Committee.

Thus, in practice, the state release system is dependent on the national one: no variety released in a state is automatically notified for seed production. The states with strong breeding programmes make their own decisions; while those with relatively less developed plant breeding depend completely on the central system for improved varieties. State-released varieties are constrained by a recommendation domain restricted to a single state because they are not accepted in other states with similar agro-ecological conditions.

2.5.3 Seed production, certification and distribution

Seeds are central to farming and food production. Availability of quality seed is very critical to enhancing agricultural productivity – both in terms of quality and quantity. The non-availability of seed of new varieties appears to be a major constraint in the rapid adoption of new varieties and replacement of old cultivars. There are four types of seeds

- Nucleus seed – seed produced by the breeder to develop the particular variety that is directly used for the multiplication of breeder seed
- Breeder seed – seed material from the nucleus stocks that is directly controlled by the originating or the sponsoring breeder or institution for the initial and recurring production of foundation seed
- Foundation seed is the progeny of the breeder seed. Foundation seed may also be produced from the foundation seeds. Production of foundation seed (stage I and II) may be permitted, under the supervision and approval of the certification agency. The main criterion in the process is to maintain specific genetic purity and identity.
- Certified seed is the progeny of foundation seed or the progeny of certified seed and is grown on a large-scale by seed organisations and farmers and sold for commercial crop production.

At present two Government of India agencies, i.e. the National Seeds Corporation Limited (NSC) and State Farms Corporation of India (SFCI), together with 13 State Seed Corporations (SSCs) are responsible for the production and marketing of seeds in the public sector. The NSC and the SFCI undertake seed production programmes for a new variety using breeder seed supplied by the breeder. Seed multiplied at university farms is also supplied to state seed farms operated by the NSC and State Seeds Corporations. The NSC has the primary responsibility for foundation seed production and for the storage and supply of seed of released high-yielding cultivars of cereals, pulses, vegetables, fibre and fodder crops.

Once a variety has been released, its seed multiplication is subjected to rigorous seed certification standards that involve logistically complex field inspections and laboratory testing, before certified seed can be made available to farmers. The regulatory framework aims to keep a large proportion of seed production in the hands of the public sector, so that the supply of seed is not left entirely to market forces that may be inefficient.

In the state system seed production, certification and distribution are undertaken by various state seed agencies, the university/universities and private seed companies. In some states NGOs have also played a small part in the process. Overall authority lies with the State Seed Sub-Committee (SSSC). SSSCs are constituted by the Central Seed Committee (CSC), and are delegated to set up a State Seed

Certification Agency (SSCA), a State Seed Laboratory and an Appeals Authority, and to appoint seed analysts and seed inspectors. If seed growers wish to produce certified seed they are required to get their seed certified by the SSCA if they intend to sell it as certified seed.

3. PROCESS INNOVATIONS AND THE PUBLIC SECTOR

3.1 Public Sector Organisations and PVS and COB

CAZS NR's main local partner for its COB work in India was Gramin Vikas Trust (GVT). GVT was the implementation agency for two major DFID-supported rural development projects, namely the Western India Rainfed Farming Project (WIRFP) and the Eastern India Rainfed Farming Project (EIRFP). WIRFP operated in a number of contiguous districts of three states, namely Gujarat, Madhya Pradesh and Rajasthan; whereas EIRFP operated in various districts (not necessarily contiguous) of Jharkhand, Orissa and West Bengal.

WIRFP had five components, one of which (Component C) was Participatory Technology Development, whose Output was: "New project approaches and participatory technology and approaches generated, tested and made available in project villages and more widely in the region". PVS and COB were (probably) the main 'participatory technology .. approaches' developed through Component C.

CAZS NR's other main local partner was Action for Social Advancement (ASA), an NGO that has operated in Gujarat and which now works primarily in Madhya Pradesh. GVT and ASA have provided support on PVS to two MP state rural development projects, the Madhya Pradesh Rural Livelihoods Project (MPRLP) and the District Poverty Initiatives Project (DPIP) respectively.

3.1.1 Public sector research organisations exposed to COB/PPB

It was originally envisaged that GVT and WIRFP's Phase 2 (see below) would form direct linkages with key national organisations, notably ICAR, but this did not happen. At the end of WIRFP, it appeared that "little is known to the ICAR authorities on this … initiative (WIRFP)" (Gill *et al*., 2006, Annex 8). Nevertheless, ICAR's DG was aware of the PPB/PVS approach; and the SAUs (see below) have their own linkages to ICAR and its AICRP.

GVT's main partners in this work in western India were four State Agricultural Universities:

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

The EIRFP was also involved in PVS/COB, particularly with rice. It collaborated with Birsa Agricultural University, which is based in Ranchi, Jharkhand.

3.2 Details of PVS and COB Work Undertaken by Public Sector Organisations

Information about the various crops on which the SAUs undertook PVS is provided in Table 3.1. The data for MPRLP and DPIP were supplied by GVT and ASA respectively.

Table 3.1 Public Sector Organisations Involvement in PVS, by Crop

Organisation	Maize	Upland Paddy	Black gram	Chick pea	Horse -gram	Niger	Pigeon pea	Soybean	Wheat
MPRLP	✓	✓	✓	✓	✓	✓			
DPIP	✓	✓		✓			✓	✓	✓
SAUs									
AAU	✓	✓							
JNKVV*	✓	✓	✓	✓	✓	✓			
MPUAT**	✓	✓	✓	✓	✓				
SDAU**			✓						
BAU**	✓	✓							

* The relevant part of JNKVV (located in Indore) was recently transferred to Gwalior University.
** No data received *directly* from this university – details provided by Dr JP Yadavendra, GVT.

Table 3.2 Public Sector Organisations' Reasons for Being Involved in PVS

Organisation	Reasons for being involved in PVS
AAU	To develop drought resistant high yielding variety in rice & maize

The SAUs have applied COB to five crops between them, information about which is given in Table 3.3.

Table 3.3 SAUs' Involvement in COB

SAU	Crops (years)*
AAU	Upland rice (1997-2001), Maize
JNKVV	Blackgram, Horsegram, Upland rice, Maize
MPUAT	Chickpea, Upland rice
SDAU	Black gram
BAU	Upland rice

4. PROCESS INNOVATIONS AND CIVIL SOCIETY

4.1 Use of PVS by NGOs and CBOs

Both ASA and GVT have been involved in PVS for a wide range of crops, including both legumes and staples, as can be seen from Tables 4.1 and 4.2. (Unless stated otherwise, the source of the information in these and other tables is the survey questionnaires.) GVT's involvement began in 1992 and ASA's in 2000.

Table 4.1 NGO Involvement in PVS by Crop: Staples and Coriander

Agency	CROP				
	Maize	Upland rice	Pearl millet	Wheat	Coriander
ASA	✓	✓	✓	✓	✓
GVT	✓	✓		✓	

Table 4.2 NGO Involvement in PVS by Crop: Legumes

Agency	CROP								
	Black gram	Green gram (Moong bean)	Horse-gram	Soybean	Chickpea	Ricebean	Pigeon pea	Niger	Rapeseed Mustard
ASA	✓	✓		✓	✓		✓		
GVT	✓	✓	✓	✓	✓	✓	✓	✓	✓

GVT has implemented PVS in three states of western India (Gujarat, Madhya Pradesh and Rajasthan), through its Western India Rainfed Farming Project; and three states of eastern India (Jharkhand, Orissa and West Bengal), through its Eastern India Rainfed Farming Project. ASA has its head office in Bhopal, MP, and has been particularly active in this state, but has also worked on PVS in two other states (see Table 4.3). In addition, both ASA and GVT have collaborated with other NGOs on PVS, the latter with 20.

Table 4.3 NGO Involvement in PVS by State

NGO	Gujarat	Rajasthan	MP	Jharkhand	Orissa	Bihar	West Bengal
ASA	✓		✓	✓		✓	
GVT	✓	✓	✓	✓	✓		✓

Reasons for using PVS The reasons given by NGOs for becoming involved in PVS are shown in Table 4.4.

Table 4.4 NGOs' Reasons for Being Involved in PVS

Organisation	Reasons for being involved in PVS
ASA	ASA is a development organisation. Farming Systems Research is one of the core thematic areas of ASA's livelihoods development model. Due to very poor outreach and ineffective results of existing Agri extension model we were looking for an alternative & innovative approach for extension of agricultural technologies for betterment of peasant community of the region. ASA was convinced with the approach & methodology of PVS, and therefore decided to become involved in the implementation & dissemination of the PVSP programme.
GVT	To address the farmers' requirements for improvement in crop productivity to reduce the poverty in the project area on a sustainable basis. 1. Being a grassroot participatory development organization having interest and intent to work for the poor farmers for sustainable livelihoods and food security in the resource poor areas; 2. Being the pioneer organization having core strength in addressing the issues of alternative research protocol; 3. For strong national and international policy influencing at all possible levels; 4. Being pro-poor pro-gender sensitive development organization.

4.2 Use of PPB/COB by NGOs

GVT is the only Indian NGO that has been involved in PPB/COB. This work has been done primarily in collaboration with SAUs, and the major source of funding has been DFID's PSP. The Coordinator of GVT's crops research, Dr J P Yadavendra, previously worked for 30 years as a plant breeder at Gujarat Agricultural University; and GVT employs five plant breeders altogether. GVT's PPB/COB has covered seven crops.

ASA has not been involved in PPB/COB and argues that "There is no dearth of good varieties within the national pool of varieties including those which are in the private sector domain and some excellent indigenous cultivars that exist in India. In the current context the effort should be made to make use of the existing resources before we go into PPB – it's not cost effective. We must remember that majority (in our case all of them) of the farmers' preferred varieties have come from the general pool of varieties and not through the PPB" (Mondal, *pers. comm.*).

Table 4.5 Involvement of GVT in Client Oriented Breeding

Crops (years)	Maize (1994); Rice (1996 – or 2002?); Chickpea, Blackgram, Horsegram, Niger (1999 onwards); Ricebean (2006)
Who chooses parents?	Farmers and scientists jointly. On the basis of the feedback received from the farmers and the collaborating scientists and after analysing the results the parents were selected.
Number of crosses	Composite development in maize and one or two crosses in each crop. The PPB philosophy was developed on the premise of attempting a small number of crosses with large population size. In the case of GM 6, a maize composite that was the first ever PPB variety released officially by GAU in India, only 9 crosses were attempted using 6 parents chosen jointly by farmers and scientists. For other crops the theory remains the same and each time GVT and its partners have found the process to be successful.
Population Size in F_2 onwards	Depends on the crop. Large population size. Maize = >9000 In the cross with Sathi 34-36 rice, population size was >25000 plants.
Reasons for COB involvement	Since no ready made answer was available to address needs and demands of the farmers, and the formal system was not responding to the needs of the poor, GVT had to resort to PPB, in collaboration with SAUs. Inclusion of farmer preferred traits in a genotype and testing in the target environments have brought desirable results in a short period.

5. IMPACT OF PVS AND COB ON FARMERS

5.1 Benefits per Household of Selected Varieties

JNKVV found that the yield advantages of potential new varieties tested in the project area (in Jhabua district) over local varieties were: maize, 20%; rice, 15%; black gram, 23%; Chickpea, 24%; Horse gram, 35%; and Niger, 40% (Billore, 2006). More specific information for particular maize and horsegram varieties is given in Table 5.1.

Table 5.1 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)
AK-42, AK-21	Horsegram			>40	Yes
GM6	Maize			11-33	

5.2 Adoption Levels and Overall Financial Impact on Farmers

Information on numbers of farmers that have adopted different PVS or COB varieties is not available, although the companion study to this one on the impact of Ashoka varieties of upland rice will generate the best estimates yet. What is available is data on the numbers of farmers who have been involved in PVS trials conducted by ASA and GVT (see Table 5.2 and 5.3), which gives an indication of the initial scale of coverage.

Table 5.2 Numbers of Farmers Involved in PVS/COB by Organisation and Crop: Cereals and Coriander

NGO	CROP					
	Maize	Rice	Pearl millet	Wheat	Coriander	**Total**
ASA	512	3124	22	2939	145	6,742
GVT*	20000	40000	-	50000		110,000

* All GVT numbers are minima.

Table 5.3 Numbers of Farmers Involved in PVS by Organisation and Crop: Legumes

NGO	CROP										
	Black gram	Green gram	Horsegram	Soybean	Chickpea	Ricebean	Moong bean	Pigeon pea	Niger	Rapeseed Mustard	**Total**
ASA	2250		-	3399	70	-	1109	230	-	-	7,058
GVT	10000		2000	75000	10000	1000		7500	2000	5000	112,500

* All GVT numbers are minima.

Another indicator of adoption of varieties is the quantity p.a. of PVS variety seed supplied by PVS seed multiplication organisations to other agencies. In 2006, production and marketing of certified seed by farmer producer companies in MP went up to approximately 5,000 MT, approximately double the previous year's level. (For further details see section 5.4).

5.2.1 Release of COB Varieties

As can be seen from Table 5.4, the collaborative COB work between GVT and the SAUs has led to the release of a substantial number of varieties of five different crops in various states. Some varieties have been released in more than one state. For example, through WIRFP GVT "nurtured the official release process for GM-6 maize, which was originally bred in Gujarat .. in MP and Rajasthan" (Gill *et al*., 2006). Once COB varieties have been officially released they can be promoted through government extension services and seed companies: unfortunately, data on the quantities distributed are not available.

Table 5.4 COB Varieties Officially Released in India

Organisations involved	Crop	Variety	State(s) in which release sought	Year of release
GAU & GVT	Maize	GM6	Gujarat	(2001)
AAU & GVT	Upland rice	Ashoka 200F	Gujarat	Recommended*
BAU & GVT	Upland rice	BVD 109 (Ashoka 200F)	Jharkhand	(2004)
BAU & GVT	Upland rice	BVD 110	Jharkhand	(2004)
GVT & JNKVV	Blackgram	JU 8-6	MP	(2005)
GVT & JNKVV	Blackgram	JU 4-8-6	MP	(2005)
GVT & JNKVV	Horsegram	JVH 2	MP	(2006)
GVT & MPUAT	Chickpea	Pratap Chana 1	Rajasthan	(2004)
GVT & JNKVV	Chickpea	JG 412	MP	(2004)
GVT & JNKVV	Upland rice	Ashoka 200F	MP	Recommended* (2005)
GVT & MPUAT	Upland rice	Ashoka 200F	Rajasthan	Recommended* (2004)
GVT & JNKVV	Maize	JVM 421	MP	Released (2005)

* This means the variety was developed and released in another state and subsequently recommended in this state.

5.3 Who Benefits from PVS and COB Work?

The work by GVT has been undertaken primarily in some of the least developed districts in India, most of which have populations a large proportion of which are tribal. These include Jhabua in MP which has been identified as one of the five poorest districts in India; and Dahod and Panchmahals districts in Gujarat. The same applies to ASA, whose working area can be categorised as marginal, with a high percentage of small farmers (average holding size 1 ha. per household).

5.4 Production, Distribution and Promotion of PVS/COB Varieties' Seed

The more farmers who are aware of and have access to PVS/COB varieties, the greater their impact will be. Limited availability of and access to farmer-preferred varieties can be a major constraint on their adoption and spread. The WIRFP impact assessment of GVT's PVS/COB work concluded that the lack of sustainable seed supply systems was "the single most important constraint on continued success of the entire crops sub-component" of GVT's PTD programme, and the "most important outstanding issue" (Gill *et al*., 2006). In principle, there are three kinds of stakeholders that can produce and distribute the seed, although certain combinations of these are also possible, namely:

- public sector extension services and seed corporations
- private sector (commercial) companies
- farmer organisations.

5.4.1 Public sector involvement

Despite policies that give priority to poverty reduction, particularly in tribal areas, it has been argued that the public sector seed corporations have failed "to supply

marginalised tribal areas with appropriate seeds at affordable prices" (Gill *et al*., 2006).

Another limitation on the contribution of public sector agencies is that seed of a variety can only be included in the state agricultural extension system's package of recommended practices when that variety has been officially released. They can then be officially promoted, would stand a better chance of spreading to neighbouring states in the same agro-ecological zone and could be sold through the national and state seed corporation, hence qualifying for subsidies (Gill *et al*., 2006). Thus, any farmer-preferred varieties identified through PVS trials that have not been released, such as local landraces from another area or varieties only released in another state, will not be distributed. Attempts by the NGO ASA to persuade the extension services in MP to distribute seed of farmer-preferred varieties were unsuccessful (Mondal and Pastakia, 2007) – see section 6.1.1.

5.4.2 Private sector involvement

The contribution of the private sector to supplying seed to poor rainfed areas has been minimal. Scepticism has been expressed about the feasibility of significant private sector involvement in the supply of seed of farmer-preferred varieties in the poorer regions of India, on the grounds that the returns would be too low and there is no guarantee of repeat sales - as farmers traditionally rely on saving their own seed or obtaining it from other farmers (Gill *et al*., 2006). However, some believe that the potential volume of business for composite and improved varieties in rainfed areas could yet attract private companies (Mondal, 2007).

5.4.3 NGOs and farmer organisations

The two major NGOs involved in PVS have been undertaking some seed supply and also supporting the involvement of CBOs in seed production (see Table 5.5). GVT has been encouraging and supporting SHGs to produce the seed, but the IA expressed serious concern about their financial soundness (Gill *et al*., 2006). Of the eight established, four had folded and the others were struggling. A key issue is which farmers produce the seed: the poorest farmers have difficulty producing enough, and GVT later began to involve better-off farmers.

Table 5.5 Production and Distribution of PVS/COB Varieties

Organisation	Involved in seed supply	Support CBO seed production	Farmers Contracted to Produce for sale	Act as intermediary for Production & Marketing
NGO				
GVT	Yes	Yes	Yes	No/ Yes??
ASA	Yes	Yes	Yes	Yes
Public sector				
AAU	Yes	No	No	Yes

ASA's work in Madhya Pradesh[4] Since 2005, ASA has been organising farmers into Farmer Producer Companies (FPCs) - under the Indian Companies Act, 1956, Amendment, 2003) - to undertake the production of seeds of farmers' preferred

[4] The information about ASA's work has been taken from Mondal and Pastakia, 2007.

varieties. The companies' other functions include input supply, marketing of agricultural produce, contract farming, insurance, agricultural credit etc.

Initially, buy-back arrangements were made with private seed companies in order to meet the demand of the farmers. Seeing the considerable market potential, these private companies are now attracted to enter into business alliance with the FPCs. Currently 14 such FPCs, with membership coverage of over 20,000 small and marginal farmers, are engaged in seed production. In 2005, these companies together produced nearly 2,500 Metric Tonnes (MT) of certified seeds (certified by the State's Seed Agency) and traded them with the private seed companies. In 2006, production went up to approximately 5,000 MT. The average annual turnover per FPC is over Rs. 25 lakhs at the age of 1-2 years.

The companies have built upon the Common Interest Groups (CIGs) established through the state's DPIP project. These groups of farmers produce the certified seed on behalf of the company, and are also the shareholders of the company. The Board of directors and shareholders are the key decision makers, but the day-to-day management is carried out by a group of professionals. Each company has also developed a fleet of Service Providers for agricultural services from among the local youth of the area. The ultimate goal of the companies is to provide backward and forward linkages especially for small and marginal farmers who are unable to cope with private sector traders on their own.

The MP state Agriculture Ministry made a key policy change in 2006 that enables a farmers' company - through a single licence - to get the seed production activity certified for all its members engaged in seed production. The individual producer does not have to get registered separately with the seed certification agency. This policy change has proved to be a shot in the arm for the FPCs. The Rural Development Ministry has also made a commitment to provide financial support to the FPCs for promotional activities for the initial three years, provided they arrange for their business plans to be appraised by the Ministry first.

ASA believes that the FPCs require promotional support for the initial years. It envisages, however, that they will become financially viable in the long run, because of their ability to make professional business plans and to negotiate effectively with the other private sector actors. It argues that in the short run these FPCs should get incentives from the state in terms of a tax holiday, low interest on working capital, infrastructure support for establishment of storage facilities and purchase of grading and other equipment.

6. CROP IMPROVEMENT SYSTEM DYNAMICS: A FRAMEWORK

This section and sections 7 and 8 are concerned with the inter-relationships between the implementation of PCI processes (PVS and COB/PPB), 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. A major aspect of these dynamics is the extent to which the PCI processes have become institutionalised within India'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 6.1.

Table 6.1 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*	

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 different various stakeholders from at least three of the domains (research, intermediate organisations and 'demand', i.e. farmers).

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.

7. PVS and CROP IMPROVEMENT SYSTEM DYNAMICS

Both ASA and GVT, the NGO partners in the PSP-funded projects, have been involved in advocacy work to promote the use and institutionalisation of PVS by government agencies. 'Policy Influence' was officially a component (from 2002-2006) of the WIRFP, for which GVT was responsible, although it had no staff allocated to it and lacked a strategy (Sharma *et al*., 2006). ASA's advocacy work focuses on PVS (not PPB) and it believes that mainstreaming of PVS within government agencies is important because:

(a) the government continues to be the largest agriculture extension agency in the country
(b) there are now several agriculture technology promotion schemes which are propagating a PTD approach
(c) the seed policy 2002 emphasises the involvement of farmers, private sector and NGOs in varietal development and
(d) there is a pool within the public agricultural extension community who are sympathetic towards a participatory approach in varietal development.

Government distribution of PVS varieties As mentioned in section 5.4, public sector agencies will only distribute seed of varieties that have been officially released in their state or through the central varietal release system. Consequently, they have not distributed some farmer-preferred varieties that had been highlighted through the use of PVS, and the final step of the PVS process – wider dissemination – has been restricted.

Despite putting a lot of effort into "policy advocacy for institutionalization of PVSP[5] within the formal system" until 2004, ASA failed to convince the extension system to make available to farmers seeds of about 20 farmer-preferred varieties identified through PVS (Mondal, 2007). The difficulty of getting distribution of PVS selected varieties institutionalised within the state extension system led it to switch to an alternative strategy of organising farmers into Producers' Companies to undertake the production and supply of seed.

In other respects, however, ASA and GVT have had a significant influence on the use and institutionalisation of PVS by some state governments, as discussed below.

7.1 Institutionalisation of PVS in MP

The one state where PVS has been widely implemented and institutionalised significantly is Madhya Pradesh. PVS has been implemented by three projects of the state government, namely: MPRLP, DPIP and ATMA. The involvement of government projects has been associated with a change in the 'Policy & Institutions' domain of the state innovation system. In DPIP PVS had to be officially accepted at the outset by the project and the Ministry of Rural Development as a component. The IAS officer in charge asked whether PVS was 'legal'. ASA had to prepare a protocol, which the official circulated to SAUs, government agencies and the Principal Secretary for comment. Eventually the protocol was approved, and was published by DPIP, thereby legitimising the use of PVS in DPIP and by implication in other projects

[5] The P in PVSP stands for 'promotion'. Some people argue that PVS includes promotion, and hence that there is no need to add this.

of the MP state government. The recognition of PVS by the state government is one important indicator of institutionalisation (see Table 7.1).

Table 7.1 Institutionalisation of PVS in Madhya Pradesh

1a. State (or national) policies and procedures		
Favourable government policies	National Indian policy framework for agricultural extension 2003 recognises farmer participatory approaches & advocates NGO participation in extension	
Government recognises PVS in extension-related procedure(s)	PVS protocol adopted and published by MP state government.	
Government extension services distribute farmer-preferred non-released varieties	No	
1b. Breadth & depth of use in MP		
* geographical coverage by government agencies (number and % of districts)	MPRLP 5+, DPIP 14 (23%+)	
* no. of crops covered by government extension agencies or projects	MPRLP 7, DPIP 6	
* geographical coverage by principal individual NGOs (number of districts)	1 crop	>1 crop
- GVT	?	5
- ASA	0	9
* Aggregate geographical coverage by NGOs after eliminating duplicates (number of districts)	-	11
* geographical coverage by NGOs (% of districts)	22	
* no. of crops covered by NGOs (ASA & GVT)	15(ASA 9, GVT ?)	
* Number of NGOs using PVS	2	
* Qty of seed of PVS varieties produced & distributed annually	CBOs - approximately 5,000 MT of certified seed + some truthfully labelled seeds being produced by the farmers' owned companies	
* No. of CBOs producing seed of PVS varieties	14 Farmer Producer Companies with which ASA is working	

An indicator of the *breadth* of PVS institutionalisation in MP is the number and proportion of the state's districts in which it has been implemented. PVS has been carried out in at least 14 of MP's 50 districts. (Information about the ATMA project's PVS districts and crops was not available.). The *depth* of institutionalisation is reflected in the number of agencies implementing it; and also the number of crops to which it is being applied, which is substantial (see Table 7.1).

According to Ashis Mondal, ASA's Director, nobody in MP questions the efficacy of PVS nowadays. This appears to be largely due to the fact that the principal NGOs have been implementing and promoting PVS here for many years, and key individuals in these organisations have acted as 'process champions'.

7.2 Institutionalisation of PVS in NGOs and other states

GVT has been implementing PVS in a large part of its programme area, including Gujarat and Rajasthan. PVS has also become a standard component of ASA's rural development programmes, and it also provides technical support on PVS to projects outside MP. In Bihar the World Bank funded Bihar Rural Livelihood Project (BRLP) is implementing PVS in three districts with technical support by ASA. BRLP has followed a similar process of legitimisation to that which occurred in MP (Mondal, *pers. comm*.). It plans to reach more than 48000 farmer households through PVS processes during 2008-2011, of which about 8000 have been covered already. Ashis Mondal believes that in a couple of years' time Bihar could be the leading state for PVS in the public sector.

In Jharkhand, where ASA has trained three NGOs in PVS, it is being implemented as part of a UNDP project. However, beyond these NGOs and the central states of India there appears to be very little PVS taking place.

8. COB/PPB and CROP IMPROVEMENT SYSTEM DYNAMICS

8.1 Influence of the Crop Improvement System on Use of COB/PPB

ICAR and its research centres have not been involved in COB/PPB, and the dominant attitude towards COB/PPB among senior management is negative. (Reasons for this situation will be discussed later.) It remains the case that the CVRS procedures are not conducive to release of varieties developed through COB/PPB. Thus, all COB varieties released have been at the state level – through the state varietal release committees - rather than at the national level; and all COB/PPB varieties that have been released were developed by SAUs (in collaboration with GVT). The release submission cannot be made by an NGO, and the value of implementing COB/PPB is limited if it does not result in the official release of a variety. This is probably an important reason why GVT is the only Indian NGO to have been involved in PPB.

The stance taken within ICAR's head office can also exert an influence on the SAUs, for which it is a major (sometimes dominant – e.g. Gwalior University) source of funding. The Vice Chancellor of an SAU could discourage his/her university's plant breeders from being involved in PPB is (s)he was aware of the ICAR HQ attitude and was worried about the implications for university funding from ICAR. In one case ICAR's ADG Crops is reported to have told Birsa Agricultural University (BAU) to stop working on PPB, which he considered to be a waste of time, and to have threatened to stop ICAR grants to BAU if they continued.

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

The work undertaken by WIRFP, in collaboration with the SAUs, has influenced the varietal release process at the state level:

> "Following WIRFP, restriction on release of varieties beyond the CVRC notified jurisdiction seems to have been lifted, at least in the participating states. … Currently, varieties released for a particular rainfed situation, after proper testing, are being allowed for release in similarly placed farmers' needs and farming conditions. For instance, based upon the proposal by the project scientists and recommendations of the Zonal Research and Extension Advisory committees of the Madhya Pradesh and Rajasthan, respective SVRCs have approved release of maize GM 6 … which was initially released for cultivation in Gujarat. Likewise, Ashoka 200F and Ashoka 228 (product of Eastern India Rainfed Farming Project) released in Jharkhand have been recommended for cultivation in Madhya Pradesh, Gujarat and Rajasthan" (Gill *et al.*, 2006, Annex 8).

8.3 Institutionalisation of COB/PPB

8.3.1 National/state level

Varietal release A significant indicator of the institutionalisation of COB/PPB at the national and state levels is the extent to which varieties developed through this process have passed through government procedures and systems and been

accepted for official release. A substantial number of such varieties of various crops has been released (see Table 5.4), albeit only through state varietal release systems.

Another significant indicator (see Table 8.1) would be changes to the official codified SVRC procedures to reflect the practices described in section 8.2. However, the influence of WIRFP/GVT on the SVRCs was informal: COB/PPB has not been formally accepted and incorporated by the official plant breeding and release system, which means that it would be easy to stop practising this institutional change.

Curriculum reform In the longer term, mainstreaming of PPB depends on plant breeders being routinely trained in its used, so curriculum reform is essential. As of February 2006, there had not been any changes to any of the SAUs' curricula or syllabi regarding the use of PVS/PPB (Gill *et al*., 2006). However, there was recently some change in a major report on 'Revised PG Course Curricula and Syllabi for Agricultural and Allied Sciences', which was published by ICAR on 5 February 2009. One of the courses described in the report is 'GP 503 Principles of Plant Breeding', whose objective is 'To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement'. UNIT VIII of this course covers: "Cultivar development- testing, release and notification, maintenance breeding, **Participatory Plant Breeding**, Plant breeders' rights and regulations for plant variety protection and farmers rights".

8.3.2 Organisational level

While there may have been some small signs of change at the national/state level that is not the case at the organisational level – at least not in public sector organisations. Currently there is no PPB being done within public sector research organisations in India.

Table 8.1 Institutionalisation of PPB at National and Organisational Levels

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

8.3.1 ICAR

ICAR recognises the merits of farmer participation in the technology development process for other technologies, but not in the case of plant breeding (Billore, Gwalior University, *pers. comm.*). ICAR's Director General, a plant breeder by training, is known to be highly antagonistic towards COB/PPB[6], and to have instructed ICAR institutes not to become involved in it. The ADG Crops put forward a number of arguments against COB/PPB to the author (Shukla, *pers. comm*.): these and other issues are discussed in section 8.4. It is quite common, if not normal, for plant breeders to have a negative attitude towards participatory approaches to crop improvement, but the intensity of the antagonism within ICAR's head office is exceptional. One key informant said that this stemmed from the publication of the 'Seeds of Change' book (Witcombe *et al*., 1998), and the fact that it criticised the existing Indian system as well as advocating PPB.

8.3.2 State Agricultural Universities

Even in the SAUs where COB/PPB was implemented with DFID funding, this has now been discontinued. This is despite the fact that the:

> "Impact on researchers and others in the SAUs directly engaged with Component C has in most cases been powerful, as demonstrated by their enthusiasm and commitment. Some of them have introduced participatory methods into the plant breeding courses they teach, work is now being done for the first time at all four universities on crops for rainfed tribal areas, deans and directors of research have sanctioned farmer-participatory projects, and

[6] For this reason one senior plant breeder based in South Asia (jokingly) advised the author to wear a bullet-proof vest if interviewing the DG about PPB.

> one Vice Chancellor reported cross-fertilisation to other projects" (Gill *et al*., p vi).

Visits to two SAUs by the author revealed that they have not attempted to continue COB/PPB in the absence of donor funding. The plant breeders who were involved, some of whom are very positive about PPB, think that PPB cannot be implemented solely through their regular funding due, they say, to its higher costs (Billore, JNKVV/Gwalior; Pathak, AAU; *pers. comm*.). There appears to have been a lack of institutionalisation[7] within these SAUs at the organisational level – see Table 8.1. These findings confirm those of the WIRFP Impact Assessment:

> "…conventional plant breeders do not readily endorse [PPB] as a supplement/supplant of formally accepted technique of varietal development and release. Neither they are enthused enough to support modifying regulatory framework for the testing, release and popularization of new varieties including PPB as a tool" (Gill *et al*., 2006, Annex 8).

8.3.3 Institutionalisation of COB in NGOs

GVT is the only Indian NGO that has been involved in PPB/COB. This work has been done primarily in collaboration with SAUs, and the major source of funding has been DFID's PSP. The Coordinator of GVT's crops research, Dr J P Yadavendra, previously worked for 30 years as a plant breeder at Gujarat Agricultural University; and GVT employs five plant breeders altogether. This, COB/PPB appears to have been institutionalised in GVT. However, Dr Yadavendra and one of his senior colleagues are due to retire soon, and it is remains to be seen whether GVT is able to replace them with equally experienced and committed staff as such people are a scarce resource.

8.4 COB/PPB Issues in India

Neither the PSP projects supported by DFID through its RNRRS, nor the farming systems projects supported by DFID bilaterally, were orientated towards advocacy, institutionalisation and policy change. While the RNRRS managers may have welcomed policy influence by research projects they did not favour a significant allocation of project funds for that purpose. WIRFP, on the other hand, was meant to be actively involved in advocacy work, but lacked a strategy for doing so: thus, "an opportunity to institutionalise *influence* went begging" (Sharma *et al*., 2006). According to Witcombe (cited in Sharma et al., 2006), "strategically, [WIRFP] did not position the activity [PVS and PPB] to influence policy".

However, the lack of a concerted and strong push for institutionalisation and policy change is by no means the only reason why it has not happened. The GVT/SAU experience with COB/PPB has, after all, been quite widely publicised in plant breeding circles in India, and under more favourable circumstances some degree of institutionalisation might have occurred as a result. International experience, as well as India's, is that "institutionalization of PPB has been slow" (Walker, 2007),

[7] An exception (in terms of curriculum reform within an SAU) is that Dr M. Billore at Gwalior University is teaching about PPB on a post-graduate (2 lectures) course; and touches on it on the undergraduate course as part of a lecture on how farmer/researcher linkages can be improved (Billore, pers. comm.)

suggesting that there are more general factors at work discouraging PPB. It is important to understand what the reasons are for this situation in the Indian context.

Table 8.2 Factors Identified as Hindering the Institutionalisation of COB/PPB

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

[1]Information in India 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).

Factors identified by key informants as hindering the take up and institutionalisation of COB/PPB are summarised in Table 8.2. Factors 7 and 8 appear to be related to each other and the fact that COB/PPB tends to require more funds (up to 20% more – Yadavendra, *pers. comm.*.) than conventional breeding to cover the costs of on-farm trials: current budgeting *norms and procedures* for SAUs may be inadequate to cover these costs, and this aspect of institutionalisation may not have been addressed.

In addition, within the SAUs there are *disincentives* to plant breeders' involvement in PPB. In JNKVV university (now Gwalior) PPB was seen as additional work on top of the plant breeder's general responsibilities, which meant that to fit it in required her to work on it during her leisure time (e.g. on Sundays and public holidays). Nor was there any remuneration from JNKVV for doing the PPB work (Billore, *pers.comm*.). Thus, in the absence of any incentives, PPB is more demanding than CB for researchers and requires greater commitment.

Regarding factors 3 and 5, to some extent breeders' attitudes are influenced by a misunderstanding as to what PPB is – i.e. some of them think that in PPB breeding is to be done by farmers and that there is no role for plant breeders. This is partly why CAZS NR now favours the term client-oriented breeding to PPB.

Many arguments are used in India by COB/PPB protagonists and those who support the current system. Some of these arguments relate to the costs and benefits of the two approaches, while another important concern relates to intellectual property rights of plant genetic materials.

8.4.1 Cost and benefits

Protagonists say adoption rates are higher for PPB varieties. However, ICAR (and other supporters of the status quo) does not necessarily accept that (a) adoption rates for conventionally bred (CB) varieties in marginal rainfed areas are low; or that, if they are low, (b) this means that they are unsuitable for farmers. In the latter case, they argue that low adoption rates are due to weaknesses in the extension and seed supply systems (Yadavendra, GVT). These and other arguments relating to costs and benefits are summarised below:

- **Costs & benefits – general 1** There is currently a lack of evidence that PPB is more efficient/cost-effective than conventional breeding.

- **Costs & benefits – general 2** The costs of PVS are much lower than those of PPB, and the returns much quicker; and good varieties can be found through PVS for any crop and situation - so why invest in PPB? (A Mondal, ASA). (A sub-argument here is that where there is no ideal PVS variety it may be possible to compensate for the weakness(es) of a good variety through other agricultural practices instead of developing a new variety in which the weakness has been eliminated.)

- **PPB adopters (benefits) - sceptics** The potential number of adopters of niche varieties developed through PPB is likely to be small - say 3000 (Shukla, ICAR).

- **CB adopters** India has a successful plant breeding system through AICRPs (cited by Tiwari, ICAR). The traditional approach works well – farmers like released varieties (Shukla, ICAR).

- **PPB adopters (benefits) – protagonists** The seed demand in farmers' fairs shows the perceived benefits of new PPB varieties developed by JNKVV/GVT in MP (Billore, Gwalior SAU). In Dahod and Panchmahals districts of Gujarat GM6 maize has achieved 90% adoption/coverage and it has also entered MP (Pathak, Anand SAU): it's the most dominant maize variety in Gujarat (Yadavendra, GVT).

- **Costs** PPB requires more funds and manpower than conventional breeding (Pathak, Anand SAU; Shukla, ICAR).

- **(Hidden) Costs** The DFID-funded PPB work in India was, in effect, subsidised by ICAR, because it used, for example, laboratory facilities that had been paid for by ICAR. Therefore, these costs should be included in any cost/benefit analysis of PPB v. conventional breeding systems (Shukla, ICAR). (Another example of a hidden cost - not mentioned by Shukla - is the time of KVK staff involved in PPB.)

8.4.2 IPR issues

IPR issues associated with PPB were mentioned as a concern by plant breeders (Billore, Pathak) who have been involved in PPB, as well as ICAR's Seeds ADG (Jambhale, ICAR). The concern is that valuable plant materials, originating from the public sector, that are being tested in farmers' fields may be given (or sold at low price) by farmers to private sector dealers who may take commercial advantage of them – or even an entrepreneurial farmer may do so. This concern applies to self-pollinated crops (Pathak, Anand SAU). This is not so much of a problem or concern for poor tribal areas (Pathak). The quality of the seed produced by private sector/farmer would not be assured and hence could bring a bad name to researchers. Due to IPR concerns, there is advice from ICAR that researchers should not test new varieties in farmers' fields prior to release (Pathak).

8.4.3 Agricultural Research: Narratives, Paradigms and Values

Although largely unspoken, and hence more difficult to discern, some of the important reasons for the disinterest (if not hostility) within ICAR towards COB/PPB may be subjective and related to narratives, paradigms and values. India has emerged, particularly during the last 15 years or so, as a major economy on the global stage that is increasing competitiveness in world markets; and the private sector has increased in importance, including in the agricultural sector. These changes have been accompanied by a new narrative over the future of Indian agriculture that envisages an emphasis on:

> "competitive export sectors, with large, consolidated and mechanised farms competing with the equivalents in other parts of the world for high value export markets …Under this scenario the poor, marginal small scale farming sector … [is] not really part of the picture, being seen more in terms of state obligations for welfare support, and as part of a more general encouragement of deagrarianisation and diversification away from agriculture" (Seshia and Scoones, 2003).

This narrative is bound to be reflected to a certain degree within ICAR and India's agricultural policy community. From this perspective, the use of COB/PPB to serve resource-poor farmers in rainfed areas is almost irrelevant and a prop for a way of agriculture whose time has passed.

Table 8.3 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: - research under researcher conditions - Farmer knowledge & views NOT valued	Associated with: - research under farmer conditions - Farmer knowledge & views highly valued

There is also a potential conflict between the scientific research paradigm and participatory approaches to technology development, as indicated in Table 8.3. 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 8.2, 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 India'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.

9. LESSONS AND CONCLUDING OBSERVATIONS

9.1 RNRRS neglect of capacity strengthening and institutionalisation

The PSP recognised the importance of getting Indian research organisations (SAUs) to undertake PPB by funding a number of projects that supported them to do so. However, this study has shown that the process innovation did not become institutionalised in any of the SAUs and its use stopped when the funding ended. This must be at least partly due to the fact that RNRRS rules required that the projects had to be designed as 'research' projects rather than capacity strengthening projects. (The short duration of the funding – there were no 'phase 2s' due to termination of the RNRRS - may have also been a factor.)

9.2 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. However, there has been virtually no other funding for PPB by SAUs in the central states that have been the main focus of this study. In the case of PVS, although GVT and ASA 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.

The CGIAR has a Systemwide Program on Participatory Research & Gender Analysis (PRGA), of which PPB has been a central focus for over a decade. One of the key outcomes that the PPB component is aiming to achieve is "Widespread application of PPB in national programs and in the CGIAR Centers". Crop-focused CGIAR centres working in India include ICRISAT, which has a campus outside Hyderabad, and CIMMYT, which has a South Asia office in Kathmandu, Nepal. Is it possible, therefore, that the CGIAR, and in particular the PRGA's PPB component, has had a positive influence on PPB in India? That possibility can be ruled out, as the CGIAR centres themselves appear not to be implementing PPB. A senior plant breeder in CIMMYT's South Asia office told the author that the only CGIAR centre in the world practising PPB was ICARDA, which is based in Syria and does not operate in India. If anything, the fact that the CGIAR centres generally practise conventional breeding methods may reinforce the validity of these methods in the minds of some national research staff.

9.3 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.

9.4 Cost/benefit analysis

There is a major need for a thorough comparative cost/benefit analysis of COB/PPB and conventional breeding. Better evidence is needed on the costs and benefits of PPB vis-à-vis conventional breeding, including:

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

Internationally, one of the arguments against using a participatory approach to technology development with resource-poor farmers has been that the unit costs are high, whereas the number of potential beneficiaries (the recommendation domain) is likely to be low. The same argument is being used in India by PPB sceptics/opponents. It is important, therefore, to gather evidence on actual or likely numbers of adopters of PPB varieties, as the RIU Rainfed Agriculture technology IA studies have been. The impact assessment of improved (Ashoka) rice varieties published in this series is a key source of evidence on this issue. Nevertheless, this is only one example: thus, it would be desirable for DFID's RIUP to commission a further study on the impact of GM 6 maize.

9.5 Government funding

The prospects of getting mainstream (government) funding for PPB appear to be weak, primarily because its operational (T&S) costs can be higher, at least in the early stages. This can be a constraint even when the benefits are likely to be high, giving a favourable cost/benefit ratio, as the benefits come later. The likelihood of government funding may be higher at the state level, particularly in states where effective PPB has been done already. This is partly because the benefits of PPB (in terms of adoption rates) are more visible to decision-makers at this level than at the national level; and partly because plant breeders in these states who already have experience of PPB are generally enthusiastic about it.

9.6 The contribution of individuals

This study has focused on policies, organisations and broader social processes. However, large organisations like ICAR and the SAUs are not necessarily monolithic, and individuals within them can and do exert a significant influence: the same applies to people working in NGOs and civil society generally. The current status of crop improvement in India has been strongly influenced by: (a) various *champions* of PCI processes, including Dr JP Yadavendra of GVT, Mr Ashis Mondal of ASA, and Dr John R Witcombe and Dr D S Virk of Bangor University's CAZS-NR; and (b) various *critics* of PCI processes, notably ICAR's Director General, Dr Mangla Rai. Most of these individuals are close to retirement, and the future of PCI processes in India will depend to some extent on who, if anyone, replaces them in advocacy arenas and processes.

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ANNEX 1 Questionnaire Part A

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

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 Laxmi Thummuru who is Assistant Professor at the Centre for Economic and Social Studies in Hyderabad.

Please find the time to complete this questionnaire electronically and email it to us, preferably by 22 August 2008, at the following addresses:
laxmi.thummuru@gmail.com 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/PPB 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:	
Complete office address:	
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 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? Yes ___ No ___

If 'Yes' please answer questions 2.8 (a), (b) and (c):

2.8(a) Please elaborate on the nature of difficulties:
Availability of human resources/skills ___ Financial resources ___
Technical information ___ Other (specify) ___

2.8(b) Whom, if anyone, have you contacted when there was a problem in implementing PVS?

2.8(c) With your organization's experience in implementing PVS, are you confident that you have the resources and expertise to implement PVS on your own? Yes ___ No ___

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:

3. Involvement in Client Oriented Breeding/Participatory Plant 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:

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

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

(c) 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'): Kharif _____ Rabi _____ summer _____

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) BPL Yes ___ No ___ (Insert 'X')
(b) tribal 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/ICAR/AU/O)	Status of cultivars *at time of PVS* (NR,RiS,RoS)*	Selected? (Y=yes)

♦ (F = farmer. ICAR = ICAR research institute. AU = agricultural university. O = other
* NR = not released. RiS = released in state where PVS carried out.
RoS = released outside state where PVS carried out.

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 acre)*					
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 acres) 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 and activities
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)
1/3	• S Khanwalkar, State Coordinator Crops and Livestock, Madhya Pradesh Rural Livelihoods Project
2/3	• Ashis Mondal (& colleagues), Director, Action for Social Advancement (ASA) (+ Yogesh and Raja Chakrabarti, agronomist)
3/3	• Dr Mridula Billore, Gwalior University (formerly JNKVV), Indore
4/3	• Dr I S Tomar, KVK, Jhabua District
5/3	• Prof. M C Varshneya, Vice Chancellor Anand Agricultural University (formerly part of GAU) • Dr A R Pathak, Director of Research & Dean P.G. Studies, Anand Agricultural University
6/3 AM	• Dr N D Jambhale, ADG (Seeds), ICAR • Dr S N Shukla, ADG (Crops), ICAR • Dr ADG (Oilseeds?), ICAR
6/3 PM	• Dr S Prakash Tiwari, DDG (Education), ICAR • Dr S A Patil, Director, Indian Agricultural Research Institute, ICAR • Dr Malavika Dadlani, Head of Division of Seed Science & Technology, IARI, ICAR