SYSTEMWIDE PROGRAM ON PARTICIPATORY RESEARCH AND GENDER ANALYSIS FOR TECHNOLOGY DEVELOPMENT AND INSTITUTIONAL INNOVATION

Plant Breeding Working Group

GUIDELINES FOR DEVELOPING

PARTICIPATORY PLANT BREEDING

PROGRAMS

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PART 1 OVERVIEW

1.1 INTRODUCTION

- These are extended guidelines, compiled for all those interested in supporting Participatory Plant Breeding (PPB) work, whether from a research or development perspective.

- These guidelines are not meant to serve as a 'how to' manual. Rather, the document discusses options-- and shares insights (strengths/weaknesses and trade-offs) of those experimenting with diverse PPB approaches, drawn from consultative meetings, email exchanges and select literature in this newly developing field.
- By implication, PPB means partnership, or inter-partner collaboration. PPB is more than a documentation of what farmers do alone or what formal breeding institutions do alone --- as interesting as these perspectives may be.
- These guidelines are organised in two sections: one providing and an overview of the field and the other offering guidelines for developing PPB programs. The latter in turn is divided between formal-led and farmer-led PPB.

1.2 WHAT is PPB?

- Participatory Plant Breeding refers to the involvement of end users (and sometimes other actors) in any number of the full range of genetic improvement activities. This includes setting breeding goals, creating genetic variability, selecting within variable populations, evaluating and selecting experimental varieties, releasing and popularising new varieties and multiplying and distributing seed.

- Under the rubric of 'Participatory Plant Breeding' (PPB)-, the Plant Breeding Working Group (PBWG) defines two broad PPB approaches: when farmers join in breeding experiments which have been initiated by formal breeding programs ('Formal-led PPB'); and when scientists seek to support farmers own systems of breeding, varietal selection and seed maintenance ('Farmer-led PPB').
- Intensive exchanges among PBWG members have revealed how much the two approaches represent a continuum, with users (e.g. farmers, processors, consumers), development workers and scientists actively involved in both. For instance, in formal-led PPB, farmers can help set strategic goals and are working with landrace as well as exotic materials. In farmer-led PPB, new germplasm and new selection methods are being introduced to farmers by formal breeders.

- The seminal differences between formal-led and farmer-led PPB hinge on who ultimately controls the breeding process and seed systems (i.e. whether researchers or farmers are the driving force) and the scale on which the work is undertaken. These differences greatly shape how the work can unfold. In focusing on the variable of 'who controls the process' and 'scale', and using the terms Formal-led PPB and Farmer-led PPB, this document highlights what the PRGA sees as the key variables shaping PPB programs.

- Formal-led PPB has certain unique characteristics, predominantly shaped by its institutional affiliation. Formal-led PPB programs have an obligation to feed information back to the formal research sector, as well as to feed forward to farming communities. There is the expectation that they will improve/complement the formal sector research system, e.g. refining breeding strategies, or possibly re-orientating entire programs. Generally, formal-led PPB programs also involve strong linkages to the formal variety release and seed production system. Finally, scientists involved in formal-led programs have a mandate to extrapolate their results beyond the individual farmer or community with which they work and programs often need to show what the advantages of farmer participation are, compared to research station centred breeding work or standard on-farm approaches. Thus this dual need to focus on end-users, as well as on the formal sector institutions themselves, shapes the types of participation, the types of products used or targeted and the types of data needed for formal-led Participatory Plant Breeding programs.

- To-date, farmer-led PPB tends to be clustered in one or a few communities, with no obligations either to feedback information for wider extrapolation, nor to feed products such as varieties into formal release and seed systems. As a result, the approach to both technology generation and data collection is near-exclusively community-centred, and varieties identified for further diffusion have the option of being site-specific and heterogeneous.

- The PBWG chooses to analyse these two approaches as distinct in order to compare and contrast the methods, institutional arrangements, and outcomes of each. We can make no judgement on whether farmer-led or formal-led approaches are more effective: much depends on which goals are paramount and the scale on which one works. A priori, we also cannot affirm that farmer-led PPB programs are more 'participatory' than formal-led ones-- or vice-versa. Indeed, case analysis shows there is a very wide range of collaborative arrangements in both types.

- Note that other terminology has been used to describe participatory approaches in plant breeding, with terminology differing by the variable which authors choose to emphasise. Some focus on the stage of germplasm development at which collaboration starts, i.e. whether materials are stabilised, as in Participatory Varietal Selection (PVS), or whether the material is still segregating, as in Participatory Plant Breeding (PPB). These two together have been labelled, Participatory Crop Improvement (PCI) a term which seemingly could embrace also non-genetic options, such as fertility management. Others emphasise the fact that farmers are involved at all in formal breeding work and use the generic label of Farmer

Participatory Breeding (although, it is not clear if there are other parallel forms of participatory breeding). Still another group puts weight to the fact that farming and researcher communities are working together and use the epithet: Collaborative Plant Breeding.

- In exploring PPB, the PBWG is aiming to enrich the basket of choices available in the breeding world--to meet better the needs of small farmers: in better environments and in marginal environments-- and particularly for women and the poor. Our challenge is to explore how PPB and classic breeding can better complement each other: what approach works best, where, for whom, and to meet which end.

1.3 POSSIBLE OUTCOMES OF PPB

- A range of outcomes can emerge from PPB programs. Because all may not be simultaneously realizable--and partners may have to accept trade-offs in reaching certain goals-- it is important at the very beginning of a PPB collaboration for researchers and development workers to discuss exactly what joint outcomes they are aiming for.

- The following provides a tentative list of the kinds of outcomes PPB might achieve, depending on how the programs are designed and unfold.

A. Production gains

- ✓ yield increases, stability
- ✓ faster uptake
- ✓ wider diffusion
- ✓ benefits gained through higher market value of product (income generated)
- ✓ better identification of farmer-preferred quality traits, such as taste, etc.
- ✓ better performance of genetic material in worst conditions
- ✓ (note that production edge of PPB may be not just in normal years--but when conditions are variable)

B. Biodiversity enhancement

- ✓ communities get wider access to germplasm
- ✓ communities get wider access to information/related knowledge
- ✓ more intra-varietal diversity
- ✓ more inter-varietal diversity
- ✓ compatibility of new materials with existing ones
- ✓ (less varietal replacement; more compatible with landraces)
- ✓ targeting of more micro-niches

Notes

- An objective may be to manage the pool of diversity versus “a variety”
- Efforts might be aimed at enlarging 'useful' diversity: that is, putting emphasis particularly on those traits which farmers value and are eager to maintain and promote.
- Strategies can be devised which encourage diversity both in space and time

C. Effective targeting (or meeting) of user needs

- ✓ greater inclusion (of different kinds of users) relating to access and benefits
- ✓ higher degree of farmers' satisfaction
- ✓ broader range of users reached
- ✓ reaching of the most marginal (particularly women and the poor)
- ✓ researchers’/breeders’ increasingly aware of farmers’ diverse and differentiated selection criteria

D. Cost-efficiencies; cost-effectiveness

Note: this is a criterion most applicable to formal-led breeding)

- ✓ reduced research costs in relation to impact gained. e.g.: acceptable varieties identified faster
- ✓ fewer research dead-ends
- ✓ more opportunities for cost-sharing in research
- ✓ less-expensive means for diffusing varieties

E. Capacity building and knowledge generation for both farming communities and the formal research and development (R &D) sectors

- ✓ farmer capacity enhanced to breed more accurately (if needed). This sharpened capability may be part of a larger process of empowerment.
- ✓ formal breeder understanding enhanced of the complexity of traits desired by farmers and of the site-specific exigencies.
- ✓ extensive knowledge dissemination: helping farmers become more aware of the formal system: e.g. let them see (and judge) gene banks.
- ✓ extensive knowledge dissemination: helping the formal system understand the nuances of farmer breeding and seed systems so as to more effectively plan joint work.

F. Empowerment, particularly of farming communities

Note: It is a significant challenge to develop indicators of empowerment. This implies a common shared conceptual framework among partners of what 'empowerment' looks like and indications of which changes in status are positive or negative.

- ✓ changes in types of participation; in relationship between partners, e.g. depth of recognition of farmers' own breeding within this activity.

- ✓ changing priorities or needs (e.g. farmers have equal voice in setting the joint breeding agenda): changes in patterns of decision-making.
- ✓ changes in access to and control over germplasm development, supply and information.
- ✓ changes in farmers' critical awareness of research and policy arenas

G. Institutional and organizational innovation

- ✓ identification of sustainable ways to decentralize PPB: in marginal and higher potential environments, bringing different partners in the process
- ✓ clarification of strategies for scaling up process of PPB
- ✓ identification of options for moving and scaling up the products of PPB
- ✓ improvement of links to help farmers to strengthen their access to sources of material and information. [Put another way, if a farmer-driven programme results in less overall diversity in their fields, this is not necessarily a problem if farmers continue to have access to diversity, should they so desire it.]
- ✓ changing relations/attitudes between communities and formal research systems.

H. Breeding program and seed policy modifications to accommodate expansion and institutionalization of PPB.

- ✓ recognition of farmer varietal assessment/acceptability as a key condition of release
- ✓ formal release of site-specific materials
- ✓ support to localized seed multiplication and distribution enterprises
- ✓ strengthening and support to informal/local farmer seed systems

1.4 IMPACTS AND OUTCOMES OF PPB PROJECTS TO DATE [1]

Farmer –Led	Formal- Led
- Farmers' options significantly expanded; - Social and biological obstacles to diversity overcome; - Farmers' access to material through local seed supply and storage improved; - Biodiversity appears to have been enhanced; - Useful indicators for empowerment suggested.	- Breeders' selection criteria and methods modified; - Breeders confidence in farmers' capacity for evaluation increased; - Farmer-preferred improved varieties identified; - Adoption of new varieties increased; - Differentiated varietal preferences of user groups recognized; - Possibility of targeting breeding specifically to user groups recognized; - Varietal diversity in farmers' fields

1 Note that this is a list of achievements in a number of cases and not a list of achievements of each of the cases.

	increased; - Variety release and seed production systems examined and modified; - Decentralization of breeding process; - Farmers' organizations involved in partnerships.

1.5 CONTEXTUAL FRAMEWORK FOR PPB

Based on a preliminary inventory of work-in-progress and published studies, four sets of broad criteria have been defined by the PBWG to frame PPB work. The framework's purpose is heuristic: a) to try to cluster together 'like' studies and compare and contrast how methods used in similar cases shaped results; and b) to identify gaps in PPB work, in which critical studies should be funded. (Facilitator's note, this framework is being substantially refined.)

A. Environments of PPB

- The first set of criteria considers the environment of PPB, that is, the broad context in which it takes place. There are two parameters in this set of criteria: the agroecological environment, and the economic environment.

- The *agroecological environments* in which PPB programs have been developed range from a cluster of marginal, low input, and variable environments (which tend to be risk prone and heterogeneous) to a cluster of more favoured and uniform environments (which are sometimes high input and more easily controlled)[2.]

- The second parameter suggests the broad *economic environment* of PPB, that is the degree of market integration of participating communities. This can range from those which are primarily subsistence-oriented, implying that their crop choices are governed by their own adaptive and preference needs, to systems in which crop production is largely driven by urban consumer and/or commercial processor needs. The latter contexts tend to demand a high degree of homogeneity in product and often favour a narrow range of grain, taste, and cooking types.

- In terms of the environmental contexts for PPB, existing cases can be mapped along the full length of both axes and also at the majority of their intersects (Table 1). The largest number of cases is clustered within the marginal, basically subsistence-oriented production environments (e.g. work in Eastern India, Syria, and high-altitude Nepal). However,

2 It is important to note that "marginal" and "favoured" are not absolute categories as the characterisation of lands depends on various biophysical and socio-economic factors – like management and access to markets and labour; often these categories are relative.

surprisingly, an increasing amount of PPB work is now unfolding in the more favoured, market-driven contexts (e.g. irrigated areas of the Philippines, high potential areas of Terai Nepal). This is currently happening principally for two reasons: some PPB programs aim to expand intra-crop varietal diversity in what have become relatively uniform farming areas; and in some cases, NGOs are helping farmer groups organize PPB programs in more favoured environments primarily to gain more control over the breeding process, i.e. the case of rice in several Asian countries.

- PPB programs could also be appropriate in the more favourable areas where: existing seed systems are inadequate; or if user preferences are not fully being met by conventional breeding and/or users are seeking more organic products.

- In terms of distinguishing between formal-led and farmer-led-PPB: no point along the axes is denied absolutely to either group--although there would tend to be more farmer-led breeding in the very subsistence contexts and in the more favourable areas where groups make links to organic agriculture. (This would include the strong possibility for PPB in Europe).
- PPB not just a southern issue--Alternative farmers' groups, like the Zeeuwse Flegel, in Zeeland, Netherlands often articulate needs for access, or for germplasm services (such as cleaning potato landraces of viruses for an NGO's collection of old varieties) from the formal system. Thus, PPB, in terms of providing services to farmer-breeders, could be quite relevant in the North, as well, though the specific needs may be quite different. While co-operation is starting to occur in the North, barriers are still considerable, especially due to seed laws (DUS, listing requirements), but also due to institutional gaps and lack of trust between agencies.

TABLE 1

Distribution of PPB cases by type of environment (BEING MODIFIED)

Environment

Unfavourable.....Favourable

Market Integration **Commer.....Subsistence**

CORPOICA/CIAT Colombia CIMMYT Mexico IRRI/India partners	CIAT/CIAL/Colombia (beans) Sokoine/CRSP Tanzania Tanzania NARS/CIAT	SE Brazil/ EPARGRE CONSERVE/Philippines PNAP/CIP/Rwanda USDA Guanxi
IRRI India partners CNPMF NE Brazil NARC/DFID Nepal KRIBCHO/ODA India REST/Ethiopia ICARDA/Syria SURE/ICRISAT/India Guanxi Narendra Dev/India IER/KIT Mali ICRISAT/Namibia ICRISAT/Niger	PNL/CIAT Zaire BBA/India UPWARD/Philippines SAVE/Sierre Leone ISAR/CIAT/COOPIBU Rwanda	

Farmer-Led PPB
Formal-Led PPB

B. Crop Development Parameters of PPB

- The second set of criteria is drawn from the crop development parameters of PPB. In table 2 one axis divides PPB work by the *way the crop is reproduced*: vegetatively propagated, open and self-pollinated. The other specifically looks at the *developmental stage* at which the participatory collaboration is initiated.

TABLE 2 Distribution of PPB Cases by Crop Development Parameters

Propagation Mode

Stage At Which PPB Focused	Vegetatively	Open-Pollinated	Self Pollinated
Setting Goals	?	?	?
Work with Variable Materials	?	CIMMYT/ Mexico, maize SURE/ICRISAT, pearl millet ICRISAT/ Namibia, pearl millet ICRISAT/ Niger, pearl millet REST/Ethiopia, cereals Yiching/China, maize	IRRI/India, rice ICARDA/Syria, barley NARs/CIAT/Tanzania, beans NARC/ODA/LI-BIRD/Nepal, rice CIAT/Colombia, beans SEARICE/Philippines, rice Sokoine/CRSP/ Tanzania, beans
Work with Stabilised Lines	CIAT/Corpoica/ Colombia, cassava EPAGRI/ SE Brazil, cassava CNMPF/ NE Brazil, cassava UPWARD/ multiple locations, sweet potato PNAP/CIP/ Rwanda, potatoes	KRIBCHO/ODA/(DFID)/ India, maize (HYBRIDS)	IRRI/India, rice ICARDA/Syria, barley KRIBCHO/ODA/ India, rice PNL/CIAT/ Zaire, beans ISAR/CIAT/COOPIBU/ Rwanda, beans BBA/India/ beans, rice SAVE/Sierra Leone, rice Narendra Dev/India, rice
Seed Sytems	CORPOICA/CIAT, Colombia, cassava CORFOCIAL/ Colombia, maize		CIAT/Colombia, beans ISAR/CIAT/COOPIBU Rwanda, beans

- The most oft-cited developmental divide has been made between PPB programs that use variable materials and those that evolve around stabilised/fixed lines. Perhaps a more instrumental way to categorise PPB cases is to identify the plant breeding stages in which the work is taking place. Five stages of plant breeding can be outlined and depicted in a cyclical fashion (Figure 1). PPB programs can start, and receive farmer input (in a variety of forms), at any one of these stages, and each stage can feedback (or forward) into the others. The five stages are:

  - ✓ **Setting Goals**- The breeding goals and strategy are determined.

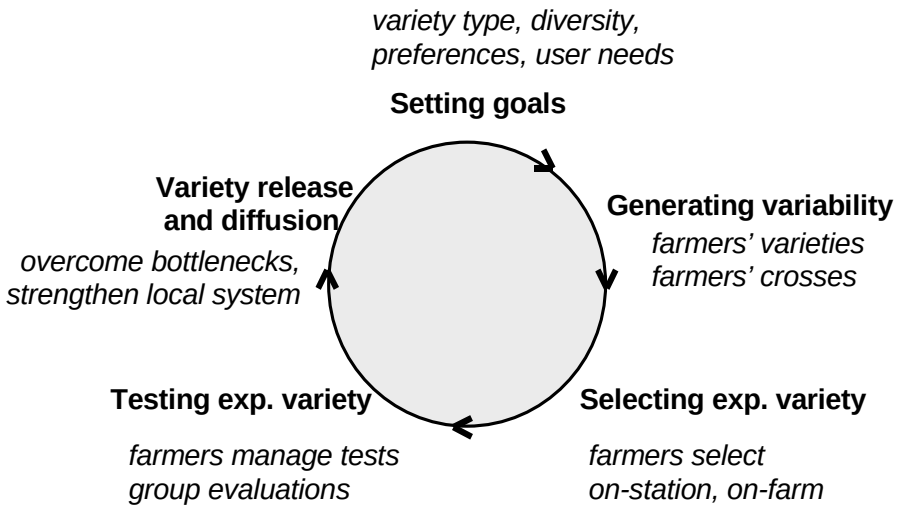
  - ✓ **Generating Variability-** Crosses are made between diverse parents with complementary trait combinations; population crosses are generated; germplasm is collected from different places (gene banks, farmers' fields etc.).

  - ✓ **Selecting Experimental Varieties-** The variability generated in the previous phase is narrowed down, through selection, and a limited number of potential new varieties are kept for testing.

  - ✓ **Testing Experimental Varieties-** The experimental varieties are tested for desired traits in replicated trials over a range of environments.

  - ✓ **Variety Release and Diffusion**- After PPB work has helped to create or introduce new genetic variability, programs have to focus on multiplying and distributing the products of PPB--that is, getting seed and plantings throughout communities and beyond

Figure 1. The Cycle of Plant Breeding Stages, with examples for farmers' contributions (in italics).[3]



3 From Weltzien RE/ Smith M, Sperliling L, and Meitzner, 2000

- The involvement of farmers in planning the objectives and strategy for a formal-led PPB effort has yet to be assessed. There is also a lack of work exploring whether formal or farmer-led PPB can link farmers with 'pre-breeding' and applications of biotechnology to genetic improvement.

- The PBWG regards seed systems issues as integral, not optional, in PPB programs. Both the informal, farmer systems as well as the formal, often state-financed and managed agencies are possible suppliers of material. The type of seed system into which materials will feed (formal, farmer, intermediate) needs to be determined at the beginning of the PPB work as it shapes the types of varietal options which can be distributed at the end of each PPB cycle.

- As Table 2 shows, PPB programs have been found across crop types (in vegetatively propagated, open- and self-pollinated). About an even number of cases have worked with variable and stabilized materials.

- Most PPB work has been with staple food crops. However, there is no reason why the approach could not be successful with other crops. Some of the vegetables and local crops, e.g. buckwheat, neglected by the formal system should be expected to have particular relevance. (The term 'neglected' crops refers to those suffering from poor research allocation by national and international systems.) Crops closely linked to industrial production, those that are difficult to breed, like sugar cane or beet, and many perennial crops probably provide less fruitful avenues for PPB collaboration.

- Very few programs have tried to unite the development of PPB materials with subsequent seed system diffusion. A handful have successfully introduced PPB materials into the formal sector (in India and Nepal)--but without resolution of possible property right discrepancies. Some programs have specifically worked with groups of farmers who can take over the seed multiplication for their own communities (Rwanda/beans, Colombia/beans, Colombia/cassava, and Colombia/maize).

C. Quality of Participation

- Another important criteria for characterising PPB cases is by the quality of participation that they are using. The quality of participation has four dimensions: the actors, the stage, the degree, and the roles.

- The *actors* in a participatory process need to be identified very carefully to ensure that all the relevant stakeholders are involved.

- The *stage* of participation is the parameter that is most often sited in describing the quality of participation used. It refers to the stage in the breeding cycle at which farmers are involved. As stated above, farmers can be involved in any of the five stages.

- The *degree* of participation describes the level of influence and decision making power farmers or other users have in a process at any given stage.

- The *role*, or the function of the actors in a participatory process can vary significantly (e.g. information-giver, germplasm-provider, active researcher)

D. Organisational Process

- A final parameter for the characterisation of PPB cases is the organisational process: how the breeding process is structured, what type of organisations are involved, how they interact, their roles and links to communities and to seed supply systems, and the scale.

- Many PPB programs conduct on-farm tests in order to develop new varieties in the actual planting conditions that they are destined for. This decentralisation of breeding – essentially a reorganisation of the breeding process - has sometimes been confused with actual participatory processes where roles, responsibilities and benefits are shared.

PART 2

RESEARCH GUIDELINES FOR DEVELOPING PPB PROGRAMS

The first draft of these guidelines (issued: October 1997) drew extensively on the results of a small expert consultation, conducted in The Hague, the Netherlands, June the same year. This third version still builds on what was recommended by the 1997 working groups, but further adds insights from Weltzien et al., forthcoming, McGuire et al, 1999, from a series of PPB workshops conducted in Malawi, Ethiopia and Ivory Coast, in 1998–1999 and from the feedback sessions held at the International Symposium on PPB in Latin America and the Caribbean held in Quito, Ecuador in August, 1999. We hope that the fourth round of this document will build still further on what is an accumulating body of on-the-ground PPB experience. We urge readers and practitioners to contribute actively to these guidelines: comments, criticisms, field examples, subject additions...

This section is divided into three parts. The first gives guidelines that are applicable to both formal and Farmer-led PPB. The next two parts give guidelines and share insights specific to Formal- and Farmer-led PPB respectively.

2.1 GENERAL

This section discusses elements that are important to all PPB programs weather Farmer- or Formal Led:

- ✓ Clarification of Expectations
- ✓ Background Information
- ✓ Baseline Information
- ✓ Terminology
- ✓ Major Steps

A. Clarification of Expectations/Protocols

- Any relationship between farming communities and researchers, whoever takes the lead, demands that expectations be clarified on both sides. This means that all parties have to understand who is responsible for what, who makes which decisions, and who controls the outcomes.

- Such 'clarifying of expectations' can be more formal or less so--but has to be done very explicitly. Some PPB exchanges are based on simple oral agreements, while others can take the form of semi-legal documents or protocols. PPB work has special challenges in that it can identify products such as breeding techniques or germplasm which have value beyond

the site-specific locale and which may have tangible rewards (e.g. money). Clarifying who has contributed to and controls such value is a must. This is particularly true in the absence of formal recognition of the role of farmers in much of the breeding work and varietal management to-date. The Farmer Rights debates are far from being resolved--yet PPB adds still another layer of complexity: as the work is explicitly shared, so the benefits and recognition have to be shared.

- To-date formalised protocols have more often been evoked in farmer-led research and development (e.g. CBDC, 1996). However, there may be ample scope for respecting some of the same protocol principles in a wide body of Formal-led PPB work. Some of the preconditions which might be addressed in a PPB protocol include:

  ✓ Explicit description of farmers' and scientists' roles in making the decisions
  - setting priorities
  - determining divisions of labour
  - evaluating products

  ✓ Elaboration of mechanisms for making all stages of the collaboration transparent and for redressing conflicts/concerns

  ✓ Pre-determination of credit sharing arrangements, including property rights or benefit sharing on products (varieties) and research processes and findings.

  ✓ Assurances/strategies for making resulting products (e.g. varieties/seed) and processes (e.g. skill building) more widely available.

B. Background Information

- Collaborative or participatory efforts in breeding are about much more than germplasm. They are about intervening in complex agricultural systems (biological, social). Key background information is needed to help those involved in PPB contextualize and develop their work along the most promising technical and organisational lines. Work should be designed to encourage sustainability of the PPB work, as well as equity in the results. To do joint work on PPB in an informed manner, the PBWG suggests that partners have a good basic and shared understanding of the local area in terms of:

  Crops and characteristics of crops

  Which are most important?

  Who is doing what in terms of crops/varieties, including analysis of the different networks on which one can build?

Farmer profiles

Language, ethnicity, caste, age, gender, income, education, market relations/orientation, How are they organised? What is the full range of stakeholders? What are the relationships among groups?

Farmer/community expertise

Some understanding of local knowledge, practices, and innovation systems (including who does the innovation and who are there experts?).

Farmers' needs

Needs of different groups
Crop limitations; production limitations

Seed supply /exchange for both the farmer and formal seed systems.

How effectively does material normally move (with what speed, over what distances, among which social groups)?
How much new material can local systems handle?
How efficiently can material be maintained within and across communities?

Basic biophysical characteristics of the sites, including biodiversity available

Policy Environment: incentives/disincentives for meeting farmer objectives and supporting joint as well as local innovation

C. Baselines

- Certain kinds of qualitative/quantitative baselines might also be needed against which the effects of a PPB program can be assessed. As not all aspects can be measured and monitored, the partnership should clearly decide what its objectives are and then together construct the range of indicators that can inform partners as to whether the process is unfolding as expected and whether objectives are being met. Some indicators might be very site-specific, and meaningful primarily to farmers (sometimes called 'grassroots' indicators'). Others might be more generalizable, scientific, and 'transferable' to other sites. So, for instance, if the PPB collaborators aim to enhance farmer breeding capacity, they need to develop a means to assess such factors as: the current art of local germplasm and selection practices, rate of progress and selection during the collaboration, perhaps the effects of modified management on local germplasm and/exotic germplasm.

- For each of the aspired objectives of the PPB program, 'process' and 'product' baselines might be articulated. These might be both in grassroots and more generalizable formats. Milestones of progress can then be set in relation to these baselines.

D. Terminology

- Terminology is crucial in encouraging collaboration among different partners. In PPB work, care has to taken to develop a common language from the very beginning stages. Farmers' existing cognitive categories may be useful in helping to establish commonalties. For example, Tigrayan farmers describe hybrid varieties as “married”, and F1 hybrids as “mule” lines. Important nuances have to be mutually understood. For instance, many farming communities do not establish clear boundary domains between varietal maintenance and varietal improvement: gradual actions in the former simply lead to the latter. Establishing 'local indicators' for recognising active 'improvement' may be important for the collaboration.

- Developing a glossary of local crop improvement terms and concepts may also be an early priority. Often one of the biggest challenges from the scientists' point of view is learning how to avoid western technical jargon-- and how to think in terms that can be truly shared.

E. Major Steps

Following are the major steps that need to be planned and negotiated within any PPB program. The emphasis on one set of steps or another will vary in Formal- and Farmer-led programs. Each step and how it should be treated in one or another approach will be discussed in detail in the following two sections.

Setting Objectives
- Overall diagnosis: Is PPB necessary?
- Definition of the objectives of PPB
- Understanding the Context
- Diagnosis among users: What do they want?

Technology Generation
Where/Sites?
Who will participate? (institutions/farmers/communities/users)
What is on offer?
Who does what in the breeding/screening process? (divisions of labor)
Evaluation
Feedback and Feedforward
Seed Systems Issues
Information dissemination on Innovations
Addressing Intellectual Property Rights

Planning For A Cycle Of PPB

2.2 GUIDELINES FOR FORMAL-LED PPB

- We use the term PPB within the Formal-led work to refer to the full scope of activities associated with plant genetic improvement, including:
  - ✓ identification of breeding objectives,
  - ✓ generation of genetic variability,
  - ✓ selection within variable populations to develop experimental varieties,
  - ✓ evaluation of experimental varieties (often termed "participatory variety selection" or PVS), and
  - ✓ variety release, popularization, and seed production activities.

  Farmers can participate in breeding programs at many different points in this continuum and to varying degrees, resulting in a broad spectrum of possible farmer-researcher interactions.

- In Formal-led PPB, there is often a need for a variety of controls, partially to allow the results of the work to be extrapolated. These controls may range from internal checks in individual trials to a range of procedures that allow the whole PPB program to be directly compared with conventional breeding. As it is the formal sector, which most often wants these controls, that is, not the farming communities, costs for such scientific standards' should probably be fully borne by the formal research partner. Farmers may also request their own controls, which may not strictly coincide with researcher comparative measures. Farmer-designated controls should be incorporated within the experimental design.

- Similarly, in Formal-led PPB, researchers might find it crucial to distinguish between the effects of decentralizing breeding and the effects of participation per se. (Decentralizing selection in a farmer's field, with farmer as manager or occasional evaluator does not automatically equate with participation). The costs for such research design exigencies should be borne by the formal research partner.

A. Setting Objectives

Overall Diagnosis. Is PPB Necessary?

- A first step in formal-led PPB is to determine whether a PPB collaboration is necessary at all. Has classic breeding not met its own defined objectives? Has it not met farmers' objectives? Can farmer breeding alone resolve the constraints?

  If none of these answers is positive in terms of meeting farmers' needs, one then has to be equally rigorous in scrutinising the potential of Participatory Plant Breeding approaches. Would a joint collaboration between farmers/communities and researchers have potential to

overcome identified constraints? Would collaboration present promising opportunities? What evidence suggests it could be worthwhile? PPB collaborations take a good deal of time and effort on the part of research and farming communities-- and should not be undertaken lightly.

Definition of objectives of PPB

- If PPB seems necessary--and if farming communities see the work as priority, it is critical for farmers and researchers to discuss in detail their joint objectives. Different PPB strategies can give very different results. The collaboration has to be based on transparent, well-defined objectives.

- In general, the objectives of formal led PPB to-date have very much paralleled what one would expect from conventional or classic formal sector research. A review of the primary goals guiding 40 formal-led PPB (Table 3) showed that most (78%) programs have focused on various aspects of production increases, i.e. the same goals towards which classical breeding programs strive (Weltzien R., et al., forthcoming.) Programs have most often targeted marginal environments, where impact from classical breeding programs has been less than expected or completely unsatisfactory. Many programs have been oriented towards the identification of better varieties; that is, those that offer clear advantages over farmers' own local varieties or locally available cultivars. Often linked with this objective has been scientists' need to better understand farmers' selection criteria and preferences for a range of traits, possibly traits with which farmers have had no previous experience (68% of PPB programs). This knowledge usually feeds back directly into on-going breeding efforts, to change priorities for testing and selection criteria. Another closely related objective, of specific importance to marginal environments is the possibility to release varieties adapted to specific zones of cultivation (13% of formal-led PPB programs).

GOAL (motivation)	# of cases	% of cases
Productivity Increase (better varieties)	31	78
Research efficiency (farmer varietal criteria, appr. testing)	27	68
Biodiversity conserved/enhanced	8	20
Policy changes (Release, seed multiplication)	5	13
Facilitate farmer learning	3	8
Other	3**	

* **some** cases are listed twice as they had multiple primary goals

** This category includes two different motivations: empowerment, and benefits to specific users

- To-date, formal-led PPB has not defined as primary objectives, goals such as enhancements in biodiversity or farmer capacity-building directly--- although these have been achieved as 'secondary' complements in a number of cases. It appears that the full range of goals has not been systematically explored in formal-led PPB programs (and that the full range of potential impacts has not been identified). The relative narrowness of present aims shaping PPB work is perhaps a feature of the newness of the approach.

- The stage of 'goal-setting' itself is not an easy one in the PPB process-- and the methodology for doing it has rarely (never?) been described in the PPB literature. This lack of deliberate methodology is worrying as, to a great degree, the goals set for PPB programs largely shape the research design as well as secondary effects which PPB programs achieve. What is on offer (skills or varieties), the type of germplasm used, the type of farmer involved, the scale on which one works, the trial design, the seed multiplication procedures are very much influenced by the overall goal(s) set.

- A process of transparent goal-setting implies that farming communities have to be fully aware of what their options may be and trade-off among these options. (Formal researchers often have sufficient background in this area). For instance, what is the potential/trade-off for increasing production and meeting certain quality characteristic simultaneously? What the possibility for increasing production and building on local varietal diversity--- versus other gains to be explored from introducing exotic germplasm? A good deal of creativity may be needed to make the potential goals truly intelligible for partners who may be unaccustomed to weighing such alternatives.

<u>Understanding of context</u> (see BACKGROUND and BASELINES in General section)

<u>Diagnosis among users. What do they want?</u>

- Accurate diagnosis of what users want and need demands a range of techniques. One method cannot usually suffice to capture nuances in overall germplasm needs and needs among different user groups.

- Examples of some techniques include: preliminary evaluation, with farmers, of 'weaknesses' in material they are already sowing; exploratory trials using both local and exotic material; as well as the more common survey, focus group or community meeting assessments.

- The full range of potential user groups should be involved at the diagnostic stage. This might include: different groups of farmers--poor, rich, those with and without irrigation; intermediaries processors; and consumers. Separate meetings are sometimes required to learn concerns of the more disadvantaged groups.

- Many of the traits that farmer may want are incompatible with each other and farmers may sample for several types--to get a seed lot, not an individual plant. Seed lot, not variety or ideotype, may prove the better vocabulary for describing farmer goals.

- Increasingly, PPB diagnoses are showing that farmers are not looking for one or two ideotypes, but rather a range of materials that, together, give them the traits they desire.

- We need better diagnostic methods, which don't involve growing out materials: this can be expensive, time-consuming--and not always possible.

- Basic to any diagnosis is that researchers understand farmers' own concept of 'variety' as well as understand the implications of local selection terminology.

- It is important to keep in mind how long the breeding cycle may take. One needs methods to accurately represent current preferences, but those involved have to be able to anticipate future needs as well, for instance, ten years onward. Exposing farmers to a very wide range of germplasm, some of it 'less known', may give an idea of moving trends. 'Trends', however, is the operative word as the level of resulting accuracy can be variable.

- Finally, the process of diagnosis itself has to be a cyclical one: repeated at regular intervals to capture changes and anticipate moving needs and preferences.

B. Technology Generation

Who will participate: institutions?

- The search for partners should be guided by a clear idea of what needs to be accomplished in the 'institutional' realm. Is capacity building a goal for any particular institution? What kinds of complementary expertise might be needed (and how can this be found within or among institutions?

- From the outset, partners have to clarify the expected roles, cost sharing arrangements and more general contributions of each.

- Is scaling up desired? (Can institutions help scale up across large geographical areas? in particular key sites? with a chosen user group?) Can the institutions involved replicate the process of PPB collaboration? Are they able to widely move the products? (Whether skills or varieties)?

- Given the choice of partners, for what time period will the collaboration be sustainable?

- Teams might also consider whether rotation of site-specific partners (e.g. communities, cooperatives) is beneficial. There are usually trade-offs between capacity building in one site and potential to sustain the PPB work and---reaching large numbers of potential users.

Where/Sites

- Formal-led PPB usually has to be concerned with the extrapolability of the results of any one PPB program. As such:

  a) site selection should be probably be done by multi-disciplinary team (e.g. breeder, social scientist, NGO, environment/ecologist) in collaboration with communities to ensure that biases are minimized; and

  b) the site should large enough to justify the job: that is, it should representative of the larger target group and objectives. However, the site should also be 'small' enough to meet farmers' needs to target micro-niches.

Who will participate: farmers/communities/users?

- In a collaboration, each partner should decide exactly who will represent the interests of their particular group and who will take direct part in the technical decisions being made. However, there are some potential biases, both positive and negative, which can sharply influence the success of PPB---and of which all involved should be aware. Minimally, strategies to counteract the negative biases should be sought. There are a number of issues to consider:

  - *Individuals or groups.* Often, researchers have tended to work with individual farmers: those with whom they may have a good collaborative history, or perhaps those identified through an extension service. However, in work aimed toward more inclusive participation, there are compelling arguments to strive to work with groups of farmers. Groups of farmers, together, probably have more weight in ensuring that their needs are being net; that capacity building takes place; and multiple links are made to different activities--e.g. seed multiplication.

  - *Expertise or representativeness.* In most communities, certain types of individuals (e.g. older women) or even specific individuals are renown for having more knowledge about particular crop germplasm than others have. These are not necessarily the same people who outsiders would identify as 'wealthy' 'innovative' or progressive farmers. Rather, germplasm experts may be those who regularly experiment with varieties, may recognize important intra- as well as inter-varietal differences, and who target specific varieties to

different micro-niches. In a PPB collaboration, it might be useful for formal experts to work together with local experts.

- However, those with special expertise, do not automatically represent the full range of community interests in terms of germplasm preferences. Commercially oriented farmers may be looking for different varietal traits than those who mostly consume the crop themselves. Women might have particular quality demands relevant for food processing; the poor might need markedly shorter-cycle cultivars than those who can afford to go only for maximum yield.

- There are definitely trade-offs between working relationships based solely on special expertise and those based on representativeness. Partners collaborating in PPB should try to minimize these trade-offs by using multiple selection/evaluation strategies. If this is not possible, minimally, partners should seek to understand the biases, which may be inherent in the completed PPB work.

- Community selection of representatives does not automatically translate into participation by experts or representative users. As in many situations, those who are the most powerful tend to shape any interaction.

- *Equity*. If equity is an objective, particular attention needs to be paid to the needs of the marginalized (whether this is a feature of gender, age, ethnic group or something else). The interests of the disadvantaged community elements may not be expressed by those representing community interests (who are often the elite). Note that the marginalized/disadvantaged may also not simply have the time 'to participate'.

- If the subsequent seed multiplication is going to be community-based, involvement of key seed multipliers may be very useful at the selection/evaluation phase.

- In no situation should farmers just be selected (by communities or researchers) in a random manner to work on PPB. One farmer's evaluation (or general input) is not automatically the same as another's (there may be biases in expertise or representativeness--see above). Formal breeders/scientists should take at least as much care in trying to understand the differences among farmers as the differences among the varieties they sow.

<u>What is on offer</u>?

What can participants/breeders offer to future users?

- Generally, two types of broad items are on offer in a PPB program: skill building and germplasm (either introduction or improvement on existing materials).

Skill building

- Skill building of formal sector breeders often takes the form of better understanding farmers' general selection criteria and of more effectively being able to distinguish among criteria of different users.

- Skill building of farmers may involve strengthening farmer breeding skills, particularly for dealing with cross-pollinated crops, with segregating materials, or in selecting for tolerance to stresses for which their knowledge base may be less developed (for example in identification of plant diseases). A good deal of groundwork is needed to strengthen these skills successfully. Questions need to be answered, such as:

    - ✓ Is local farmer breeding in need of strengthening at all?
    - ✓ Can farmers benefit from new skills and methods? Who should define these?
    - ✓ If so, who might be trained?
    - ✓ Exactly what kind of training support do farmers need?
    - ✓ How might knowledge be further transferred? to whom? By what mechanisms?

Germplasm

- Different types of germplasm might be used in PPB collaborations. For example:

    - ✓ local: either segregating, stabilized populations, lines
    - ✓ exotic: segregating, stabilized populations, lines
    - ✓ options with introgressed genes

  Whether one uses local or exotic--or both--depends on the goals defined for the PPB process. In some cases, researchers might simply consider adding value onto what farmers already have: e.g. eliminating a pathogen from a vegetatively-propagated crop.

- If germplasm introduction is to take place, the formal-led PBwg recommends that joint research first work with stabilized materials: the learning process is easier for both partners; it costs less; and farmers get access to finished product more quickly.

- The number of materials to be screened depends on several factors:

    - ✓ logistics: whether screening is on an individualized farm or centralized plot;
    - ✓ resources available: e.g.: amount of land on offer, the window of planting time;
    - ✓ methods: intensity of evaluation expected for each entry;
    - ✓ experience: farmers' former exposure to germplasm and how comfortable they feel with looking at many materials.
    - ✓ the goal of the screening exercise: is it an exploratory evaluation to get feedback on farmers' criteria and preference needs? or is the screening the screening explicitly to

offer farmers an already client-oriented pool from which they can choose material for directly subsequent testing (either in community plots or on individual farms)

- It is through targeted diagnosis of farmers', and other end-users needs that the PPB program can move from general exploratory pools to more client-oriented or focused ones.

- In general, it is better to aim for joint work with a maximum range of useful genetic diversity: that is, offer more, rather than fewer options. (Note: the upper limits of successful joint formal-led PPB to date: 140 with rice in Nepal; 100 with beans in Rwanda and 80 with barley in Syria and Tunisia).

Who does what in the breeding/screening process: divisions of labor

- Formal breeders and farmers (including farmer-breeders) can play a range of very different roles in the breeding process itself. Much depends on the objectives desired and the comparative advantage of each of the partners.

- In theory, each of the steps in Box 1 could be decided/managed by a single partner [whether farming community or researcher(s)], or by both partners jointly.

(Note: the SWP PRGA is now rigorously evaluating the different breeding options available. The next version of these guidelines will elaborate case studies of the different divisions of breeding labor currently being assessed.)

- For example:
  - ✓ Genebanks/breeding programs may simply supply genetic diversity to farmers-- and then schedule a follow-up years later.
  - ✓ Farmers and formal breeders may do joint selection of segregating material in farmers' plot (if adaptation and disease are problems and segregating material required)
  - ✓ Farmers may choose material for further evaluation, on the research station or in community plots
  - ✓ farmers may be primarily responsible for some traits, and breeders for still formal breeders for still others

- Breeding responsibilities may also change through time, as each partner becomes familiar with the others' expertise. For example, at first, farmers may screen for what they can immediately 'see'; and then move on to screen for other more complicated stresses that they have learned to evaluate.

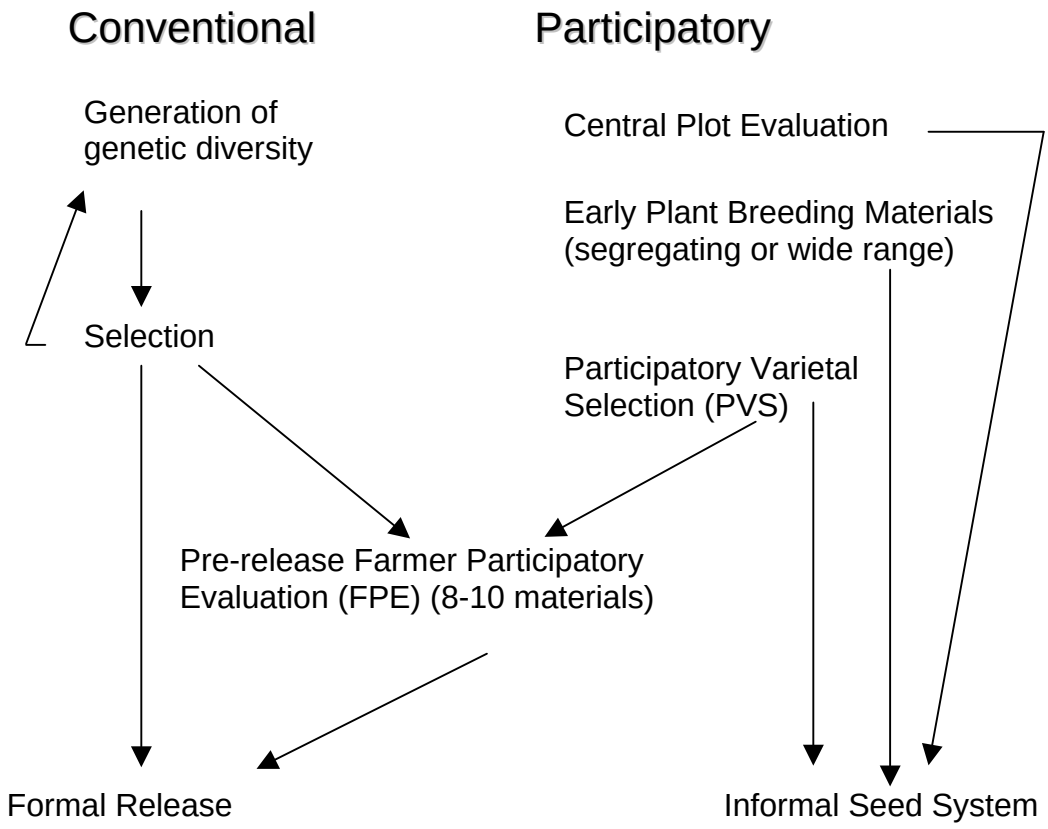
- In general, the earlier farmers are involved, the greater the possibility that the informal seed sector will have to be accessed to move the resulting PPB materials. Early evaluation can mean exposure to and acceptance of a greater range of varieties. It can mean that different groups choose more site-specific materials. Diagram 1 illustrates this process.

BOX 1: POSSIBLE ROLES IN PPB: WHO/WHEN?

* Setting overall breeding goals
* Diagnosing specific breeding/seed system constraints
* Generating variability
* Screening variable lines on station
* Screening stabilized lines on station
* Screening variable lines On farm
* Managing variable lines on farm
* Managing stable lines on farm
* Evaluating entries on farm
* Deciding which germplasm is acceptable for seed multiplication
* Seed multiplication
* Seed distribution
* Information dissemination on innovations

Diagram 1

The Relationship Between Breeding Framework and Supporting Seed System



Evaluation

- Evaluations of the materials should be done jointly at several intervals: if possible, at different critical stages of plant development: e.g. flowering, pre-harvest, post-harvest. Post-harvest features, such as storability, milling quality and potential marketing price should be considered along with crop development parameters (maturity cycle, growth habit--and whatever other aspect farmers deem important).
- A variety of methods can be used to get this immediate feedback: e.g. :open-format dialogue, structured and unstructured surveys, focus groups, matrix ranking.
- It is important that these immediate evaluations be done with a range of users-- so as to understand their similar----- or different varietal preferences and needs. In this same vein, the evaluation should be analyzed so as to understand possible differences among potential range of potential user groups: for example farmers (women, men, rich, poor), intermediate processors, consumers...
- Evaluations should encompass both qualitative (e.g. acceptability) and quantitative aspects (e.g. yield).
- Evaluations should also be scheduled to encompass longer-term horizons of use: e.g. 2-3 seasons after first testing. Such evaluations are important for understanding:
    - ✓ farmers' fundamental appreciation of the material, (are they replanting it; at what rates, why; is seed saved; does it enter into local systems?);
    - ✓ constraints they may have to using it, (are there quality problems? seed supply constraints?; as well as
    - ✓ modifications in the germplasm itself or the way it is being managed.

Feedback and Feedforward

- It is important that feedback (to the formal research program) and feedforward (to farming communities and beyond) be carefully programmed in PPB work.
- This might imply use of different formats: reports, community meetings, broadcasts.
- This also usually implies use of different languages for different audiences.
- Feedback and feedforward helps to further verify results; share information in ways that may enhance its diffusion; and identify possible opportunities/biases in joint results achieved.

Seed Systems Issues

- Ensuring that seed systems can move PPB material is essential. The ability of existing channels to handle the new material should be analyzed in relation to potential constraints:

  Can the seed channels identified:

  - ✓ ensure the phyto-sanitary quality needed by farmers (this is a particular problem for vegetatively-propagated crops);
  - ✓ ensure the genetic composition desired (this is a concern for the cross-pollinated materials);
  - ✓ handle the quantity needed, of each material;
  - ✓ diffuse at an acceptable rates (speed)
  - ✓ diffuse over the desired geographic distance
  - ✓ diffuse to a wide range of users
  - ✓ diffuse at acceptable cost
  - ✓ promote the diversity of materials identified at one point in time?
  - ✓ promote a diversity of materials through time (allow for turnover)

- Because different seed channels may have different strengths, PPB work might expressly aim to experiment with different seed system support approaches (maybe for different crops, for different types of end users).

Information Dissemination on Innovations

- In order to have the benefits of the joint PPB work move beyond those directly involved (and beyond their communities), there may be a need to program actively information sharing on a number of levels. Even if the materials are fed into a formal release system and a formal seed supply system, this strategy cannot ensure that those who should be reached by the PPB innovations will indeed reap benefit. The communities involved will serve as one important information source. For formal-led PPB, however, which aims to reach a large range of potential users, other means of information extension need to be considered (for example, radio?)

Addressing IPR Issues

- Joint collaboration should mean joint benefit sharing. This issue has been touched on in the section on 'Clarifying expectations'. There are no ready-made arrangements to suggest here and the SWP PRGA has recently started major work to address property rights issues for the range of PPB collaborations identified (about 8 to 10 type cases). One innovative approach used by the maize program of Embrapa, Brazil has been to announce officially a variety shaped within a PPB program as the product of joint, participatory work. This notation has appeared on the release announcement and promotion flyer of 'Sol Da Manha NF (Nitroflint)'.

C. Planning for A Cycle of PPB

- It is important to remember that the process of PPB itself is one, which builds skills and sharpens the choice of options for all partners involved. In this iterative learning process, organizations may be strengthened and evolve, roles may shift, and even the choice of outcomes may be broadened.

- The challenges of the first cycle of PPB often differ significantly from those of subsequent cycles. The focus may move from work on 'breeding technique' and 'germplasm access' to issues of institutionalization and scaling up. Partners engaging in joint PPB work should program activities with flexibility.

D. Lessons From Formal-Led Cases To-Date

(Section adapted from Weltzein et al. 2000)

Biophysical and Socioeconomic Environments of PPB

- ✓ Around a third of Formal Led PPB cases are found in marginal, high stress environments for which conventional programs have not developed adapted materials. PPB is also being used by formal programs and the private sector in semi-favored and favorable conditions where the product undergoes tough scrutiny for quality by intermediaries and consumers.
- ✓ Most formal –led PPB programs are working with major food crops (i.e. crops that are part of the formal sector's breeding mandate). There are very few programs working on minor crops.
- ✓ Most of the formal-led programs are working with self-pollinated crops, followed by cross-pollinated, clonally propagated, and tree species.
- ✓ The primary objective of most of the formal-led programs is the identification of varietal needs and preferences to feed into formal breeding practice.

Issues of Participation

- ✓ The specific cropping system and the rate of seed increase and multiplication of the crop will have an affect on the stages and ways in which farmers can participate.

- ✓ Various methodologies can be used to understand farmers' varietal needs and preferences. Two approaches that have been effective are:
    a. On station: exposing farmers to a broad range of genetic material at the research station in order not to limit the discussions to materials and traits that they are familiar with.
    b. On farm: ask farmers to grow a highly diverse set of materials on their own farms to allow them to observe the materials and to express themselves in their own contexts.

- ✓ Most projects are testing methods for farmer involvement in evaluating varieties in final stages of development. i.e. when genetic composition will no longer change and enough seed available.

- ✓ Some programs on the other hand are working with early generations. Their experience indicates that involving farmers at this stage can be very effective as farmers often have the skill to evaluate for a combination of desirable traits quickly. A few approaches have been tried:

    a. First generations of segregating progenies are grown on station, selected for specific traits and seed is increased. Farmers then receive preselected bulks to evaluate and select from under their management.
    b. Allow farmers to make first selections within F_2, F_3 or F_4 bulks or open-pollinated population bulks either on the research station or on their farms. Farmers would share seed from selected individuals with breeders and decide whether to keep selecting within the chosen materials. Breeders in turn test key traits that are harder for farmers to evaluate, and multiply seed of the most promising materials.

- ✓ Farmers are rarely involved in generating variability for use in formal-led PPB. The few cases that do exist indicate that farmer participation in this stage can be very fruitful because this is the stage when the most drastic selection of materials is made. Usually these evaluations are based on traits that are already fixed and visible to the naked eye.

- ✓ Skeptics ask if PPB is really necessary, if classical breeding could achieve the same results if they had the right goals, they selected in the target environments and had thorough knowledge of client preferences. The answer is "yes" provided
    a. client preferences were clear-cut and well articulated ,
    b. breeders could develop client-oriented product using standard experimental designs ,
    c. breeders had the resources to select in the target environments and

d. breeders had stabilized materials adapted to the target environments.

- ✓ PPB is necessary and could not be replaced by conventional breeding in the following situations:
    a. in cropping systems with strict quality standards that require "judgement values" such as taste.
    b. systems where client preferences are highly differentiated
    c. in marginal environments (that are extremely variable and sometimes subject to sporadic stress) where it is too costly for formal programs to test on a large enough scale.
    d. for crops that have complex character tradeoffs.
    e. for minor crops that are not in the mandates of formal breeding programs.

- ✓ This means that PPB is necessary when:
    a. farmer expertise is needed
    b. farmer preferences are highly differentiated
    c. farmer labour is needed
    d. farmer environments are needed
    e. the scale of the desired impact requires that farmers take over adaptive testing
    f. farmers want greater control over germplasm and seed supply and
    g. farmers need to take on future breeding efforts.

Gender /User Differentiation and PPB Programs

- ✓ Different kinds of farmers can be involved in PPB programs depending on the goals of the collaboration:
    a. If the program needs *farmer expertise* (for screening segregating materials for example), those involved would be the local germplasm, variety or seed experts. "Expert" farmers are those who have a strong interest in germplasm issues and are engaged in either improving, selecting or supplying seed.
    b. If the program needs to consider *different preferences,* it would be important to involve farmers from a range of stakeholder groups (caste, ethnic groups, gender etc.)
    c. If the program needs to test varieties in a *range of environments,* the farmers involved would be those whose lands represent the different environments.
    d. If the program needs a large number of *on farm trials* or to ensure that the *benefits of collaboration* are widely spread, a community leader or person who has the support of his/her community would be sought.
    e. If the program seeks to *build skills* of farmers, those who are most able and keen peer communicators might be involved.

- ✓ Involving women farmers in PPB programs can significantly improve the quality of the work. This is because:

a. Women are often responsible for domesticating wild species, selecting germplasm and saving seed in small scale farming systems.
b. Women's involvement and expertise in PPB can benefit the whole community.
c. Women's varietal criteria and/or preferences are often (but not always) significantly different to men's.
d. Not involving women can sometimes have negative consequences on the program and in the community.

Institutions in Formal Led PPB

- ✓ Very few Formal-led PPB programs have managed to change the way in which their institutions work nor the linkages and power relations they have with other institutions.

- ✓ PPB by definition implies the collaboration of different types of institutions. If PPB is to take place under current institutional arrangements four challenges need to be addressed:
    a. Creating shared agendas.
    b. Building accountability into the research process. Those who are involved should be accountable for the relevance and quality of the results.
    c. Creating effective intra-institutional linkages.
    d. Ensuring effective communication between researchers and farmers.

- ✓ Very few Formal-led PPB programs have tried to scale up their work to reach a larger number of farmers. It has been done in two general ways:
    a. Scaling up the process:
    Large numbers of farmers can be involved in setting objectives through farmer surveys, community focus-group discussions or on-station farmer varietal evaluations. Variety testing can be performed by many farmers again on-station, or if trials and materials are distributed to many communities. Another approach could be to create multiple decentralized programs where PPB would take place independently at different sites.
    b. Scaling up the products
    Large numbers of farmers can be involved in testing the adaptability of the products of PPB (seed) only if it is widely diffused.

- ✓ Most of the programs that have attempted scaling up have worked with stabilized materials. While participatory varietal selection over broad areas has been effective in addressing local demands, the need and usefulness of scaling up farmer participation in generating variability and selection in segregating populations is still questionable.

Transfer of Benefits

- ✓ Informing farmers about the availability of a new varietal options can help to create demand and be very instrumental in transferring benefits

- ✓ Local seed systems are often quite efficient in diffusing new varieties to non-participant farmers. Formal-led programs however usually seek to diffuse seeds through formal release channels. All seed systems have their strengths and weaknesses and practitioners should be conscious of these. The following elements should be considered:
    a. The number of varieties that will be diffused.
    b. The scale and target groups to whom the diffusion is aimed.
    c. The property regimes of the seed systems and their acceptability to the partners.
    d. The homogeneity or heterogeneity of the final PPB material.

- ✓ Property rights and ethical issues have not been adequately addressed in formal-led PPB programs and as of yet there are no examples, precedents or arrangements for best practices to be illustrated. However farmers', breeder's (and other groups') varying contributions in specific areas of PPB can be followed, documented and studied to give insights on each actor's rights.

- ✓ A starting point for meaningful discussions about varietal property rights could be mutual learning of the different partners' concepts surrounding varieties and seed systems.

COLLABORATORS: THIS NEXT SECTION IN PARTICULAR NEEDS TO BE FLESHED OUT: PLEASE SEND COMMENTS

2.3 GUIDELINES FOR FARMER-LED PPB

- Farmer-led PPB aims to support currently existing plant genetic resource management systems. This does not mean that such programs aim to work with farmers in order 'to keep them where they are, or to remain static'. Skills may be enhanced and new flows of germplasm may be introduced. What is key is that, within Farmer-led PPB, the control, management and priorities of the farming system remain firmly under farmer control.

- In general, Farmer-led PPB programs, that is, those in which scientists and development personnel work to actively support farmers' own breeding and seed systems processes, are fewer in number and less documented in the written literature (whether grey or official).

- Farmer-led PPB programs could be particularly effective in agricultural systems undergoing significant change, whether as a result of war, natural disaster, ecological change, or radical changes in policies (for instance in respect to markets or use of inputs). Such dramatic shifts may require re-establishment of seed supply systems; recovery of adapted materials or even adaptation of very new material to altered circumstances. In all cases, local needs and experimental capacity will have to steer the R & D agendas.

- It is surprising that more active 'interventionist' work has not been done in this area of Farmer-led PPB (although studies of farmers' own breeding methods and seed systems are on the rise).

- Some argue that farmer breeding itself is still the major evolutionary force in agriculture, and that additional ('outside') support to farmer breeding will be the only way to encourage significant improvements in two broad realms: in the many minor or alternative crops untouched by the conventional breeding system; and in the many micro-environments whereby it is not cost-effective for conventional breeding to devote resources.

- While protocols have been mentioned earlier (see section 'General'), their centrality in farmer-led PPB bears some repetition and elaboration here. Within farmer-led PPB programs, all contact with communities must follow certain protocols or codes of behavior in order not to undermine farmers as decision-makers and controllers of their own resources. Protocols have to clearly establish that the PPB work is a demand-driven process. Some elements of Farmer-led PPB protocols would include:

    - ✓ Frank discussion of IPRs (non-IP options or lack of them)
    - ✓ Assertion that full control of the process will remain with farmers
    - ✓ Confirmation that joint work strives for development goals and is not just research-oriented
    - ✓ Expressed sensitivity to secrecy and property issues

- ✓ Expressed sensitivity to time and other constraints faced by farmers
- ✓ Ethical and practical guides for linking with other individuals and organisations.

- Many of the technical insights proffered in the Formal-led PPB Section equally apply to the more Farmer-led PPB work. Below are listed additional concerns associated particularly with Farmer-led PPB.

- The overall steps for Farmer-led PPB very much parallel those of Formal-led, but with a different 'content emphasis'. For instance, 'Understanding the Context' is given much more weight in farmer-led PPB as farmers' variety and seed systems are the base on which the PPB work is built. Similarly, the steps of 'Evaluation', onward are modified considerably, as the domain of action tends to be relatively local. Varieties are not released and are not officially multiplied. There is a good deal of leeway in the type of material deemed acceptable and distributed within the community/ies.

A. Setting Objectives

Overall Diagnosis. Is PPB necessary?

- Farmer-led PPB should only be initiated when communities themselves define joint collaboration in breeding as a priority for action.

- A review of farmer-led PPB suggests the range of goals pursued under this rubric (see Table 4: drawn from McGuire et al. 1999). It is broader than that conceived by the formal-led programs

  * As many of the programs work with farmer varieties (FVs), their interest in conservation is not surprising. What is particularly of note is that many farmer-led programs see conservation and improvement as inter-linked, and classifying them as distinct goals has not always possible or useful.

  * Some farmer-led projects introduce germplasm as a basic step in crop improvement, with several known cases making a central aim to expand farmers' options by supplying crops species that were new to an area. (see table: SAVE and CIAL introduced modern varieties MVs, while USDA, operating at the dawn of professional plant breeding, still mainly distributed FVs.)

  * Programs with self-reliance as a goal sought to (re) gain farmers' control over key processes. This usually related to seed supply, but also to crop development; the latter goal closely related with skills-development as a PPB strategy. Notably, farmers' groups or NGOs generally initiated these cases.

* Several cases respond directly to disaster or dramatic change, despite the potential need for farmer-led PPB to work in such situations.

Table 4. Goals in Farmer-led PPB: a selection of cases[4]

Case*	Principle goals				Broad approaches				
	Conserve/ Improve germplasm†	Introduce new crop options	Promote self-reliance§	Adjust to change or disaster	Germplasm support: local	Germplasm support: non-local	Skills development	Promoting links	Indirect support
BBA	FV		x			x			x
CIAL		MV				x	x	x	x
CONSERVE	FV/MV		x		x	x	x	x	x
PTA	FV/MV		x		x		x	x	x
REST	FV		x		x		x		
SAVE		MV				x	x		
SOH	FV/MV			x	x	x		x	
Guanxi	FV/MV		x				x		
UPWARD	FV				x	x			
USDA		FV				x		x	
Zamorano	FV		x				x		

Cases showing their main goals and approaches taken. *Main institutional type: **bold**: NGO; **underlined bold**: farmers' group; *Italic*: NARS; plain text: CGIAR.
†FV: Farmer/local Varieties, MV: Modern Varieties. §Seeking to regain farmers' control over seed supply or variety development that had previously been lost.

4 From McGuire et al., 1999

Understanding the context**:**

(see BACKGROUND and BASELINES in GENERAL section see section WHO WILL PARTICIPATE, below')

Who will participate: institutions

- The selection of linking organization strongly shapes all future collaboration with farmers. It is important to work with groups that have an immediate link to the community, which preferably have an established relationship and enjoy the confidence and the trust of the local population.

- NGOs and other civil-society organisations are possible candidates, as well as (occasionally) extension services. Farmer cooperatives or community-based organizations might also serve to link communities with outside research and development groups. Protocols of behavior should be established for the linking organisations as well as for the intervenors (called the 'scientific sector': CGIAR, NARS, universities, some NGOs.)

- The intermediary organization can be/ideally is the source of the knowledge about wider context in which the community has been developing. This knowledge might come from the intermediary's own diagnoses--which have often emerged from their much broader development mandates.

Where/Sites

- Even farmer-led PPB should be concerned about the wider applicability of its PPB work as efforts tend to be so intense, with significant inputs by both partners, that some scaling up should be considered in the spirit of reach a 'wider good'. It is wise to choose sites with agroecological conditions that have a high probability of wider use of the results. This can be achieved, as shown by work in Nepal (NARC/rice) experience where site-specific research in fact was useful for similar but scattered niches elsewhere.

Who will participate: farmers/communities/users

- Decisions about who should participate should be based on an informed *stakeholder analysis of the entire breeding and seed systems* of the local community. Overall, this implies that all relevant actors are identified (desegregated by gender and by social identity), and that the links (functional and social) among actors are traced.

- It is important to emphasize that breeding issues and seed systems issues need to be treated separately.

- In terms of *breeding*, community, development and research partners might particularly pursue the following:
    - ✓ Identify who are the farmers doing breeding; are they the same as those articulating demand?
    - ✓ Decide how many groups/selectors to work with (based partially on community desires and partially on the upper limit with which research might collaborate)
    - ✓ Assess the germplasm needs of marginal groups: are they special? different from each other?
    - ✓ Especially target the poor. Remember that their having seed equals sustaining their livelihood.

- In terms of *seed systems*, community, development and research partners might:
    - ✓ Decide with whom to work with directly based on analysis of local seed system.
    - ✓ Assess if local seed system is inclusive or exclusive.
    - ✓ Carefully guide and monitor how seed distribution proceeds to marginal groups. (Starting with different user groups can result in different patterns of seed distribution.)

- Overall: an analysis of the local seed supply system, including associated local knowledge and practices must include a full account of the entire seed chain: seed selection systems and methods, storage, distribution/diffusion, and access to germplasm for breeding and to seed for production. The analysis should cover variations within the community with respect to all aspects of the seed system, such as individual (personal) differences or differences by gender or any other relevant socio-economic variable.

- Note that those whose situations are too marginal to even spend time in a PPB project should be identified. While targeting will frequently be desirable and possible, it may not always be possible to work directly with the poorest of the poor.

- Questions of how to target with PPB benefits need to be directed to the seed supply system, and to analyses of channels of access and exchange. Parallel distributions may need to occur, for instance, as was seen in Nepal. Equity of benefits may be addressed in other ways, such as making lower-caste farmers the source of commercial seed so that they have a product that can be sold to their neighbors for a small amount of cash.

- Expertise or representativeness. Every community has farmers with different levels of germplasm expertise. The terms 'village experts', 'mass selectors' and 'non-selectors' (those who do not consciously select) might serve as useful categories.

- One challenge is to identify these village experts or farmer-breeders. Sometimes this can be done through the community, or sometimes with the intermediary's (NGO) advice. It is

important to be aware of the relationship of these selectors with others in the community (and try to counteract possible biases).

B. Technology Generation

What is on offer?

There are different types of interventions, which could potentially be on offer in farmer-led programs (section modified from McGuire et al. 1999). These include

- ✓ germplasm
- ✓ skills
- ✓ forming new links
- ✓ indirect support

This list is presented in terms on factors that might constrain farmer-breeding. As such, any could be a starting point for stimulating farmer-breeding. A stakeholder diagnosis of the seed system could help prioritise possible approaches. Such a list will certainly be refined, and possibly expanded, with experience and with a richer understanding of farmer-breeding in context.

1. Germplasm support.

- Farmers may have limited exposure or access to genetic variation, constraining their ability to attain their goals in crop development. We term germplasm support all efforts to increase available diversity, and draw two distinctions: between working with segregating or fixed lines, and with local or non-local material. Support to seed storage and exchange systems can also enhance available diversity.

  a) segregating vs. fixed

  The range of options between fixed and segregating lines relates to the division of labour between farmers and breeders in screening, and multiplying (self-pollinated) materials. It also has implications for the degree of local adaptation, the level of farmer skills required, the number of lines and farmers that can be involved, and the ease and speed of multiplication and dissemination . Thus it is an important factor in weighing trade-offs, in both formal- and farmer-led PPB approaches.

  b) local vs. non-local

  Stable vs. segregating implies different stages of cultivar development in a formal seed system. However, the uniformity and stability usually required for formal release may not be necessary for *farmers'* seed systems. Local material (FV or MV) may be useful, but

inaccessible to some farmers, due to social or economic barriers to its access, or simply because some local seed systems are fragile. For example, valuable support can come through re-supplying local material that had been lost, or through supporting particular groups in accessing local germplasm. Thus, we distinguish between segregating and non-segregating, as well as between local and non-local germplasm support.

c) seed systems

The type of seed storage system may restrict the level of diversity available, especially material not immediately used. Also, absent or restrictive supply systems may prevent some farmers from accessing seed. Direct support to farmers' seed storage and exchange systems could be another way to enhance *access* to diversity. This support could be material, such as establishing community seed banks. However, much seed system support probably relates to skills or to building linkages.

2. Skills support.

- Skills-development may be necessary when working with processes that are difficult or unfamiliar, such as segregating materials or new crops. This can take two broad starting points. One recognises that some farmers may have exceptional knowledge and skills that are unknown or unappreciated by others. Support here seeks horizontal extension of 'best practice' among farmers, making it more widely known.

  A second approach seeks to develop skills in "what farmers don't know" about crop development. Examples include how to select for heritable traits, promote crossing, or isolate outcrossing varieties. A practical understanding of basic processes can spur a burst of innovation among farmers.

- In terms of introducing new techniques, care should to be taken to ensure that these techniques are both sought after by farmers, and are relevant to their tasks.

- To introduce new techniques, *tools for learning* need to be be developed. This is a two-way process, as learning needs lie both with farmer-breeders, and with formal breeders.

- [note: Farmer field schools, as developed by FAO and others for IPM in South-East Asia, may be one model for developing an investigative culture, and for sharpening farmers' empirical approaches, as well as for stimulating new innovations.

3. Support in forming links.

- Links between institutions and individuals – to exchange material or information – are important for any type of crop development. Promoting and reinforcing links can help

expand the scope and sustainability of work. This can be conceived at different levels: links among farmers or between institutions.

Promoting farmer-farmer links can facilitate horizontal exchange. Links between farmers and other institutions are also important in exchanging germplasm or information. For example, ties between farmers and genebanks have been aluable in germplasm restoration, and conservation. "Opening the genebanks" does not guarantee equity: links among farmers and institutions still shape access. Institutional relationships and roles can evolve, especially as farmers gain confidence. Long-term goals for capacity-building or farmer empowerment require that links evolve beyond simple supply-channels, and become a stable, flexible inter-relationship, possibly within entirely new institutions.

4. Indirect support.

- Political or economic barriers may limit farmers' engagement or even their interest in breeding. Indirect support to farmer-breeding includes confronting such barriers. Supporting markets for grain or seed can stimulate farmers' innovation. Challenging restrictive seed laws, especially those requiring DUS or hybrid material, can also help. Any support that empowers marginalised, but important actors in farmer-breeding, such as women, may significantly help breeding itself.

  In the face of heavy promotion of external technologies, some groups use education and advocacy to strengthen awareness and respect for local practice and varieties, especially among the young. For instance, local seed fairs in India, and the Andes have been effective.

Table 5: Simple framework describing approaches to supporting farmer-breeding.

Germplasm	**Skills**	**Linkages**	**Indirect**
non segregating/segregating non local/local seed systems	new skills extending best practice	among farmers between institutions	Markets Education Advocacy

Table 5 summarises the framework of farmer-led PPB approaches, listing some examples under the four categories described above. Germplasm support may come through direct inputs of material, or through supporting seed systems for supply and storage. Skills-development can address skills new to farmers or work to extend current good practice. Linkages can be supported among farmers or across different types of institutions, and indirect support can involve stimulating markets, or promotion through education and advocacy. In practice, these categories interact. work with seed systems also involves skills-development and support for linkages, and working with segregating material may require new skills for farmers.

Evaluation

- Evaluation in Farmer-led PPB is done for the community and usually by the community or community representatives. This doesn't automatically mean that everyone's needs will be met as some community members will have different needs/preferences than others.

- In the cases of farmer-led PPB reviewed for an SWP PRGA overview paper (McGuire et al., 1999) there was little mention of the involvement of women in much of the farmer-led PPB documentation (which could just be a written, rather than actual omission). For the post-harvest qualities (for example, taste, processing) women's insights are often critical for the community well-being. Their presence, especially at the latter stages of PPB work could be key to developing a useful product. Further, for many of the minor or neglected crops, women hold the central varietal and seed management expertise: thus, their lesser involvement in farmer-led PPB, at the evaluation stage and beyond, could compromise the results.

- Because the testing sites in Farmer-led PPB are often directly comparable to the range of sites which will be eventually used, there is often less need to consider methodological issues of extrapolation (versus in formal-led formats).

Feedforward

- The greater focus on skills development in farmer-led PPB as well as the role of farmers in its transfer, are innovative features which shape what is 'feed' and how.

- Several methods have been described for farmer-to-farmer transfers of knowledge: community walks showing 'best local practice', seed fair sharing of techniques, and journals in the vernacular (such as Honeybee) are two options. Some of the more inter-linked farmer-led groups, also exchange information from one local network to another.

- Information about new varieties/seed can also pass through normal farmer-to-farmers exchanges--with the same strengths and weaknesses which such channels normally offer: not all social groups 'communicate' and the speed at which information passes can be highly variable.

- Is it possible that formal institutions (including extension) could have a greater role in backstopping farmers' horizontal information exchange? -- both on skills and on varietal/seed characteristics? (with what caveats, if any ?)

Seed Systems Issues

- Varieties identified in farmer-led PPB have generally not fed into formal seed systems. (One exception is PTA's work in Brazil). Sometimes this results from an active decision to avoid conflicts over property rights; in other cases the material developed through farmer-led collaboration has not been suitable for formal release: it has consciously developed NOT to meet DUS requirements.

- Provisions need to be actively made to move material emerging from Farmer led PPB. The adage that a good variety moves itself' (particularly if it is self-pollinated) isn't entirely true. Self-pollinated crops do 'move themselves' but may take years and years to do so--- and partially transform in the process.

- In some farmer-led cases, those involved have: fed varieties into local channels (markets, even burial societies) and set/or up small commercial enterprises.

- In building on existing channels or stimulating the development of new intermediate ones, many of the same questions apply as mentioned in the formal-led PPB section: What quality seed it needed? What diversity? In what quantity? For whom? How fast should it move?.....

Addressing Intellectual Property Rights

- Farmer-led PPB aims to involve farmers' knowledge and germplasm more directly in crop development, raising host of questions around ownership, access, rights to benefits. Prior informed consent and firm codes of conduct are but the start of a range of ethical issues which need to be addressed.

- Property rights are being analysed/confronted by the SWP PRGA in a special initiative, (initiated in March 1998).

- Farmer-led PPB as well as Formal-led PBB has to be pulled into the complex global debates in IPRs.

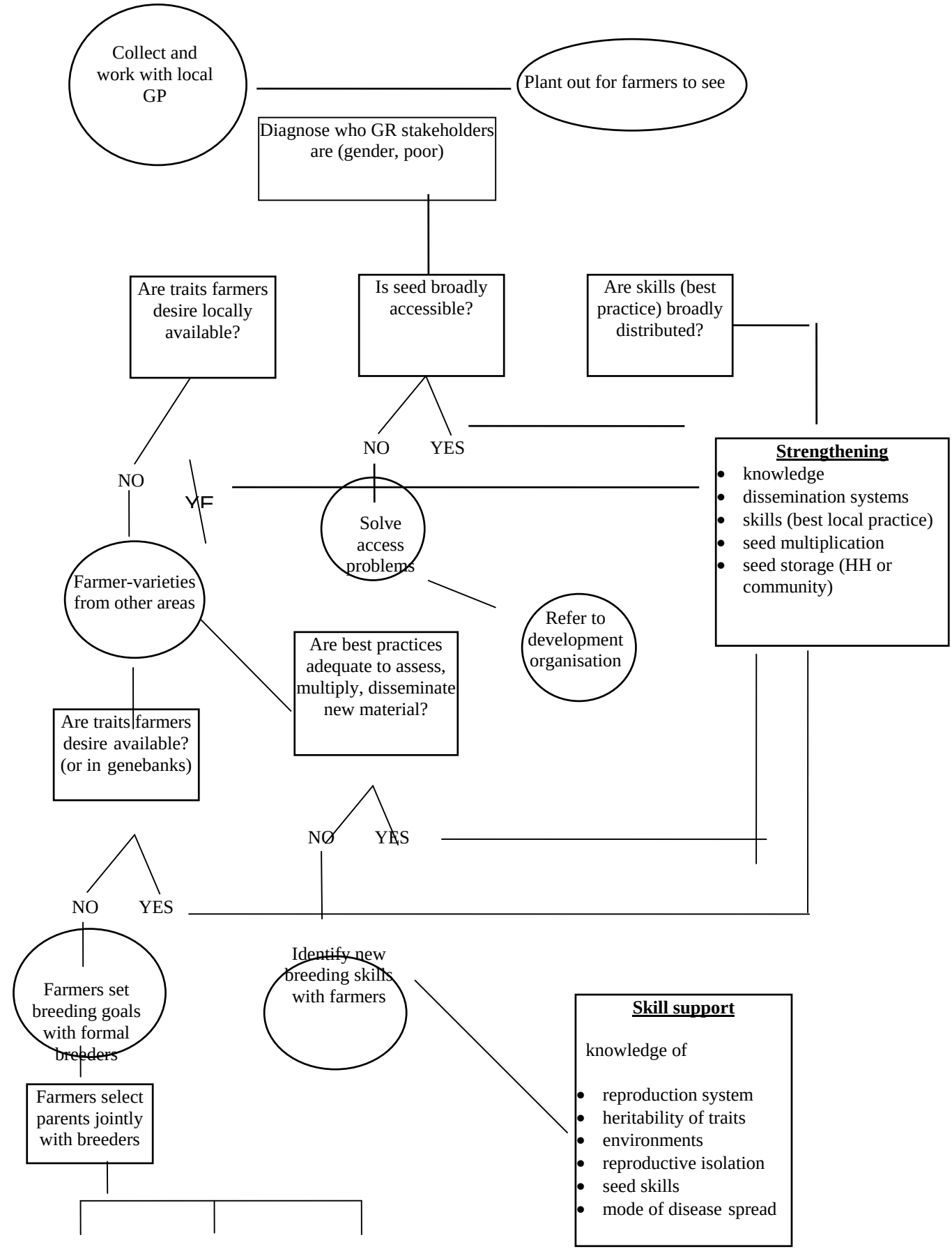
C. A Process Of Interaction

- A sketch of the process of farmer-led PPB appears below, as broadly conceived by a small expert consultation in the Hague, June 1996. The sketch, basically a flowchart, shows how each step is predicated on decisions made at the community-level, and by a series of options at each level.

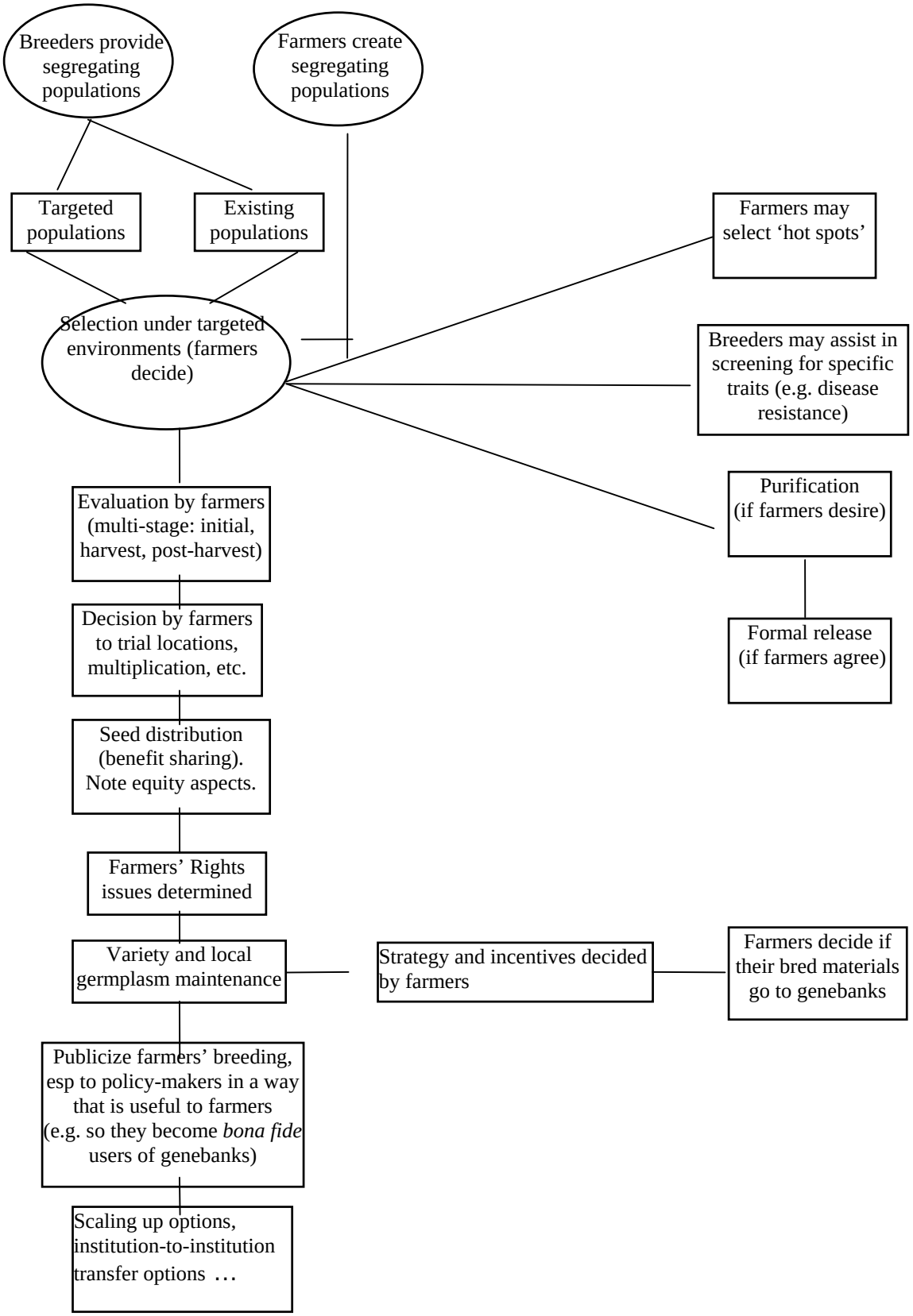
- In brief. The first step involves collecting local germplasm and planting it out for all stakeholders to see. The group then explores whether there are any constraints: are locally desirable traits available? is seed broadly accessible? are skills (best practice) broadly

distributed?. On the basis of each response, the community/scientist collaboration develops (see diagram 2). At the end of the cycle (bottom of the chart,) even scaling up options and transfer options (or germplasm or skills) have to be discussed with farming communities. Is scaling up even an objective? to communities in a region? beyond the region?

Diagram 2: A flowchart of the major Elements of Farmer-led PPB Collaboration



Decisions about who has access and control over material: IPRs and Farmers' Rights



E. Lessons from Farmer-Led Cases

(Section adapted from McGuire et al. 1999)

General Observations

- ✓ Farmer led PPB is found across a broad agroecological range. This indicates that the ability of formal systems to meet farmers' needs and goals is also a relevant indicator for potential interest in PPB.
- ✓ Most of the Farmer-led cases to date are working on major (staple food) crops. It is unknown whether this reflects genuine farmer interest or the availability of information stemming from institutional interests.
- ✓ Many farmer-led cases cite conservation as an important goal that is interlinked with that of improvement although it is often not clear (in the program documentation) how initial PPB goals have been set.

Breeding Strategies

- ✓ Exposure to new germplasm is often an important need among farmers.
- ✓ Such exposure should include variety testing by farmers and promotion.
- ✓ Local crop improvement may be necessary in some contexts, and farmers can display much enthusiasm and patience for such work.
- ✓ Conservation seems to be more effective when it is directly tied to crop development

Involvement of Different Users

- ✓ Diagnosing different stakeholders' needs and constraints can be very useful in prioritising goals and support strategies. Notably, non-farmer groups such as landless farm laborers, urban consumers, and seed merchants can be important stakeholders with distinct varietal preferences.

- ✓ Farmers' crop choices often vary by gender and relative wealth and status.

- ✓ It is important to critically assess the involvement of different users. There are trade-offs in working with expert farmers, with representative farmers (expertise does not always coincide with social relations), with individuals or with communities, with different types of institutions etc. A guiding factor in this decision is how the benefits will be shared with stakeholder groups.
- ✓ Empowerment can begin to be measured through indicators such as: attainment of material and/or skills (control over farmer-breeding); control over decisions and processes. However more work is needed to define and refine impact indicators. Skills-development and self-reliance in areas such as seed supply may offer useful indicators for empowerment.
- ✓ Marketing and policy arenas are other important areas of support.

Institutions in Farmer Led PPB

- ✓ Existing networks and institutions can be useful, however creating new institutions such as community gene banks and farmer's clubs can also be effective when benefits are passed on to users.
- ✓ PPB projects and strategies are shaped by the institutions promoting them, and this may pose particular challenges for links between institutions.

Transfer of Benefits

- ✓ As programs evolve, the transfer of skills and responsibilities to participants can help scaling up by freeing staff time to work with new groups. Farmers' groups with links to networks and social movements can facilitate scaling up.
- ✓ Attention and support to farmers' seed systems is needed. This may reflect either the challenges faced by formal seed supply, or the desire of farmers for control over seed supply, both are rationales for PPB.
- ✓ Issues of Intellectual Property over germplasm and related knowledge are gaining importance in the world arena. The hotly contested debate over who should own and control these resources is extremely relevant to Farmer-led PPB. Although current legal frameworks such as the Convention on Biodiversity do not yet address jointly developed material and knowledge, PPB programs should consider these issues. Ignoring them risks undermining trust among partners and ultimately sacrificing farmer rights and interests.

REFERENCE DOCUMENTS

Community Biodiversity Development and Conservation Programme (CDBC) 1996: CBDC Protocol

McGuire, S., G. Manicad and L. Sperling 1999: Technical and Institutional Issues in Participatory Plant Breeding Done from the Perspective of Farmer Plant Breeding. Working Paper No. 2. CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation.

Weltzien R., E., M. Smith, L. Sperling and L. Meitzner 2000: Technical and Institutional Issues in Participatory Plant Breeding Done from the Perspective of Formal Plant Breeding. Working Paper No. 3. CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation.

APPENDICES

The final document will have eight appendices, corresponding to each of the possible outcomes of Participatory Plant Breeding Work:

1. Production gains
2. Biodiversity enhancement
3. Effective targeting (or meeting) of user needs
4. Cost-efficiencies; cost-effectiveness
5. Capacity building and knowledge generation for both farming communities and the formal research and development (R &D) sectors
6. Empowerment, particularly of farming communities;
7. Institutional and organizational innovation
8. Breeding program and seed policy modifications to accommodate expansion and institutionalization of PPB.

The appendices will serve as a resource for those practitioners who want to explore in greater depth any particular outcome. The guidelines will help general PPB practitioners: conceptualize the outcome, construct hypotheses which might be useful for breeding/farming research on the outcome, and suggest indicators for measuring changes in the outcome (positive or negative). Appendices will be limited to 3-5 pages each, with references attached for those seeking more refined insights.

Expert advice will be sought from specialists for each appendix: e.g. for 'biodiversity', guidance will be sought from IPGRI, the CIMMYT/Oaxaca biodiversity Programme--and others who focus on this theme. Most important is that the appendices be useful tools for field practitioners working on PPB. We are not aiming for academic studies.

Two draft of appendices appear below.

Draft Appendix

Biodiversity in Participatory Plant Breeding Programs

I. Broad Questions:

Within a PPB program, there are a number of key, researchable questions, which link Participatory Plant Breeding to biodiversity concerns. Some of these are outlined below.

1. Can biodiversity be maintained along with production and/or quality increases? Are there trade-offs? and for whom?
   - can PPB halt erosion in marginal, heterogeneous areas
   - can PPB promote more diverse products compared to conventional/classic breeding?
   - which methods are most likely to enhance/increase biodiversity?
   - breeding methods (eg. bulk population breeding)
   - seed system forms
   - storage options
   - which feasible organizational options (eg level of decentralization) is likely to promote/maintain greater levels of diversity

2. Are farmers interested in biodiversity in the context of PPB programs? If so, how is diversity conceived:
   - intra-variety?
   - inter-variety?
   - inter-crop?
   - as a set of complementary traits (and which?)

3. Do different farmers (men women, poor rich) conceive of 'useful' biodiversity in similar ways?

II. How might 'diversity' be measured in a PPB program

1. diversity at different scales might be considered
   - within field
   - within farm
   - across farms, in a community

- within agro-ecological region

2. Time frame at which diversity needs to be monitored within PPB program

- every season can get sense of initial appreciation
- takes several seasons to understand true adoption
- takes longer period to gauge
- the relationship of new cultivars to old (replacement?)
- use of new materials (are the 'stars' starting to transport the slightly less-appreciated choices?; are their initial dips in cultivar use until farmers feel comfortable handling more materials?)

3. Possible indicators of diversity

- from farmer perspective:

✓ changes in frequency of desired morphological and/or performance traits
✓ changes in farmer's crop management practice (eg staggering of harvest dates)
✓ changes in farmers' ability to manage crop, respond to change, anticipate fluctuations caused by such factors as drought/flood, market changes, disease outbreaks, etc.

- from scientist perspective:

✓ eco-geographic distribution of identifiable subset (eg local, improved, mixes)
✓ number of cultivars in a given area
✓ % area occupied by given phenotype

Box 1 outlines in greater depth some indicators which might be used to look at diversity changes. (Thanks to IPGRI and Tony Brown for these insights.)

Box 1.
Indicators for investigating population genetic structure of PPB products.

Allelic richness and multilocus genotypic diversity

- Population number and sizes or areas of planting
- Mating system, degree of outcrossing
- Variation in human use of the produce (flavour, multipurpose varieties, etc.)
- Number of distinct morphological phenotypes (subspecies, races, varieties)
- Morphological major gene polymorphisms (colour, pubescence, etc.)
- Marker diversity (isozymes, RAPD, DNA fingerprints, DNA sequences, etc.)

Special adaptations to the local environment

- Habitat diversity

- Disease and pest occurrence or damage
- Phenological variation (maturity diversity)
- Targets or purposes of farmer selection
- Stress tolerance experiments (salinity, aridity)
- Response shown by selecting outstanding sublines or components
- Pest and pathogen resistance

Scale of localised diversity

- Topographic variation in the region
- Geographic cultural diversity, trading patterns, language groups etc
- Seed supply systems
- Transplantation experiments - field performance measurements
- Partition of marker diversity between different geographic scales
- Gene genealogies for tracing relationships between populations

Temporal changes in genetic composition

- Local history of varietal use, farmer selection criteria and perceived changes
- Extinction-recolonization cycles in the rotation of landraces in the landscape
- Comparison of stored or historic samples with current populations
- Changes in pathogen incidence, pathotype and resistance structure
- Allele and genotype frequency changes in time

Operation of crop evolutionary processes

- Absence of factors leading to further fragmentation or loss of landraces
- Response to variation in agronomic practises
- Difference in genetic structure before and after 'seed' selection by farmers
- Response to planting in disease nurseries
- Migration measured by genetic markers, or data on seed movement
- Variation in mating systems

4. Measurement issues : how to assess diversity (contribution of IPGRI)

   This methodological issue is yet to be answered. There are many approaches. Average coefficient of diversity (1-coefficient of parentage) weighted by cultivated area, genealogical distance (genetic distance is measured as total branch length of dendrogram constructed from Ward's cluster analysis of coefficient of diversity), spatial diversity, temporal diversity and so on are reported in literature (see Box 2).

Box 2: Indicators that plant breeders and social scientists use to measure genetic diversity in crop plants from genes to fields

Conceptual measure	Operational measure
1. Diversity in single genes	Biochemical analysis (isozymes and seed storage protein) of variation in alleles for single gene; classical Mendelian

	analysis
2. Polygenic diversity	Multivariate analysis of morphological variation in traits whose expression is determined by multiple genes
3. Latent diversity of genome	Genealogical analysis; analysis of cytoplasm donors; molecular (DNA) analysis and probes (RAPD)
4. Pedigree complexity	Genealogical characteristics
5. Performance-based diversity	Analysis of genotypic variance and genotype-by-environment interactions; analysis of variance at farm, district, national, or regional level
6. Spatial diversity	Number of cultivars by source, use, or trait; percentage distribution of area planted to cultivars
7. Temporal diversity	Average age of cultivars per time period; rate of cultivar replacement

Draft Appendix

Effective targeting (or meeting) of user needs/ Gender Analysis for PPB

Is PPB necessary?

- What is the problem: who should be involved in defining it?
    1. Who are the key stakeholders (researchers, NGOs, policy-makers, middlemen, and farmer groups -- women, men according to ethnicity, wealth and age?
    2. Which of these stakeholder groups are most affected by and affect the problem.
    3. Which of these stakeholder groups should be involved in discussing solutions

- Is PPB the right solution?
    1. For what? For whom? Who will benefit? Who will invest? Who will set indicators of success and failure? Who will monitor?
    2. How will the relevant stakeholders (especially the appropriate women and men farmer user groups) be affected?

Objectives of PPB

- What are the main limiting traits of the crop
  How are the limiting traits perceived by the different groups of men and women farmers who use the crop?

- What traits do different groups of farmers consider important?
  (men, women, by wealth, ethnicity and age) EXAMPLE

- What is the range of acceptability within a trait?
  Do different user groups prefer different ranges of variability?

  Tools . Preference ranking tool EXAMPLE
  Matrix ranking tool EXAMPLE

Understanding the context

1. Crops and characteristics of the crops
    - Which are the most important characteristics of crops and crop varieties for different categories of farmers (men, women, by wealth, ethnicity, market access, and ecology….)
    - Who (men, women, other categories) is doing what in terms of crops
2. What is the profile of farmers?
    - What are the important distinguishing socioeconomic characteristics of farmers?

- What are the different needs, opportunities and constraints of men and women, and other categories of farmers?
- Are there different mechanisms and networks for seed supply/ exchange for men and women, and other categories of farmers
- What are the activities (task, time allocation, timing) undertaken by men and women, and other categories of farmers in crop management and crop production
- Do activities and time allocation vary by gender, age, class, wealth, location…?
- What time is allocated to other activities by men and women, and other categories of farmers?
- Is availability of labor for particular activities a constraint to crop production by certain categories of farmers?
- What are the resources required for PPB? Who has access to and control of these resources?
- What is the pattern of decision making in relation to crop production? Who (men, women, others…) takes decision related to crop production

3. Which farmers (men, women, richer, poorer, etc. have knowledge and expertise regarding different aspects of production, conservation and use?

TOOLS:

- Gender Activity Analysis Matrix
- Gender agricultural calendar
- Access, control and decision making analysis
- Resources/Constraints analysis
- Farmers' assessment
- Gender sensitive PRA tools

EXAMPLES

Diagnosis among users

- What do they want?
- Do men and women and other categories of farmers have different needs, preferences and demands for technology? What are these differences?
- What types of technology do men and women, and other categories of farmers want?
- What are the specific traits and crop/variety characteristics that men, women and other stakeholders want?
- What are the tradeoffs acceptable to different categories of farmers?
- What are the selection criteria used by men, women, and different categories of farmers in assessing crop or variety? Are there differences, and what are they (if any) in the selection criteria used by men and women, and other categories of farmers
- What are the current crop and varietal preferences and future needs of men, women, and

other categories of farmers?
- What is the level of knowledge/skills of crops and varieties by men and women, and other categories of farmers in relation to crop and variety selection and management?
- What are the resources available to men, women and other categories of farmers for PPB? Who has access to, control of and decision making power of the available resources required for PPB?
- Is access/control and decision making affected by gender and other farmers differentiation?
- Is the absence of certain resources a constraint to certain categories of farmers?
- To what extent are resources and decision making separate or joint between men and women?
- What changes are likely to occur in terms of preferences, needs, constraints, access and control of resources in relation to PPB?

Tools: Gender sensitive PRA tools

TECHNOLOGY GENERATION

1. Who will participate? Partner institutions

What needs to be accomplished with what institutions?
What are the gender implications (property rights, socialisation, community organisations) of these institutions involved in PPB?
What are the roles and responsibilities of the institutions involved?
What is the geographic coverage of these institutions?
Does the institution have a policy of gender equity?
Does the institution have a gender-balanced field staff?

2. Where/sites?

Does the site offer opportunities to involve women? E.g. Women's groups.

3. Who will participate: farmers/communities/users?

- If you want to involve women farmers group situations should be prioritised

4. What is on offer?

- When taking into account different user criteria, a comparison should be made between the criteria of men and women.

- Are women included in the groups of farmers being trained?
- When feeding back information and new knowledge, are women's groups specifically

targeted?

Who does what in the breeding/screening process: divisions of labour?

- Whose knowledge is important (men women, older younger)
- Who owns the land being used
- Whose labour will be used for the experiment
- Whose farm inputs will be needed
- Whose management strategies need to be taken into account
- Who will record data for monitoring experiment (men or women farmers)
- Who will organise the information (will both men and women be involved?)

Evaluation

- Remember that farmers are not a homogeneous group and will have different appreciation criteria.
- Have you enumerated constraints for each of the user groups you have identified? (men, women, rich, poor)

Feedback and Feedforward

- Have you insured that the information you are presenting to community groups takes into account those who are not literate?
- Have you taken care that different user groups in the community are present in the feedback and feedforward session.

Seed Systems Issues

- What seed systems already exist? Who is involved in the (men, women)?
- Under what circumstances and for what purposes are seed exchanged or given away
- Who is in charge of the storage of seed and for what crops (men, women)?
- Who selects the seed for storage and who is authorised to take see out of storage and for what purposes?
- Under what circumstances do conflicts of interest appear in the management of seed systems?

Information Dissemination on innovations

- Remember that communities are not homogeneous groups?
- Be sure that different user groups have access to information and planting materials
- What are the constraints that specific user groups (especially women) have to access information and planting material
- How can the program or project help to overcome these constraints?

Addressing IPR issues

- Does the "joint participatory work" recognise the contributions of different user groups within the community?
- Have expectations regarding property rights and benefits been clarified with the appropriate user groups.

ENDNOTE

These guidelines are being developed by the Plant Breeding Working Group of the CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation.

Critiques and inquiries on this can be sent to the working group facilitator at: L.Sperling@cgiar.org