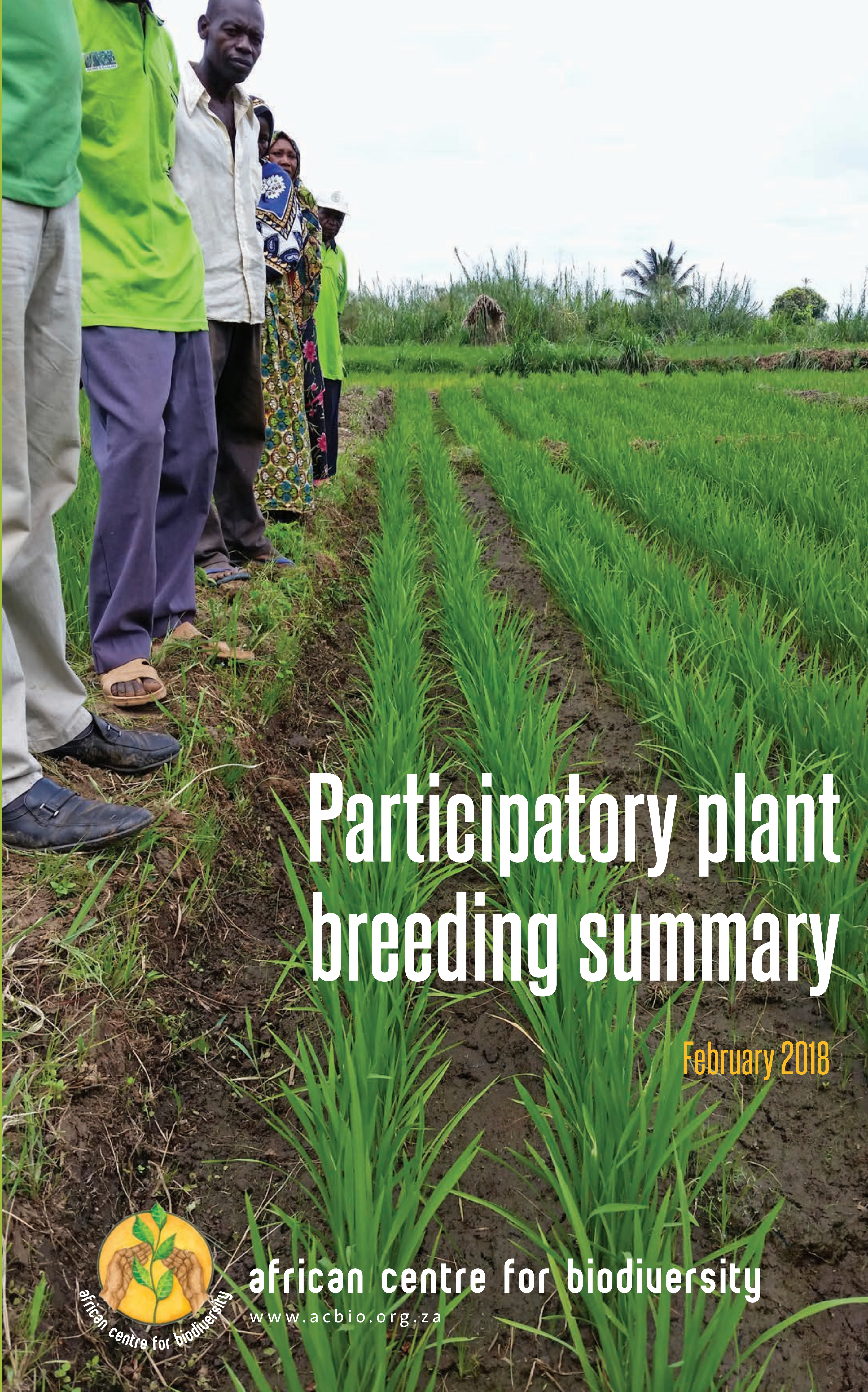

Participatory plant breeding summary

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Introduction

This is a summary of a review of participatory plant breeding (PPB) and lessons for Africa conducted by African Centre for Biodiversity (ACB). PPB is a very specific set of institutional/organisational arrangements, with farmers and formal breeders working together. It has developed in practice, globally, over the past 25–30 years.

The report is part of ACB's ongoing research and advocacy on farmer seed systems in Africa. The objective is to learn more about this area of work, and to identify ways in which smallholder farmers are already or may become actively involved in crop improvement.

Plant breeding is closely related to biodiversity conservation and use, and to seed multiplication and dissemination. In practice, these are integrated processes. In farmer seed systems materials are under a continual and cyclical process of use and improvement. In conventional (formal sector) approaches, breeding tends towards a linear process with a defined product in the form of a distinct new variety at the end.

This summary covers the main sections of the report, including: background to plant breeding and PPB; the structure of a plant breeding programme; and assessment and lessons from PPB in practice, based on a literature review and communications with practitioners.

Background to plant breeding

Crop husbandry and stewardship by cultivators themselves has been the bedrock of agriculture for thousands of years. Scientists only entered this space from the 1700s, leading over time to the rise of plant breeding as a specialised activity, and its separation from farmers. Early work in the US focused on hybridising maize to produce an improved crop for industrial agriculture. Expanded to include wheat and rice, this became the basis of the Green Revolution. It was spread to Mexico, Brazil and Argentina in the 1940s, Kenya in the 1950s, and India, Pakistan, the Philippines and Indonesia in the 1960s.

Efforts were made to expand further in Africa in the 1970s but proved to be inefficient, given the wide range of agro-ecologies under limited input use and rain-fed production. Neoliberal restructuring and structural adjustment in Africa in the 1980s and 1990s resulted in a decline in spending on agricultural research and development (R&D), including plant breeding. More recent initiatives in Africa have oriented to public-private partnerships (e.g. the Alliance for a Green Revolution in Africa). The plant breeding challenge for sub-Saharan Africa is to optimise existing genetic diversity to match the agro-ecological cropping and consumption system heterogeneity that characterises food and agriculture on the continent.

Formal breeding has historically focused attention on increasing yields (productivity). This is obviously important to all stakeholders, including farmers. However there are also trade-offs in adopting formal breeding:

- Formal breeding tends to focus on relatively few crops and to direct activities towards favoured, high-potential areas, with little, if any, work on diverse demand in more marginal areas.
- The formal breeding system is not very responsive to issues beyond yield, with unintended consequences that ripple out into seed systems. Other traits and qualities, including appearance, conservation, processing and culinary value are marginalised or even traded off for yield.
- Materials developed in Consultative Group for International Agricultural Research (CGIAR) institutes are often developed for wide use but are poorly adapted to diverse local conditions, and will need local adaptation and testing to be integrated into local farming systems.
- Varieties that may perform well at research stations ('on-station'), under ideal conditions, with fertilisers, irrigation and so on, are not necessarily good in relation to specific and unique socio-ecological contexts, especially marginal areas.

Farmers also face contemporary challenges to their historical roles in biodiversity conservation and adaptation:

- In the process of pushing a commercialisation and modernisation project onto African agriculture in the form of the Green Revolution, for example, formal plant breeding has fallen under the sway of private interests. These interests are pushing for intellectual property (IP) protection and standardised quality controls shaped by their needs. This involves promoting certified seed as the only legitimate seed for farmers to use, and the simultaneous denigration of farmer seed as diseased, low quality and illegal.
- There is limited recognition amongst government authorities that most seed is produced and reproduced in farmer systems. This has produced a marginalisation of indigenous and farmer varieties and knowledge, despite the existing agricultural biodiversity maintained by smallholder farmers.
- Public sector investment in plant breeding is declining; there is an over-emphasis on biotechnological tools for plant breeding; young scientists are showing declining interest in conventional plant breeding; and there is a lack of innovative and simple plant breeding methods for use by local institutions.
- Farmers in sub-Saharan Africa also face other pressures. Poor soil fertility, low rainfall and frequent drought limit agricultural production across the region. Farmers who survive develop complex, adapted farming systems and strategies to respond to these realities. However, these diverse farming systems themselves are presently undergoing rapid change, including declining size of landholdings, reduction in fallowing periods, and low productivity. Traditional crops and varieties ideally adapted to certain farming practices and site-specific conditions tend to disappear because of technological or climate change, urbanisation, bulk commodity markets, economic pressure, changed food habits, and loss of traditional knowledge.

Background and overview of PPB

PPB emerged as a way to overcome some of the limitations of conventional breeding and to bring farmers back into the breeding process as active participants. Some public researchers at the CGIAR institutions began to experiment with more participatory approaches in the 1970s. By the late 1990s, a range of participatory research projects by CGIAR institutes, national research centres and non-government organisations (NGOs) showed success. By 2009, there were about 80 known PPB programmes worldwide, including in Central and South America, Asia and Africa. Current multi-country and multi-regional programmes include USC Canada's Seeds of Survival programme in 13 countries, Oxfam-Novib's Sowing Diversity, Harvesting Security (SD=HS) in 5 countries, and Bioversity International's Seed for Needs initiative in 15 countries.

The essential core of PPB is collaboration between farmers and formal breeders through various stages of the breeding process. Breeding plots are located in farmers' fields, sometimes with parallel plots on agricultural research stations, with farmers actively involved in selection and testing for agronomic and quality traits tailored to their specific requirements.

Three main objectives are common to most PPB programmes:

i) Improvements to genetic materials to suit farmer and user needs;
ii) Farmer access to a greater diversity of genetic materials, adapted to the local context;
iii) Farmer empowerment – technical and organisational skills for maintaining and developing materials under their control, on-farm management, and local creativity/innovation.

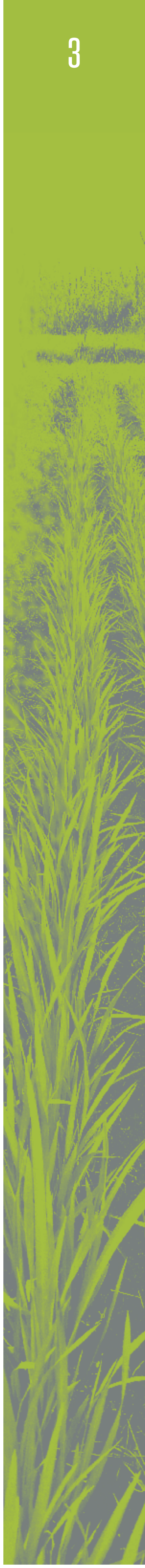
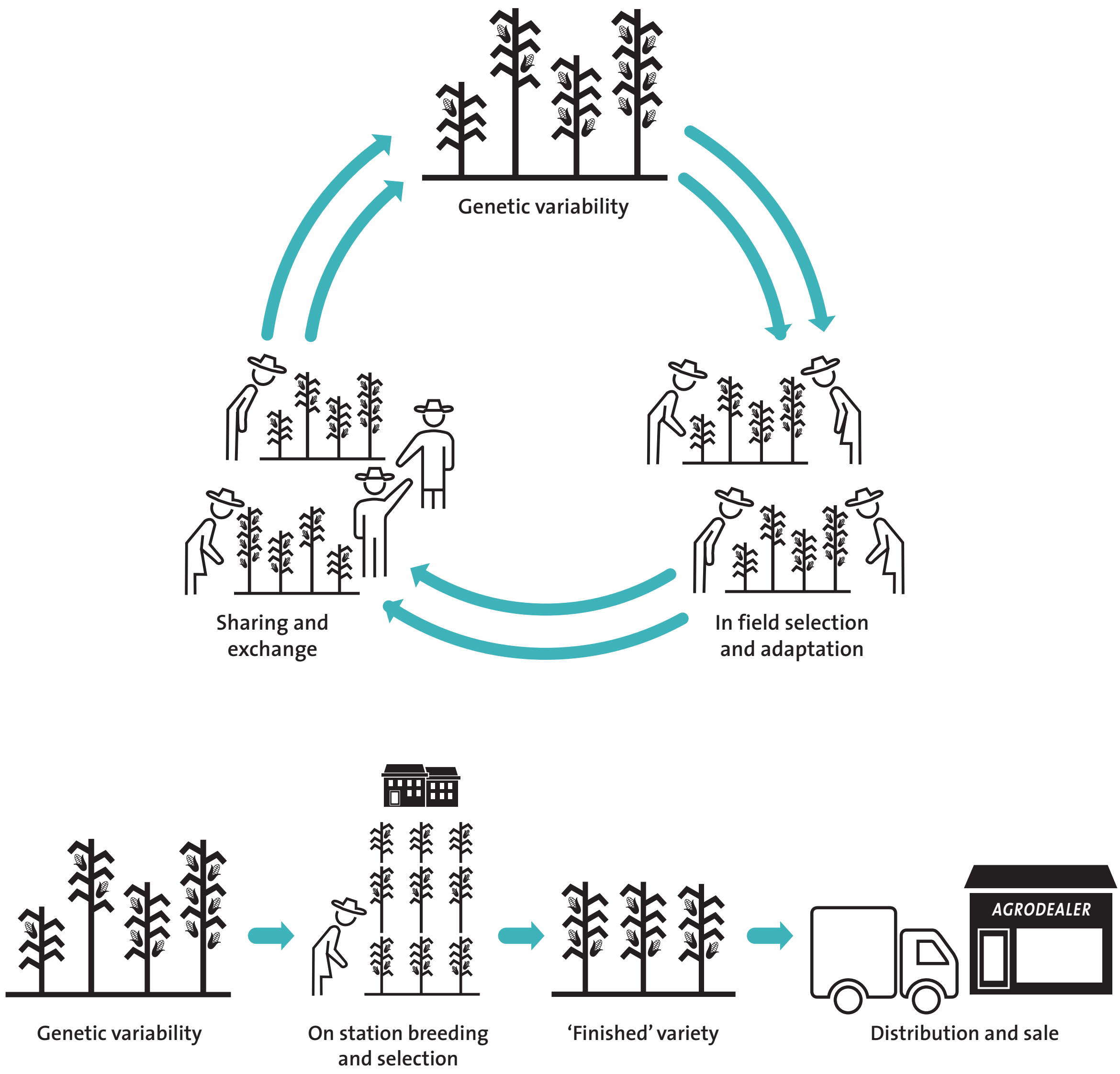


Figure 1: Comparison of PPB and conventional breeding



Some breeders consider participatory breeding to simply be a more effective or efficient way to do plant breeding. However, PPB may be more than simply complementary to conventional breeding programmes, because it proposes a different structuring of priorities, objectives and processes. Systematic crop improvement is integrated into farmers' practices and is shaped by the context. It is more cyclical, with materials constantly feeding into new rounds of production, selection, adaptation and use. This is in contrast with conventional breeding, which generally seeks a finished, distinct product for commercialisation in a discontinuous or detached process (Figure 1). Table 1 shows some of the differences between conventional and participatory plant breeding.

Participation has its critics. In some contexts it could be used to secure compliance from farmers in extractive processes. However, participation is best viewed as operating on a continuum of farmer control over the breeding/crop improvement process. Participation can also be understood as a process itself, which may start off in a relatively contained way and then expand and deepen over time.

Table 1: Conventional vs participatory plant breeding

Aspects of breeding	Conventional	Participatory
Crop improvement	Linear with a distinct finished product as the output, disposal of unwanted germplasm	Cyclical with materials continuously feeding into living adaptive processes in the field; germplasm enters into the production system throughout the process
Priority setting	Private sector, breeders, industrial users	Farmers and breeders, at times other users
Sources of germplasm	Farmers via national gene banks, CGIAR institutions, private collections	Farmers directly, national gene banks, CGIAR institutions
Institutional locus	Private companies, ARIs/ universities	Farmer organisations, ARIs/ universities, NGOs
Operational structure	Centralised	Decentralised
Selection and testing	Breeders, at times including farmers in PVS towards the end of the process	Farmers and breeders
Location of field trials	On-station	In farmer fields and on-station
Product	Officially released varieties	Improved materials for own use, sometimes officially released varieties
Characteristics	Few traits, yield maximisation, genetically homogenous, broad adaptability	Bundle of traits, diverse characteristics, genetically heterogeneous, local adaptation
Extension	Private, public	Public, farmer-to-farmer

Structure of a plant breeding programme

Biodiversity conservation and maintenance, use and enhancement are intertwined. Crop improvement/enhancement depends on a wide base of genetic variability to work with, and there may be a need to build up this base. The objective of biodiversity conservation, maintenance and enhancement is a base of flourishing agricultural biodiversity. There are various sources of material that contribute to this diverse base (Figure 2). These include maintenance and enhancement within the existing gene pool, mixing of new and existing materials, and introduction of finished new varieties. The focus of the research is on improvement/enhancement of existing materials, both from within the locally available gene pool, as well as mixing of materials from the existing gene pool with introduced materials.

Conservation, maintenance and use are required to prevent existing agricultural varieties from degenerating through exhaustion and lack of evolution. This may occur where the genetic base for a particular crop gets too narrow. New materials may be introduced through integration of wild plants into cultivation systems, especially by women, with home/kitchen gardens as key sites for integration. Introduction of new varieties from outside can also add to biodiversity, although there may be concern at times with the displacement of many local varieties, with few 'improved' varieties coming from the formal plant breeding system. Fieldwork conducted by ACB with partners in Southern Africa in recent years indicates that smallholder farmers seek both to retain diverse existing varieties and also to have access to new varieties appropriate to their contexts. A balance is required to ensure existing varieties and materials don't entirely fall out of use, thereby reducing choice available to farmers in difficult and changing production conditions.

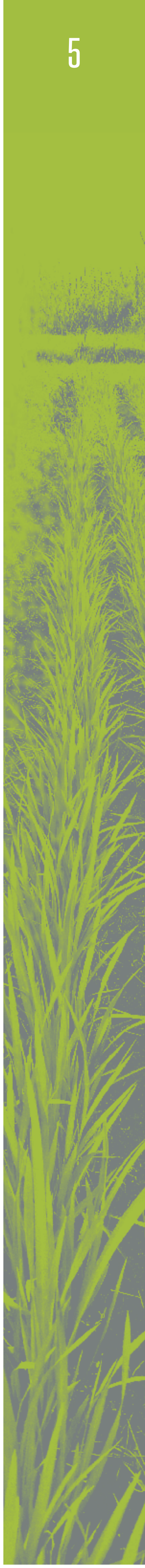
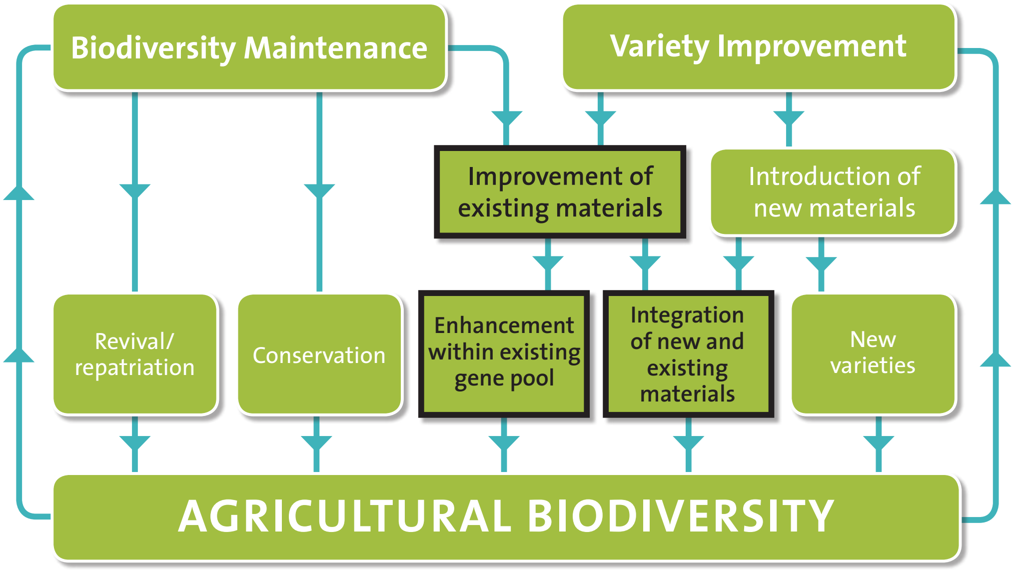


Figure 2: Biodiversity maintenance and crop improvement



Stages in a plant breeding programme (Figure 3) include setting priorities and objectives, generating genetic variability and sources of germplasm, selection, and testing of experimental cultivars. In the formal system the objective is registration of a finished variety.

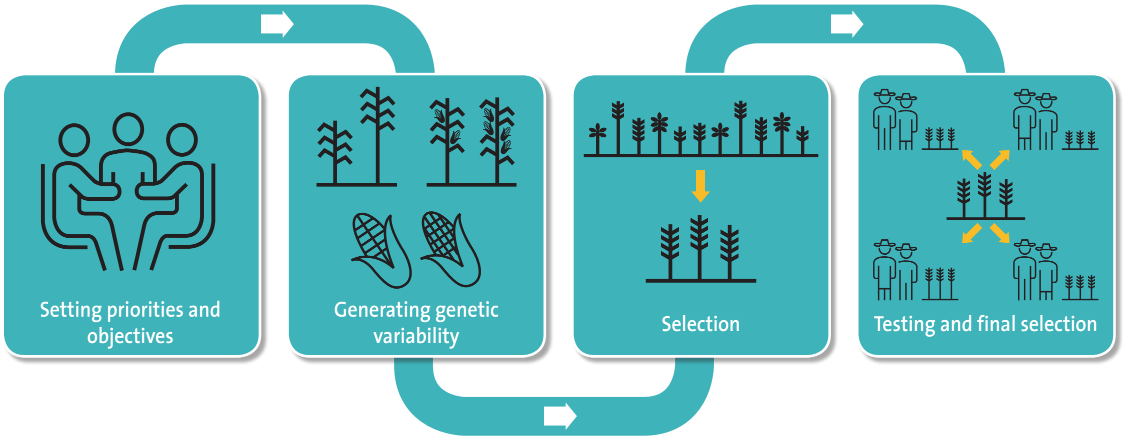
The first step in a breeding programme is to define the ***priorities and objectives*** in particular contexts. These can arise from many places, such as farmers' specific production and consumption needs, processing or other end user needs, or from the researchers themselves, based on their work to date. Considerations may include priority traits, decision-making authority and divisions of labour between different stakeholders, selection of methodologies, types of results and data required, and quality controls. Farmers' active participation in setting priorities and objectives is one of the key features of PPB. Special attention should be paid to integrating women farmers into activities, since women have specific requirements and knowledge, but tend to be left out of formal breeding activities.

A plant population needs ***genetic variation*** and diversity, otherwise it will not continue to evolve. An important source of parent material is farmer germplasm. In the formal system, farmer involvement in the collection of varieties ends with germplasm going to gene banks for use by formal breeders. PPB is significantly different, in that collected materials are identified and used by farmers together with breeders for further development. Aside from farmer materials, germplasm and variety collections are maintained in different places, including the national agricultural research institutes (ARIs) and CGIAR institutions, gene and seed banks and private/corporate collections. CGIAR institutions are prime movers in the history of PPB and continue to provide materials for practical work. Farmer varieties, landraces and wild relatives harbour large amounts of genetic variability. If this material is used, it simply involves the collection of the plants as parents for the next stage.

Once the materials are assembled, some crossing may take place prior to selection and testing in the field. Crossing involves combining genetic material of selected parents with the objective of producing progeny with combined traits. Crossing is not a necessary element of a participatory breeding programme, and is rare in practice because of the technical difficulties of crossing in farmer fields. Approaches such as evolutionary plant breeding create greater space for natural processes of genetic intermingling in the field, with farmers selecting from a diverse pool of materials that is continually evolving to the specific conditions through these natural processes.

Germplasm ownership and access is a key issue to consider at the start of a crop

Figure 3: Main stages in a plant breeding programme



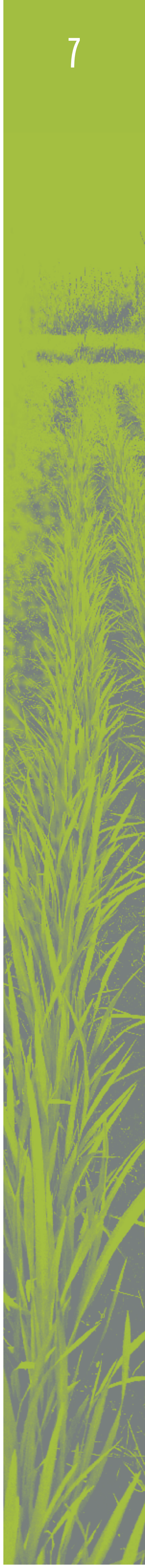
improvement programme. There may be ownership rights on genetic materials used in PPB. Mostly, materials come from farmers and from public sector and CGIAR collections. In most of these cases, where IP rights exist, they are waived. However, there are still rules and procedures on accessing these materials, and on benefit sharing, if improvements are commercialised. Germplasm introduced through the formal system is governed by international and national policies, laws and regulations on ownership and use of materials, in particular the Convention on Biological Diversity (CBD) and its Nagoya Protocol, and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

These international agreements have agricultural biodiversity conservation as their objective and promote the role of farmers as custodians of biodiversity. However, they sit alongside prevailing obligations in the World Trade Organisation (WTO) Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement, as well as the International Union for the Protection of New Varieties of Plants (UPOV). TRIPS requires signatory countries to have some kind of plant breeders' protection, which has to cover certain basic protections, but it is ultimately up to the individual country to decide how to formulate these. There is a lot of pressure on countries, especially in the global South, to adopt UPOV 1991 as the standard. This particular model is historically based on commercial developments in Europe that favour private breeders' rights over the rights of farmers. Every revised version of UPOV has progressively restricted breeder exemption (which allows other breeders to freely use protected materials for further research and development) and farmers' rights to recycle, use, exchange and sell seed in Article 9 of the ITPGRFA. An underlying principle of PPB is that farmers' contributions should be recognised if property rights are attributed to finished materials.

In defining PPB, we may want to include the requirement that there should be some use of farmer and local varieties in the experiment, beyond merely as a control, even if the programme also includes the introduction of other materials from outside. This roots material ownership with farmers.

Once the preferred genetic materials are selected and generated, the next step is to narrow down the large diversity of genetically different breeding material to a number of preferred lines that will eventually produce true to type, with the desired bundle of traits. This is the selection stage. There is no standard methodology for assessing materials, with different selection processes for different crop types, and greater or lesser farmer participation. In the early stages of selection there are still many segregating lines,[1] which are later reduced to fewer nearly finished lines (where selected traits are fixed and the lines will finally reproduce

1. Mendel's law of segregation: During gamete formation, the alleles for each gene segregate from each other so that each gamete carries only one allele for each gene. See: https://en.wikipedia.org/wiki/Mendelian_inheritance



true to type). Selection usually occurs at two stages of the plant production cycle. First, an evaluation is done at flowering, and then at or after harvest for processing, handling and consumption characteristics. A minimum element of PPB must be farmer in-field experimentation, trials and selection. In PPB, on-station evaluations and selections usually will be conducted parallel to participatory selection in farmers' fields for comparison and as a backup in case field selection fails.

Once cultivars are selected for recommendation, these may be compared with favoured local varieties to see if they do indeed perform better in localised contexts, based on the prioritised characteristics. In the formal process this is known as value for cultivation and use (VCU). VCU can serve a good purpose, even when registration is not sought in allowing farmers to see whether enhanced materials perform well in their specific contexts. VCU trials are multi-environment trials (METs) to test the reaction of the materials to a multitude of environments, for example, location, years, different types of agronomic management. The aim is to have as many locations as possible. Advantages of a decentralised VCU approach include wider number of test environments, cost savings, and the opportunity to test against other varieties.

Distinct, uniform and stable (DUS) testing – which is done at the same time as VCU testing, typically for two to three seasons – aims to establish the unique character of a variety for IP and certification purposes. The requirement for a variety to be distinct and new is primarily an IP issue. A variety must be distinct from an already registered variety, so that ownership can be conferred for a period. It must also not be genetically the same as a variety previously registered. Uniformity refers to the progeny of the seed having the same characteristics as one another. This is important for large-scale agro-industrial production, but local markets may at times also prefer some level of uniformity, for example, grain/meal colour. 'Stable' means the advertised traits must be faithfully replicated in the progeny, the seed must breed 'true to type', at least for the first crop planting. With hybrid seed, these characteristics disintegrate with further plantings. DUS is not always appropriate for farmer needs, especially the need for diversity and dynamic evolution.

Multiplication and dissemination

Once breeding is completed and new cultivars are produced, there are different routes to share. Many PPB programmes share genetic materials with participating farmers throughout the selection process. Farmers can keep and propagate and otherwise use the materials as they wish. Farmers are encouraged to share materials with others who may benefit from it. This free and informal dissemination of germplasm and enhanced materials is at the core of decentralised approaches, where the objective is the development of locally adapted varieties for local use.

However, these practices may fall foul of laws on the dissemination of genetic materials that are common in many countries, including in Africa, and that follow UPOV and International Seed Testing Association (ISTA) standards and procedures for variety registration and release, and for seed multiplication, storage and distribution. These laws are mainly designed to provide an official guarantee that seed is of appropriate quality and is identifiable at the time of purchase. In most countries, a variety must be registered and certified before it can be sold.

In the formal system, once a variety has been registered, it is legally eligible for production and commercial sale. The seed that is registered is breeder seed. This must now be multiplied out in successive batches, with quality controls to ensure the seed retains its registered characteristics and that it performs according to claims. Seed is planted in certification plots, with quality control inspections and post-harvest supervision for sealing of raw seed and processing. Seed samples are sent to a registered seed certification authority to verify conformity to standards, including genetic and physical purity (field test), germination rate, moisture content, and to ensure the batch is free from weed seed and seed-borne disease. If the seed passes inspection, it is certified and the seed lot is released for multiplication or marketing.

The technical illegality of exchange and sharing of unregistered and uncertified seed poses a significant threat to PPB programmes and to public sector involvement in such programmes where the objective of the programme is to produce enhanced varieties that are to be locally circulated. The public sector is unable to participate in activities deemed illegal (such as distribution of unregistered/uncertified varieties). For farmer innovation to be incorporated into breeding, exemptions are required on the sale and exchange of seed, with flexible quality controls based on farmer-user interactions and agreements.

Assessment and lessons of PPB from reviewed case studies

A review of case studies on PPB included the following findings:

Setting priorities and objectives

- Despite the fact that women smallholder farmers play a major role in maintaining and reproducing agricultural biodiversity, almost universally women were minor participants in reviewed PPB programmes. Reasons cited for lack of women's participation included gendered decision-making norms, unreflective exclusion from projects, and lack of expressed interest.
- Case studies showed uneven interest amongst farmers in participating in breeding/crop improvement. Not everyone wants to work on breeding and it is better to identify and work with those who are interested, for example, seed custodians (Figure 4).
- There is value in involving end users/ buyers in the process of establishing priorities and in selection and evaluation of materials being developed, as well as determining the potential and limitations of the available breeding materials.
- Evidence shows that farmers sought a diversity of varieties with a diversity of traits, rather than a single dominant trait. In a number of cases, farmers selected for a group of attributes 'on average', rather than for individual traits in isolation. This is a notable feature of PPB over conventional breeding, which usually focuses on the development of a single trait, usually associated with yield/productivity.

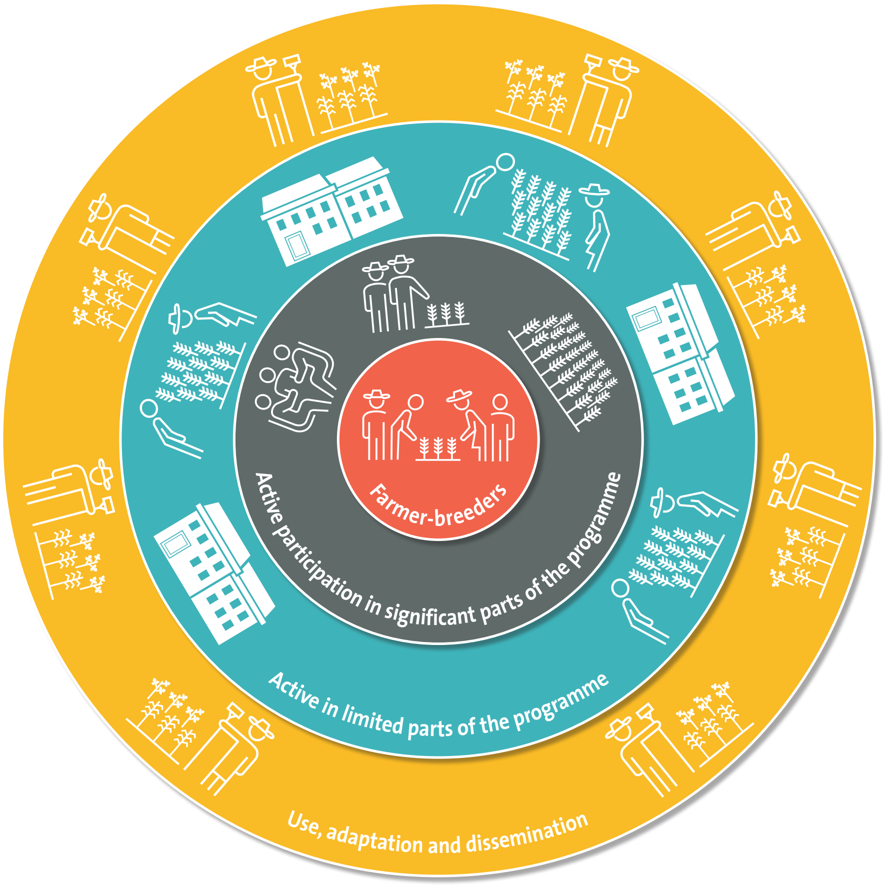
Farmer organisation

- Farmer organisation is very important to facilitate participation and knowledge sharing. Successful forms of farmer organisation include co-operatives, and farmer research and experimentation groups. The aim of farmer organisation is to carry the process institutionally at local level and to ensure farmers are driving and shaping the process.
- Farmer-to-farmer learning and sharing and, especially, the farmer field school (FFS) methodology, appear to be very successful.
- Support is required to build independent smallholder farmer organisation to articulate farmer interests in seed and biodiversity conservation and maintenance, breeding and crop improvement, seed production and distribution.
- Challenges for farmer organisation identified include maintaining active and stable participation, representation of different farmer categories, and limited involvement of women in breeding programmes.

Technical and institutional support

- PPB is best carried out as a multidisciplinary research process, involving farmers and their organisations, NGOs, public sector breeders and research institutions, as well as end users (Figure 5).
- Involving government departments and extension services creates a higher likelihood of processes being institutionalised.
- Participation of women should be encouraged and supported – case studies reveal the importance of both men and women being involved in deciding on traits and selection, for example, because there are gendered dimensions to the criteria.

Figure 4: Degrees of farmer participation



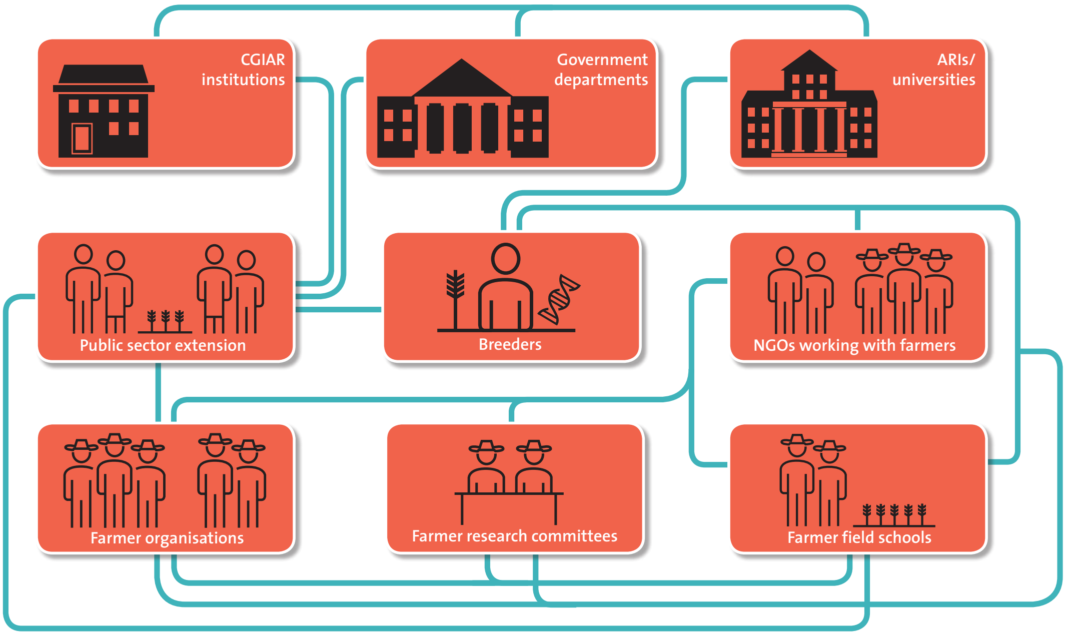
Decentralisation

- Decentralised selection and comparative testing is usually more effective than centralised, on-station processes. It increases the number and range of test environments; reduces costs by decentralising tests to different institutions/farmers, who can take responsibility just for their own tests; allows for collective decision-making; and allows for testing against other varieties. The main potential downside is lack of rigorous quality controls.
- This requires decentralisation of resources, incentives and decision-making. Changes in the organisation and execution of national breeding and extension programmes will be needed.

Sources of germplasm and generating genetic variability

- In the reviewed case studies, germplasm for PPB mostly came from a combination of CGIAR and national gene bank/ARI materials and farmers' materials, with only one case of private sector involvement.
- Farmer involvement in crossing was rare, mainly because of technical complexity.
- There was limited, if any, specific discussion on IP for incoming parent materials in the reviewed cases. Generally, it seems that materials were made available to the programmes without cost. In most cases, farmers were encouraged to take ownership of experimental materials they liked, either to adapt further, or to multiply and distribute.
- Farmer ownership of the process and products will be enhanced if farmer materials are used as parent materials. Germplasm should be made available to farmers at any stage in the process. In conventional systems, rejected lines are usually discarded. But individual farmers may favour lines that are rejected in the programme and should be able to take this material for their own use and dissemination to others. Final cultivars should also be available to farmers to use, multiply and distribute without constraint. One of the key benefits of PPB is availability of diverse materials to farmers.

Figure 5: Institutional structure



Linking biodiversity conservation and use, crop improvement, and seed production and dissemination

- PPB is only one part of a bigger picture. Plant breeding on its own, no matter how democratically and inclusively it is done, is not going to resolve all the ills and challenges facing smallholder farming communities. PPB should be situated in a wider agenda of agro-ecological programming and support.
- Biodiversity conservation, maintenance and use, repatriation and rescue of varieties, variety enhancement, multiplication and dissemination are parts of continuous and integrated processes of crop and seed production cycling through the seasons. Wider agricultural biodiversity is a necessary basis for PPB, and pre-breeding activities to build this base may be required. A key feature of PPB is a more overt recognition of the cyclical and continuous character of these processes, as opposed to a conventional linear process.
- Raise awareness on the importance of smallholder farmers' ongoing activities and varieties in conserving, maintaining and enhancing genetic diversity.

Selection

- In some ways, selection is at the heart of crop improvement. It takes place over a number of seasons to gradually move towards varieties and genotypes favoured by farmers and other users in specific contexts.
- Where farmers participated in selection (in most cases reviewed), materials were grown by farmers in communal or individual fields with parallel plantings on-station, both for comparison and as a backup.
- Case studies revealed farmers were capable of managing large numbers of lines in their fields, despite the technical complexity.
- There are significant gendered differences in selection criteria. Across the globe, men tended to orient towards productivity and in-field traits, while women also took into account organoleptic and post-harvest characteristics.
- Challenges for involving farmers in early stage selection arising from field experience include lack of identity of the entries, as they are still fairly heterogeneous; lack of sufficient plant material; and small plots, which may reduce selection efficiency with a large number of entries.

Seed laws and policies

- PVP and seed laws and regulations, as they are currently formulated, pose a significant obstacle to systematic participation of farmers with their own varieties in PPB, as well as to public sector support and upscaling.

- There should be an immediate exemption to allow public sector entities to work through approved programmes to support farmer seed production and distribution that does not require passing through existing formal registration and certification processes designed for large-scale commercial production.
- It is up to farmers whether they want to officially register and certify their varieties. However, technical requirements may be onerous and not always relevant to their situation, and there are costs attached.
- Advocacy is required to carve out space for PPB within the policy and legal frameworks, to allow the flexible registration and certification requirements that suit the specific contexts facing farmers as breeders and users of seed.

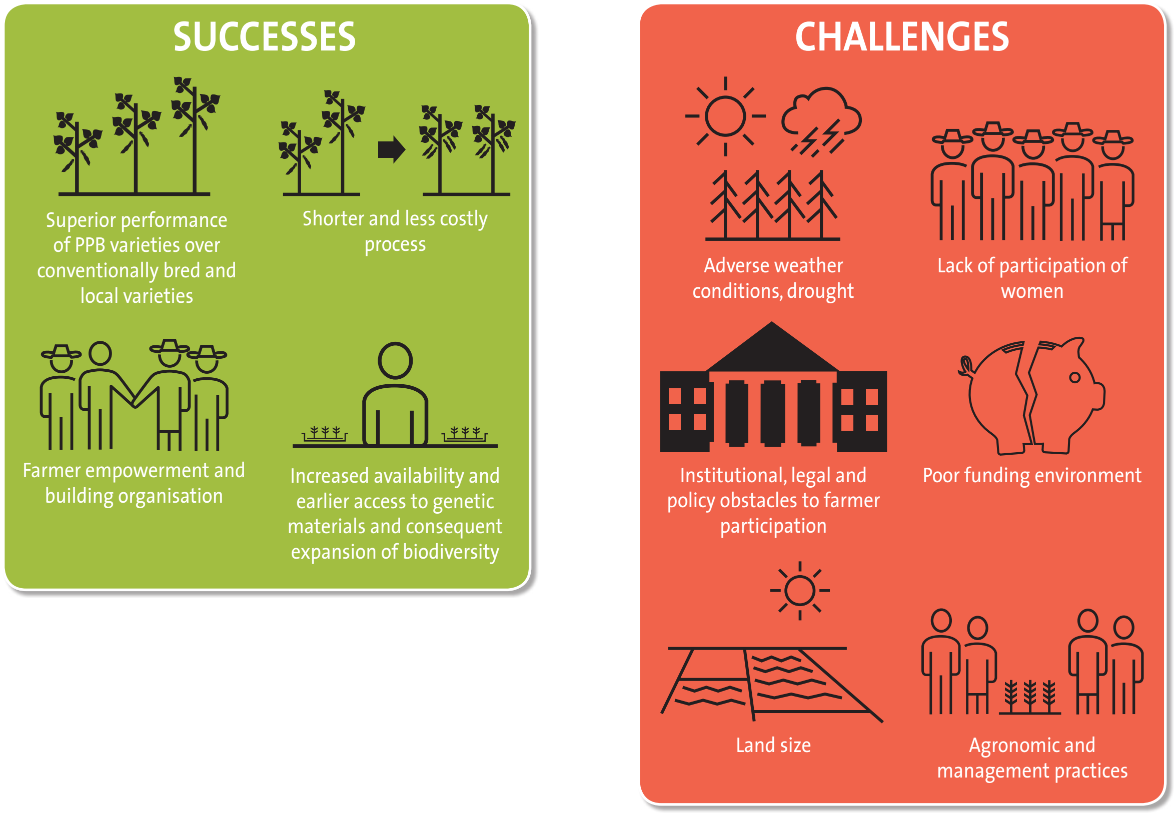
DUS, VCU and registration

- In some PPB cases, official registration for newly developed cultivars was sought. This is the objective of most conventional breeding processes. Reasons for seeking registration for PPB varieties often had to do with gaining recognition for PPB and farmers' expertise, rather than expectations of financial reward.
- Farmers may also want to register cultivars because government will not support breeding/crop improvement programmes or purchase and dissemination of varieties, unless they are registered and certified.
- DUS needs to be relaxed, depending on the purpose of the seed. It may apply to large-scale commercial production, but is not equally relevant in farmer seed systems. Because there is a policy vacuum on farmer seed, the commercial standards bleed into farmer systems.
- Spaces should be opened for crowdsourcing, evolutionary plant breeding models and other innovations, without imposing unnecessary constraints on the use and distribution of materials.
- There is lack of official recognition of farmer testing, even if this is rigorous. Even where farmers do follow the procedures, bottlenecks in multiplication, dissemination and promotion may limit greater adoption of varieties they have produced.
- PVS could be made a statutory requirement in formal sector/conventional breeding, with the objectives of ensuring seed is appropriate to the context, and of building farmer capability in crop improvement. PVS is a good entry point for farmers to acquire technical skills/knowledge on selection and breeding/crop improvement.
- Provide blanket protection of registered farmer varieties from biopiracy, even if the varieties are not protected under PVP laws, as a condition for engagement in registration processes.

Seed production quality controls and certification

- ISTA standards and requirements for storage, packaging, labelling and marketing are designed for commercial production and not for farmer seed systems. However, they end up regulating farmer seed systems in the absence of any specific legislation or regulations covering the latter. The formal standards are fairly onerous for smallholder farmers to abide by, and may not be appropriate, especially when the seed is primarily for local dissemination.
- There is need for a set of flexible and context-driven quality standards and controls, based on farmer-user interactions and agreements (formal and informal). There are some existing practices. More investigation is required and ACB has been doing some background research on this.
- The scope of quality declared seed (QDS) could be expanded to incorporate farmer-based quality assurance and control processes and geographical expansion for distribution beyond the locality. Shared codes could be facilitated through farmer-to-farmer exchanges.
- Geographical expansion of QDS would require the development of quality control processes, including across agro-ecological zones and administrative and legal borders. The vision is for farmer-based processes. But external agents could also enter, with partial approaches, and work with farmers to expand these together, in the same way that PPB can start in fairly narrow ways and expand outwards to encompass more complexity over time.

Figure 6: PPB successes and challenges



Successes and challenges

Reviewed PPB projects showed a number of tangible successes, including superior performance of PPB varieties over conventionally bred and local varieties; a shorter and less costly process; increased availability and earlier access to genetic materials, and consequent expansion of biodiversity; and farmer empowerment and building organisation amongst farmers.

Challenges include adverse weather conditions, especially drought; lack of participation of women; institutional, legal and policy obstacles to farmer participation; a poor funding environment; limited land size; and agronomic and management practices.

The full report can be found at www.acbio.org.za

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