Participatory plant breeding to promote Farmers' Rights

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Introduction

The International Treaty on Plant Genetic Resources for Food and Agriculture (the Treaty) is the first legally binding international agreement that explicitly recognizes farmers' rights. The normative content of the Treaty's Article 9 on farmers' rights is relatively open-ended. It sets the scene for proactive and imaginative national-level implementation and for continued normative evolution at the international level by the Treaty's Governing Body.

There are, of course, numerous potential complementary ways to promote farmers' rights. Perhaps the most commonly cited substantive element of farmers' rights is the right to save and exchange seed and the concomitant need to actively guard those rights through policy and legal means. Another commonly cited element is the right to earn benefits from the commercialization of farmers' varieties; adjusting national seed laws to allow the registration and commercialization of farmers' varieties would support farmers in this regard. These strategies are important and need to be supported. This brief seeks to raise the profile of participatory plant breeding (PPB) as an additional, complementary and powerful strategy for advancing the rights and interests of farmers.[1]

What is participatory plant breeding?

Participatory plant breeding is the process by which farmers are routinely involved in a plant breeding programme with opportunities to make decisions throughout. Farmers' involvement in PPB can take many forms (see Figure 1): defining breeding goals and priorities; selecting or providing sources of germplasm; hosting trials on their land; selecting lines for further crossing; discussing results with the scientists; planning for the following year's activities; suggesting methodological changes; and multiplying and commercializing the seed of the selected lines.

Participatory variety selection (PVS) refers to processes whereby farmers are involved in selecting lines that they judge to be most appropriate for their own uses from among a range of fixed (stable) lines that are being

Box 1: World Bank commentary on PPB

"Decentralized and participatory approaches allow farmers to select and adapt technologies to local soil and rainfall patterns and to social and economic conditions, using indigenous knowledge as well. […] It was found that participatory plant breeding and varietal selection speeds varietal development and dissemination to 5–7 years, half the 10–15 years in a conventional plant-breeding program.

"In the very poor, rain-fed rice-growing areas of South Asia that the green revolution passed by, participatory plant breeding is now paying off with strong early adoption of farmer-selected varieties that provide 40 percent higher yields in farmers' fields. The approach needs to be more widely tested in the heterogeneous rain-fed environments of Africa, where involving farmers, especially women farmers, in selecting varieties has shown early successes for beans, maize and rice. The cost effectiveness of the approach for wider use also needs to be evaluated."

Source: World Development Report: Agriculture for Development, 2008, pp 160–161; available at http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf

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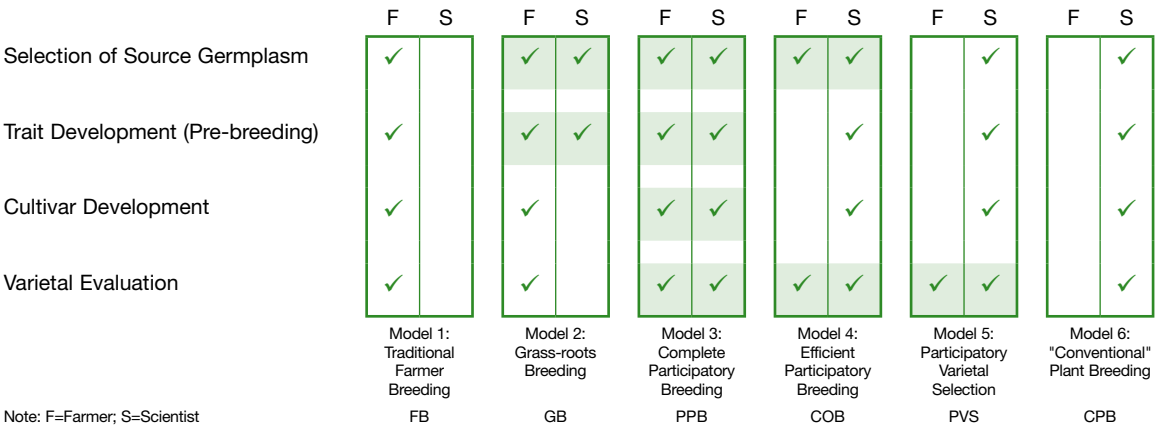

Figure 1. Various approaches to participatory plant breeding based upon stages of participation in breeding process. (Source: Modified from Morris and Bellon, 2004)

field tested. PPB generally involves a higher and more complex degree of involvement of farmers, as they are engaged in decision-making in earlier and more fundamental stages of the variety development chain; PPB therefore has a higher empowerment effect than PVS (Witcombe 2005).

Before proceeding, it is important to note that farmers' interests in the outcomes of PPB or PVS rarely end with the evaluation of improved materials. Farmers' ability to certify or multiply and distribute seed is directly affected in many countries by legal regulations and standard-setting bodies. PPB and PVS therefore can and should raise farmers' awareness of those regulatory frameworks and, where possible, involve farmers in efforts to influence the modification of those frameworks if they limit farmers' ability to maximize the benefits of exploiting the materials they participated in improving.

How does PPB contribute to farmers' rights?

PPB contributes to farmers' rights in several ways.

PPB provides farmers with the opportunity to influence the development of technologies in ways that are informed by their specific needs, agro-ecological environments and cultural preferences. In so doing, PPB increases considerably the likelihood that the final products will be well-suited to the conditions of the farmers concerned and therefore contribute better to their livelihoods. Commercial conventional breeding tends to focus on producing varieties for resource-rich farmers that are adapted to a wide array of non-extreme conditions with high production potential. These varieties may not perform well on land subject to extreme conditions, which is often the only land that resource-poor farmers can afford (Gyawali et al. 2006).[2] Non-commercial conventional breeders, such as state-owned extension stations and breeding/research institutions, commonly lack the resources needed to address the needs of resource-poor farmers, including not having access to conditions comparable to those found on farmers' fields and lack of knowledge of the specific needs of farmers, and hence may not be able to cater for farmers who produce under extreme conditions. (Of course, there are well-known examples of where so-called conventional breeding has given rise to precisely targeted niche products.[3]) The participatory approach is not only reflected in the different background of the people involved in the selection/breeding process, but also in the location of the (field) research. Test fields are located within the community and new varieties can thus adapt to real production conditions. The genetic material that is used is chosen together with farmers and has often already been cultivated in the community; this is another way to maximize adaptation to the local agro-ecological circumstances. PPB also involves providing farmers with access to genetic diversity as a basis for their innovation. In addition, as the participatory process progresses, the farmers develop an increasing sense of ownership as the lines they select in one breeding cycle are used to make crosses and start a new cycle. Such empowerment can lead to a cascading series of local innovations. Although PPB is particularly appropriate for developing products for use in more extreme environments, it is equally successful in improving materials for use in high-yield production potential environments.[4]

PPB provides farmers with the opportunity to influence decision-making about where financial resources for research, and agricultural extension services, should be dedicated.

PPB makes use of the traditional knowledge of the farmers involved. It thereby elevates the profile of that knowledge and of the holders of it, creating incentives to continue using and developing it.

While it is still not a very wide-spread practice, **PPB can be structured to provide opportunities for women to participate**. There are programmes in Eritrea, Jordan and Yemen where women's participation has been encouraged through the presence of women among the scientific staff. In China, in many regions where men have migrated from farms to towns and cities, women are playing key roles in PPB processes.

Participatory processes bring farmers into contact with professional breeders, thereby raising the farmers' awareness of what science can offer them. This has an empowerment effect which is evident in the enhanced quality of farmers' participation over time; they become true research partners. PPB involves mixing local as well as introduced improved materials. As such, PPB facilitates knowledge and technology transfer and capacity strengthening, both for the farmers and the formal-sector breeders with whom they come into contact.

In more broadly conceived PPB projects, which focus on downstream use and dissemination of PPB products, **farmers are involved not only in breeding activities, but also in the registration of the variety produced, its maintenance, seed multiplication and distribution, and, as appropriate, commercialization**. In some cases, it may be worthwhile to explore obtaining formal rights over such materials, whereby the farmers involved, their associations or communities could be recognized, based on their contributions through the participatory process.

PPB can strengthen farmer seed systems, defined as the ways in which farmers produce, select, save and acquire seeds (Weltzien and Vom Brocke 2001). A healthy seed system includes four important characteristics: (i) it maintains a germplasm base that provides diversity, flexibility and a base for selection; (ii) it produces quality seed for production (free of seed-borne disease, with high germination rates and vigorous); (iii) it ensures seed availability and distribution (seed sources, social networks, markets); and (iv) knowledge and information about the seed are available and shared (growing methods, utilization, knowledge of new materials) (Hodgkin and Jarvis 2004). PPB, properly executed, should contribute to each of these four components.

The Treaty's Article 9.2 states that Contracting Parties should promote farmers' rights through protecting traditional knowledge related to plant genetic resources for food and agriculture (PGRFA), sharing benefits derived from the use of PGRFA with farmers, and allowing farmers to participate at national level in decision-making concerning the conservation and use of PGRFA. The seven points above illustrate how PPB contributes significantly to each of these three fundamental elements of farmers' rights (as well as the right to save, use, exchange and sell seed pursuant to national law, as set out in Article 9.3).

Additional advantages of PPB

So far, we have been concentrating on how PPB contributes to farmers' rights *per se*. However, PPB has other advantages that must be considered. By focusing on the development of varieties that are suited to particularly extreme agro-ecological niches, PPB supports the development and maintenance of a more genetically diverse portfolio of varieties. The success of PPB should therefore be measured more by the number of new varieties produced and used in those niche environments (and the improvements they contribute to farmers' livelihoods) than by the total number of hectares sown globally to a particular variety. In Syria, where a PPB programme on barley started in 2000, 25 varieties have so far been selected, named and multiplied; each of them occupies between 5 and 25 000 hectares. Similarly, six barley varieties have been named and multiplied for their adaptation to the north-west coast of Egypt, and three varieties of barley and one of lentil are being multiplied by farmers in Eritrea. Other successful examples can be found in countries as diverse as China (maize), Nepal (rice and maize), Mali (millet), Cuba (maize, beans, rice, cassava and tomatoes) and Honduras (maize and beans). PPB provides a forum for building participants' knowledge and skill in genetic resources conservation and empowers rural institutions and farmers in community-based crop improvement and biodiversity enhancement (Sperling et al. 2001; Sthapit and Rao 2007).

PPB can also be less costly to conduct than traditional breeding, due to potential savings on field testing sites, lower overhead costs and the shortening of the research period required for producing useful materials. One study reports that "on-farm crop variety evaluations revealed a cost of US$0.50 per recorded data point for participatory trials, compared with $0.80 for conventional trials." (Toomey 1999) A recent cost-benefit analysis of participatory and conventional plant breeding conducted in Syria shows that the benefit/cost ratio of PPB is 2.6 times higher than that of conventional plant breeding (Mustafa et al., 2006). PPB can speed up varietal development and release, as noted by the World Bank (see Box 1). It is too early to say that such savings will always be possible, and more economic analysis would be helpful. Early indicators, however, provide reasons to be optimistic.

Furthermore, it has been demonstrated that PPB products are not necessarily local in nature and can be international public goods, as demonstrated in the case of rice varieties developed in Nepal that are used in India and Bangladesh (Joshi et al. 2006; Joshi, Sthapit and Witcombe 2001). Similarly, PPB varieties developed in Syria are also being grown in Iraq. There are numerous such examples. However, the most important global public goods resulting from PPB work so far are the methods and models for engaging farmers in breeding and research. These can be replicated and adapted for use with many different crops anywhere in the world.

The global status of PPB

Despite the advantages of PPB listed above, its long-term adoption in national and international plant breeding programmes has been slow. Short-term projects are more common. The Working Group on Participatory Plant Breeding (PPB-wg), established in 1996 under the framework of the Consultative Group on International Agricultural Research

(CGIAR) System-wide Program on Participatory Research and Gender Analysis, estimates that nearly 100 participatory breeding projects are currently being implemented worldwide. The International Center for Agricultural Research in the Dry Areas (ICARDA), for example, has ongoing PPB programmes in Algeria, Egypt, Eritrea, Iran, Jordan and Syria on barley, wheat, lentil, chickpea and faba bean. Bioversity, the International Center for Tropical Agriculture (CIAT), the International Potato Center (CIP), the International Maize and Wheat Improvement Center (CIMMYT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Rice Research Institute (IRRI) have also been involved in PPB projects. Still more initiatives are led by national agricultural research organizations and non-government organizations, with many examples in Asia, Africa and Latin America (Vernooy 2003).

Making the most of PPB for farmers: policy challenges and options

Policies and laws have a significant impact on the degree to which farmers are able to take full advantage of their involvement in PPB. For example, in some countries only scientists with an MSc or higher degree can apply to register a variety in the national register; registration is a pre-requisite for the commercialization of the variety (and, in some countries, to even being able to make it available for free). This would preclude most farmers engaged in PPB activities from being able to register new varieties in their own names or that of their association or community. Furthermore, in a growing number of countries, varieties

Box 2: PPB in Nepal: the case of 'Pokhareli Jethobudho' rice

In 1999, various stakeholders[6] started a participatory selection process in the Pokhara valley in the Western Development Region of Nepal with the objective of improving a local rice variety known as 'Jethobudho'. Many farmers cultivate 'Jethobudho' on relatively large plots as its quality traits, such as aroma, taste, softness and other cooking properties are highly valued despite the variety's susceptibility to lodging, diseases and its low yield. In addition, production of 'Jethobudho' does not meet demand, which pushes up its price. In many areas of the valley, the crop is sold even before harvest.

Stakeholders started by identifying plants with valuable characteristics by way of an extensive field diversity collection survey that was carried out at seven locations in the valley where 'Jethobudho' is traditionally grown. A total of 338 lines from farmers' fields were then evaluated on their performance.

Farmers, traders and hoteliers established a list of trait characteristics of the ideal 'Jethobudho' variety. The 338 lines were screened against these traits at several locations. In this process, farmers had a decisive role. The lines displaying most of the identified traits were judged on post-harvest quality traits and then selected. This brought down the number of lines to 46. From these 46 lines, six distinct lines that showed most of the identified traits were selected but kept separate. The six lines were mixed together and the resulting material was named 'Pokhareli Jethobudho' in order to relate it to its geographic origin. Over the years, overall performance of the enhanced 'Pokhareli Jethobudho' was found to be superior to the farmers' own 'Jethobudho' in a number of desirable traits such as uniformity in quality of post-harvest traits (milling recovery, taste and aroma), grain yield, straw quality and tolerance to blast and lodging. The comparison of the productivity of 'Pokhareli Jethobudho' shows that improved accessions have higher grain yield potential (up to 3.35 t/ha) than the highest range of productivity of this landrace in 1999 (2.4±0.1 t/ha).[7] In order to obtain recognition and at least the right to commercialize 'Pokhareli Jethobudho', the stakeholders who had carried out the selection process decided to apply for release of 'Pokhareli Jethobudho' under the regime of the Nepalese Seed Act 1988 (as amended in 1998 and 2001).

Although farmers are allowed to apply for variety registration and release under the Nepalese Seed Act, directives issued by the National Seed Board require that applicants have at least an MSc degree and set requirements for infrastructure to support breeding activities that practically rule out applications from farmers. In order to get at least co-recognition for participating farmers, the project team filed an application in the name of the project stakeholders,[8] the six custodian farmers on whose land the six lines had been found and the Fewa farmers group, which grows and markets seeds of the enhanced variety in the Pokhara valley. The application of the testing guidelines concerning uniformity was relaxed by allowing the registration of a multi-line variety, thereby allowing 'Pokhareli Jethobudho' to have a lower level of uniformity than might otherwise have been required. The variety was formally registered and released by the Variety Approval, Registration and Release Committee (VARRC) in June 2006 as 'Pokhareli Jethobudho'. The release symbolized the recognition of farmers as co-owners of a new variety for the first time in Nepal's history.

must conform to relatively strict standards of distinctness, stability and, especially, uniformity before they can be registered. Some PPB products—while potentially very useful for farmers—will not be able to satisfy these criteria. The policy objective behind the introduction of these standards is, of course, perfectly justifiable—consumer safety, particularly that of farmers buying seed. But if applied too strictly the standards may limit the ability of farmers to exploit commercial markets for their PPB products. It is also important to recognize that PPB, like conventional breeding, is flexible and can be used to produce varieties with different genetic structures, including pure lines and hybrids. In some countries, new research is now underway to identify appropriate policy and legal options to support PPB, in order to keep the diversity-friendly advantages of the approach (Ceccarelli and Grando 2007).

Similarly, seed laws setting standards for the conditions under which registered seed must be maintained and multiplied can also have the effect of squeezing out farmers who participate in PPB. Again, although the public policy goals of such regulations are important, the challenge is to find a middle ground where the benefits to farmers (of getting their seeds to market) and diversity maintenance goals are taken actively into consideration. It is important to recall that, in many developing countries, up to 90% of seed planted is produced by farmers, not by seed companies. Release of PPB products into existing informal seed systems is a potentially very efficient, low transaction-cost approach. Accommodations of this nature—e.g. relaxing uniformity standards for

Box 3: Pioneering PPB in China

A major PPB project is being carried out in Guangxi province in south-west China and follows up on an impact study carried out from 1994 to1998 by the International Maize and Wheat Improvement Centre (CIMMYT) to assess the impact of CIMMYT's maize germplasm on poor farmers in south-west China (Yiching Song 1998). One of the key findings of the impact study was that the systematic separation between the formal and the farmers' seeds system resulted in inadequate variety development, poor adoption of formally bred modern varieties, an increasingly narrow genetic base for breeding and a decrease in genetic biodiversity in farmers' fields.

A project team has been established in which local farmers cooperate with the Centre for Chinese Agricultural Policy, which is part of the Chinese Academy of Sciences, and the Guangxi Maize Research Institute. The multidisciplinary research team carries out trials in six villages and on-station using both PPB and PVS experiments. The trials allow for comparison in terms of locality, approach, objectives and the types of varieties tested. Varieties include landraces, open-pollinated varieties, so-called waxy maize varieties and varieties introduced by CIMMYT. Some of the CIMMYT varieties have been locally improved through crossings and selections. Agronomic traits, yields, taste and palatability of these improved varieties are satisfactory. They are showing better adaptation to the local environments. Varietal diversity is increasing. The project team supports farmers' groups by bringing them into contact with formal system actors through training, network building and raising awareness about markets.

The PPB field experiments, both in farmers' fields and on-station, have been functioning successfully as a platform to involve the main stakeholders from both formal and farmers' systems. They have facilitated effective interaction, communication and collaboration among them. Through this platform, the approach and results have reached high-level decision-makers (at the provincial and national levels) and some inroads into the policy process have been made. Farmers, women in particular, are now speaking up in meetings and expressing their ideas, needs and interests. The participatory breeding activities have also strengthened the local-level organizational and decision-making capacity of farmers. Groups of (mostly women) farmers have started to define specific support that they would like to receive from the extension service.

They have put forward the idea to initiate seed production and marketing, in particular of waxy maize variety seeds. Marketing research is underway in Guangxi and neighbouring provinces. The aim is to add value to the women farmers' produce. This is expected to make the on-going activities and process of participatory plant breeding and agrobiodiversity management more sustainable. In addition, following the organization of a first successful diversity fair in 2003 in the township they are now planning follow-up fairs in their villages and possibly in the city of Nanning, the provincial capital. They plan to sell their seeds at these fairs.

Source: Adapted from Vernooy R. 2003. Seeds that give: participatory plant breeding (IDRC, Ottawa); Vernooy R. and Song Y. 2004. New approaches to supporting the agricultural biodiversity important for sustainable rural livelihoods. International Journal of Agricultural Sustainability 1:55–66.

landraces or PPB products in national laws—are not without precedent. The testing guidelines for the Nepalese Seed Law have been amended to allow lower levels of uniformity for some products (see Box 2). The draft European Community Directive on Conservation Varieties[5] also allows for the registration of so-called conservation varieties pursuant to relaxed standards and marketing of those varieties (subject to a number of restrictions).

Other recommendations for policies and practices in support of PPB include:

- More dynamic and participatory formal breeding processes overall, through which breeders obtain a better understanding of farmers' criteria;
- The local organization of crop management and seed production through mechanisms such as women-led seed production and marketing enterprises and farmer-organized local research groups that, among other things, provide access to germplasm (see Box 3 on PPB in China, as an illustration);
- A more dynamic organization of seed production as exemplified by open channels and regular germplasm flow between the formal and farmers' seed systems and the formal recognition of and supportive policies for farmers' seed production;
- Basing research programmes on integrated genetic and natural resource management approaches as illustrated by research projects that go beyond crops *per se* and address interrelated questions of social, economic and environmental sustainability;
- Extension of *sui generis* forms of intellectual property protection over PPB products to farmers and farming communities, linked to traditional knowledge protection efforts; and
- Farmers' inclusion as members of formal variety release committees or boards (Vernooy et al. 2007).

Conclusions

Mainstreaming PPB in national and international agricultural research programmes was recognized during the negotiations of the Treaty as an important measure to advance the sustainable use of PGRFA (under Article 6.2(c)). At the same time, PPB also promotes farmers' rights. This should come as no surprise. The two concepts are inextricably intertwined. There cannot be sustainable use without farmers' rights; farmers' rights are meaningless outside the context of sustainable use.

Governments should encourage and facilitate the adoption of participatory approaches by public and private sector institutions involved in breeding. To this end, among other things, they should adjust their regulatory frameworks, particularly concerning variety registration and maintenance and seed production and marketing, to ensure that farmers are able to gain maximum benefit from PPB programmes.

To achieve wide-scale mainstreaming of PPB, technical assistance for national (and international) programmes will be necessary. Some such assistance is already available through the Food and Agriculture Organization of the United Nations (FAO), the CGIAR centres and civil society organizations with experience in the field. The Global Partnership Initiative for Plant Breeding Capacity Building (GIPB)[9] will also include substantial emphasis on building capacity for PPB. The more that the work of all of these initiatives can be considered and guided by the Governing Body of the Treaty, the better.

In addition to providing a forum for the exchange of experiences on PPB, the Governing Body could provide guidance on how countries can support PPB. Equally importantly, the Governing Body could work to define indictors to measure the impact of PPB on both the sustainable use of PGRFA and farmers' rights.

Endnotes

1 The CGIAR coordinated a side event entitled 'Options for National Implementation of Farmers' Rights: Participatory Plant Breeding and Participatory Variety Selection' on June 12, 2006, during the First Session of the Governing Body of the International Treaty. Speakers included Jan Engels (Bioversity International), Pratap Shrestha (LI-BIRD), Ruaraidh Sackville Hamilton (IRRI) and Rodomiro Ortiz (CIMMYT). This brief expands on themes addressed during that event.

2 Joshi et al. (2006) have also demonstrated that PPB is equally successful in high-yield-potential environments.

3 For example, the King Baudoin Award 2006 was awarded to CIMMYT for deploying improved maize in stressful African environments where smallholders grow the crop. Breeding cassava to address cassava mosaic disease is another example of niche breeding that addresses poor farmers' needs.

4 Since the mid-1990s, the CAZS-Natural Resources, University of Wales, Bangor, UK and their national partners have worked in PPB in several well-known geographic poverty traps and marginal production environments in South Asia. They focused on rice and maize and have published a series of success stories that indicated early adoption of PPB products (Sthapit et al. 1996; Joshi et al. 2001; Joshi et al. 2002; Virk et al. 2003; Witcombe et al. 2003; Virk et al. 2005; Witcombe et al. 2005). On average, the 'new varieties' gave 40% greater yields in farmers' fields than the 'old' varieties farmers had cultivated at the start of the project. It has also been shown that PPB can be usefully integrated into mainstream breeding programmes, lowering costs, increasing yields and improving the 'uptake' of new breeding products.

5 Draft Commission Directive providing for certain derogations for acceptance of agricultural landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion and for marketing of seed and seed potatoes of those landraces and varieties, available at http://www.semionline.it/file_download/90/proposta_dir_ue.pdf [accessed October 25, 2007]

6 The project on Strengthening scientific basis of in situ conservation of agricultural biodiversity on-farm was implemented jointly by the Fewa lake farmers' group in the Pokhara valley, LI-BIRD (Local Initiatives

for Biodiversity Research and Development, which has participated in several in situ projects coordinated by Bioversity), the Nepal Agricultural Research Council (NARC) and Bioversity International.

7 Therefore, the enhanced 'Jethobudho' would contribute to the livelihood of the small and medium farmers if scaled-up around Pokhara valley after releasing formally. "Variety Proposal for commercial release of agriculture crops (Pokhareli Jethobudho) in June 2006". Proposed Jointly to Ministry of Agriculture and Cooperatives, National Seed Board, Variety Release and Registration Committee. p. 5.

8 LI-BIRD, NARC, District Agriculture Development Office Kaski and Bioversity.

9 For more about the Global Partnership Initiative for Plant Breeding Capacity Building, see http://km.fao.org/gipb/

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