Case study

Teacher’s notes

**Domesticating PES: Payments for Agrobiodiversity Conservation Services**

**(or How the Economic Valuation of Agrobiodiversity can be used to Design Incentive Mechanisms for its Conservation)**

**Adam G. Drucker , Conservation and Availability of Agrobiodiversity Programme, Bioversity International**

# Introduction

These Teacher’s notes aim to assist teachers to use the case study**: Domesticating PES: Payments for Agrobiodiversity Conservation Services**in the classroom.

The Teacher’s Notes:

* Describe the key concepts covered in the case study, with references to the agrobiodiversity economics literature where explanations can be found (full references at the end of these notes).
* Give tips on how to prepare and run the exercise and discuss the main learning points that students should be able to derive from the case study.
* Provide an outline commentary to the PowerPoint presentation which can be used to introduce the case study to the students. The PPT presentation is divided into 4 sections and contains: ABD economic concepts; a discussion of PES, PACS and the implementation steps required; PACS project results; student information/instructions for the working group exercises; and a summary and highlights of the key take-home messages. Suggestions are provided for integration of the PPT presentation with the case study and video.
* Suggest important points to draw out in the discussion and in students’ strategies.
* Provide further information

This case study includes the following components:

* The case study
* Video: Developing incentives for farmers to conserve agrobiodiversity for the public good
* Teacher’s PowerPoint presentation
* PACS factsheets, research findings, policy brief, technical notes and journal articles.

# Key concepts to introduce in this Case Study

* **Status and Importance of agrobiodiversity (ABD) conservation and use** (FAO, 2010; CBD, 2011, Brush, 2000),
* **Categorisation of values associated with ABD and the private vs. public good nature of those values** (FAO, 2007; Drucker et al., 2005; Pearce and Moran, 1994)
* **Justification and need for interventions and incentive mechanisms (including PES) to ensure the conservation of socially desirable levels of ABD** (Narloch et al., 2011a; Pagiola et al., 2004; Pascual and Perrings, 2007; Smale et al., 2004; Wunder, 2005)
* **Importance of understanding opportunity costs for designing incentive mechanisms**
* **Designing competitive tenders for on farm ABD conservation, including elaboration of conservation goals and implications for efficiency, effectiveness and equity** (Narloch et al, 2011a&b; Drucker, 2006;

# General Background:

Agricultural biodiversity[[1]](#footnote-1) is the basis of human survival and well being. However, despite providing a key input into the agricultural development process and forming a cornerstone of global food security, agrobiodiversity at the ecosystem, species and genetic levels continues to be lost at an accelerating pace from many production systems throughout the world. Causes of such loss include indiscriminate replacement, changes in production systems, changes in consumer preferences, market development and globalization, misguided government interventions (including subsidies), disease epidemics, natural disasters and civil strife (FAO, 1997 and 2007, among others).

Such loss has far reaching consequences, especially for poor indigenous farming communities. These communities often play a key role in the conservation of species, varieties or breeds with unique adaptive traits (e.g. disease resistance, drought tolerance) bred over thousands of years of domestication across a wide range of environments. Genetic resource diversity contributes in many ways to human survival and well-being, with differing characteristics and hence outputs being tailored to suit a variety of local community needs[[2]](#footnote-2) (CBD, 2011; Anderson, 2003). Such species, varieties or livestock breeds are likely to play a key role in future agricultural research and development, particularly in the context of climate change, the globalisation of disease epidemics and biotechnology developments. Such diversity loss, which includes resources with high productivity (and market potential) in the type of marginal environments farmed by the poor, threatens to deprive local communities of important assets for strengthening food security, incomes and resilience in the face of climate change.

Over recent years, *in situ* conservation methods have increasingly begun to be recognised as complementary to ex situ approaches (see Box 1), with the former also being mandated by the Convention on Biological Diversity (CBD).

Such recognition generates opportunities for smallholders as a collective to identify, develop and be rewarded for the maintenance of an asset of strategic value to broader society. This is because, while individual poor smallholder farmers (women and men) play a key role in maintaining specific plant and animal genetic resources (PAGR), it is in fact the overall portfolio of diversity maintained across all farms in a community that constitutes a strategic asset of local, national and global importance. Through a process of prioritisation and targeting, such assets can be identified, secured and developed.

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| **Box 1: Complementarity of *In situ* and *Ex Situ* Conservation Methods**  Concerns about genetic erosion in crops have led to efforts to “insure” against losses by sampling and storing large numbers of landraces and wild relatives of cultivated plants ex-situ in collections, or genebanks. However, most of the world’s crops, especially those that may be critical to the livelihoods of marginalized people, are not represented (Smale and Drucker, 2007).  Over recent years, *in situ\** methods have increasingly begun to be seen as complementary to *ex situ\*\** approaches (Maxted et al. 1997), with the former also being mandated by the CBD. *In situ* conservation provides a major link with *ex situ* conservation and both approaches complement each other. There is also recognition that these methods address different aspects of genetic resources and neither alone is sufficient to conserve the total range of genetic resources that exist.  The current, largely *ex situ* approach suffers from a number of significant limitations. These include: i) most of the world’s crops, especially those that may be critical to the livelihoods of marginalized people, remain unrepresented; ii) key elements of crop genetic resources cannot be captured and stored off-site and, even where they can be, a backup to genebank collection is necessary; iii) genetic resources are more than just raw genetic material but also embody ecological relationships such as gene flow between different populations and species, evolutionary adaptation and selection to predation and disease, and systems of agricultural knowledge and practice associated with genetic diversity; and iv) it has become increasingly evident that agricultural development is not necessarily incompatible with the on-farm maintenance of diversity (Brush, 2000). This is particularly so under heterogeneous and marginal conditions where locally adapted landraces contribute not only to stability and resilience (particularly in the face of catastrophic risks) but also to maintaining productivity in low-input, low-output production systems, including those susceptible to future change.  \* According to the CBD, "*in situ* conservation" means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. <http://www.cbd.int/convention/articles/?a=cbd-02>  \*\* According to the CBD, "*ex situ* conservation" means the conservation of components of biological diversity outside their natural habitats. <http://www.cbd.int/convention/articles/?a=cbd-02> |

As part of an urgently required major effort dedicated to supporting *in situ* on-farm genetic resources management, the securing of such a strategic asset managed by the poor would be expected to contribute to the national and global public good (provision of ecosystem services and future option values), as well as constituting an instrument for development leading to the strengthening of poor smallholder food security, nutrition and incomes.

A key constraint to implementing such conservation strategies is that while the benefits of agricultural biodiversity are increasingly recognized, the existence of pervasive externalities (i.e. positive or negative impacts not reflected in market prices) means that their value is often not fully accounted for by individuals or society. This is because many components of agricultural biodiversity provide a mixture of private and public benefits, with markets capturing only a part of their total economic value (see Box 2) and thus underestimating their true worth. This results in a distortion where any trade-offs that must be made between growth and biodiversity conservation tend to favour the former, regardless of the increasing scarcity of the latter (Pearce and Moran, 1994; FAO, 2007).

Agricultural biodiversity needs to be properly valued and mechanisms put in place to permit the “capture” of those values by the indigenous farmers who incur the conservation costs, thereby providing them with an incentive to conserve that which benefits wider society. This requires the development of appropriate economic methods, decision-support tools and policy intervention strategies.

This case study presents the results of an innovative developing-country application of PES for motivating domesticated biodiversity conservation (hence the title, “Domesticating PES”). The results allow an assessment of the potential of such “payments for agrobiodiversity conservation services (PACS)” schemes to serve as a least-cost and pro-poor agrobiodiversity conservation incentive scheme.

The aim of the case study is to improve understanding of the different types of value associated with the maintenance of agrobiodiversity and how consideration of the existence of significant public good values for traditional and underutilized crop species can be used to justify *in situ* on-farm conservation interventions. Such values are then used to inform the design of suitable types of incentives that can not only encourage smallholder farmers to participate in interventions capable of ensuring that socially desirable levels of agrobiodiversity are conserved, but also allow pro-poor concerns to be explicitly taken into account.

# How to run the exercise

This interactive group exercise is synchronized using the PowerPoint presentation, the video and the case study, and can be run in many ways depending on the time available and size of the class. It is best if the students have already read the case study before they start the exercise.

The suggested sequence for use of the integrated case study and supporting materials is as follows:

1. PPT presentation (Slides 1-29, Sections I, II, and III)
2. Video - should be shown following PPT Slide 29 in order to provide further insights into how the tender was implemented and its outcome.
3. Working Group exercise - follows the video (introduced in PPT Slides 30 – 34, Section IV: Working Group Exercises)
4. Final summary (PPT Slides 35-44, Section V: Summary and take-home messages)

Ideal number of students: 12-20.

Ideal length of class: 2.5-3 hours, broken down as follows:

* ***Introduction:*** Sections I - III of the PowerPoint, followed by the 9 minute video – *approx 30 minutes*
* ***Group work:*** suits 2-5 groups of 4-6. Each group devises a conservation strategy for a specific threatened crop species or variety. Teacher can introduce the group work with PPT slides 30-34 for Section IV: Working Group Exercises. Threatened livestock breed case studies may also be considered. Students discuss the case study amongst themselves, responding to the 10 ***specific*** points listed in the Powerpoint working group exercise slides (Exercise Part I: Establishing a PACS scheme for ABD conservation and Exercise Part II: Identifying potential rewards. This involves agreeing on the conservation objective (i.e. why to conserve), goal (i.e. how much should be conserved), what rewards may be required and how these might be financed. Each group should begin by nominating a chairperson (to help manage the discussion) and a rapporteur (to take notes and report back to the full class). The teacher should be around to answer any queries the groups have. *1* – *1.5 hours*.
* ***Group Presentations***: each group presents its case study on threatened on-farm crop species/variety or livestock breed conservation strategy verbally to the class (supported by main points written on a flip chart or in a ***PowerPoint*** presentation) – *10 minutes per presentation*, with 5 minutes after each presentation for questions/comments by the rest of the class and teacher*.* Or the teacher may choose to deal with just points of clarification after each presentation and allocate more time for the main discussion under the following step. *30 minutes*
* ***Final discussion***: led by the teacher allowing them to make general comments about what was good, what was missed, what they learned, etc. – *10 minutes.*
* ***Concluding Remarks:*** Section IV of the Powerpoint presentation which provides a summary and highlights key take-home messages and policy implications – *20 minutes*

# Case study supporting materials background information

***Video***: runs for 9 minutes and provides an overview of how the competitive tender was organised, who was involved and farmers’ views on their experience of participating in the tender. It also contains pictures that are useful for understanding the type of Altiplano agroecosystems that we are discussing. If the video is used in conjunction with the PPT slides, the Video should be shown following Slide 29 in order to provide further insights into how the tender was implemented and its outcome. Following the video, the Working Group exercise may be undertaken, as described above and in Slides 30 – 34.

***PowerPoint***: about 60 minutes (divided into sections of 40 + 20 minutes). This re-emphasizes some of the points from the video, but also allows explanation of some specific issues raised in the case study.

The PowerPoint slides are organized as follows:

**Section I: Introduction to ABD Economics Concepts (Slides 2-9)**

*Slide 2:* Signals the beginning of Section I of the presentation, which provides an introduction to concepts associated with the economics of ABD conservation and sustainable use

*Slide 3:* Provides an explanation of how economists view the loss of biodiversity in general as part of a conversion process. Note the key point that specialised production systems allow humans to more easily appropriate the benefits, which leads into the discussion of different types of value on the next slide. For illustration purposes, the teacher could use the example of converting a tropical forest (diverse private good values associated with timber, fruits, medicinal plants, etc. and wider public good values associated with carbon sequestration, maintenance of soil and water quality, repository of diversity, etc.) to an agricultural monoculture (potentially higher private good values associated with the crop but much reduced public good values, if any).

*Slide 4:* In the slide, note how the direct use values (coloured in blue) are private good values (i.e. can be easily appropriated by the farmer), while the public good values (coloured in green) are ones that tend to benefit broader society and are consequently harder for farmers to appropriate those values just for themselves. The bequest and existence values are also public good values but apply more to wild (e.g. tigers, pandas, whales) than domesticated diversity, so are not discussed here in any detail. It is this existence of important public values that provides the justification for interventions designed to ensure that socially desirable levels of diversity are conserved.

*Slides 5-6:* These are described in detail in Factsheet 1 – Why are incentives for ABD conservation and use necessary?

*Slide 7:* Provides some of the international policy context, particularly under the Convention on Biological Diversity (CBD).

*Slide 8 - 9:* Slides show that there is a diversity of economic methods and tools that can be used to assess the total economic value of ABD and the types of policy-relevant questions that can be addressed using such methods and tools (current presentation focuses largely on the first 2 questions, but the other 2 are also generally of relevance).

**Section II: Domesticating Payments for Ecosystem Services (PES) (Slides 10-21)**

*Slide 10:* Signals the beginning of Section II, where some of the conceptual aspects of payments for environmental services (PES) and PACS are discussed.

*Slide 11:* Presents the main principles behind PES. Students and teacher may wish to read Wunder, 2005 in association with discussions regarding PES. Note that PES has previously been applied to other areas but not ABD per se.

*Slides 12 - 13:* Overview of Bioversity PACS project work and the 5 key implementation steps. The following slides specifically refer to these steps.

*Slides 14 -15:* Slides relate to the Weitzman prioritisation tool (students and teacher should have read Technical Note 1: *“Weitzman’s “Noah’s Ark Problem” -- how to identify agrobiodiversity conservation priorities”*). The Noah’s Ark problem is about which animals Noah should have boarded onto the Ark in order to conserve the most diversity possible, or in more modern times, how to allocate a fixed conservation budget so as to maximise the diversity conserved. Slide 14 is a livestock (African Zebu breeds) example of the phylogenetic tree that shows the degree of genetic dissimilarity between breeds. Note how the Madzebu (top) and Iringared and Malazebu (bottom two) are very distinct from all the other breeds and hence contribute significantly to the overall measure of diversity. One would want to ensure that these breeds continue to exist even if they are not currently threatened (a rather different recommendation than that followed by many current conservation approaches, which are focussed only on threatened species or breeds). The loss of breeds which are more closely related e.g. those in the middle of the tree would be unfortunate but not have a great impact on the overall diversity conserved.

*Slides 16 – 19:* These slides relate to the elements that might be considered in establishing a conservation goal for the on-farm conservation of threatened crop species and varieties. Such a goal has not yet been articulated for crops although one does exist for livestock. An emerging crop example from Italy is however cited. Students and teacher should read Technical Note 3: *“Identifying in situ Conservation Goals: A Safe Minimum Standards Approach”* in association with this topic.

*Slide 20:* Slide relates to the competitive tender approach and students and teacher can learn more about the conceptual thinking behind competitive tenders by reading Technical Note 2: “*Competitive Tenders for the Conservation of Local Plant and Animal Genetic Resources.”*

*Slide 21:* Slide relates to how interventions may be assessed (based on efficiency, effectiveness or equity) and the implications for participant selection. Teacher to read Narloch et al., 2011b for further information on this topic.

**Section III: Implementing PACS: Activities and Findings from the Andes (Slides 22-29)**

*Slide 22:* Indicates beginning of Section III related to PACS project results in Peru and Bolivia.

*Slides: 24 – 29:* Present a summary of the results of the project and students and teacher should read the Research Findings (Boliva/Peru 1) Factsheet “*Competitive Tenders: Designing Agrobiodiversity Conservation Programmes so as to Minimise Costs while Maximising Social Equity*” for more details regarding these results.

The Video should be shown following Slide 29 in order to provide further insights into how the tender was implemented and its outcome

**Section IV: Working Group Exercises (Slides 30-34)**

Following the video, the Working Group exercise may be undertaken (as described above and in Slides 30 – 34. Note, slides 30-31 repeat earlier slides to remind students of the underlying principles of PES and the PACS implementation stages.

**Section V: Summary and Take-Home Messages (Slides 35-44)**

*Slide 35:* Signals the beginning of Section V, related to providing a summary and highlighting key take-home messages. Section V is to be presented following completion of the working group exercise and will build on and complement the discussions held during that exercise.

*Slide 37:* Highlights potential elements of a policy intervention strategy. These are also discussed in further detail in the Policy Brief factsheet *PACS Policy Intervention Strategies*.

*Slide 39:* Presents a (non-comprehensive) list of potential rewards. Teacher may wish to stress how many of these are in-kind and could be provided by existing government agricultural and educational development programmes.

*Slide 40*: Presents some of the images seen in the video related to the in-kind rewards actually used in the PACS project.

*Slide 41:* May be used to highlight how niche product market development, though often touted as a solution to ABD loss, is unlikely to be a silver bullet. Having established a priority conservation portfolio (for example using a Weitzman approach) there is no guarantee that everything that you want to conserve has market potential and the displacement issue arising from successful market development (e.g. case of white quinoa) also needs to be addressed. Worth noting that to date there has been very little research into the degree to which market development potential is significant in priority conservation portfolios, the initial investment costs and periods over which such investments may be recovered, and the market volumes required relative to modest conservation goals.

*Slide 42-44:* Key take-home messages to reinforce issues and conclusions resulting from the group exercise discussions.

# Important points to draw out in discussion and to cover in student’s strategies

## Comments about the questions

Think about:

1. *What it is that we want to conserve? (Defining the conservation strategy through prioritisation)*

Many PAGR are threatened and, given limited funding, we cannot conserve everything. In order to decide what to conserve, we need to develop a process by which it is possible to decide “which species to take on board Noah's Ark”. Weitzman (1992, 1993, 1998) and others suggest combining measures of: i) diversity/dissimilarity; ii) current risk status; and iii) conservation costs, so as to permit the identification of a cost-effective, diversity-maximizing set of species/varieties or breed conservation priorities.

Hence, for any given quantity of conservation funding available, it is possible to identify a priority conservation portfolio that maximizes the diversity that can be conserved. Such a prioritization approach has a strong appeal due to its rigorous mathematical justification and the possibility to derive optimum conservation decisions with well-defined properties. Nevertheless, despite the conceptual basis having been developed for an important decision-support tool, there is no existing example of this approach having been used to inform actual “real-life” conservation policy design and implementation. This is true for animal and crop genetic resources.

1. *How much should we conserve? (Defining the conservation goal)*

Once PAGR have been prioritized regarding their level of threat and their uniqueness or disimilarity, another challenge lies in defining how much of the prioritised resource should be conserved.

Although many PAGR are widely recognised as being threatened, there is only limited information available regarding their actual status. Only isolated efforts at monitoring agrobiodiversity on-farm have been undertaken. There is no equivalent of a “Red List” for domesticated crop species or varieties under threat, although Bolivia has published a Red List of crop wild relatives. Conventional monitoring efforts, where they exist at all, suffer limitations due to *ad hoc* approaches that lack rigorous survey and sampling methods, poor understanding of search effort costs, do not systematically involve the participation of local-level actors and are usually based on collections instead of direct observations in the field. Given the nature of the information required, participatory diversity status and threat monitoring systems, integrated with systematic conventional, non-participatory monitoring activities urgently need to be developed and tested.

Furthermore, even once PAGR status has been established, the definition of critical risk values remains to be undertaken i.e. defining how much of the prioritised resource should be conserved in order for it to no longer be considered at risk. PAGR and their (uncertain) future values may be lost irreversibly if their population falls below a critical threshold or so-called safe minimum population size. In defining such a population size, it should be noted that the on-farm conservation of PAGR is the result of an evolutionary process involving human selection and practices. Accordingly, on-farm conservation does not only imply the cultivation of certain land areas and thus the generation and conservation of seeds, but also the maintenance of seed distribution networks, local traditions and local knowledge. As such, PACS schemes may well need to incorporate a conservation strategy aiming for the maintenance of local seed systems as a whole (comprising seed production, storage, exchange and related agricultural knowledge). As part of such a strategy, a conservation goal needs to be defined in terms of which PAGR are to be conserved (as per (1) above) and what might be considered to constitute a safe minimum standard (SMS) or population needs to be established. However, such issues have only been dealt with, at best, to a limited extent in the literature on PAGR (Drucker, 2006).

A safe minimum standard (SMS) is defined as one that results in the maintenance of the resource in question within a safe ecological limit and thereby avoids irreversible losses. In the context of agrobiodiversity, it can be considered as a means of restricting the replacement of local PAGR by improved PAGR to an extent that does not threaten the long-term in-situ survival of the local resource. Such an approach, widely applied with regard to wild biodiversity, thereby seeks to avoid maximum future losses.

The complexity in the application of a SMS approach lies in the difficulty of defining such a minimum PAGR population size. In the case of domesticated animals, FAO (1998) defines a livestock breed generally not to be at risk if there are 1,000 breeding females and 20 males. In the case of crop genetic resources, the estimation of a SMS is likely not only to be based on the cultivated area[[3]](#footnote-3), but also on the amount of seeds available in local systems and their age, the number of farmers who cultivate a specific landrace and the degree of local knowledge maintained. Additional criteria, such as geographical distribution of PAGR and associated agro-ecological factors within those locations, existing seed distribution networks or breeding infrastructure, socio-cultural traditions and market integration could also be taken into account when establishing a workable SMS (as per Simianer et al., 2003 and Marti et al., 2003).

Consequently, it appears that there are many factors and underlying dynamics that would affect the definition of a SMS for PAGR. While it is possible that such goals might be fairly modest (e.g. individual landrace conservation area goals might be expressed in hectares or tens of hectares rather than hundreds or thousands of hectares), to the best of our knowledge, existing research of this type is extremely limited and more work needs to be done in this area.

As with most PES programs, PACS may need to trade-off to some extent the use of scientifically rigorous conservation indicators against those that are somewhat easier (and less costly) to implement in practice. Scientific precision in linking conservation goals with the provision of agrobiodiversity conservation services is, nevertheless, urgently needed, so as to make sure that limited resources are invested in those conservation activities that indeed lead to additional conservation services. As in other PES schemes this is also important for the generation of additional funding, as potential beneficiaries are more likely to be willing to finance such schemes where the provision of conservation services is clearly verifiable (Narloch et al, 2011a).

1. *How much will the conservation programme cost and how can we minimise these costs? (Assessing farmer/community willingness to participate in conservation activities)[[4]](#footnote-4)*

The total costs of a PACS scheme comprise: i) *opportunity cost payments to the farmer*, ii) *implementation costs* and iii) *transaction costs*.

*Opportunity costs* are the forgone benefits of alternative land-uses to the farmer. If the benefits that farmers forgo from participating in the conservation activities rather than using their land for some alternative activity are comparatively high, payment levels have to be correspondingly high. PACS schemes might therefore be expected to make most sense at the margin of profitability, where small payments to landowners can tip the balance in favour of the desired land-use (Wunder, 2007). Least-cost conservation of PAGR should thus focus on species/varieties/breeds and agricultural practices that provide considerable private values to the farmer and high public values to wider society (Smale et al. 2004). As poor smallholder farmers are often carrying out *de facto* conservation, they may be expected to provide opportunities to implement relatively low-cost conservation strategies at very low opportunity cost. Such individual farmer or community-level opportunity costs may be revealed through a competitive tender approach. It may be expected that reward-levels for PACS schemes may be lower than those for conventional PES, since farmers’ opportunity costs of not using (e.g. forest) land for agriculture would normally be expected to be higher than those of agreeing to continue the existing agricultural practice or undertaking an alternative one.

In addition to opportunity costs the farmer could incur *implementation costs* if investment in land-use change is required. While opportunity costs are permanent costs, implementation costs are often one-off costs associated with changing the agricultural system to incorporate the conservation activity under consideration (Pagiola et al. 2004). PES schemes might be expected to involve higher implementation-costs, since they are directed towards land-use changes, while PACS schemes might require less costly interventions (e.g. involving improved access to certain seeds or agricultural knowledge, or assistance with rotation of male breeding animals between villages, etc.).

*Transaction costs* should also be accounted for when assessing the total costs of a PACS scheme. Costs include start-up costs (such as prioritisation, location identification and information acquisition, program design, negotiation and contracting) and the permanent costs of running the scheme (administration, monitoring, enforcement). As conservation of PAGR may be relatively easier to monitor and to enforce, transaction costs might be expected to be lower for PACS than for PES. Where PACS/PES schemes can focus on communities rather than on individuals, some cost savings might be obtainable, since economies of scale tend to reduce average transaction costs. Contracting a few large farmers rather than many small ones, as do some PES-schemes, could also be a strategy to reduce transaction costs. However, where the PACS goal is to conserve local public values (such as traditional knowledge and culture), rather than just national/global option values, a minimum network/number of farmers would still be required. Furthermore, there is also a trade-off between efficiency and equity that needs to be considered.

With specific regard to the *monitoring and enforcement of PACS contracts*, institutional arrangements would need to be created that deal with baselines, verification of service delivery and sanctions in case of non-compliance. As noted above, the establishment of scientifically rigorous baselines is a necessary precondition for any PES/PACS scheme. Determining baselines requires the construction of easily understandable performance metrics, clearly associated with specific conservation services in order to allow evaluation of “additionality” (i.e. the degree of conservation achieved by the intervention compared to no intervention) over the contract period.

1. *Where will the funding come from? (Identifying sustainable sources of funding for the long-term implementation of the PACS scheme)[[5]](#footnote-5)*

The *sustainability of PACS interventions* is a key area of concern. Programs might have a limited life-span, unless adequate funding can be established over the long-term. A number of options appear to be worth exploring.

With regard to the potential of existing agricultural market channels in promoting the use of threatened PAGR, local and global consumers of PAGR may pay for the on-farm utilization of local PAGR through such mechanisms as eco-labelling, certification or denomination of origin schemes when niche product markets are developed. Such *niche product market development* for agrobiodiversity-related products is increasingly being promoted as a means of sustainably achieving conservation through use. These “conservation-through-development approaches” can potentially be sustainable, as they build on existing agricultural market channels and thus could be used to generate a sustainable source of funding.

Although it has been shown that niche product market development can facilitate the conservation through sustainable use of “neglected and underutilized” or traditional crop species/varieties (amongst others see: Hoeschle-Zeledon et al. 2009; Padulosi et al. 2000 and Rojas et al. 2009, respectively for Italian hulled wheat, Indian minor millets and Andean grain examples), the potential to use such an approach as a cornerstone of a wide-ranging, cost-effective, diversity maximizing national agrobiodiversity conservation and use strategy remains to be explored. It should be noted that relying solely on market development might be a dangerous strategy for the conservation of a diverse genetic resource pool, especially as market conditions can change rapidly and generally consumers and agribusiness tend to favour a narrow suite of crop species/varieties or animal breeds. Market chain approaches may also require relatively high initial investments to generate appropriate product volumes, with such volumes being far in excess of those required to achieve modest conservation goals, and where overly successful may even displace other threatened agrobiodiverse genetic resources (leakage effect).

In this context, PACS schemes might be capable of providing a stronger and more flexible longer-term foundation for conservation activities, and may be better suited for ensuring the in-situ conservation of safe minimum populations of PAGR. Niche product market development and PACS may thus be viewed as complementing each other. In fact, a broader conservation strategy could incorporate a mixture of incentive instruments, and as such could combine niche market development with PACS schemes built on governmental funds as well private sector funding, such as through biodiversity offset programs.

In addition, *private sector entities* with forward or backward linkages to agriculture may be identified as an additional category of beneficiaries through potential future product development. There are also certain private industries whose operations directly and indirectly exacerbate the replacement of traditional PAGR. Drawing on the concept of biodiversity offsets, regulatory obligations and corporate social responsibility could be used to motivate their support for investments aimed at mitigating their negative impacts.

As marginal commercial values of agrobiodiversity conservation for industry are normally not high enough to fund larger-scale on-farm conservation efforts and as offsets for adverse biodiversity impacts are only just emerging, *government agencies* at a local, regional, national or even international level may be required at present to take on the role of service buyers. For example, local authorities could foster the use of traditional crop varieties by buying related food products and distributing them to public facilities (e.g. school-meal programmes). The fact that in-kind rewards paid at a group level were shown to provide adequate incentives for conservation programme participation also suggests that materials distributed by existing government programmes (e.g. related to agricultural/rural development and education) could also be harnessed to support PACS. These functions may also be fulfilled by *quasi-governmental entities*, such as development banks and conservation agencies or *NGOs* that acknowledge the importance of agrobiodiversity.

# Further information

Bioversity International’s Policy Briefs, Factsheets and Technical Notes related to PACS:

* Policy Brief 1 Payment for Agrobiodiversity Conservation Services (PACS): Policy Intervention Strategies
* Factsheet 1 Why are incentives for Agrobiodiversity Conservation and Use Necessary?
* Factsheet 2 Domesticating PES: Applying Payments for Ecosystem Services to Agrobiodiversity Conservation Issues
* Research Findings (Bolivia/Peru 1): Competitive Tenders: Designing Agrobiodiversity Conservation Programmes so as to Minimise Costs while Maximising Social Equity
* Research Findings (Bolivia/Peru 2): Payment for Agrobiodiversity Conservation Services (PACS) and Implications for Institutions of Collective Action
* Technical Note 1 Weitzman’s “Noah’s Ark Problem”: how to identify agrobiodiversity conservation priorities
* Technical Note 2 Competitive Tenders for the Conservation of Local Plant and Animal Genetic Resources
* Technical Note 3 Identifying in situ Conservation Goals: A Safe Minimum Standards Approach
* Technical Note 4 Collective Action, Property Rights and Payments for Agrobiodiversity Conservation Services (PACS)

Brush, SB. 2000. The issues of in situ conservation of crop genetic resources. In: Brush, SB (ed.) Genes in the field. On-farm conservation of crop diversity. Boca Raton FL, Lewis Publisher USA, pp 3-26.

Drucker, A.G., 2006. An application of the use of safe minimum standards in conservation of livestock biodiversity. Environment and Development Economics 11, 77-94.

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# Glossary

**Agricultural biodiversity** – Agricultural biodiversity provides humans with food and raw materials for goods - such as cotton for clothing, wood for shelter and fuel, plants and roots for medicines, and materials for biofuels - and with incomes and livelihoods, including those derived from subsistence farming. Agricultural biodiversity also performs ecosystem services such as soil and water conservation, maintenance of soil fertility and biota, and pollination, all of which are essential to human survival. In addition, genetic diversity of agricultural biodiversity provides species with the ability to adapt to changing environment and evolve, by increasing their tolerance to frost, high temperature, drought and water-logging, as well as their resistance to particular diseases, pests and parasites for example. This is particularly important regarding climate change. The evolution of biodiversity, and therefore both its and our survival, mainly depends on this genetic diversity (CBD, 2011, <http://www.cbd.int/agro/importance.shtml> ).

**Bequest value –**

**Competitive tender** – a form of reverse auction (lowest offers are accepted first) that provides an incentive for farmers to reveal their true opportunity costs, despite the fact that the conservation agency running the tender would only have a rough idea of what these would otherwise be.

**Direct use value** – Derives from the utility gained from the food, fibre, and medicinal products to which plant genetic resources contribute, including the amentity and socio-cultural values associated with their attributes. Such values may consequently be associated with a mixture of private and public goods, with the latter being more difficult for individuals to appropriate.

**Ecosystem services** – Soil and water conservation, maintenance of soil fertility and biota, and pollination, all of which are essential for survival.

**Existence value** -

**Indirect use value** – The contribution of crop genetic resources to surroiunding habitats or ecosystems.

**Opportunity Costs** - the alternative that must be given up when allocating a scarce resource among its mutually exclusive uses

**Option value** – Type of insurance against unknown future demand, for example, such as that resulting from climate change.

**Private goods** -

**Public goods** – formally public goods and services are those that are non-rival and non-exclusive. Street lighting is the classic public goods example. Citizens benefiting from the existence of street lighting do not stop other citizens from benefiting from that too (i.e. non-rival), unlike when we consume a physical product (e.g. food). It is also not possible to restrict use of the product (non-exclusive). Once the street lights are in place, anyone can benefit from them. Agrobiodiversity is an impure public good as individual crops and livestock are owned by and benefit individual farmers (i.e. are **private goods)**, but the ecosystem services associated with the maintenance of agrobiodiversity (e.g. resilient agroecosystems, maintenance of evolutionary processes and future option values) are benefits that are captured by broader society and not just the farmer.

**Willingness to accept (WTA) -** The payment that someone is willing to receive or accept to give up a good or service. In the context of PACS, the farmer is having to give up the use of part of their land that would have been planted with a more commercial species or variety of quinoa. However, they do get to keep most of the resulting threatened species/variety that they agree to cultivate under the conservation tender contract. The difference in values is the opportunity cost and the use of the competitive tender approach helps to ensure that the WTA and opportunity cost measures are similar.

1. Smale and Drucker (2007) note that agricultural biodiversity refers to all diversity within and among species found in domesticated systems, including wild relatives, interacting species of pollinators, pests, parasites, and other organisms. Domesticated biodiversity (crops, trees, aquaculture fish, livestock), is a consequence of deliberate human intervention, serving both as a production component and as a source for genetic improvement (Cassman et al., 2005). Located within cultivated landscapes, domesticated biodiversity is linked outside these landscapes with the biodiversity found in protected reserves or maintained in the ex-situ collections of breeders and genebanks. Wild relatives are interspersed within both cultivated landscapes and ex-situ collections. [↑](#footnote-ref-1)
2. Agricultural biodiversity provides humans with food and raw materials for goods - such as cotton for clothing, wood for shelter and fuel, plants and roots for medicines, and materials for biofuels - and with incomes and livelihoods, including those derived from subsistence farming. Agricultural biodiversity also performs ecosystem services such as soil and water conservation, maintenance of soil fertility and biota, and pollination, all of which are essential to human survival. In addition, genetic diversity of agricultural biodiversity provides populations with the ability to adapt to changing environment and to evolve, by increasing their tolerance to frost, high temperature, drought and water-logging, as well as their resistance to particular diseases, pests and parasites for example. This is particularly important regarding climate change. The evolution of biodiversity, and therefore both its and our survival, mainly depends on this genetic diversity (CBD, 2011, <http://www.cbd.int/agro/importance.shtml> ). [↑](#footnote-ref-2)
3. Relating the conservation of specific crop species/varieties or livestock breeds to associated levels of genetic diversity is a rather complex task, and it is also unclear to what extent these can be directly linked to the wider provision of agrobiodiversity conservation goals, such as the maintenance of evolutionary processes or cultural traditions. [↑](#footnote-ref-3)
4. Drawn from Narloch et al., 2009. [↑](#footnote-ref-4)
5. Draws upon Narloch et al., 2011a. [↑](#footnote-ref-5)