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## **DOMESTICATION OF PAYMENTS FOR ECOSYSTEM SERVICES: NEW EVIDENCE FROM THE ANDES**

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## **ABSTRACT**

The current project has sought to assess i) the potential of agricultural biodiversity-focused PES to serve as a cost-effective and socially equitable domesticated diversity conservation incentive scheme, as well as ii) how economic incentive mechanisms such as PES can be designed to build on and complement local institutions of collective action. Results are presented from pilot Payment for Agrobiodiversity Conservation (PACS) schemes and framed field experiments implemented in the Bolivian and Peruvian Andes aimed at sustaining diversity within quinoa, a traditional Andean grain.

Findings indicate that opportunity costs of conservation vary widely not only between the two study sites, but also between community-based groups within each site. This creates opportunities to minimize intervention costs by selecting least-cost conserving farmers. However, as shown with respect to the role of wealth and cooperation in determining opportunity costs, this also has implications for the type of farmer to be included in the conservation programme. Promisingly, depending on the fairness principle deemed most important in the local context, there does not necessarily have to be a significant trade-off between the schemes' potential cost-effectiveness and equity outcomes. The observed behavior in the farmer experimental games further supports such findings and suggests that understanding farmer perceptions of fairness can have important implications for the design of conservation incentive mechanisms, particularly given the important influence of such perceptions on the pro-social behavior that underlies much de facto conservation. Incentive mechanisms, such as PACS, that can support socially valued ends not only by harnessing selfish preferences to public ends but also by evoking public-spirited motives are also more likely to be sustainable over the long-term.

The use of PACS incentives for the maintenance of traditional crop varieties and the improvement of smallholder farmer livelihoods thus appears promising for further development and up-scaling.

**Keywords: Payment for environmental services (PES), Incentive mechanisms, Agrobiodiversity conservation, Farmer experimental games, Crowding effects, Conservation goal, Cost-effectiveness, Social equity, Collective action**

## **ACKNOWLEDGMENTS**

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# DOMESTICATION OF PAYMENTS FOR ECOSYSTEM SERVICES: NEW EVIDENCE FROM THE ANDES

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## 1. INTRODUCTION

### Importance and status of agrobiodiversity

With the signing of the Convention of Biological Diversity (CBD), the importance of conserving a broad range of biodiversity in agricultural landscapes was highlighted. Agricultural biodiversity (henceforth agrobiodiversity<sup>2</sup>) is the basis of human survival and well-being, contributing importantly to sustainable agriculture, food security and a wide range of ecosystem services (Thrupp 2000; Esquinas-Alcázar 2005; Perrings et al. 2006; Jackson, Pascual and Hodgkin 2007; Kontoleon et al. 2009; Pascual, Jackson and Drucker 2013, Jarvis et al. 2011).

Despite this, diversity at the ecosystem, species and genetic levels continues to be lost at an accelerating pace from many production systems throughout the world leading to genetic erosion and vulnerability (among others, FAO 2007 and 2009; Jackson, Pascual and Hodgkin 2007). With growing commercialization and industrialization of farming systems, including as a result of the Green Revolution, agro-ecosystems are increasingly characterized by a high level of intensification with low levels of diversity (Thrupp 2000; Jackson, Pascual and Hodgkin 2007). This is mainly because a wide range of local plant and animal genetic resources (PAGR) are being replaced by a few commercially profitable ones, as markets tend to create a bias towards the latter by not fully capturing the total economic value of agrobiodiversity due to the public goods characteristics of many of its services (Drucker, Smale, and Zambrano 2005; Narloch, Drucker, and Pascual 2011).

Furthermore, the existence of ex-situ gene banks with growing collections of germplasm (FAO 2009) are not sufficient to secure the full range of agrobiodiversity conservation services and the agricultural knowledge needed to manage PAGR. Consequently, in recent years, in-situ agrobiodiversity conservation has been increasingly seen as a complementary strategy (Maxted et al. 2002)<sup>3</sup>.

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<sup>2</sup> Agrobiodiversity here is understood as all diversity within and among species found in an agricultural landscape or ecosystem (henceforth agro-ecosystem) that contribute to food and agriculture in the broadest sense (Jackson et al. 2005; Smale and Drucker 2007).

<sup>3</sup> Why is in situ conservation necessary?: 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 gene banks. 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, Ford-Lloyd and Hawkes. 1997), with the former also being mandated by the Convention on Biological Diversity (CBD). There is 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. Key elements of crop genetic resources cannot be captured and stored off-site and, even where they can be, a backup to gene bank collection is necessary. Secondly, crop genetic resources are more than just raw

The loss of agrobiodiversity is expected to have far reaching consequences, especially for the livelihoods of poor indigenous farming communities (IPGRI 2002; Gruère, Giuliani and Smale 2009). Such communities play a key role in the conservation of species, varieties or breeds with unique adaptive traits (for example, disease resistance, drought tolerance) bred over thousands of years of domestication across a wide range of environments. At the same time, agrobiodiversity conservation and use provides a mixture of private benefits to the farmer (for example, through their largely private direct use values), local public benefits to the farming community (for example, through their indirect use values, such as contributing to risk management, agroecosystem resilience, maintenance of soil and water quality, maintenance of indigenous knowledge and socio-cultural practices) and national and global public benefits (for example, maintenance of evolutionary processes and option<sup>4</sup> values, as well as non-use values such as existence values). Insurance values play a role in contributing to ecological stability and resilience (Baumgärtner 2007; DiFalco and Chavas 2009), while option values permit the maintenance of material resources and knowledge (Bellon 2008).

### **Impure public good nature of agrobiodiversity, institutions of collective action and conservation incentive mechanisms**

These characteristics of an impure public good distinguish PAGR from many other natural resources (Smale et al. 2004). Hence, while the use of crop varieties and livestock breeds lead to a private good for the farmer to which private property rights can be attached to, they also contribute to the maintenance of genetic diversity with characteristics of a public good, to which the attachment of property rights is much more complex. Furthermore, as markets capture only a part of the value of these resources, thus underestimating their true worth (Gruère, Giuliani and Smale 2009), distortions result where any trade-offs that must be made between growth and biodiversity conservation tend to favor the former, regardless of the increasing scarcity of the latter (Pearce and Moran 1994; Drucker 2007).

The impure public goods nature of agrobiodiverse resources has led to many poor farming communities having made use of institutions of collective action in order to manage PAGR and complementary inputs (for example, land) collectively (Eyzaguirre and Dennis 2007). Ostrom (1990) has shown that, under certain conditions, rural communities are able to self-organize in order to manage natural resources for reaching common goals; while, among others, Nagarajan et al. (2008) provide a specific example of how the collective efforts of producer groups has had a positive impact on minor millet conservation in India. Such findings lead some observers (see Badstue et al. 2006, among others) to hypothesize that the loss of agrobiodiversity from traditional

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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 (Altieri and Merrick 1987). Thirdly, 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.

<sup>4</sup> Option values are a kind of insurance value given risk aversion and uncertainty about the future – such as that arising from climate change or new disease challenges.

production systems can be associated with the erosion of institutions of collective action, and a widening gap between private and social incentives (see Annex I for a schematic representation of the links between collective action, PACS and sustainable livelihoods).

From an economics perspective, the maintenance of socially desirable levels of agrobiodiversity requires that, where significant public good values exist, these should be recognized and mechanisms put in place to permit the “capture” of those values by the farmers who incur the conservation costs. Such mechanisms would provide farmers with the incentive to conserve that which benefits wider society. While “payment for environmental services” (PES)<sup>5</sup> schemes are one such mechanism and have been hailed by some observers as “arguably, the most promising innovation in conservation since Rio 1992” (Wunder 2005), a review of the literature (inter alia, Dasgupta et al. 2008; Wunder 2007; Mayrand and Paquin 2004; Landell-Mills and Porras 2002; and Pagiola, Bishop, and Landell-Mills 2002) covering hundreds of PES and PES-type schemes, reveals that there has been almost no explicit consideration of PES in the context of agrobiodiversity conservation and only limited consideration of indigenous farmer contexts (Narloch, Drucker, and Pascual 2011; Bioversity International 2011b). Instead PES has tended to focus on carbon sequestration and storage; non-domesticated biodiversity protection, watershed protection and protection of landscape aesthetics.

Such so-called “payments for agrobiodiversity conservation services” (PACS), a subcategory of agricultural-related PES (see Narloch, Drucker, and Pascual [2011] for the conceptual framework), would seek to tackle market price distortions associated with the public good characteristics of genetic diversity. This may be achieved through the use of (monetary or in-kind) reward mechanisms in order to increase the private benefits from local PAGR so as to sustain their on-farm utilization.

Conceptually, PACS may be seen as a means for aligning private and social incentives in order to manage the public good characteristic of agrobiodiversity in a decentralized way, by assigning new forms of property rights over conservation services to farmers providing such services. It is hypothesized that the rewards associated with PACS instruments can be designed in such a way as to create incentives to act collectively in order to contribute to the conservation goal and receive rewards. By contrast, it is also possible that PACS schemes, if not appropriately designed, could undermine existing institutions of collective action in poor farming communities. Communities and households that are able to take advantage of market-based interventions (including PACS schemes) may be relatively few and may encompass the most powerful actors, leaving the poorest unable to participate. Existing patterns of collective action might consequently be undermined if market-based solutions provoke a large increase in perceived inequalities within the community. The importance of such existing institutions could also be reduced or substituted by the rise of new PACS-relevant community-level institutions, including in situations where the PACS scheme has a too narrow a focus in terms of conservation strategy (that is landraces covered by the scheme) and replaces broader-based institutions. Careful study of the conditions under which smallholders are able and willing to participate in PACS schemes and an assessment of the potential impact of PACS on existing patterns of collective action is

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<sup>5</sup>PES typically involves a payment in cash or in-kind by a purchaser which is conditional on the (voluntary) provision of an environmental service by a given provider. In many respects PES resembles environmentally motivated taxes and subsidies but is more direct in the way that it “purchases” the conservation of environmental assets (Wunder 2005).



needed in order to determine how PACS schemes can be designed so that they may build upon rather than undermine such institutions.

Consequently, there is also a need to carry out an assessment of the degree to which the alternative PACS schemes may be able to draw upon, support and complement local practices, rules and institutions of collective action that are included in the farmer systems for managing and using agrobiodiversity. While the interrelationship of institutions of property rights, collective action and PES is recognized (Swallow, Meinzen-Dick, and van Noordwijk 2005), there has been only limited empirical work carried out so far. In addition, research on collective action related to the provision of impure public goods, such as the management of PAGR is only just emerging (Eyzaguirre, Di Gregorio, and Meinzen-Dick. 2007, Padmanabhan 2008; Markelova et al. 2009), even though there are a number of studies related to collective action in the management of common pool resources and the provision of public goods in general. Furthermore, due to minimum scale and threshold effects, Landell-Mills and Porras (2002) and Swallow, Meinzen-Dick, and van Noordwijk (2005) argue that market-based mechanisms for the maintenance of biodiversity conservation services have to address collective action at the community level, especially in the context of smallholder farmers. By acting collectively, poor farmers are also more likely to participate as they are able to overcome entrance barriers, such as those related to transaction costs. Gruère, Giuliani, and Smale 2009 (2009) also argue that collective action initiatives are absolutely necessary; pooling resources, realizing economies of scale, sharing information, and developing a community-based incentive structure are essential contributions of collective action. Such findings, largely drawn from commercial market development studies, need to be evaluated in the context of PACS schemes that do not depend on conservation incentive creation through commercial market development. As can be seen in Figure 1.1 and is discussed further in Section 3, there may be important synergies between PACS incentive schemes and market development approaches aimed at securing the conservation through use of specific PAGR. This paper focuses on that part of the framework (highlighted in bold in lower half of figure) specifically related to the former, while acknowledging the importance of the market development components of the framework.

## Research focus

The consideration of PES-type approaches of relevance to agrobiodiversity conservation forms an innovative research agenda. The knowledge gained from such research will be of critical importance to the implementation of future PACS schemes world-wide and constitute a global public good, as well as directly supporting the Convention on Biological Diversity's COP 8 Decision VIII/25 (Incentive measures: application of tools for valuation of biodiversity and biodiversity resources and functions)<sup>6</sup>.

In this paper we consequently focus primarily on a comparative economic analysis of alternative incentive mechanisms in terms of their potential in reaching a conservation goal (that is effectiveness) at least-cost (that is efficiency) and in a socially equitable manner (for example, by accounting for distributional, gender or poverty alleviation dimensions). Key issues addressed relate to consideration of generic PES constraints<sup>7</sup>,

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<sup>6</sup> <http://www.cbd.int/decisions/view.shtml?id=11039>

<sup>7</sup> Generic PES constraints include issues related to conflicting tenurial arrangements and lack of institutional frameworks for dealing with baselines (that is what extra services are provided above what

as well as the sustainability of such instruments (that is who might be the potential conservation service purchasers able to fund PACS schemes over the long-term). In addition, consideration needs to be given to issues related to the level at which rewards should be paid (that is collective vs. individual).

The following research questions are addressed by the empirical research underlying this paper:

- i. How can conservation payments be targeted so as to maximize the cost-effectiveness of PES under multiple conservation goals whilst taking equity principles on board, so that the scheme fulfils efficiency and fairness criteria.
- ii. How does PACS interact with local institutions of collective action and thereby affect conservation behavior; and how can individual preferences and rewards be potentially harnessed for the achievement of collective goals?

Empirical insights are gained from the Andean Altiplano (high plains), where increasing market pressures threaten quinoa genetic diversity, a traditional Andean grain. The two study sites – a Peruvian site where farming systems are mainly subsistence-based and a Bolivian site where farming systems are more commercialized – permit a comparison across market contexts. The analyses draw on data from methods that have found relatively little application in the PES and wider conservation literature. These include: (i) a conservation (procurement) tender through which community-based groups (CBG) applied for conservation contracts by defining their participation conditions (including the required payment level); and ii) framed field experiments in the form of a (n) (impure) public goods game, in which farmers take hypothetical decisions with regard to the cultivation of different crop varieties in face of competing individual and collective pay-off situations<sup>8</sup>.

The paper aims to provide a broad overview of the PACS work carried out to date. Further details can be found in the associated literature cited. The remainder of this paper is structured as follows: Section 2 describes the study sites. Section 3 describes the conservation tender approach and presents the findings of the two PACS schemes which were implemented. Section 4 presents a summary of the results of the farmer experimental games, improving our understanding of collective action in agrobiodiversity conservation and the pathways through which conservation behavior might be affected by external institutions such as PACS. Sections 5 and 6 provide an overview and

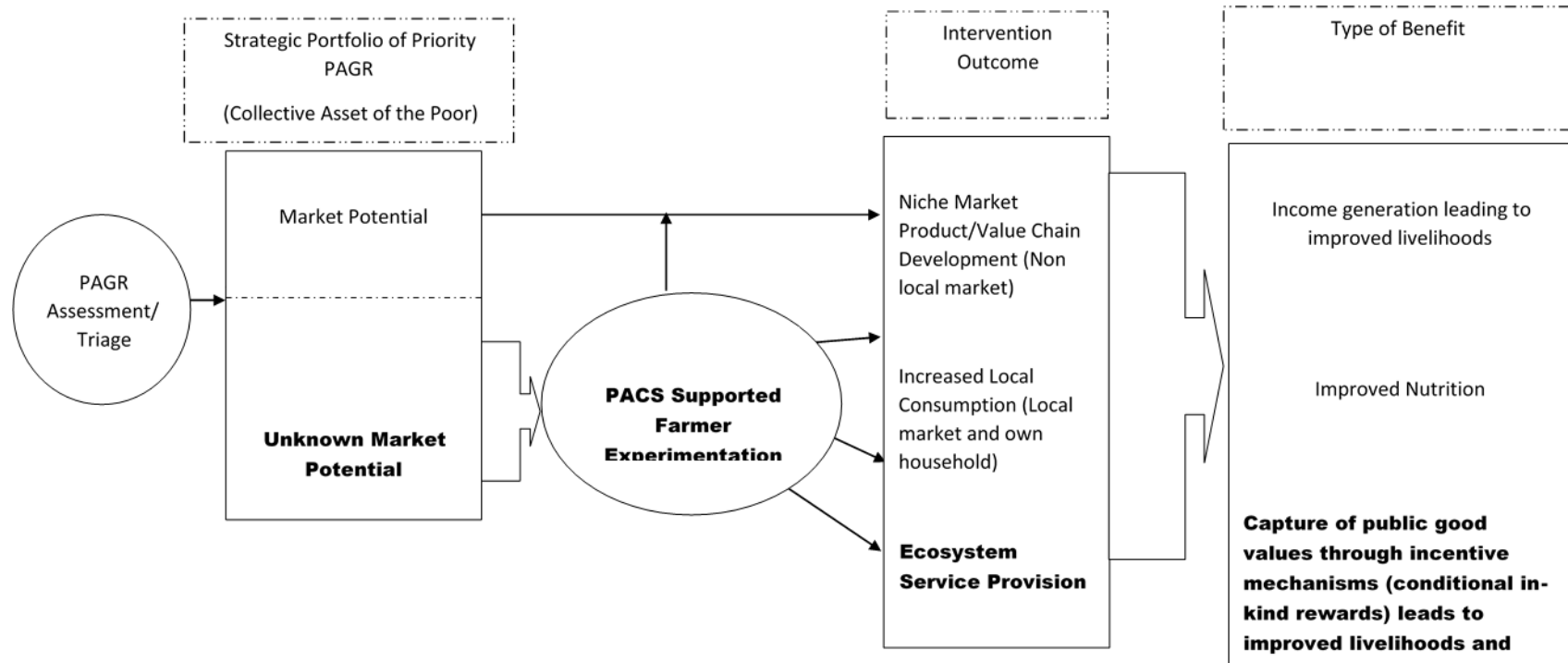
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would be expected without intervention), leakage (that is what negative outcomes occur in non-intervention areas and for the non-participating poor as a result of interventions), and verification (that is the system to assess the delivery of services) [Wunder 2005 and 2007; Pagiola, Arcenas and Platais 2005; Pagiola, Bishop, and Landell-Mills 2002; Pagiola et al. 2004; Ferraro and Kiss 2002; and Ferraro and Simpson 2002]. Additional issues also need to be considered, such as the development of performance evaluation metrics, the identification of the payment recipients and the level and form in which payment is to be made (Pagiola, pers. comm.). While it might be expected that tenurial conflicts and the impact on non-participants might be less severe under PACS relative to other types of PES schemes, service “purchasers” might be more difficult to identify.

<sup>8</sup> It is important to note that the intention of the experimental games was not to inform the choice of reward mechanism under the PACS pilot tender per se, but rather to understand the broad pathways through which such incentive mechanisms might impact on farmer behavior in the presence of institutions of collective action. In particular, the PACS group-level approach cannot be exclusively identified with the collective rewards approach used in the games, as the types of rewards requested by communities participating in the PACS scheme although paid at a group level ranged from rewards for individual use, shared use and collective use.

discussion of the research findings, as well as recommendations for future research and up-scaled implementation.

**Figure 1.1: Framework for PAGR Market Development and PACS Incentive Mechanism Complementarity**



Source: Author's own figure.

## 2. STUDY SITES<sup>9</sup>

Farming in the Andes has a long history, reaching back almost 7,000 years, with farmers managing a high diversity of traditional food crops, such as maize, potatoes and quinoa (Zimmerer 1996). Yet a decreasing utilization of some traditional crops has been observed going hand-in-hand with increasing genetic erosion within these crops, which is undermining the livelihood security of Andean farmers (Castillo 1995; Hellin and Higman 2005; Rojas et al. 2009). An interesting case study setting is provided by the Andean Altiplano. These high plains, at an average altitude of 3,800m, stretch from the Peruvian-Bolivian border region around Lake Titicaca (Northern Altiplano) to the Bolivian-Chilean border region around the Salar of Uyuni, the largest salt flat in the world (Southern Altiplano). Two study sites were chosen, one Peruvian site from the Northern Altiplano with communities located around Puno and one Bolivian site from the Southern Altiplano with communities located around Uyuni (Figure 2.1) in order to compare findings across different community contexts. While in both sites farmers share the same socio-historic background with Quechua or Aymara ethnicity, there are some key differences between farming systems in the two sites as described below.

### **Agro-ecosystems and the role of quinoa**

Farming on the Andean Altiplano is subject to extreme climatic conditions with frosts at night occurring throughout the year and high temperatures during daytime, as well as highly erratic rainfall levels that are becoming concentrated in one or two months only (Perez et al. 2010). Quinoa (*Chenopodium quinoa* Willd.), a traditional Andean grain, which can be grown under marginal production conditions such as poor soils and very low input use is relatively well adapted to this environment (Tapia and Fries 2007). Being rich in vegetal proteins quinoa is associated with very high nutritional values and also forms an essential part of many cultural traditions, so that it plays a key role in the livelihoods of farmers from the Altiplano (Hellin and Higman 2003; Rojas, Soto, and Carrasco. 2004). Consequently, a large number of quinoa varieties encompassing a grand variety of genetic information has evolved with the regions around Lake Titicaca and the Salar of Uyuni assumed to be the centers of origin of quinoa diversity (Tapia and Fries 2007; Del Castillo et al. 2007).

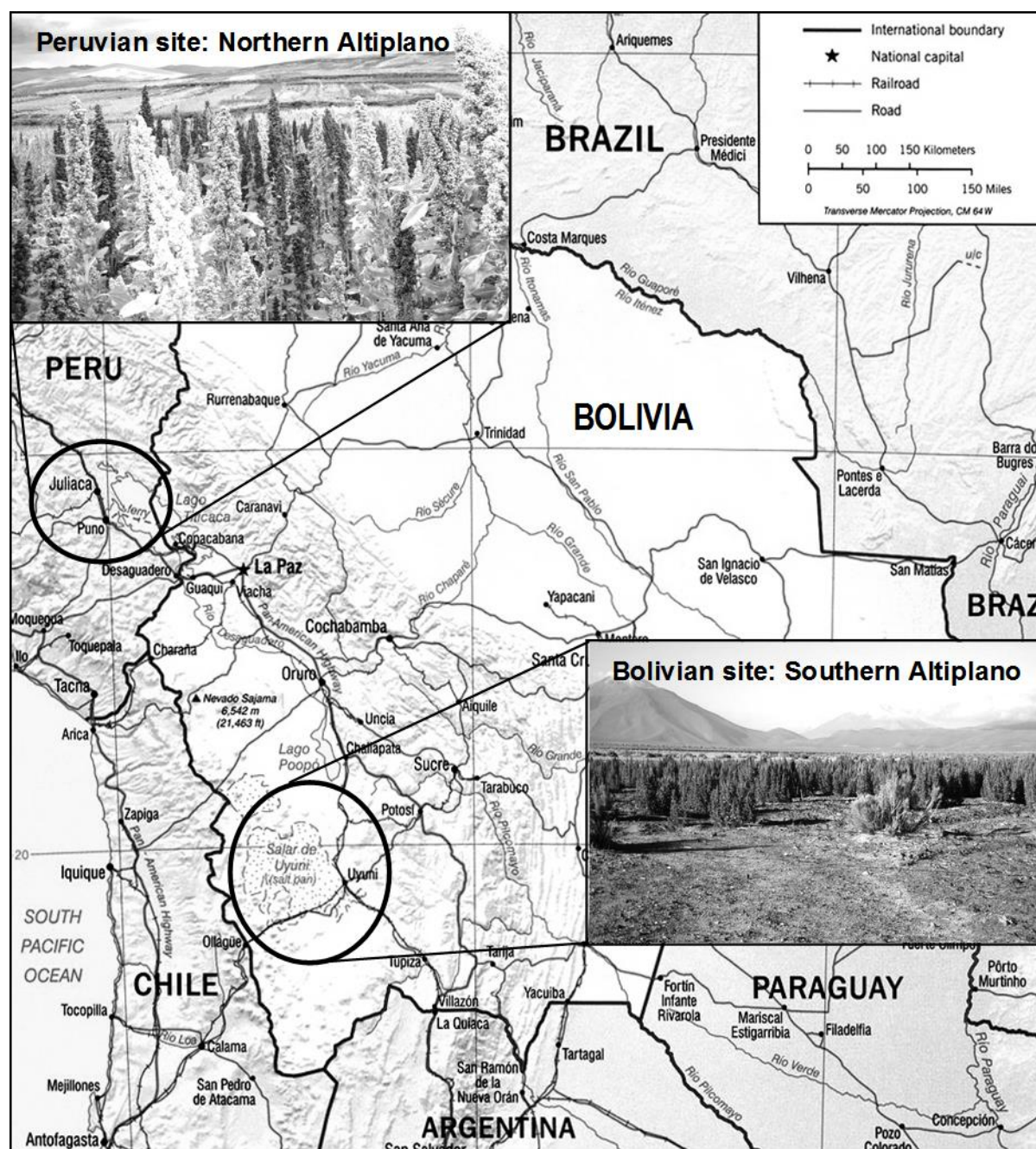
Agroecological conditions and thus farming systems vary significantly between the Northern and Southern Altiplano with water scarcity and extended drought periods, as well as higher temperature variability in the latter zone (Rojas, Soto, and Carrasco 2004; Andressen, Montasterio, and Terceros 2007). In the Bolivian communities quinoa is one of the very few crops that are cultivable under these harsh climatic conditions. Accordingly, the production system is characterized by the mono-cropping of quinoa with fields left fallow for three to six years and used for pasture for llama and other livestock (VSF 2009). By contrast, in the Northern Altiplano weather conditions are more favorable and soils are more fertile, so that farmers normally follow a multi-crop rotational system, switching between quinoa, potatoes, other cereals, beans and fallow land (Canahua et al. 2002; Aguilar and Jacobsen 2003). Experimental trials in 2002 indicated significant differentials in productivity between quinoa varieties and between agro-ecological zones

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<sup>9</sup> This section draws heavily on Narloch (2011).

with quinoa yields varying between 600 to 900kg/ha in the Southern Altiplano and between 2,200 and 3,600kg/ha in the Northern Altiplano (Rojas et al. 2009).

**Figure 2.1 Bolivian and Peruvian study sites on the Andean Altiplano**



Source: Narloch (2011) based on map from US CIA (2006)

## Property rights regimes

Property rights over plants and complementary inputs, such as land are not separable from one another and play an important role in the management of PAGR (Eyzaguirre, Di Gregorio, and Meinzen-Dick. 2007). Intellectual property rights aside (for example,

concerning genetic material), property rights are associated with access to, withdrawal from, as well as the management and control (via exclusion and alienation) of physical resources (Schlager and Ostrom 1992) and may lie in the hands of many different actors (Leach, Mearns and Scoones 1999; Bracer et al. 2007; Ahmed et al. 2008). These rights can be formal (de-jure) or customary (de-facto) rights, covering either private or common property (Anderson and Centonze 2007).

Farmers on the Andean Altiplano cultivate land areas that are formally owned by their communities, as in many other contexts (for example, Eyzaguirre and Dennis 2007; Howard and Nabanoga 2007). Generally all community members have access to these lands, but plots are often used by the same family, who holds an informal right to withdraw crops planted on these lands, and passes these rights on from generation to generation (VSF 2009). This system of de facto land use rights is widely established and accepted, so that other farmers are normally excluded from obtaining benefits from the land under cultivation by a certain family. Yet the ultimate control still lies with the community, which could sell or lease the land. In Peruvian communities recently private ownership rights have been assigned by local governments based on the existing de facto land use rights. By contrast, in Bolivia such titles still remain to be developed. Whereas land is rather scarce in some parts of the Northern Altiplano due to inheritance related subdivision, farmers in the Southern Altiplano have access to large areas of community lands (Rojas, Soto, and Carrasco 2004).

### **Collective action institutions**

Collective action institutions often evolve around property right regimes (Ostrom 2003) and the interplay of the two is a conditioning factor in agrobiodiversity conservation (Eyzaguirre and Dennis 2007). Farming communities in general also build on patterns of collective action to exchange germplasm between farmers and communities and many crop varieties have evolved from a collective process of seed saving, seed exchange and seed selection (Evenson and Gollin 1997; Brush 2007; Dennis et al. 2007; Meinzen-Dick and Eyzaguirre 2009; Stromberg, Pascual, and Bellon 2010).

In the agro-ecological context of the Andean Altiplano, an interesting example of collective action can be found associated with the traditional crop rotation practices undertaken on community lands, known as Suyu (also called Aynoka, or Manta). A group of farmers – sometimes the whole community – decides collectively on which plots within a communal land area are to be planted with a certain crop species (or to be left as fallow land). Each farmer then individually manages his/her piece of land according to these group-level decisions (Canahua et al. 2002)<sup>10</sup>. These systems illustrate well-functioning, self-regulating mechanisms where individual interests (for example, maximizing cultivation of the most profitable crop) might be at odds with collective interest (for example, rotating crops in order to maintain soil quality and other regulating services). As farmers still remain free to choose the specific crop varieties to plant, such systems are associated with a level of diversity within the selected crop species, such as quinoa (Canahua et al. 2002; Aguilar and Jacobsen 2003).

In support of such strong collective action institutions, communities at the Altiplano have developed complementary ways of co-managing their farming systems, for example through the exchange of labor and agricultural equipment (VSF 2009). Furthermore, due to several governmental organizations and NGOs operating on the

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<sup>10</sup> Farmers who do not comply with these collective decisions normally face internal sanctions.



Andean Altiplano to promote rural development and with new market opportunities, many farmers have organized themselves to receive technical assistance and to participate in markets. Such formalized agricultural networks play an important role in facilitating the utilization of CGR.

**Table 2.1 Formalized agricultural networks: participation in organizations by study site**

purpose	Bolivia (n=80)			Peru (n=80)		
	households participating	households with post <sup>a</sup>	average no. of years <sup>a</sup>	households participating	households with post <sup>a</sup>	average no. of years <sup>a</sup>
quinoa production	51.3%	19.5%	6.82	80.0%	28.1%	3.86
quinoa processing	5.0%	0.0%	5.33	25.0%	20.0%	2.40
quinoa marketing	26.3%	10.5%	7.06	26.3%	23.8%	3.90
non-quinoa production	0.0%	-	-	11.3%	11.1%	6.00
livestock management	0.0%	-	-	20.0%	25.0%	4.94
marketing of agricultural products	1.3%	-	-	10.0%	0.0%	8.43
marketing of non-agri. products	2.5%	0.0%	7.50	6.3%	20.0%	3.00
women self-help group	12.5%	30.0%	12.63	35.0%	41.7%	8.64

Source: Narloch 2011

Notes: a conditional on participation

As can be seen in Table 2.1, marketing organizations play a relatively modest role in the study sites compared to those focused on production matters. In the Bolivian site farmers participate in fewer agricultural organizations, are less likely to hold a position of responsibility within these networks and have a longer tradition in these organizations. Farmers in the Peruvian site appear to have more organizational experience as measured by the sum of the years of involvement (not shown in Table).

Informal agricultural networks are reflected by connections through which a group of farmers cooperates for various agricultural related purposes. The range of such networks in the study sites is shown in Table 2.2. For example, with regard to exchange and the safeguarding of indigenous planting material, in the Bolivian and Peruvian sites it can be seen that 40-50percent of the surveyed farmers exchange seeds with other farmers and 20-30percent declared that they cooperate with other farmers in the conservation of traditional varieties. The level of connectedness (measured by the average number of farmers participating in these connections) and trustworthiness (as measured by the reliability of other farmers), both of which can play an important role in crop variety exchange, is significantly higher in the Peruvian case study site.



**Table 2.2 Informal agricultural networks: connections between farmers by study site**

purpose	Bolivia (n=80)			Peru (n=80)		
	households with access	average no. of households participating	high trustworthiness of others <sup>ab</sup>	households with access	average no. of households participating	high trustworthiness of others <sup>ab</sup>
conservation of traditional varieties	21.3%	7.7	31.3%	28.8%	8.4	63.2%
seed exchange	53.8%	4.5	28.6%	38.8%	8.8	65.5%
soil conservation	48.8%	10.4	23.7%	32.5%	23.6	80.0%
collective land management	31.3%	8.3	20.0%	41.3%	22.8	73.1%
exchange of workforce	48.8%	6.9	31.6%	53.8%	8.3	73.2%
exchange of agricultural equipment	36.3%	3.6	14.3%	8.8%	16.9	85.7%
livestock management	13.8%	3.5	66.7%	32.5%	3.7	65.4%
water management	41.3%	24.1	72.7%	35.0%	28.1	60.7%
marketing of agricultural products	18.8%	6.6	64.3%	17.7%	16.9	75.0%
transformation of agricultural products	1.3%	2.0	0.0%	8.8%	10.9	71.4%

Source: Narloch 2011

Notes: a conditional on participation, b households indicating availability of others as 'always' or 'often'

### The role of increasing market orientation

There is growing demand for minor crops from developing countries from consumers in industrialized countries who seek to satisfy specific tastes, improve nutrition or contribute to rural development (Hermann and Bernet 2009). Quinoa is being heralded as an organic fair-trade crop, thus gaining popularity among consumers around the Western world (Tapia and Fries 2007). With organic labeling schemes in place, certified varieties can benefit from high price premiums (Rojas, Soto, and Carrasco 2004; Laguna, Caceres, and Carimentrand 2006; Del Castillo 2008).

Given active export promotion of quinoa by the Bolivian government, soaring market prices for a few certified varieties and the increasing availability of alternative food products (such as rice), quinoa farming on the Altiplano has become more market orientated relative to its traditional role as a subsistence crop (Rojas et al., 2004; Hellin and Hgman 2003 and 2005). In the Southern Altiplano a large expansion of the area under a narrow suite of commercial quinoa varieties can be observed together with the displacement of varieties with less market potential (VSF 2009). A single variety now makes up 37percent of production and the top three varieties account for 72percent of production (Astudillo, 2007) In the Peruvian communities, where there is little potential for agricultural expansion, farmers also mostly cultivate a restricted set of improved, commercially certified, varieties (Canahua et al. 2002; Rojas et al. 2009). This has resulted in the increasing marginalization of many quinoa landraces and an ongoing loss of traditional agricultural knowledge (Canahua et al. 2002; Rojas, Soto, and Carrasco

2004; Rojas et al. 2009), even though there is still high level of intra-population genetic variety (Del Castillo et al. 2007).

### **3. IMPLEMENTING THE PACS SCHEMES<sup>11</sup>**

Given the importance of quinoa diversity for both livelihoods and the provision of public good ecosystem services, as well as the increasing threat to quinoa diversity, including as a result of market development, there is a growing justification for intervention.

In addition to associated location targeting and capacity building (see Bioversity International 2011a), a number of key steps are required to establish a PACS intervention. These include:

- i. Defining the conservation strategy through prioritization (What it is that we want to conserve?)
- ii. Defining the conservation goal (How much should we conserve?)
- iii. Assessing farmer/community willingness to participate in conservation activities (How much will the conservation programme cost and how can we minimize these costs?)
- iv. Identifying sustainable sources of funding for the long-term implementation of the PACS scheme (Where will the funding come from?)

While full details are given in: Bioversity (2011b); Narloch (2011); Narloch, Drucker, and Pascual 2011; Narloch, Pascual, and Drucker 2011; Narloch, Pascual, and Drucker 2013 and Drucker, Padulosi and Jager 2013; the discussion below focuses on the prioritization and farmer willingness to participate aspects.

#### **Defining the conservation strategy through prioritization (What it is that we want to conserve?)**

##### *Background*

Given limited funding, not everything can be conserved. In order to decide what to conserve, a process needs to be developed by which it is possible to decide “which species to take on board Noah’s Ark?” Weitzman (1992 1993 and 1998; also see Bioversity International 2011d) suggests 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.

Once PAGR have been prioritized regarding their level of threat and uniqueness or dissimilarity, another challenge lies in defining how much of the prioritized resource should be conserved. PAGR and their (uncertain) future values may be lost irreversibly if their population falls below a critical threshold or so-called safe minimum population

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<sup>11</sup>This section draws heavily on Narloch 2011.

size<sup>12</sup>. On-farm conservation does not only imply the cultivation of certain land areas 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, together with the establishment of what might be considered to constitute a safe minimum standard (SMS) or population. However, such issues have only been dealt with, at best, to a limited extent in the literature on PAGR (Drucker 2006; Bioversity International 2011e).

### *Project implementation*

Drawing on such an approach in the face of limited risk status and diversity information, the current project sought to firstly identify quinoa landraces of relevance in the farming systems of the study sites through a participatory process (following Bellon et al. 2003) between farmers and local development NGOs PROINPA (Bolivia) and CIRNMA (Peru) using community workshops and key-stakeholder interviews. Secondly, for the 30 (20) Bolivian (Peruvian) landraces identified (see Soto et al. 2010), a risk analysis was undertaken. An expert group formed by local scientists and agricultural extension experts from PROINPA/CIRNMA evaluated each landrace's threat status with regard to (i) the area under cultivation for each landrace, (ii) the number of farmers cultivating the landrace in question and (iii) the level of traditional knowledge associated with that landrace as measured by the number of uses of that landrace in farming, food preparation and for socio-cultural purposes known by farmers; and (iv) the amount of seed stored by farmers (see Soto et al. 2010). Thirdly, in order to help focus on the most unique landraces, a dissimilarity analysis was additionally carried out for the most endangered landraces. As information on genetic traits was not available, the landraces were classified based on their agro-morphological characteristics, such as color, grain size and resistance to specific weather conditions (for example, frost or drought) (see Soto et al. 2010).

Following this process, in January/February 2010 a portfolio of priority landraces to be included in the conservation tender was defined. In the Bolivian site five landraces, Chillpi Blanco, Huallata, Hilo, Kanchis and Noveton, were selected, and in the Peruvian site four landraces, Misa quinua, Chullpi anaranjado, Janko witulla and Cuchi willa, were selected.

## **Assessing farmer/community willingness to participate in conservation activities through the use of conservation tenders**

### *Background*

Conservation tenders provide a framework through which farmers apply for conservation contracts by identifying the cost of delivering specific conservation services via a conservation activity predefined by the conservation agency acting as service purchaser,

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<sup>12</sup>A safe minimum standard (SMS) based on maintaining the resource in question within a safe ecological limit and thereby avoiding irreversible losses of PAGR 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 resource. Such an approach, widely applied with regard to wild biodiversity, thereby seeks to avoid maximum future losses.

(Latacz-Lohmann and van der Hamsvoort 1997; Latacz-Lohmann and Schilizzi 2005; Stoneham et al. 2007). The idea is to award conservation contracts to those land users who can provide conservation services at least cost and thus would require lower compensation payments. These sorts of reverse tender are a means by which to tackle the existence of information asymmetries (Stoneham et al. 2003; Ferraro 2008). Due to the competitive process, the scope for rent-seeking behavior is limited, as farmers have an incentive to bid for contracts close to their real opportunity costs (Latacz-Lohmann and van der Hamsvoort 1997; Jack, Leimona, and Ferraro 2009). It has been acknowledged that substantial efficiency gains can be realized when the targeting of conservation payments accounts for the conservation costs of land users (Babcock 1996 1997; Ferraro 2003; Naidoo and Ricketts 2006; Chen et al. 2010). At the same time conservation tenders are a means to create values, through the awarding of conservation contracts, for those agricultural conservation services that generate public good characteristics (Latacz-Lohmann and van der Hamsvoort 1998; Stoneham et al. 2007).

Conservation tenders in general have proven to be more efficient in generating conservation services than fixed price programs, whereby a uniform price is offered for a pre-defined conservation activity (Schilizzi and Latacz-Lohmann 2007; Windle and Rolfe 2008). That said, the transaction costs of running conservation tenders can be relatively high, since the conservation agency has to coordinate invitation, bidding, selection, contracting, verification, and delivery of payments to a number – of possibly dispersed – land users (Latacz-Lohmann and van der Hamsvoort 1998). However, dealing with groups of land users can reduce such transaction costs and foster self-organization skills of communities. Moreover, group-level approaches may be more appropriate in contexts where land use is based on customary rights established on community lands accessible to a larger group of land users (Engel and Palmer 2008).

There are a growing number of conservation tender examples through which farmers apply for compensation payments for setting land aside for conservation purposes (Stoneham et al. 2003; Kirwan, Lubowski and Roberts 2005; Latacz-Lohmann and Schilizzi 2005; Klimek et al. 2008). Notwithstanding its potential in informing the targeting of conservation payments by estimating possible environmental and social outcomes ex-ante, there is very limited application of tender approaches in developing countries as part of PES programs (Jack, Leimona, and Ferraro 2009).

### *Project implementation*

Bioversity International in collaboration with PROINPA/CIRNMA decided to undertake a group-level agrobiodiversity conservation tender process to award PACS contracts and payments to farming community-based groups (CBGs). The agrobiodiversity conservation tender was based on a first-price (that is CBGs could only prepare one bid offer) and sealed-bid (that is CBGs would not know about competing offers) reverse procurement tender (see Latacz-Lohmann and Schilizzi 2005; Ferraro 2008) approach. In launch meetings and field visits organized by PROINPA/CIRNMA from January to April 2010, representatives from 18 Bolivian and 20 Peruvian existing CBGs were invited to submit proposals for the conservation of the priority landraces during the 2010/11 planting season starting in August/September 2010. The invited CBGs were women's associations and quinoa-based producer groups that came from four Bolivian and five

Peruvian districts, thereby covering different zones within the two study sites<sup>13</sup>. Most of these CBGs had collaborated with PROINPA/CIRNMA in other projects and studies.

Between March and May 2010 those CBGs interested in participating in the tender were assisted by local extension experts from PROINPA/CIRNMA in preparing their bids following a consultative process with the CBG representatives. These representatives were in charge of organizing their CBG members so as to include a minimum of two farmers in the bid offer. Each interested farmer could freely define the conservation area per landrace and the compensation payment required per land unit cultivated under this landrace (bid price). Based on this information CBG representatives calculated the final bid offer by indicating for each of the chosen priority landraces:<sup>14</sup> (i) the total conservation area, (ii) the number of farmers to take part in the conservation activity and (iii) the bid price per conservation land unit (a proxy for the opportunity cost of conservation). From this information the total bid value was derived (the product of conservation area and bid price), which reflects the total payment level required in local currency units<sup>15</sup>. CBGs were also asked to define their preferred participation mode, choosing between accepting conservation contracts only if all their landrace bid offers were selected (conditional participation) and accepting conservation contracts for any of the landraces from which their bid offers were selected (partial participation).

The CBGs were advised that payments would be made in-kind and representatives could freely choose their in-kind payment type, such as inter alia, agricultural equipment or inputs (for example, seeds), construction or school materials, and that these would be provided by PROINPA/CIRNMA conditional on the fulfilment of the contract at the end of the 2010/11 harvest. Contract fulfilment also involved 2 percent of production being collectively saved as seed for conservation purposes. The contract also contained a "force majeure" clause to reduce uncertainties about payment in the case of verifiable extreme climatic events damaging the conservation plots (further details below). Participating CBGs were informed that winners would be selected on the basis of "bid value" that is those who could offer the greatest conservation service in terms of area and farmer numbers per conservation cost. Bid offers would be regarded as indivisible units.

#### *Conservation bid offers*

Bids were received from 13 Peruvian CBGs by April 2010 and from 12 Bolivian CBGs by May 2010. To calculate the adjusted bid value and thus the conservation costs, the required payment level was adjusted for seed cost purchase if the necessary amount of seeds to cultivate the indicated conservation area was not accessible to the CBG (which in a number of cases was expected as some landraces were ranked as 'critical' or 'at risk' in terms of seed availability). In these cases PROINPA/CIRNMA would purchase the seed at local markets or from farmers in the region that still managed these landraces, in order to provide the selected CBGs with the necessary planting material, so that lack of seeds was not a participation constraint.

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<sup>13</sup>The Bolivian CBGs are located around the Salar of Uyuni with an average distance of 130km to Uyuni, the next urban and market center. The Peruvian CBGs are found in an area ca. 60–80km North of Puno (Quechua zone) and ca. 80–100km South of Puno (Aymara zone) (see Figure 2.1).

<sup>14</sup> CBGs could choose between preparing a bid offer for at least one and a maximum of all of the priority landraces.

<sup>15</sup> No ceiling was placed upon the conservation area or payment levels that could be requested.

The bid offers received indicated that conservation costs vary between CBGs within each of the two study sites. For instance, as can be seen in Figure 3.1, in order to allocate one hectare to a given priority landrace through a PACS scheme, the minimum payment would range from US\$143 in Bolivia to US\$2,400 in Peru. Where effective conservation might be considered to require the involvement of at least 20 farmers per landrace, this would cost US\$460-US\$920. Assuming that effective delivery requires at least five CBOs, conserving any given landrace would cost US\$200-US\$500 in Bolivia, and US\$800-US\$1,500 in Peru.

Different land tenure systems are what may result in larger conservation areas being offered in the Bolivian site. Here farmers have access to large community land areas and thus are able to expand quinoa production into non-cultivated areas. In the Peruvian communities, land is scarcer due to inheritance-related land divisions, and quinoa competes with other crops. Also the number of farmers forming part of the landrace bid offers is generally higher for all the Peruvian prioritized landraces, which may be due to the existence of more robust patterns of collective action.

The significant differences in the bid prices may also arise because of agro-ecological conditions which allow quinoa yields in the Peruvian site to be more than double those in the Bolivian site (see Rojas et al. 2009), thus increasing the foregone benefits when not cultivating commercial varieties (that is the opportunity costs of conservation). At the same time, risk factors may drive these differentials. Farming in the Bolivian site is subject to high climatic risks due to heavy frosts in the planting months and extended drought periods in the growing season. In such a context risk-averse farmers have an incentive to reduce their bid prices in order to secure a non-stochastic income component as noted by Ferraro (2008).

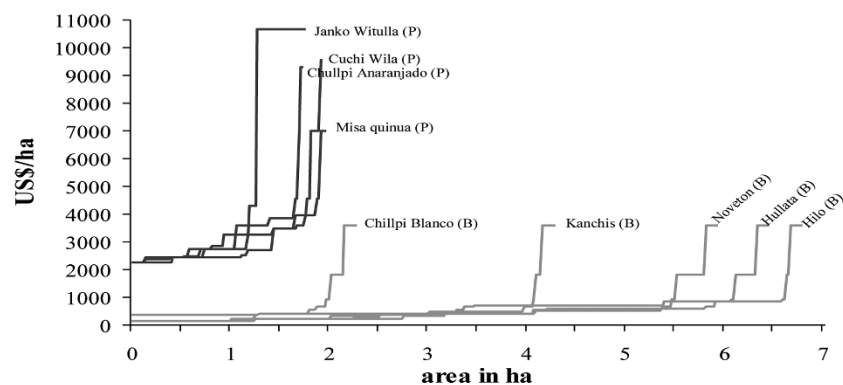
## **Targeting of Conservation Payments**

### *Background*

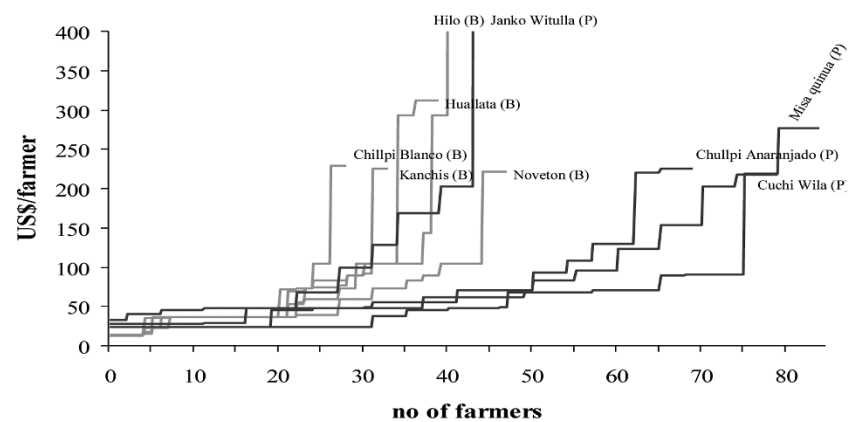
The targeting of payments also determines distributional outcomes, namely who gets how much for what. Many authors have highlighted the potential of PES as a multipurpose instrument, with their design guided by different motivations, such as reducing poverty and local inequities (see for example, Grieg-Gran, Porras, and Wunder 2005; Zilberman, Lipper, and McCarthy 2008; Lipper et al. 2009; Swallow et al. 2009). Yet as it is widely argued that PES should have their primary emphasis on conservation goals (Pagiola, Arcenas, and Platais 2005; Wunder 2007; Engel, Pagiola, and Wunder 2008); which even may lead to socially desirable goals needing to be traded-off or existing inequities exacerbated (see Corbera, Brown, and Adger 2007; Corbera, Kosoy, and Martinez 2007). Nonetheless, targeting payments on efficiency grounds only, whilst ignoring fairness considerations in the distribution of payments, may erode the legitimacy and sustainability of such interventions, so that social and conservation goals are intertwined (Swallow et al. 2009; Pascual et al. 2010; Muradian et al. 2010). Consequently, equity considerations are extremely relevant in the growing application of PES in communities that share strong norms of fairness. Yet fairness is a multi-faceted construct, which can take many different dimensions, and individuals value equity principles differently in their fairness perceptions depending on local and personal contexts (Pascual et al. 2010; Schilizzi 2011).

**Figure 3.1: Supply cost curves for the conservation of priority landraces**

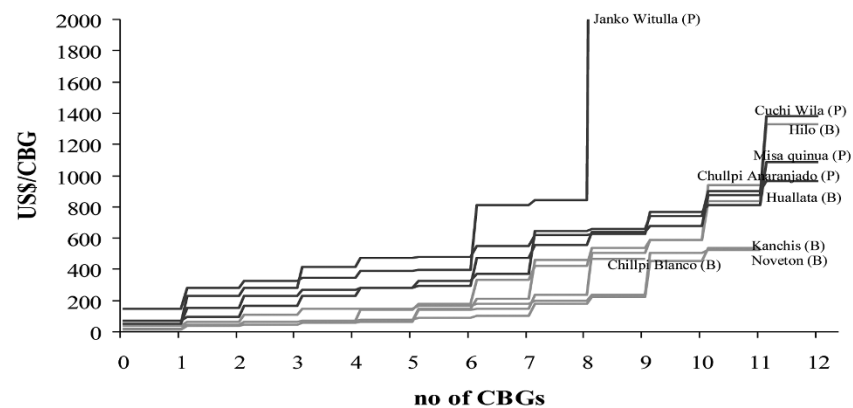
Costs in US\$ per hectare



Costs in US\$ per farmer



Costs in US\$ per CBG



Source: Narloch 2011

Note: Bolivian landraces are represented in light grey and Peruvian ones in dark grey.

So, the question is if/how different equity principles can be aligned with one another whilst taking multiple conservation goals into account? Drawing on data from the agrobiodiversity conservation tenders, a number of targeting approaches are assessed with regard to their cost-effectiveness in terms of different conservation goals, as well as their equity impact.

### *Project Implementation (Ranking and selection of bid offers)*

A total budget of US\$ 4,000 was available in each site to cover conservation payments (including seed purchase costs, but excluding the transaction costs<sup>16</sup> of running the scheme). Narloch, Pascual, and Drucker (2011) ranked the bids with regard to their cost-effectiveness in terms of three conservation goals: (i) cultivated land area (A) under a specific priority landrace as a proxy for the seed production and maintenance of genetic diversity in the field, (ii) the number of farmers (F) conserving such landraces, as a proxy for the maintenance of local agricultural knowledge and cultural traditions and (iii) the number of participating CBGs (G) as proxy for the maintenance of informal seed exchange networks and, hence, geneflow across communities. Combined (C) rankings were also considered, with a weighting of 40 percent for ranks from A, 40 percent for ranks from F and 20 percent for ranks from G found to best reach a compromise solution of balancing conservation area, farmers and CBGs.

For the selection of bid offers an iterative process was followed for each of the targeting approaches under consideration, whereby the highest ranked bids per landrace were selected, whilst seeking to distribute the conservation funds as equally as possible among the landraces, until no further bids could be selected without exceeding the budget of 4000 US\$. This selection process can be subject to alternative targeting rules, which can incorporate different equity principles.

Under a discriminatory targeting rule (D), each selected group could be paid according to the different payment levels requested by each group. Alternatively, under a uniform targeting rule (U), each selected group would receive the same payment, equivalent to the highest payment level requested among those bid offers that would be selected. Under both rules, bids may be selected independently from each other, resulting in just a subset of each group's landrace bids being selected. Yet some groups had indicated that their participation would be conditional on their entire bid offer being selected. Under this conditional targeting rule (C) each group would be paid the payment

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<sup>16</sup>Transaction costs, in terms of administering the Peruvian PACS scheme (transport and materials for the realization of workshops, support for communities to submit offers, issuing of contracts, monitoring and verification, training, visits related to award ceremonies, and so on.) were estimated to be in the region of New Soles 16,600 (\$6,450). Given that the overall field budget was \$4,000 this reveals that the fixed costs formed a large proportion of this small-scale pilot PACS scheme's implementation costs. However, it might be expected that a larger scale multi-year implementation across a wider range of quinoa varieties and other threatened neglected and underutilized species would have a relatively lower proportion of transaction costs associated with it. A Bioversity International proposal submitted to the Peruvian government in 2011 upon their request estimated that an upscaled programme for two Peruvian provinces covering two Andean grain crops would incur transaction costs of 40 percent during a first five year period, falling to 16 percent during a second five year phase. Under such circumstances, the proposed upscaled PACS scheme would then be broadly considered to be approaching the cost of agricultural support schemes in other parts of the world. For example, in the EU such costs form typically 1-11 percent of the total programme budget (MAFF 2000: 96-97). However, it was noted that the actual management and administration cost goal would nonetheless need to be carefully considered in the context of the actual target conservation zone characteristics (likely to be more remote than comparative EU locations) and the typical costs of other Peruvian support programmes.



level requested. These three different rules incorporate alternative principles of fairness (that is proportionality, equality/non-discrimination and procedural justice) and, as can be seen below, result in varying conservation and distributional outcomes (that is related to the distributional equality of payments among farmers and groups, and the distributional effects of payments on different types of groups (Narloch, Pascual, and Drucker 2013).

### *Targeting performance*

The combination of the aforementioned four conservation goals (area, farmer numbers, community group numbers and a combined measure) and three targeting rules (discriminatory, uniform and conditional), results in a set of 12 targeting approaches representing three different cost-effectiveness criteria and three equity principles.

#### *Performance under the discriminatory targeting rule*

Under the discriminatory targeting rule (D), results indicate the existence of significant cost-effectiveness trade-offs between alternative agrobiodiversity conservation goals (see Table 3.1). There appears to be a non-complementary relationship between maximizing the conservation area and the number of conserving farmers, since area-based targeting approaches would result in significantly smaller numbers of farmers and vice-versa. Neither area-based nor farmer-based targeting would be closely connected with maximizing the number of targeted groups. For instance, A would target 3.29 ha of landrace Hilo, conserved by 11 farmers in four CBGs with a total expenditure of US\$ 1,051, under F the number of targeted farmers would be 27 but only 0.53 ha and six CBGs would be targeted, while under G eight CBGs but only 1.72 ha and 17 farmers would be targeted for conservation of Hilo.

**Table 3.1: Targeted conservation area, number of farmers, number of CBGs and budget by discriminatory rule targeting approach and priority landrace**

	area in ha				No. of farmers				No. of CBGs				budget in US\$			
	A	F	G	C	A	F	G	C	A	F	G	C	A	F	G	C
Bolivia																
<i>Chillpi Blanco</i>	1.96	0.39	0.88	2.00	11	22	14	12	4	5	7	5	779	687	646	815
<i>Huallata</i>	3.30	0.74	3.38	3.38	14	24	16	16	5	5	7	7	740	803	849	849
<i>Hilo</i>	3.29	0.53	1.72	1.72	11	27	17	17	4	6	8	8	1051	901	741	741
<i>Kanchis</i>	3.00	0.80	3.19	3.15	9	25	17	16	5	6	9	8	675	842	868	796
<i>Noveton</i>	2.94	0.61	2.63	2.98	17	23	17	18	5	4	7	6	717	714	846	754
Peru																
<i>Misa quinua</i>	0.39	0.30	0.37	0.44	11	31	17	32	2	3	4	4	901	985	976	1223
<i>Chullpi anaranjado</i>	0.45	0.28	0.28	0.28	14	18	18	18	3	4	4	4	1030	772	772	772
<i>Janko Witulla</i>	0.47	0.43	0.43	0.43	11	28	28	28	2	4	4	4	1128	1100	1100	1100
<i>Cuchi Wila</i>	0.41	0.30	0.33	0.33	13	36	19	23	2	3	5	4	920	919	982	779

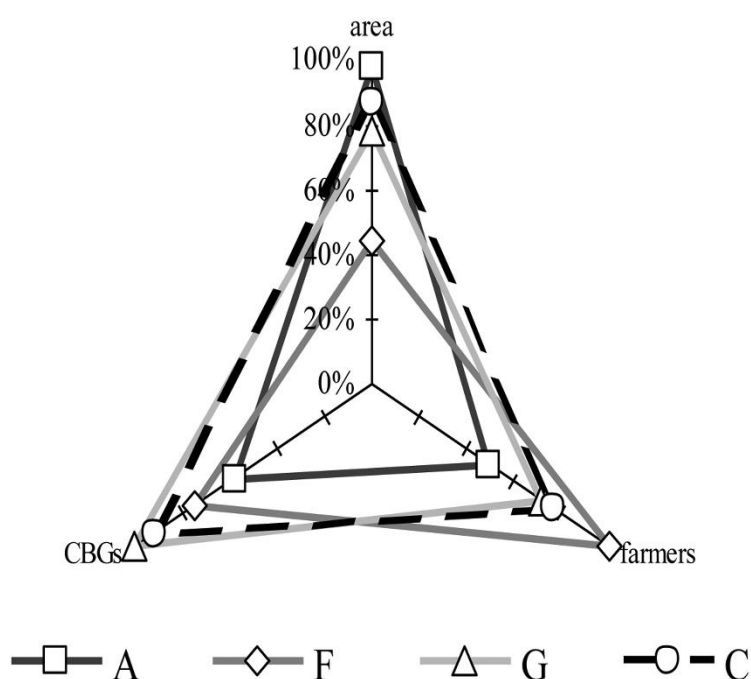
Source: Narloch, Pascual, and Drucker 2011

Notes: An approach maximizing conservation area, F approach maximizing number of farmers, G approach maximizing community-based groups, and C combined approach

A combined goal (C) with an arbitrary weighting of 40 percent (A)-40 percent (F)-20 percent (G) was found to best balance the three conservation goals (see Figure 3.3).

Using such a combined goal would result in an average across the nine landraces of 87 percent of the maximum potential conservation area, 77 percent of the conserving farmers, and 92 percent of the participating CBGs relative to the targeting approach that would maximize these landrace-specific conservation goals within the budget. The actual weights that might be assigned to each conservation goal would of course be expected to directly influence the degree of additionality achievable. In this context the lack of a scientific framework for assigning weights is a serious significant constraint. This limitation is further compounded by the fact that different weights could also result in another type of trade-off, that between cost-effectiveness and equity.

**Figure 3.3 Cost-effectiveness trade-offs between conservation goals under the discriminatory rule targeting approach**



Source: Narloch, Pascual, and Drucker (2011)

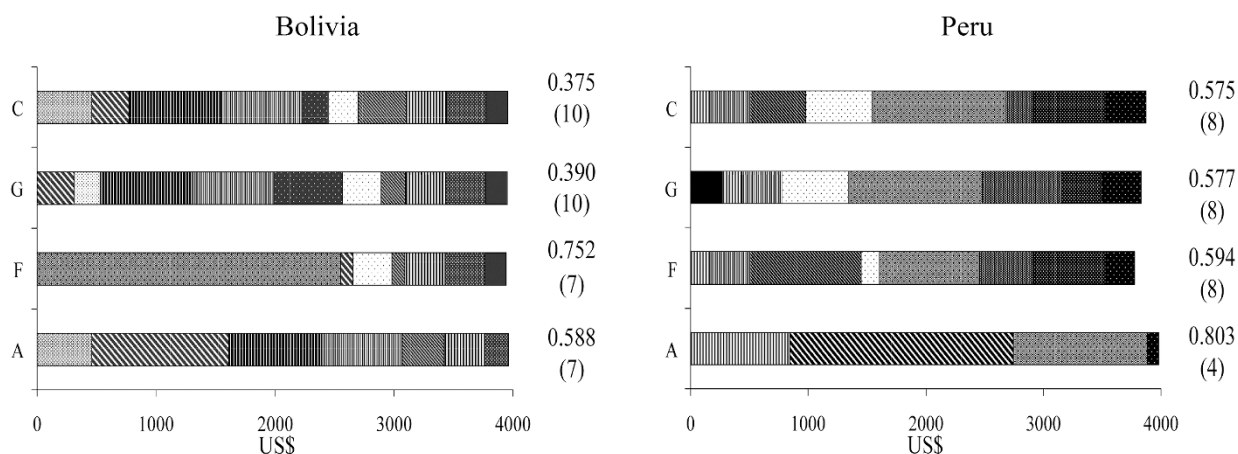
Note: The four targeting approaches aim at maximizing (A) conservation area, (F) number of conserving farmers, (G) number of CBGs or (C) a combination of these goals. The axes indicate the average of the nine priority landraces conservation goal outcomes measured as a percentage of the landrace maximum that could be reached under any of the four targeting approaches subject to the conservation funds available.

For example, in Bolivia under the discriminatory targeting rule, the group and combined goal approaches would favor groups with significantly older farmers and almost all targeting approaches would result in groups being selected that are represented by more women. In Peru, area goals compared to all the other goals would lead to groups being selected that are more male-dominated and poorer in terms of agricultural assets. Surprisingly, area goals in the Bolivian site would target groups with smaller quinoa areas. And in Peru all discriminatory rule targeting approaches would distribute payments between groups with relatively smaller quinoa landholdings. (Narloch 2011).

Optimizing cost-effectiveness with regard to the conservation area or number of farmers would also be associated with a highly unequal distribution of payments. As can be seen in Figure 3.4, under the discriminatory targeting rule the distribution of payments (that is who receives how much of the funds) is highly sensitive to the targeting approach, as some CBGs would secure an excessive share of the payments under some targeting approaches, but not receive anything under others. As such, the conservation goals and targeting rules taken into account in the selection process significantly condition the scheme's performance and as such cost-effectiveness and equity trade-offs.

For example, the largest number of CBGs facing such exclusion would occur under discriminatory rule targeting approach A, whereby five CBGs in Bolivia and nine in Peru would be excluded from the programme. The most unequal distribution would be associated with targeting approach F in Bolivia, with just one CBG appropriating more than 60percent of the total budget. In Peru, targeting approach A would have also created a highly unequal distribution of the conservation budget, since up to two thirds of the Peruvian budget would be allocated to just two CBGs. In both countries a more equal distribution would be achieved under targeting approaches G and C, although the Gini coefficient still remained relatively high in Peru. Consequently, in the current study, it is apparent that compromise solutions may be achieved through multi-criteria targeting approaches that assign different weights to relevant conservation goals so as to balance the cost-effectiveness in terms of these goals whilst taking into account relevant equity considerations.

**Figure 3.4: Distribution of conservation funds among CBGs by discriminatory rule targeting approach and study site**



Source: Narloch (2011: chapter 7)

Note: CBGs are anonymized and represented by specific shading. To the right the Gini-indicators measuring the inequality of payments and the number of targeted CBGs (in parentheses) are displayed.

#### *Performance under alternative targeting rules*

In both sites the discriminatory targeting rule proved superior compared with the uniform and conditional ones regarding all potential conservation outcomes, as well as

distributional equality (see Table 3.2). The conditional targeting rule would have been the least preferred in terms of the number of participating groups, as well as with regard to the inverse of the Gini coefficient. Furthermore, Table 3.2 indicates that the performance of the three targeting rules varied between the two sites. In Bolivia a significantly larger conservation area and a higher degree of equality was achievable, but with fewer farmers (Narloch, Pascual and Drucker 2013).

**Table 3.2. Conservation outcomes and distributional equality under the targeting rules**

	Bolivia			Peru		
	<i>discriminatory</i>	<i>uniform</i>	<i>conditional</i>	<i>discriminatory</i>	<i>uniform</i>	<i>conditional</i>
conservation area in ha	13.23	8.61	8.00	1.46	1.34	1.45
number of farmers	47	33	42	68	63	41
number of groups	10	7	6	8	7	6
1/gini	2.67	1.75	1.39	1.74	1.61	1.55

Source: Narloch, Pascual, and Drucker, 2013

Overall, it seems that targeting rules accounting for uniform pricing or preferred participation mode underperform relative to discriminatory pricing rules. This is because the latter two pose a binding constraint to the targeting of payments, whereby generally fewer CBGs (and thus fewer farmers) would be targeted, so that payments are distributed highly unequally and smaller conservation areas are attainable, as explained by Narloch (2011: chapter 7). This would imply that non-discriminatory or procedural fairness principles would need to be traded off against cost-effectiveness, as well as equity principles based on collectivism, inclusiveness and equality (Narloch 2011). The degree to which PACS participants might in fact be willing to incur such trade-offs is further explored in the context of the experimental games that are described in Section 4.

#### *Targeting approach adopted*

Based on the above findings, a combined conservation goal (C) approach was adopted in both sites coupled, however, with different targeting rules. On the one hand, in the Peruvian site where conditional participation had been indicated, procedural fairness concerns were accommodated by adopting a conditional targeting rule. On the other hand, we adopted a discriminatory targeting rule in the Bolivian site, as no conditional participation preference had been indicated.

#### **Post-tender follow-up**

Following the completion of the competitive tender and awarding of the conservation contracts additional field data was collected from the PACS scheme participants in both countries during monitoring and verification visits. With a view to tracking reward and seed use, in Peru an additional post project survey covering 25 (approximately 55 percent) of the participants was also carried out a year later; while in Bolivia a similar

survey was carried out two years later covering 26 (approximately 60 percent) of the participants. While the nature of the resulting data is largely qualitative, it nonetheless provides further insights about the PACS scheme implementation. A summary of the findings related to farmer perspectives regarding their participation in the scheme is presented below along with some notable quotes.

### **Box 3.1: Farmer Perspectives of the PACS Scheme**

#### **i) Impact of the PACS scheme on community relations and institutions**

- In Bolivia, participants stated that they interacted with other members of their group during the growing season principally with regard to labor exchange related to sowing and harvesting. They also stated that interaction between the group members had improved as a result of the project, in part as a result of discussions about the progress of the cultivated variety and visits to each other plots. Discussion also related to the importance of maintaining such varieties for subsistence use (as their grandparents would have done) and not just for commercial production. Similarly, Peruvian farmers stated that they viewed their participation in the PACs scheme as having been “good” and “successful”, as all contracts had been complied with. Additionally, the experience had allowed them to work more closely together as a group. Expectations had been met (since rewards were paid), although one community group noted that they would have preferred a cash reward.
- In terms of challenges faced during the tender process, Peruvian community leaders stated that not all such communities had been able to participate in the initial information workshops as they had not been able to reach an internal accord with their members regarding potential participation. Some difficulties were also experienced in calculating opportunity costs and obtaining the required seed themselves had not been possible. No difficulties were reported with regard to the seed selection training received nor the receipt of rewards.
- In the Bolivian community of Aguaquiza because of a “lack of soil moisture”, two farmers ultimately decided not to plant the variety they had contracted to. In order that the remaining farmers would get rewarded for their conservation effort, they took up the responsibilities. This provides an indication of the strength of the community-based incentive conditions (that is that no community member would be rewarded unless all had complied with their contractual conditions).
- Traditional knowledge in Peru regarding the use of the threatened varieties was limited and considerable interest was shown, particularly amongst the women, regarding the suitability of the different varieties for different kinds of traditional quinoa food products (also see participating farmer quotes in Box 3.2).

#### **ii) Use and distribution of the rewards**

- In some cases where willingness to “participate unconditionally” (that is to accept a contract for only part of the offer submitted) had been stated and consequently resulted in certain group members being excluded from a contract that the rest of their community group had been partially awarded (covering varieties that happened not to be offered by the excluded farmers), this outcome was viewed as unfair. Further discussion between the selected and non-selected members ultimately resulted in a division of the partially awarded contract being split between all the original group members.
- In Peru, four of the participating communities requested rewards that could be directly appropriated by the individual members of the group (for example, alfalfa seeds, roof sheeting and farm implements), while in two of the participating communities, the rewards were more closely associated with group use, for example, construction material for quinoa storage infrastructure or a quinoa threshing machine.
- Generally speaking, participants in both countries stated that the in-kind rewards received were to be used by the participant group but also shared with other community members through a system of labor exchange (*ayni*).

#### **iii) Seed maintenance and future participation**

In Bolivia approximately 60 percent of the 26 participants interviewed post-project stated that they still retained seed in 2013 of the threatened variety they had received in 2010. All stated that, even in the absence of any further rewards, they would be willing to cultivate other threatened varieties if seed was made available. Such statements suggest that conservation interventions for any given threatened variety do not need to be annual to be successful and reveal a potential sustainable funding mechanism (that is the use of seed, which can be reproduced regularly, as a sufficient reward).

**iv) Perceptions of Fairness**

In Bolivia approximately 24 (92 percent) of the 26 participants interviewed post-project stated that they considered the rewards to be fair ("justo") or good, on the basis that the rewards had benefited the recipients and had been paid as per the contract conditions. 6 participants (23 percent) stated that although there had been some complaints within the community following the distribution of the rewards, these were from farmers who had chosen not to participate in the first instance.

**v) Reasons for non-participation and reaction to non-selection**

- Of the 17 Bolivian communities invited to participate in the tender, only 12 submitted an offer. The 5 communities which decided not to participate stated that either they were more interested in large-scale quinoa production or that because the proportion of non-residents in the community was high, availability for sowing, management and cultivation of the crop was limited.
- In Peru, reasons for non-participation by certain communities included a fear that it would not be possible for the producers to obtain the seeds of the threatened varieties, that it had not been possible to organize a group to submit an offer in the time available (but that for future work this might be possible) and that the novelty of the scheme led some to think that rewards would not in fact be paid or would not be paid if the crop failed, so that planting a commercial variety would be less risky and would generate income rather than quinoa for home consumption.
- A number of producers that did not participate have subsequently shown interest in participating in future years as, they stated, the project showed that it would/did indeed deliver the promised rewards and because it allowed varieties that were being lost to be rescued (also see quotes in Box 3.2).
- Some of the non-selected communities in Peru were reported to initially have expressed surprise at not having been selected and complained that expectations had been unduly raised. The project reemphasized that the reason for non-selection were that the overall budget had been limited and that other communities had been able to put in more competitive offers which had been selected instead. A number of these communities later indicated their interest in being advised about future initiatives of this type, suggesting that the competitive nature of repeat tenders (as measured by their ability to maintain or increase the number of CBGs interested in submitting tender offers) might not be compromised by non-selection in previous years. Furthermore, a number of NGOs, research institutions and community members have subsequently contacted the project enquiring as to how they might also participate in future tenders.

**vi) Who participated?**

- In Peru only 5-23 percent of participating community members were considered to be amongst the poorest members of their respective communities, while 45 percent of total participants were female. This suggests that in terms of equality in participation, gender equality was high, while the participation of the poorest was substantially lower. In Bolivia, the reverse seems to be the case, with 47 percent of participants being amongst the poorest members of the community, but only 22 percent of total participants bring female.

### **Box 3.2: Notable quotes from participating farmers during final PACS verification visit**

#### **Landrace Use and Cultural Aspects**

- i. We grow mainly white quinoa because it sells well. But we discovered that these varieties like chullpi and pasankalla have other nutritional values and different ways of consumption that we appreciate in nourishing our families and children. *(Paulina Mendoza, Community of Chita, Antonio Quijarro Province in Potosí, Bolivia)*
- ii. Since these varieties had not been sown for a very long time, their uses have been forgotten. With support for training and trade fairs, we will be able to reconnect with our culinary heritage *(Elena Márquez Escobedo, Community of Tuma Chupa, District of Mañazo, Puno, Peru)*
- iii. I wish many more people felt encouraged to use these varieties in cooking different dishes just as our ancestors did in the past. *(Nilda Paucar, Community of Chita, Antonio Quijarro Province in Potosí, Bolivia)*

#### **Landrace Performance**

- iv. We noticed that these varieties are more resilient to the changing climates, and yield better because their taste on the field does not attract animals like birds and mice. *(Martín Perca Chambilla, community of Ancoaque, District of Juli, Puno, Peru)*
- v. The ability of these neglected varieties to mature earlier than some cash crops is a great advantage in coping with unforeseeable climate changes *(Faustino López, Community of Aguaquiza, Nor Lipez Province in Potosí, Bolivia)*
- vi. We are very happy with the results. They flourished beautifully. We intend to save 70 percent for consumption and 30 percent for seeds *(Genaro Miranda Vilca, Community of Collana-Cruz Pata, District of Cabana, Puno, Peru)*

#### **Seed Supply**

- vii. We are grateful and proud for this opportunity to rescue these quinoa varieties. There should be many more varieties, but their seeds are not easily available nowadays. *(Carlos Nina Muñoz, Community of Jirira, Ladislao Cabrera Province in Oruro, Bolivia)*
- viii. Neighboring farmers are curious about these varieties and have expressed their intention to buy seeds from my harvest for the next season. *(Marcelino León Ticona, Community of Caricari, District of Mañazo, Puno, Peru)*

#### **Participating in the PACS Scheme**

- ix. Other members of our women farmers association now regret they did not participate in the project from the beginning and now look forward to a future opportunity *(Modesta Villca, Community of Chita, Antonio Quijarro Province in Potosí, Bolivia)*
- x. Now that we have realized the virtues of these varieties, we will strive to keep them alive, even if the project does not go on. *(Santusa de López, Community of Aguaquiza, Nor Lipez Province in Potosí, Bolivia)*

These quotes, together with pictures of some of the project sites, participants and rewards, as well as a brief explanation of the competitive tender process may be seen in the video "Developing incentives for farmers to conserve agrobiodiversity for the public good" which can be found on YouTube and on the following webpage:

[http://www.bioversityinternational.org/research/sustainable\\_agriculture/pacs.html](http://www.bioversityinternational.org/research/sustainable_agriculture/pacs.html)

#### **4. COLLECTIVE ACTION AND THE EFFECTIVENESS OF ALTERNATIVE REWARD SYSTEMS: FARMER EXPERIMENTAL GAMES<sup>17</sup>**

As noted above, due to the impure public goods nature of PAGR, the provision of agrobiodiversity conservation services often depends on patterns of collective action. PES might affect conservation behavior through different channels, as such schemes may not only alter the economic but also the moral incentives for conservation (for example, Rodriguez-Sickert, Guzman and Cardenas 2008; Sommerville et al. 2010). There is increasing concern that PES might crowd out social norms underlying existing conservation efforts, thus hampering collective action among smallholders (for example, Pattanayak, Wunder, and Ferraro 2010). Whereas collective payments could be a means by which to complement existing social norms, increased private incentives through individual (farm-level) payments may run the risk of eroding pro-social behavior. Yet responses to these incentive mechanisms are likely be very location specific, conditioned by existing social preferences. In this context it is important to assess the effectiveness of different reward systems (here individual rewards made in proportion to individual conservation effort versus collective rewards which are divided equally regardless of individual conservation effort), controlling for their impact on collective action through their interaction with social preferences.

The application of framed field experiments can provide valuable insights into the multiple layers (individual-, group- and incentive-level) relevant to understanding collective action in conservation (Cárdenas and Ostrom 2004) and the pathways through which conservation behavior is affected by external institutions. To learn about people's preferences and decision-making in real resource- and group-contexts, research in real field contexts is needed (Cárdenas 2000; Swallow, Meinzen-Dick, and van Noordwijk 2005). There is a growing body of literature analyzing cooperative behavior in the management of natural resources in field framed experiments<sup>18</sup> conducted in developing countries (Cárdenas and Carpenter 2008; Cárdenas 2009), but to our knowledge there is so far no application in the context of (i) managing PAGR, and (ii) the impact of reward systems, such as PES.

This section describes and summarizes the results of framed field experiments. It should be appreciated, however, that these games were not intended to be used to directly inform the targeting approach adopted in the above PACS scheme. Furthermore, the PACS group-level approach cannot be exclusively identified with the collective rewards approach used in these games. Nonetheless, the experimental games contribute to an improved understanding of how such mechanisms to provide economic incentives can be designed to build on and complement local institutions around collective action.

##### **Framing economic experiments in the field**

Two phases of field experimental games were run in Peru and Bolivia between 2010 and 2012. The Phase I Games took place in Peru and Bolivia between February and April 2010. The games were constructed to analyze the impact of different reward systems on conservation and their interaction with farmers' social preferences. The results led us to

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<sup>17</sup> This section draws heavily on Narloch (2011).

<sup>18</sup> A framed field experiment is a conventional lab experiment with the relevant subject pool, which is undertaken within a field context in either the resource task or information set available to the subjects (Harrison and List 2004).



conduct a second phase of experiments in Peru in September 2012 (Phase II Games)<sup>19</sup>, with the aim of studying the robustness of the previous results when farmers can communicate before taking their decisions - as it has been argued that, in real life, people discuss together before taking their decisions individually and that the lack of such communication may influence results. Indeed, an important literature has emerged on communication showing that allowing participants to cheap talk (that is to discuss but without making binding commitments) leads to more cooperation in public goods and common pool resources dilemmas (Cardenas, Ahn and Ostrom 2004; Ledyard 1995, Ostrom, Gardner, and Walker 1992 and Ostrom 2006).

It is in this context that a(n) (impure) public goods game was framed around decisions between different quinoa varieties (Narloch 2011, Bioversity International 2011c and Midler et al. 2012). Each game participant formed part of a group of four players and disposes of a number of fixed land units. Over twelve rounds, participants decided on how many land units to allocate to the conservation of a threatened variety. As market prices for this variety are lower than for a commercial variety, the farmer incurs private conservation costs. Yet, the cultivation of the threatened variety is associated with public conservation benefits that accrue to every group member once a certain threshold is reached. Six rounds of a baseline game were played, before introducing economic incentives for conservation and playing six additional rounds with either individual rewards decreasing the private conservation costs or collective rewards increasing the public conservation benefits.

In the Phase I baseline game, the social optimum, that is where the group's total benefits would be maximized, is reached when all the group members allocate all their land units towards conservation (see Figure 4.1 for an example). However, a social dilemma arises from the participants' private incentive not to conserve and to free-ride on the others. Only when expecting the group peers to conserve a certain number of land units, would it be rational to conserve one or two land units so as to allow the threshold to just be reached (and thereby move from no public benefits to a situation where everyone receives public benefits). With external rewards the set of optimal private strategies would include the conservation of more land units depending on the expectations of others' behavior, but there would be no dominant strategy that would allow the social optimum to be reached.

### *Organization of the games*

Four experimental game sessions were organized in Bolivia and four in Peru. Half of these sessions were played with individual and the other half with collective rewards. Each session was organized with 16-20 participants from quinoa-based farm households in the same (or neighboring) communities, which were selected from different zones within the two study sites so as to maximize the representativeness of the sample.

In the Phase I experiments, participating farmers were randomly arranged in three 'uniform' (all group members have an equal number of land units) and two 'heterogeneous' (some members have more land than others) groups of four participants each. Information on group-membership was not provided to the participants, so group composition during the game was unknown to them. However, after each round the

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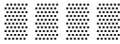
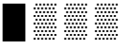






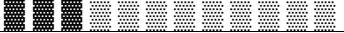

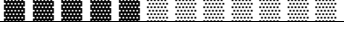







<sup>19</sup> The full results, including the econometric analysis of the Phase I games can be found in Narloch, Pascual and Drucker. (2012), while the full preliminary results of the Phase II games can be found in Midler et al. (2012).

participants were informed about their pay-offs, as well as about the individual conservation levels of their (anonymous) group peers.

In Phase II, farmers were randomly arranged in uniform groups, were informed who their peers were from the very beginning (in order to help distinguish between effects of communication and merely knowing the identities of one's peers) and had communication within groups introduced in some sessions in the second part of the game. Another difference relative to the Phase I set-up was the introduction of another type of individual reward. This reward was paid only if the group reached the threshold. It was therefore conditional on the group result, as was the collective reward.

In both Phases, in order to provide an incentive to behave in a realistic manner, two winning rounds were randomly drawn – one from the baseline games and one from the rewards game, and participants were remunerated with real money for the points earned in these rounds.

**Figure 4.1: Payoffs under alternative land allocations**

		My conservation level				
Conservation effort of group peers (number of land units)		0 	1 	2 	3 	4 
0		48	38	28	18	8
1		48	38	28	18	8
2		48	38	28	18	8
3		48	38	28	18	36
4		48	38	28	46	40
5		48	38	56	50	44
6		48	66	60	54	48
7		76	70	64	58	52
8		80	74	68	62	56
9		84	78	72	66	60
10		88	82	76	70	64
11		92	86	80	74	68
12		96	90	84	78	72

Source: Narloch, 2011

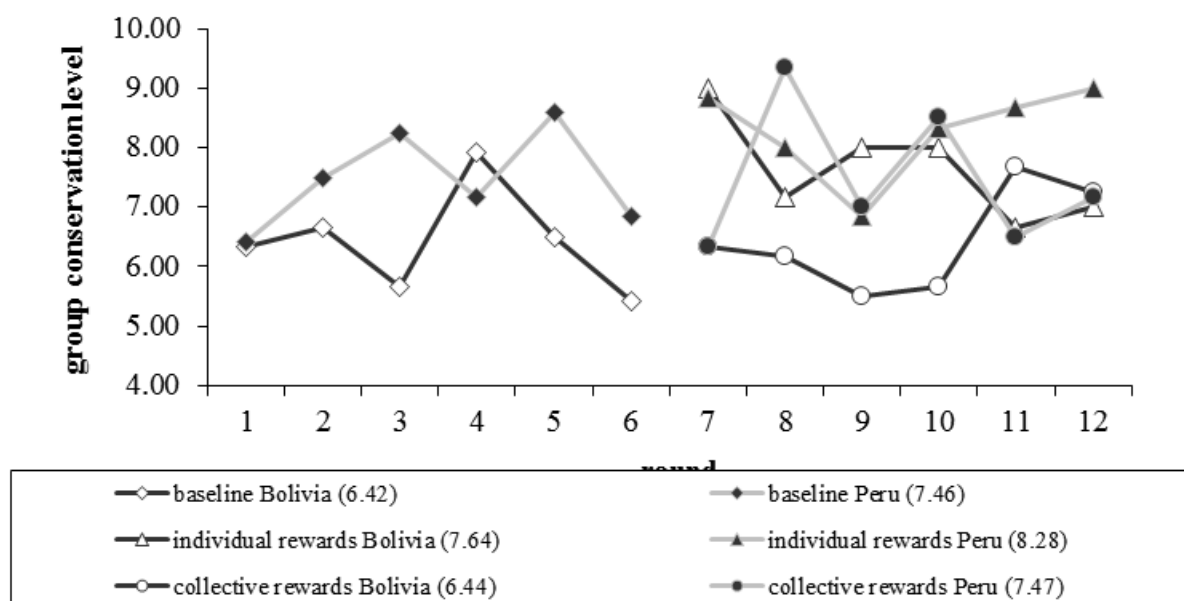
Note: Each farmer has a fixed number of land units, four in this example. S/he has to decide how many (that is between zero and four) of these land units will be devoted to conservation as opposed to improved variety cultivation. At the end of the round, the payoff will depend on her/his decision and the decision of the three group peers. In total there are 16 (4x4) land units per group. The others can therefore choose to allocate between zero and 12 (3x4) land units to conservation, as indicated in the first column. So, for example, if a farmer decides to devote two land units to conservation and his/her peers five land units, the farmer will be rewarded with 56 points.

## **Reward systems and collective action findings**

From the experimental data, further discussed below and fully described in Narloch (2011, chapter 4) and Narloch, Pascual, and Drucker (2012), social preference measures can be derived in order to explain how people value individual and collective benefit and thus contribute to collective action (Bowles and Gintis 2002; Fehr and Fischbacher 2002; Swallow, Meinzen-Dick, and van Noordwijk 2005). Following an approach in Carpenter and Seki (2010), Narloch (2011: chapter 4) estimates measures representing the following: (i) unconditional cooperativeness (that is the extent to which farmers are willing to contribute to conservation regardless of what the rest of the group does); ii) conditional cooperativeness (the extent to which participants respond to the level of conservation of the rest of the group); and iii) threshold effects (extent to which participants adjust conservation levels once they expect that the conservation threshold triggering public benefits is reached).

On average in both Phase I sites the measure for conditional cooperativeness is positive, suggesting that reciprocity prevails over free-riding behavior. Threshold effects are on average negative, signifying that participants decrease conservation levels once the threshold is reached. This result may reflect the fact that participants are willing to contribute to conservation in order to reach important thresholds, but beyond that point they would not be willing to contribute further to conservation, thereby free-riding on the collective action of their peers. This behavior ultimately leads to falling back below the threshold, from where participants again increase their conservation effort. This results in a process of dynamic stabilization around the conservation threshold (see Figure 4.2).

**Figure 4.2: Phase I Average group contribution in all treatments (Uniform groups) (average conservation levels are indicated in parentheses)**

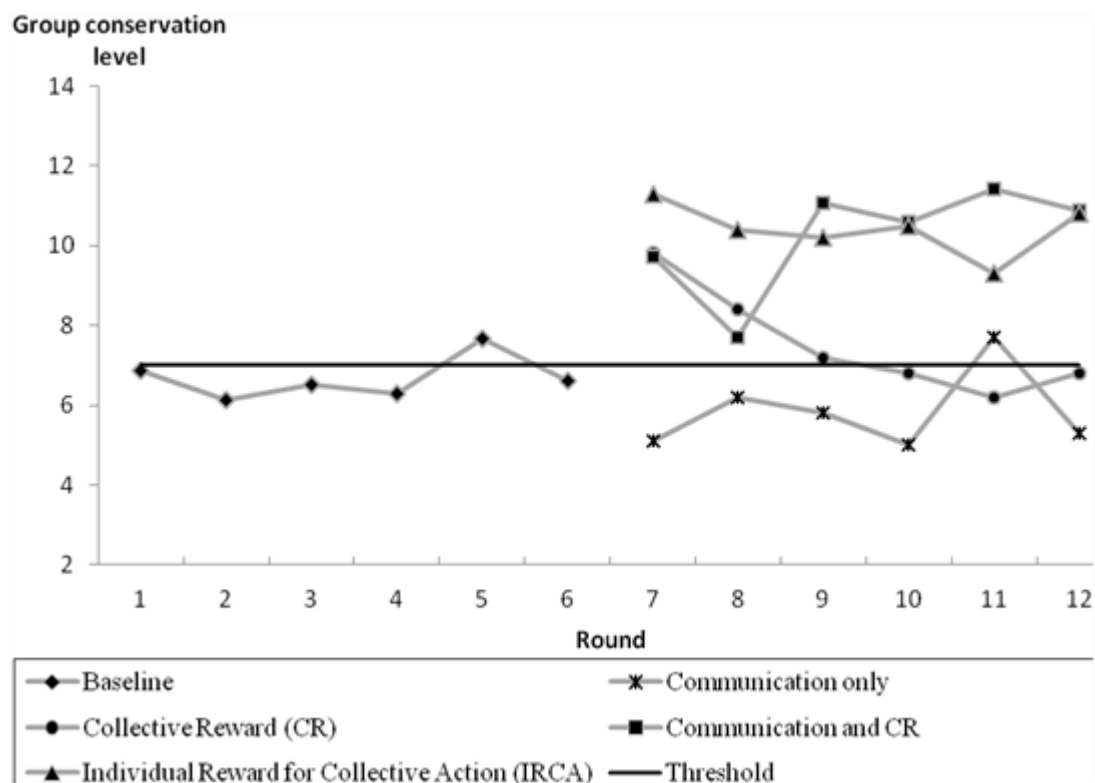


Source: Narloch 2011

In general, the observed behavior in the Phase I games (see Figure 4.2), where reward-related conservation levels are higher than that of the baseline, indicates the farmers are indeed willing to conserve a certain share of their land units and thus do cooperate for conservation purposes.

Similarly, the Phase II findings (see Figure 4.3) reveal that rewards combined with communication (and hence having non-anonymous group peers) also impacts conservation decisions positively, albeit only to a limited extent. Two effects may be considered to be contributing to this. Firstly, communication can help groups identify the threshold and therefore coordinate for collective action. Secondly, communication can enhance trust between players and thus increase cooperation (Cardenas, Ahn, and Ostrom 2004). However, the positive effect of communication is weak, possibly as a result of the fact that where it is difficult to monitor individual contributions - as was the case here - communication can become less efficacious (Ostrom 1998). In this experiment, since farmers were not obliged to make their actual decisions known to their peers, potential opportunities existed to convince others to cooperate while free-riding.

**Figure 4.3: Phase II Average group contribution in all treatments**



Source: Midler et al. (2012)

With specific regard to individual-level rewards, in both Phase I sites, such payments seem to underpin collective action by strengthening reciprocity-based behavior. By building up trust in the cooperation of others, individual-level payments may trigger pro-social dynamics. This is important since, generally speaking, collective action based on reciprocity can be fragile due to the presence of free-riders.

As for the individual reward subject to a threshold (IRCA) in the Phase II experiments, the findings indicate that it does indeed provide a strong economic incentive. Although it also has a negative impact on unconditional cooperativeness, this is largely offset by the economic incentive effect, resulting in an overall increase in conservation. Also, and contrary to the collective reward (see below), the individual one does not perform better when groups are made up of family members. This suggests that the individual reward does not require trust to be effective. The IRCA is thus found to be more effective and therefore much more cost-effective than the collective reward in increasing the conservation of traditional varieties in both sets of experiments.

By contrast, collective rewards, appear to be less effective. In the context of the Phase I experiments, Narloch, Pascual, and Drucker (2012) concluded that although potentially increasing the direct economic incentives for collective action, they may at the same time undermine pro-social norms. This crowding-out effect implies the potential existence of disguised social costs by undermining the pro-social behavior of community members.

In Phase II, the collective reward also had only a small (but positive impact) on conservation decisions. Furthermore, it was shown to have a negative effect on unconditional cooperativeness, meaning that it increases to a greater extent the cooperation of those who had strong intrinsic motivations to conserve since the beginning. The Phase II experiments also allowed exploration of whether farmers who interacted with relatives cooperate more than those who played with strangers. Results showed that this was indeed the case suggesting that the performance of the collective reward is indeed likely to be influenced by the degree of trust between group members.

Such a finding is strengthened by the fact that when a collective reward is introduced jointly with communication, we observe a strong positive impact. This suggests crowding-in between communication and the reward. It would therefore appear that communication is capable of increasing trust within groups, thereby increasing the performance of the collective reward.

It is also worth noting that the different types of rewards are not based on the same benefit-sharing criterion. The collective reward is based on an egalitarian criterion (all group member will receive the same reward) while the individual one is based on a proportional criterion (each farmer will receive a reward proportional to his/her own effort). This result suggests that the fairness criterion upon which the reward relies (for example, rewards being proportional or not to individual effort) can have an effect on its effectiveness.

Although Narloch, Pascual, and Drucker's (2012) findings highlight the importance of a careful assessment of existing social norms that are of relevance for the success of formal institutions brought in from outside the community, follow-up research is still required in order to better identify the reasons behind crowding-out and crowding-in effects, along with conditioning factors, particularly in the context of collective rewards. PES schemes with collective reward systems may also generate additional socio-economic benefits not accounted for in these games. The fact that individual farmers need to self-organize to become eligible for group level rewards may in itself foster collective action through enhancing bonding and linking social capital. Furthermore, there may be reduced transaction costs from working collectively, with cost-saving then being available to be directed toward higher collective reward levels, which could result in different social dynamics.

## **5. DISCUSSION**

### **General Findings**

PACS activities undertaken to date include: development of the PACS conceptual framework; development of protocols for the prioritization of species/varieties at risk to be the focus of on-farm conservation interventions; surveys of quinoa farmers and communities in Peru and Bolivia using stated preference methods and competitive tenders (reverse auctions) to determine willingness to provide conservation services, along with the identification of preferred farmers/communities to undertake such services based on different cost-effectiveness and equity considerations. The potential interaction of PACS-type incentive schemes with local institutions of collective action and the effects on conservation behavior was also considered through the use of experimental games.

Findings indicate that farmers/communities were indeed willing to undertake a conservation services contract for threatened priority crop varieties and that participation costs vary widely between communities, thereby creating opportunities to minimize intervention costs by selecting least-cost providers. In-kind, community-level rewards were shown to provide sufficient incentives and suggest that a number of them could be provided through existing government agricultural and educational development programmes. The enthusiasm of the PACS project participants to maintain the threatened genetic resources in future years and/or experiment with other threatened varieties regardless of any further intervention and their interest in exploring market development opportunities for these varieties, suggests that the potential for PACS to make a significant contribution to agrobiodiversity conservation and use goals, as well as to improve poor farmer livelihoods, once it is up-scaled, continues to appear promising.

By defining the conservation goal, formulating solutions and linking different actors, PACS schemes can initiate processes of social learning and social capital formation (Bioversity International 2011f). In addition, PACS can increase social capital<sup>20</sup> in farming communities by introducing formalized patterns of behavior and by increasing trust and reciprocity through social learning in the process of interactions. Farmers' networks can be strengthened by organizing themselves for dealing with funding bodies (bonding social capital) and PACS-intermediaries that may extend and link existing networks (linking social capital). Moreover, PACS has the potential to increase cohesion in indigenous communities, as the conservation of many local crop species and varieties is associated with local identities and cultural traditions.

Given that, generally, threatened PAGR are located in disadvantaged and remote rural areas in developing countries, the above PACS-based framework may prove to be a useful part of rural development packages and a useful potential tool for policy-makers. Under such circumstances, PACS schemes would need to be designed in a way that takes fairness considerations on-board in order not to undermine the long-term legitimacy of such programs and thus their robustness. As Bowles (2008) notes, 'good policies are those that support socially valued ends not only by harnessing selfish preferences to public ends but also by evoking, cultivating, and empowering public-spirited motives.' Consequently, before PACS schemes are adopted, a careful assessment should be undertaken of existing social preferences that are of relevance for the success of formal institutions brought from outside the community. This is apparent as the experimental game findings indicate that we cannot generally assume that external reward mechanisms would unequivocally provide resource users with the incentives to increase their conservation efforts. Clearly, different reward systems influence different types of resource users in different and complex ways, and thus may differ in their effectiveness depending on the market context.

With the growing implementation of PES schemes in the field, there is an urgent need for site-specific research in order to widen the understanding of the ways external rewards systems may affect existing resource management practices given various market and group contexts. This is also highly important in the context of enabling policymakers to design payments for agrobiodiversity conservation services schemes in a way they can draw upon, support and complement existing patterns of collective action.

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<sup>20</sup>Social capital with regard to natural resource management encompasses trust, reciprocity, exchange, rules, norms, sanctions, and networks (Pretty and Ward 2001)

## Challenges and recommendations

The above findings reveal the complexity of making PACS work for agrobiodiversity conservation in an effective, efficient and equitable way. In this sub-section we identify some key operational challenges and make recommendations related to: the definition of conservation strategies; status monitoring systems; the design of incentive instruments and the identification of sources of sustainable funding (Bioversity International 2011a).

### *Genetic resource prioritization for diversity-maximizing cost-effective interventions:*

Even once key ABD/poverty hotspots have been targeted, it will still be apparent that not everything can be conserved. 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-type decision-support tools (see Bioversity International 2011b and f and Samuel et al. 2013) permit the identification of a priority conservation portfolio that maximizes the diversity that can be conserved for any given budget allocation.

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 both plant and animal (livestock) genetic resources.

### *Challenges:*

There is still a high level of scientific uncertainty, especially associated with the definition of critical risk values (see Bioversity International 2011h) and with determining the degree of dissimilarity between and among species/varieties and breeds. Moreover, the cost of establishing the baselines necessary for carrying out the prioritization task needs to be taken into account and, given the general lack of detailed national statistics related to the status and trends of specific genetic resources, such activities need to be adequately funded.

### *Recommendation:*

The establishment of the current status of the PAGR targeted for conservation and sustainable use interventions, together with the definition of critical risk values<sup>21</sup> urgently needs to be undertaken. Further details are discussed under the following component.

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<sup>21</sup>Even once PAGR status has been established, the definition of critical risk values remains to be undertaken that is the defining of how much of the prioritized 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 standard (SMS). SMS approaches are widely applied with regard to wild biodiversity and seek to avoid maximum future losses of value. In the case of animal genetic resources, FAO defines a livestock breed generally not to be at risk if there are 1,000 breeding females and 20 males. No such equivalent measure exists for PGR. In the case of crop genetic resources, the estimation of a SMS is likely not only to be based on the cultivated area but also, in order to conserve the underlying evolutionary process involving human selection and practices, to also be based on the amount of seeds available in local systems and their age, the number of farmers of a specific species/variety, the degree of local knowledge maintained and geographical distribution (see Bioversity International 2011f).



*Integrated participatory diversity status and threat monitoring systems: understanding the current status of the resources within the priority conservation portfolio*

Although many PAGR are widely recognized 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 crop species under threat. 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.

While it is possible that the resulting goals might be fairly modest (for example, individual variety 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.

*Challenges:*

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 the desired agrobiodiversity conservation service per se (for example, maintaining resilient landscapes, evolutionary processes, option values and accompanying traditional knowledge) 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.

*Recommendation:*

Participatory diversity status and threat monitoring system, integrated with systematic conventional, non-participatory monitoring activities urgently need to be developed and tested. The definition of conservation goals based on a safe minimum standard approach also urgently needs to be undertaken. This will permit an enhancement of capacities to prioritize, design and implement cost-effective on-farm conservation interventions that actively involve farmers and complement on-going ex situ conservation efforts. Potential funders of PACS schemes are also more likely to be willing to finance such schemes where the provision of conservation services is clearly verifiable relative to an initial baseline.

*Incentives and mechanisms for poor female and male farmers to maintain genetic resource diversity*

Having identified where to develop ABD conservation and use interventions, on which genetic resources to focus on (as per 1 above) and their status (as per 2 above), consideration is required regarding how to design the incentives per se for farmers to maintain the public good values (for example, the evolutionary processes embodied in gene flow, agricultural system resilience, future option values) of those genetic resources in the priority conservation portfolio in a pro-poor and cost-effective manner.

As we have argued in this paper, such incentive mechanisms may draw on a “domesticated” version of payment for ecosystem services (PES). These PACS schemes have been shown to be a potentially useful complement to more conventional niche product market development. They can also generate rewards for farmers not only for undertaking conservation activities per se but also for supporting status monitoring and PACS scheme monitoring and verification services, thereby allowing poor farmers to diversify their livelihood options.

In order to determine how much a PACS-based conservation programme will cost and how these costs can be minimized, there is a need to assess farmer/community willingness to participate in the proposed conservation activities (along with associated PACS programme management costs – including for monitoring and verification activities).

Least-cost conservation of PAGR approaches would be expected to focus on PAGR and agricultural practices that provide considerable private values to the farmer and high public values to wider society. 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 (see Bioversity 2011dandi).

### *Challenges:*

In addition to the status monitoring and conservation goal identification challenges identified above, 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.

### *Recommendations:*

A number of options appear to be worth exploring, including:

- a) Existing agricultural market channels may be used to promote the use of threatened PAGR. Local and more distant consumers of PAGR may be willing to pay for the on-farm utilization of some limited range of local PAGR through such mechanisms as eco-labelling, certification or denomination of origin schemes when niche product markets are developed (amongst others see: Hoeschle-Zeledon et al. 2009; Padulosi et al. 2009 and Rojas et al. 2009, respectively for Italian hulled wheat, Indian minor millets and Andean grain examples). Yet the potential to use such an approach as a cornerstone of a wide-ranging cost-effective, diversity maximizing national ABD conservation and use strategy remains to be explored. In particular, the following challenges need to be considered:
  - the fact that crop varieties/species with market potential and those that are a priority for conservation might not align. In fact, niche product market development interventions may focus on a portfolio of high market potential traditional crop species that are either unthreatened or only locally threatened.
  - initial investment costs can be high and long-term success rates low; and
  - market development may be so successful that it displaces other priority crop species/varieties (for example, white quinoa in the Andes; minor millets in India).

It is consequently argued that there is likely to be a need to simultaneously implement such market development approaches with PACS schemes, as was illustrated in Figure 1.1. Further details regarding the potential complementarity of these two incentive mechanisms are to be found in Drucker (2012) and Narloch (2011).

Conservation service beneficiaries and purchasers beyond consumers include (Drucker, Padulosi, and Jager 2013):

- Government agencies (agricultural, development and educational institutions at local, state and national levels). May include school meal programmes, other public agency procurement (for example, for meals for hospitals and the armed forces) and public food distribution programmes;
- Development and conservation agencies (including development banks), NGOs, Foundations, Research institutions and private philanthropists, as well as a number of international conventions (such as the ITPGRFA and its Benefit Sharing Fund) and financial organizations (such as the Global Environmental Facility, a major funding mechanism of the CBD);
- Agritourists (within or outside of bio-cultural reserves);
- Breeders (both private companies and farming communities);
- Agricultural input suppliers for specialized production systems (for example, seed, pesticide, herbicide, fertilizer, tractor, irrigation equipment and other similar companies); and
- Mining companies and others private sector entities with significant environmental impacts to offset through corporate social responsibility programmes and regulatory compliance.

Enhancing the political and social legitimacy of PACS: accounting for fairness/equity considerations: As noted by Narloch, Pascual and Drucker (2013), there is growing consensus that fair outcomes play a key role in determining the political and social legitimacy of PES and thus the longer-term success and sustainability of such programmes (Landell-Mills, 2002; Corbera, Brown and Adger 2007; Swallow et al., 2009). While trade-offs may be incurred and complexity increased in attempting to account for cost-effectiveness along with a number of fairness principles, cost-effectiveness itself can be undermined if a PES-like intervention is not embraced by the service providers. In many rural communities the supply of public conservation services rely on patterns of collective action built on social norms and preferences which shape fairness ideals at the community level (Narloch, Pascual and Drucker 2012). Consequently, if existing pro-social norms are not accounted for, this may result in a detrimental impact on intrinsic motivations that underlie current conservation-related activities (Narloch, Pascual and Drucker 2013) or even generate social conflict and discord that ultimately leads to declines in cost-effectiveness as a result of increased transaction costs and reduced participation/competition in repeated tenders (as per Ferraro 2008). Thus accounting for fairness can render PES/PACS more robust and ultimately more cost-effective in the longer-term due to its higher social legitimacy (Corbera and Pascual, 2012).

### *Challenges*

The implementation of PES schemes involves choices regarding how to allocate payments to potential service providers in a cost-effective and fair way. In the PACS

context, we found that: i) the choice of payment rule determines to a large extent the conservation area, distributional equality and distributional effects achieved; ii) cost-effectiveness does not necessarily need to be compromised by fairness considerations; and iii) fairness itself can take multiple dimensions and trade-offs can even arise between different principles (Narloch, Pascual and Drucker 2013).

### *Recommendations*

The findings point to the importance of identifying the fairness principles that prevail in local fairness judgements so as to understand local priorities. Central questions for follow-up are how land tenure and power relations shape conservation costs and the perceived fairness of targeting outcomes. Such understanding of socio-cultural systems underlying the management of ecosystems would offer important insights into how to design robust PES schemes (Narloch, Pascual and Drucker 2013).

*Capacity-building for pro-poor conservation strategy design and implementation, as well as for up-scaling and mainstreaming in order to achieve a wider outcome and impact on the lives of the poor*

Recommendation: i) Raising awareness of development agency, policy-makers and national biodiversity strategy and action plan (NBSAP) managers with regard to the economic methods and decision-support tools available to support ABD conservation and use strategy design and implementation; and ii) Strengthening of implementation and analytical capacities of NBSAP, local government and NGO staff associated with ABD conservation and use programmes.

## **6. CONCLUSIONS AND UPSCALING STRATEGY**

There are a range of potential beneficiaries and purchasers of the goods and services generated by the conservation on farm of ABD. Which purchasers will ultimately form a “coalition of the willing” and the precise combination of private and public purchasers playing an important role in investing in ABD conservation will vary with context and over time. However, such a strategy could be based around a “4Rs” approach (Drucker, Padulosi, and Jager 2013), a number of aspects of which were discussed in this paper. These include:

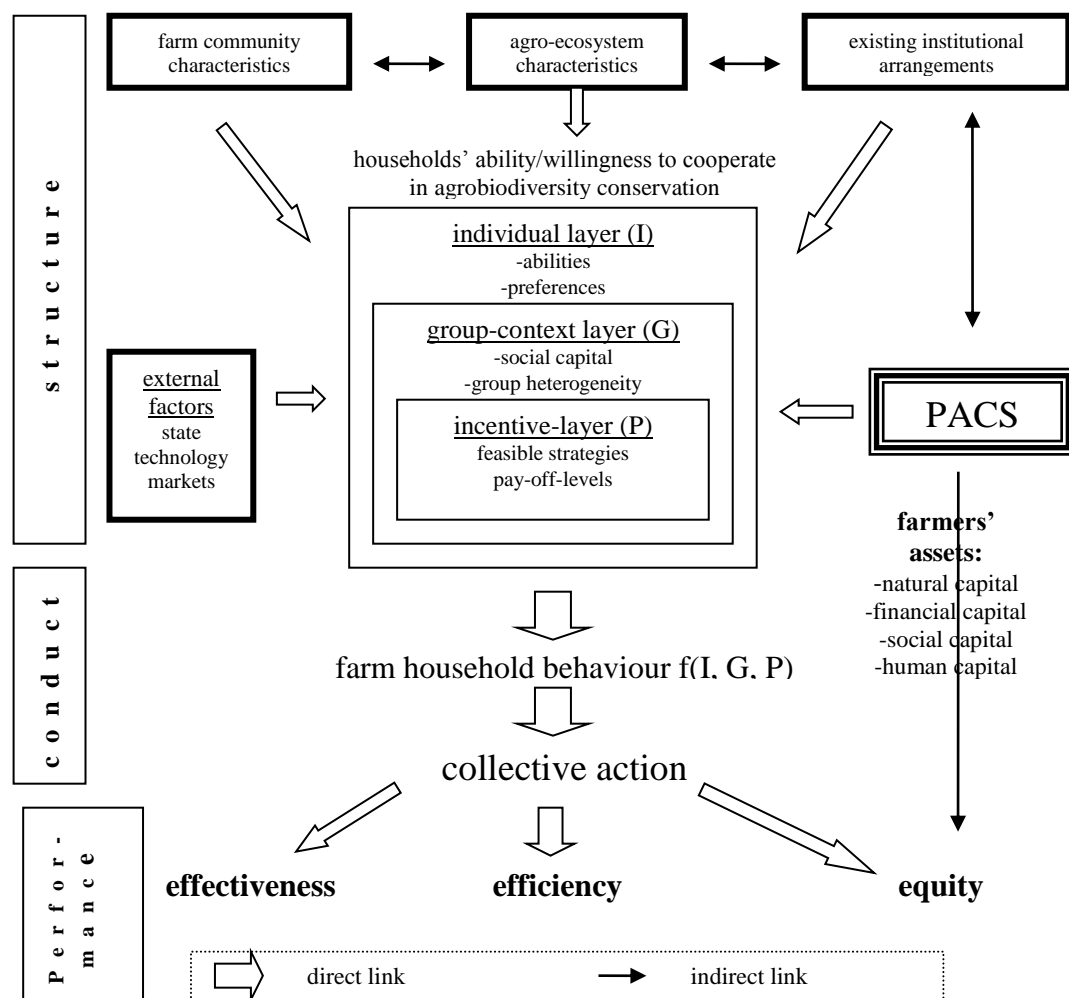
- Recognizing the need for ABD conservation interventions and that such interventions entail costs;
- Reducing intervention costs to a minimum while accounting for equity considerations, to ensure donors that their support is being efficiently and strategically used. The role of a monitoring system is also important in this context;
- Realizing product value addition and the enhancement of demand, where possible; and
- Retaining threatened ABD with important public good values that currently do not have significant market potential by ensuring the existence of adequate direct support safety net mechanisms such as PACS.

In conclusion, in order to move towards up-scaled implementation, a broad conservation strategy would likely be required, incorporating a mixture of incentive instruments. However, until strategic, national and global approaches to on-farm ABD conservation are elaborated and their implementation funded, including with priority given to the establishment of a functional ABD monitoring programme, the world will continue to lose ABD at an alarming rate because of a lack of informed decision-making and limited capacity to elaborate effective policy frameworks that facilitate optimal investment allocations and policy decisions.

## ANNEX I: SCHEMATIC REPRESENTATION OF THE LINKS BETWEEN COLLECTIVE ACTION, PACS AND SUSTAINABLE LIVELIHOODS

Collective action can be usefully analyzed in terms of structure, conduct and performance (Meinzen-Dick, Di Gregorio, and McCarthy 2004), as depicted in Figure A1.

**Figure A1: Schematic representation of links between collective action, PACS and sustainable livelihoods**



Source: Adapted from Agrawal (2001), Meinzen-Dick, Di Gregorio, and McCarthy (2004) and Cárdenas and Ostrom (2004).

Structure refers to the socio-ecological environment in which farmers interact. Overall, cooperating behavior depends on the characteristics of the agro-ecosystem, and its interaction with the characteristics of the community and with institutional arrangements, in addition to external factors as described by Agrawal (2001). External factors are given by technology, market forces and state interventions. PACS may be seen as one form of such external factors as they are implemented from outside the

community. PACS schemes may require the creation of new institutions<sup>22</sup> (and through the contracting of environmental service providers, the definition of new property rights) which interact with existing institutional arrangements, as they complement, overlap or even clash with existing patterns of behavior<sup>23</sup>. In the context of PAGR the latter may refer to historical patterns of property rights, as well as current access and management and use practices.

Conduct deals with the farm household behavior within the socio-ecological environment. Farmers' decisions on acting collectively are based on their individual situation, the group-context, and the incentive levels (Cárdenas and Ostrom 2004). The incentive levels (P) account for the material payoffs of different strategies, in addition to their feasibility and other farmers' strategies. The group context (G) is very much shaped by social capital and by group size and heterogeneity. The individual situation (I) reflects farmers' abilities to undertake certain strategies and their preferences for certain outcomes given the group context. Collective action as a dominant strategy, that is Nash equilibrium, is the result of the conduct of the farmers themselves as much as it is the best response to other farmers' behavior.

Regarding performance, different PACS instruments and their impact on collective action have to be assessed according to their effectiveness (that is do they reach the conservation goal?), their efficiency (that is do they reach this goal at least-cost?) and their impact on equity (that is can the poor participate?). PACS schemes may also contribute to poverty alleviation through enhancing the asset-base of farming communities and their adaptive capacities, as well as diversifying income sources. While poverty alleviation goals need to be achieved without undermining the primary conservation focus of PACS (as there are more direct ways to tackle poverty if that is the main goal), a given PACS scheme may nonetheless be designed so as to maximize its potential to alleviate poverty.

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<sup>22</sup> These are institutions which comprise exchange and market arrangements in order to implement negotiation, transaction, monitoring and enforcement mechanisms for changing the behavior of farmers (Wunder 2006, Cobera and Brown 2008). The development of the CIALs (Local Agricultural Research Committees) by CIAT, Colombia are one example on the development of new institutions of collective action alongside existing ones.

<sup>23</sup> Leach, Mearns and Scoones (1999) define institutions in the context of natural resource management as regularized, either formalized (for example, law) or informal (for example, habits and traditions) patterns of behavior between individual and groups in society that shape the ways in which people command ecosystem goods and services. Thus they may be understood as mediators between agro-ecosystems and farmers.

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