How much should the conservation of agricultural biodiversity cost?

Exploring the Quinoa boom in the Andes

Introduction

Quinoa is an ancient grain of the Andes, and over the past 20 years or so has enjoying something of a boom in developed countries. It is an excellent source of high-quality protein, and for many of its fans has an almost mystical connection with a less-industrial food system and a more sustainable, more artisanal way of life, closer to Mother Earth.

The average affluent person buying quinoa in a health-food store can hardly be aware of the complexity behind their well-intentioned purchase. The export market favours large-seeded, white varieties, and so that is what many farmers grow. And yet there are hundreds of other varieties whose neglect threatens them with extinction. Export quinoa fetches a good price, but that can make it too expensive for local people, threatening them with malnutrition. And because it can be a lucrative crop, farmers are tempted to abandon ancient and sustainable practices, threatening to degrade the farming landscape.

While malnutrition and environmental degradation are clearly elements that need to be considered in thinking about the quinoa boom, this case examines just one of the trade-offs. Can quinoa help to improve the livelihoods of the poor farmers who grow it without leading to genetic erosion?

The Setting

The Andean Altiplano runs roughly from the area around Lake Titicaca in the north to the Salar of Uyuni in the south, straddling Peru, Bolivia and Chile. *Altiplano* means high plains, more than 3600 metres (12,000 feet) above sea level. Farming on the Altiplano stretches back almost 7000 years, despite very

difficult conditions. Climate is extreme; daytime temperatures are high and yet frosts are possible on any night of the year. Rainfall is concentrated in two months of the year and can be very erratic. Despite these challenges, Aymara and Quechua communities have grown up on the Altiplano, making use of a range of strategies to ensure that extreme weather or epidemics of pests and diseases do not wipe them out.

The Altiplano is one of the poorest regions in the world. Roughly three-quarters of the 6 million people inhabitants live in poverty, more than half on less than $1.25 a day, which the UN defines as extreme poverty.

The Players

Most households in the Quechua and Aymara communities earn less than $500 a year. Food runs low for up to 16 weeks a year, and rates of chronic malnutrition are well above national averages. For under-fives, child mortality in Bolivia is around 63 per thousand live births, which despite rapid recent progress is still considerably higher than the average of 2-6 per thousand in developed countries.

Non-governmental organizations (NGOs) work closely with the people of the Altiplano to improve livelihoods. In Peru, the Centre for Natural Resources and Environmental Research (known by its Spanish acronym CIRNMA) has long been involved in projects to increase the value of farming operations to the people. [1] CIRNMA was founded in 1992, and starting in 2004 began to work on the quinoa crop, supporting farmer groups and developing export markets. PROINPA (Foundation for the Promotion and Research of Andean Products) is a Bolivian counterpart, which has also undertaken many projects to improve the livelihoods of rural farmers on the Altiplano by making more of their agricultural produce. In addition to working with the rural families and community-based organisations, both NGOs also have had long working partnerships with Bioversity International.

---

[1] http://www.cgiar.org/www-archive/www.cgiar.org/pdf/cirnma_english_final.pdf

Bioversity International is a member of the CGIAR Consortium and is a recognized leader in agricultural biodiversity research, working with more than 700 partners around the world to improve the lives of smallholder farmers and rural communities. Bioversity International researches the conservation and use of agricultural biodiversity in order to achieve better nutrition, improve smallholders' livelihoods and enhance agricultural sustainability.

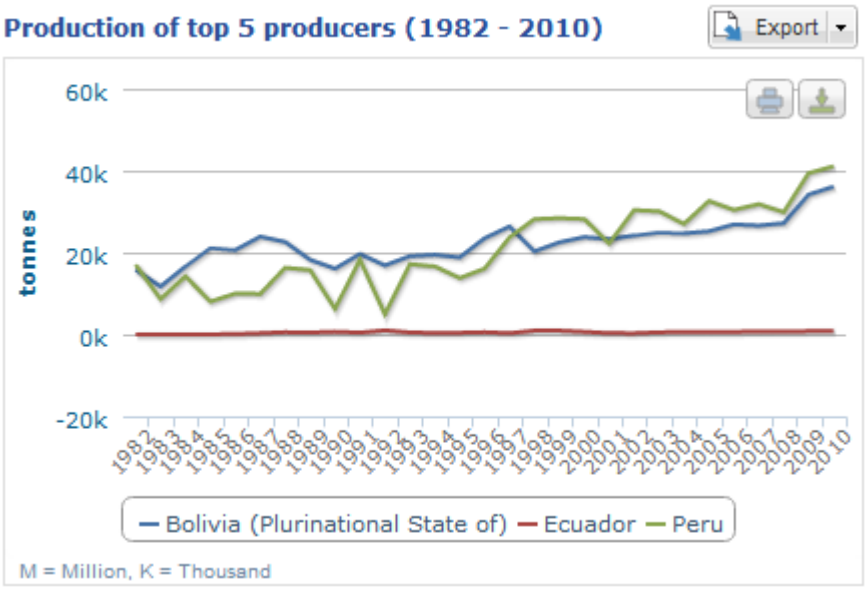
Adam Drucker, a senior economist at Bioversity, wanted to know whether it was possible to conserve quinoa diversity using an innovative approach. The farming families would be the ultimate arbiters, and the two NGOs, with their close and historic relations with both Bioversity and the farming communities, would implement the project on the ground with 18 communities in Bolivia and 20 in Peru.

Quinoa

Quinoa (*Chenopodium quinoa Willd*.) is one of the crucial crops of the Altiplano. It has been grown for more than 3000 years, and is well suited to the harsh conditions, requiring little water and nutrients and able to withstand the scorching days and freezing nights. Protein content is high, around 14%, and very well balanced for human consumption, making it more nutritious than many other crops. Hundreds of traditional varieties of quinoa exist, selected and maintained by the people, each adapted to slightly different conditions and needs, and many farmers are well aware of the differences among them.

For example, Bolivian farmer Faustino López notes that some of the traditional varieties "mature earlier than some cash crops [which] is a great advantage in coping with unforeseeable climate changes," while Martin Cherca Cambilla, a Peruvian farmer, considers that such varieties "are more resilient to the changing climates, and yield better because their taste in the field does not attract animals like birds and mice".

In the past couple of decades, however, quinoa has taken off as an export crop,[2] transforming quinoa farming and the lives of quinoa farmers.



The quinoa boom has been a mixed blessing, especially, from Bioversity's point of view, because it threatens quinoa diversity. The market favours a few large-seeded, "white" varieties. As a result, these have become more profitable, leading farmers to concentrate on these varieties and neglect many of the others. Along with a loss of diversity, traditional knowledge about the neglected varieties is also being lost. Again, farmers are well aware of these changes.

Paulina Mendoza, in Bolivia, notes that "we grow mainly white quinoa because it sells well". She says too that some of the threatened and displaced traditional varieties "have other nutritional values and different ways of consumption that we appreciate in nourishing our families and children". In Peru, likewise, Elena Márquez Escobedo says that because some of the displaced varieties "have not been sown for a very long time, their uses have been forgotten," although it is not too late to "reconnect with our culinary heritage". Another Bolivian farmer, Nilda Paucar, referred specifically to the culture history of quinoa when she said "I wish many more people felt

[2] FAOSTAT. http://faostat3.fao.org/home/index.html

encouraged to use these [displaced] varieties in cooking different dishes just as our ancestors did in the past".

If they like them so well, why don't the farmers just keep growing those threatened and displaced varieties?

Markets and values

From their own point of view, and especially in the short term, farmers are doing the sensible thing: growing the most profitable variety. We might prefer them to grow more diversity, but they would pay a price to do so. To understand this, we first need to examine the different kinds of benefits that agricultural biodiversity can deliver to individuals and to society. These benefits are laid out in Box 1.

The farmer derives certain private benefits from her crops, for example related to the production of food that can either be eaten or sold. The farmer also enjoys public benefits, for example related to ecosystem resilience and the maintenance of evolutionary processes and future options; these public goods also benefit society as a whole. Markets, however, capture only part of the total economic value; essentially that which can be easily bought and sold, such as food, and as a result people may neglect some of the public, social benefits when they decide how to change their environment. They may clear a forest, for example, because they can capture the value of the timber and subsequent crops privately. But society as a whole will be losing the public benefits that the forest provides, for example water regulation. The same is true for conservation, the costs of which tend to be local, at the farm level, while the benefits tend to be regional, national or even global.

Can we expect poor farmers to shoulder the costs of agricultural biodiversity conservation purely for the benefit of wider society?

Payments for Ecosystem Services (PES) tries to put a value on processes such as water regulation so that society can buy more of them. Payments for

Agrobiodiversity Conservation Services (PACS) extends the idea of PES to conserve socially valuable and threatened agricultural biodiversity.

Box 1: Total Economic Value

The farmer's perspective

Remember what Paulina Mendoza, in Bolivia, said: "We grow mainly white quinoa because it sells well."

This is one result of the kind of agricultural development that depends on manipulating inputs and outputs, and genetic erosion comes with the territory. Local varieties will perform better than improved varieties under marginal conditions that have barely been modified by external inputs such as fertiliser or irrigation. Improved varieties do better than local varieties under improved conditions. At some point during the intensification of production, improved varieties outperform local varieties. Once intensification has proceeded beyond that point, a farmer who plants a local variety will earn less than if she planted the improved variety. This is the opportunity cost, the profit foregone by conserving the local variety. PACS aims to make up the opportunity cost, to promote the conservation of agricultural biodiversity. An additional point is that many farmers might see PACS as a way of diversifying their income, extra money to add to what they earn from more intensive agriculture.

The economist's perspective

"Farmers may be switching to improved varieties too soon, before their system is really intensive enough to merit it," says Adam Drucker. "For agrobiodiversity, the most important reason is that the farmers' calculations ignore non-market and public goods values."

The solution is to compensate farmers for their opportunity costs in order to make it worth their while to grow threatened varieties. But there is a catch. Funds for the project are very limited, and in any case may not be available for long.

"We need to be cost efficient," says Drucker. "We need to make sure that we are getting as much conservation as possible for the payments."

A final problem is to decide which varieties should be conserved, and how much space should be devoted to growing them.

The NGO's perspective

CIRNMA and PROINPA look for ways to benefit all the people in the communities they work with. They want developments to be sustainable, and to promote social equity. So while they are keen to support the conservation of agrobiodiversity, they want to ensure that richer farmers, who may be able to undercut their poorer neighbours, do not capture all the PACS on offer. They also want to make sure that the farmers' own preferences for the payments on offer and how they should be used are taken into account.

The documents for the case include a factsheet *Why are Incentives for Agrobiodiversity Conservation and Use Necessary?* that gives a full explanation of opportunity costs. You should read and understand it before moving on. It may help to think about and discuss opportunity costs that you encounter in daily life.

Question: What do we want to conserve?

We cannot conserve everything, so we need a process that will prioritise which populations most need help. This question has received more attention for animal genetic resources than for plants, which suggests three factors that need to be taken into account

- Diversity/dissimilarity. All things being equal, we should give priority to populations that are genetically most distinct. How would we measure this?
- Risk status. Populations most at risk should have higher priorities. How do we assess risk?
- Cost of conservation. Select those populations that conserve the most diversity for the least cost.

While this approach is technically attractive, it has never actually been used to inform conservation decisions for either animal or plant genetic resources. The main reason is that there is still considerable scientific uncertainty about how to measure the various population properties, and the cost – in money and time -- of establishing techniques to make those measurements is considerable.

Question: How much should we conserve?

Conservation scientists talk about a safe minimum population size, or minimum viable population, that is calculated to ensure some specified probability of survival at some specified future date. Models are most refined for animals, and take account of such things as breeding rate, genetic diversity within the population, and the likelihood of various environmental changes. Similar models have not been fully worked out for plants, although we can be sure that similar factors – the reproductive system and seed production, the genetic diversity within the population, and the natural and artificial selection pressures applied to the population – will have a bearing. One could argue for a reasonably simple system; one-tenth of a hectare devoted to each of the priority crops. The danger in this approach is that it neglects the social milieu in which traditional varieties are embedded. How many farm families need to be involved, to protect local knowledge about how to grow and use the conserved varieties? How do varieties move within local informal seed networks, and what is needed to keep the networks vibrant? Can we develop acceptable trade-offs between, say, scientific rigour and practical applicability?

Question: What will it cost, and how can we minimise costs?

Payments to the farmer, to replace opportunity costs, are only one element of the total cost of a PACS scheme. There are also implementation costs, for example a one-off change to the farmer's agricultural system to incorporate the conservation activities, and transaction costs, for example establishing priority populations, negotiating with the farmers, monitoring their

performance, and administering the scheme. Contracting a few larger farmers would reduce these transaction costs, but would it serve social goals?

Opportunity costs pose a particular problem because of what economists call "information asymmetries". Different farmers will have different opportunity costs, based on factors such as preferences for diversity, availability of land and labour, location, wealth and so on, and each farmer presumably has a good idea of their own true opportunity cost. Because of the differences among farmers, PROINPA and CIRNMA cannot know -- other than in very general terms, for example based on average yield differences -- the true opportunity costs. The problem for the project is that these information asymmetries could give farmers a reason to exaggerate their true opportunity costs in order to maximise the conservation payments they would receive. The result would be higher overall conservation costs and, given limited conservation budgets, less funding available to conserve additional threatened varieties, a "cost-inefficient" outcome. How could the project get a better picture of the true opportunity costs?

Question: Where will long-term funding come from?

Long-term sustainability of any PACS scheme is an obvious concern. Who will pay the ongoing costs? Niche market development can allocate a portion of the price of a specific product to a PACS scheme, with informative labelling for consumers to explain the additional cost. Private-sector entities might be willing to underwrite PACS schemes either for direct benefits, such as a seed company that wants access to agrobiodiversity, or more indirectly, to demonstrate corporate social responsibility. Government agencies and even NGOs might be willing to underwrite PACS schemes as contributions to public goods. Of course all of these potential sources of funding could dry up as a result of changes in market conditions, corporate policies and government policies.

The documents for the case include a factsheet *Domesticating PES: Applying Payments for Ecosystem Services to Agrobiodiversity Conservation Issues* that explains PES in more detail, and the specific ways in which PACS differs from PES.

Competitive tendering

One way to identify the farmers' true opportunity cost is to ask them to participate in a reverse auction, where the lowest offers are selected. A competitive auction gives farmers an incentive to reveal their true opportunity costs, because if they ask too much they are less likely to be selected to participate in the conservation programme. The project decided to use a competitive tender to maximize the cost efficiency of the project, conserving the most diversity for the least cost.

In outline, the process is relatively straightforward. The Purchaser, in this case the project, identifies the outcomes required. The Supplier then puts in a bid offering to provide that outcome for a specified price. The project assesses each bid and ranks them in terms of cost effectiveness. The bids are then funded, starting with the most cost effective, until all the money has been allocated. Of course the devil is in the details, such as how compliance will be monitored and delivery assured, but competitive tenders have been successfully used in conservation (though not of agricultural biodiversity) as a way of revealing true costs. Because they are based on the delivery of specific outcomes, they can also offer farmers an incentive to find lower-cost ways of delivering the desired conservation outcome.

For the project, the price was set as in-kind rewards, rather than cash, and suppliers were farmer groups rather than individuals. Communities have a culture and history of working together to balance individual interests (growing as much as possible of the most profitable crop) against collective interests (rotating crops to maintain soil quality). One example is known as *Suyo* (also called *Aynoka* or *Manta*). A group of farmers – sometimes the whole

community – decides collectively on which plots within a communal land area will be planted with a specific crop and which will be left fallow. Each farmer then individually manages their piece of land according to these group-level decisions. *Suyo* is a well-functioning, self-regulating mechanism that, with help from the NGOs, was adapted to submitting a tender for conservation services from a group of farmers.

Adam Drucker explains: “What we asked these communities to do was to tell us which [priority] varieties they would be willing to plant on what area and how many farmers would be involved, and in addition to specify what kind of reward they would need.”

Elena Marquez Escobedo, a woman farmer from Tuma Chupa in Peru, said “as incentive, we requested transparent roofing material and alfalfa seeds”. Other rewards included fertilizer, fencing and construction materials, agricultural equipment and machinery, and school supplies, all agreed by the farmer group, which also decided how they would be allocated.

The documents for the case include a video *Developing incentives for farmers to conserve agrobiodiversity for the public good* that gives an overview of some of the ideas behind PACS, how it was implemented, and how it worked out.

“What we discovered,” Drucker says, “is that there is indeed a wide range in the offers of these different communities, but by taking this approach we are able to select those which are the least cost ones and that allows us to maximize the impact of our programme, because by minimizing the cost of conservation we can afford to conserve more.”

What the farmers discovered might be even more interesting.

“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, Chita, Bolivia.

"Neighbouring farmers are curious about these varieties and have expressed their intention to buy seeds from my harvest for the next season." Marcelino León Ticona, Caricari, Peru.

"We are very happy with the results. They [the threatened varieties] flourished beautifully. We intend to save 70% for consumption and 30% for seeds" Genaro Miranda Vilca, Corana-Cruz Pata, Peru.

"We are grateful and proud for this opportunity to rescue these quinoa varieties." Carlos Nina Muñoz, Jirira, Bolivia.

"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, Chita, Bolivia.

"Now that we have realized the virtues of these [threatened] varieties, we will strive to keep them alive, even if the project does not go on". Santusa de López, Aguaquiza, Bolivia.

Two journal articles report fully the results of the project:

Narloch, U., Drucker A.G. and Pascual, U. *Payments for agrobiodiversity conservation services (PACS) for sustained on-farm utilization of plant and animal genetic resources*. Ecological Economics

Narloch, U., Pascual, U. and Drucker A.G. *Cost-effectiveness targeting under multiple conservation goals and equity considerations in the Andes*. Environmental Conservation

Additional information can also be found in Research Findings on the Bioversity website.

Challenges

This was a pilot project with just $4000 of operational funding for each country. Do you think it was a success?

Based on some of the comments from the farmers, is this PACS project sustainable in the medium-term? Can you suggest other sources of funding?

The project had to balance cost efficiency, conservation effectiveness and social equity. Can you think of ways to improve that? What would you advise the farmers? The NGOs? Bioversity?

Bolivia and Peru, like many other countries, have national biodiversity policies. Is there a role for PACS in government policies? Is there a role for government in PACS schemes?