
Photo: Didier Bazile

Fair & sustainable expansion of traditional crops – lessons from quinoa

The recent boom in quinoa cultivation provides many lessons for an agroecological transition that enhances agricultural biodiversity. Looking at the effects of quinoa expansion, this article analyses how to protect peasant varieties, support free and fair flow of germplasm and engage in new ways of doing research.

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Quinoa (*Chenopodium quinoa* Willd.) is a cultivated grain crop that originates in the Andes. Thanks to its high genetic diversity, the crop grows under extreme climate and soil conditions and is tolerant to frost, drought, and salinity. Its popularity worldwide is the result of a combination of its hardiness and nutritional content. After centuries of neglect, the potential of quinoa was rediscovered during the second half of the 20th century. Since then, the number of countries importing quinoa increased, and quinoa is cultivated in countries outside the Andes. The United Nations declared 2013 International Year of Quinoa as recognition of the role of the Andean peoples in maintaining quinoa biodiversity and of the grain's high nutritional value. The rapid expansion of this crop, which is still classified by some as a neglected and underutilised species, is defying the belief that it only grows at altitude on the banks of Lake Titicaca, between

Peru and Bolivia. Today, nearly 100 countries around the world are growing or testing quinoa. This boom is bringing about great changes to the way quinoa is produced, to the networks that test it, to distribution and to the way it is perceived and incorporated into our diet.

Among the numerous challenges related to expansion of quinoa, this article focuses on the maintenance and valorisation of quinoa diversity. Is the way in which we cultivate, trade and eat quinoa contributing to maintaining and increasing its genetic diversity? Is this benefiting peasant producers? Some ways forward for quinoa are proposed, providing general insights for other, so called, neglected and underutilised species.

Genetic evolution Since its domestication over 7000 years ago, quinoa seed exchange has allowed the initial genetic diversity of the species to increase, resulting in five major ecotypes in the Andes today. As far back as the 19th century, seeds were already being exchanged with India, later with Kenya and Tibet, and from the 1980s-90s with the whole of Europe. Presently, quinoa is seen as an interesting alternative crop in semi-arid environments in the Mediterranean, Middle East and Asia, in soils that have often been abandoned due to high salinity levels.

Diversity and communities under pressure A clear majority of Andean communities grow quinoa using so called 'traditional' practices, based on principles of agroecology, using three components of biodiversity: genetic diversity, species diversity and ecosystem diversity.

> Farmers and researchers only have access to a few varieties

However, the spread of cultivation of quinoa to all continents and the increasing regional and global demand for the crop takes place through the introduction of so called 'conventional' or industrial agricultural models employing chemical fertilizers, pesticides and improved varieties. This is causing several problems. As a result of the globalised quinoa value chains, and in particular due to international seed regulations, farmers and researchers outside the Andes only have access to a few improved varieties of quinoa that are suitable for mechanised cultivation and post-harvest processing. At the same time, Andean peasant systems are at risk of destabilisation as intensified and expanded cultivation of quinoa is a source of potential conflicts around access to land, practice standardisation, market competitiveness, etc. The rapid shift from a subsistence economy to a market economy has also accelerated the breakdown of some community organisations, which previously managed land and collective access to resources. For example, conflicts have emerged when farmers wishing to mechanise quinoa production attempted to move into the plains that had until then been used for llama and alpaca breeding; when former migrants asserted their ancestral rights to land; or when families decided to extend their cultivated areas and shorten fallow periods. Since the 1990s organic certification, and more recently fairtrade networks, have supported better remuneration for producers and a commitment to support authentic production. But can these standards support cultivation and conservation of quinoa diversity?

Protecting peasant varieties
Agrobiodiversity exists solely because it has been created and maintained by human practices that preserve local varieties. Local varieties are also known as peasant varieties or, in scientific terms, as variety populations. This refers to groups of genetically unique individual plant species that share certain characteristics which distinguishes them from other peasant varieties. The large genetic diversity within peasant varieties, as opposed to the uniformity within improved varieties, enables farmers to reduce risk and achieve a stable average yield. Access to a broad range of varieties is

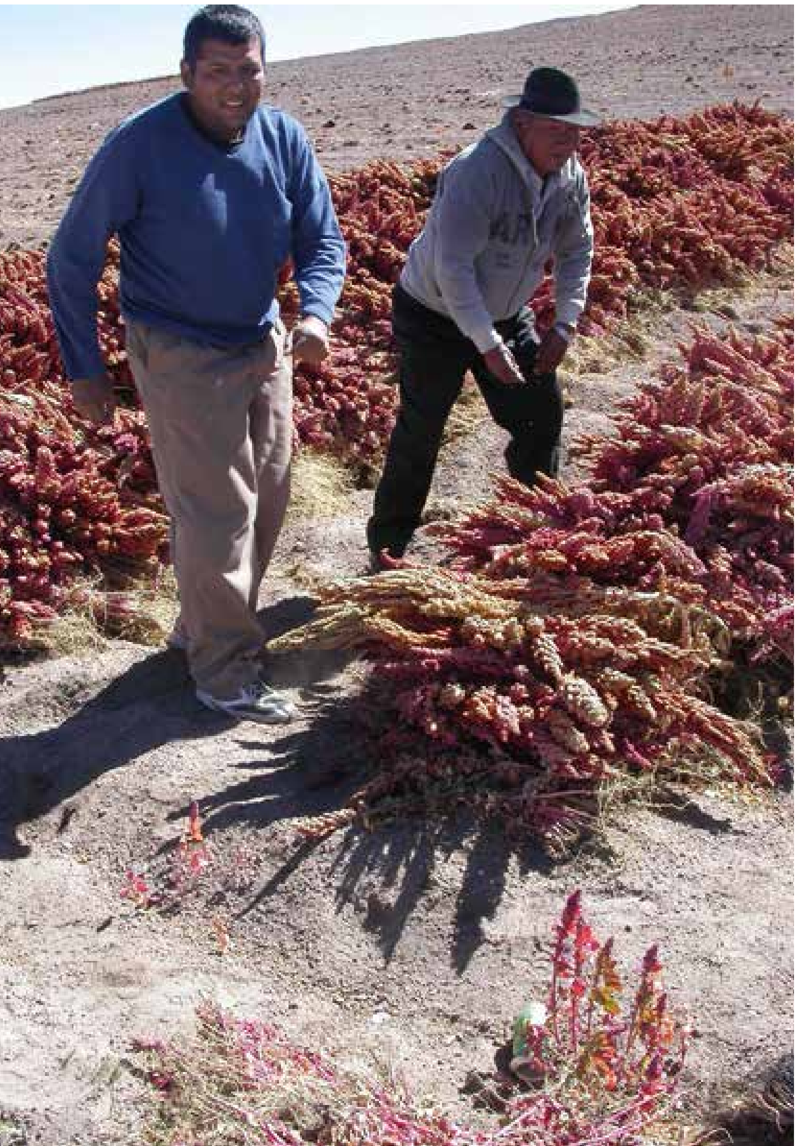
Quinoa's broad uses

While today the global general public knows quinoa for its edible grains, other uses exist in the Andean countries: the consumption of the young leaves and sometimes also the tender panicles in the same way as *huauzontle* (*Chenopodium berlandieri*), and also as animal fodder (fresh or as silage). Additionally, quinoa is used in traditional medicine, and the use of its leaves, stems and grains is currently being studied for their abortive, healing, anti-inflammatory, analgesic and disinfectant properties. Similarly, the saponin, which previously caused the crop's rejection, is currently under investigation for its natural insecticide and antifungal properties. These broad uses of quinoa contribute to its great genetic diversity, as is often the case for traditional plants.

essential for being able to make cropping decisions in response to climate and soil conditions, technical constraints, personal preferences, or market demands.

Genetic diversity loss is typical within conventional plant improvement processes that seek to move away from heterogeneity within variety populations and towards emphasising characteristics that are deemed important. In the case of drought resistance or better soil salinity tolerance, varietal selection favours characteristics that have nothing to do with nutritional properties or other characteristics that would allow the species to adapt to a new environment. Similarly, current quinoa selection and improvement focussed on several nutritional criteria runs the risk of a drift towards biofortification. However, it is actually *the overall balance* of quinoa's composition that must be preserved. This will allow farmers to have production stability through active conservation of the species. The implementation of multi-criteria plant breeding linking yield, disease resistance and nutritional value hinges on making compromises between these different factors in order to drive varietal improvement. And in fact, this is what peasants have always done.

Farmers in the Andes use genetic, species and ecosystem diversity. Photo: Didier Bazile



Knowledge cross-pollination

Participatory breeding initiatives, and in particular Evolutionary Plant Breeding, allow knowledge cross-pollination by placing trust, from the outset, in peasant farmers to integrate a new species or variety into their farming system. This type of plant breeding also considers the development of new variety populations, capable of evolving and adapting to their environment, which simultaneously guarantees production stability and active conservation of the species' genetic resources.

While moving away from standardisation of crop varieties, their protection must also be questioned as it impedes the pursuit of biodiversity creation. In this sense, current regulations pertaining to germplasm flow and plant variety rights are problematic for the evolution of quinoa diversity.

Free flow of germplasm

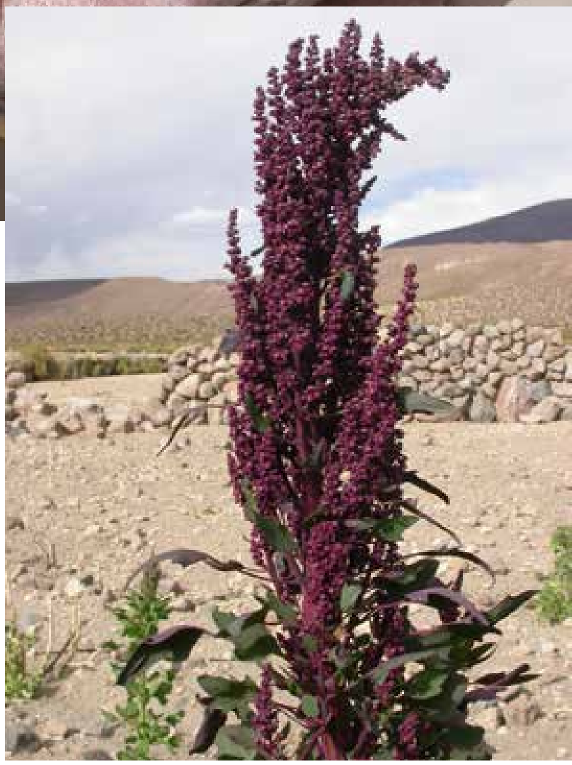
The combination of international regulations governing the spread of quinoa germplasm does not promote easy and fair access to quinoa's genetic resources. Further, it creates a situation where most researchers outside of the Andes are experimenting with a very narrow genetic base.

Real tracking of the spread of quinoa germplasm would enable the origin of the seeds for quinoa experiments to be ascertained, and demonstrate the importance of individuals and networks of research institutions in genetic material exchange outside of any legal framework. More transparency in these flows may provide greater recognition of peasants' breeding efforts and generate questions about the efficiency of the current regulations.

Undoubtedly, free circulation of genetic resources for biodiversity development would help to overcome the complex discussions regarding their intellectual property. When we think inside a system it is always difficult to imagine that another system could exist. However, models of free access to seeds by a group of users united under a common charter could transform how we think about seed regulation. Alternative models would allow us to put forward a single conceptual framework for the different seed users, but all committed to crop development through processes that preserve, if not increase, biodiversity. The Open Seed Source License is one example and the Global Collaborative Network on Quinoa, which I am currently developing, both have the goal to unite a community of practice, including farmers, researchers and private selectors, around preserving and creating more biodiversity while using it.

New ways of doing science

Analysing the changes in progress, whilst simultaneously being an actor, requires specific methodologies related to oversight and multidisciplinarity if we truly wish to promote quinoa within a global agroecological



International seed regulations are problematic for evolution of quinoa diversity. Photos: Didier Bazile

shift that considers agricultural biodiversity in all its dimensions. Role-play games and participatory modelling are helpful tools for facilitating dialogue and accompanying the process of innovation.

Treating quinoa cultivation in the Andes as not only a localised system, but as an agroecological model, can connect our thinking to a geographic process and generate new knowledge that is useful for other species, such as amaranth, chia, fonio or teff. These are following a similar development pattern, albeit one that is less reported by the media.

The evolution of quinoa is happening before our eyes

History in the making for the agroecological transition Conflicts related to decreased access to and on-farm management of quinoa genetic diversity questions the viability of the coexistence of agroecological and industrial models of farming and food systems. Certain countries are reflecting on the possible coexistence of these two models and such distinction in public policies already exists in several countries, including Peru. In summary, because the evolution of quinoa is happening before our eyes, it provides a unique opportunity to analyse whether these two competing production models should, or even can co-exist. Unlike the development of other cultivated species, we do not have to rely on reconstructions. With quinoa, we have the opportunity to act and to test various agricultural theories. It is possible to measure the effects of different policies and standards – ecological, economic and social – on biodiversity dynamics and reflect on the implication for agricultural models (conventional versus agroecology). In this sense we can take the study of the dynamics of quinoa's genetic diversity as a model for studying those of other neglected or underutilised species. We can use this opportunity to push for an agroecological transition rooted in agricultural biodiversity.

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