Quinoa

FROM THE ANDES TO THE WORLD

BMZ Federal Ministry for Economic Cooperation and Development

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Quinoa—originally food and fodder

Quinoa is a close relative to spinach. While we eat the leaves of spinach, we eat the grains of quinoa. Quinoa has been cultivated in the high Andes for over 6000 years. It was first grown along the spine of the Andes, from Colombia to southern Chile and Argentina. Quinoa grows in Peru and Bolivia at 4000 masl and most of its genetic diversity rests in these countries, around Lake Titicaca. This important crop is raising interest in other regions, such as Africa, Asia and the Arabian Peninsula.

Thousands of years ago, Andean communities relied on quinoa to survive, by planting quinoa around their villages. Grains were used for human consumption and leaves to feed llamas and alpacas. Centuries of cultivation resulted in the arousal of many quinoa varieties, whose traits make them capable to adapt to higher or lower lands and to extreme weather conditions.

Quinoa plants vary in size, bushiness, and color of leaves and seeds. Seeds also vary in size and time to maturity. Most notable to the outsider is the rainbow of flower colours: red, purple, green, pink, lavender, orange, burgundy, yellow, ochre and even black.

Quinoa ecotypes exhibit a wide variety of genetic traits depending on where they come from. There are ecotypes from the inter Andean valleys of Colombia and Ecuador, the highlands of Peru and Bolivia, the Yungas in Bolivia's sub-tropical forest, the salt flats of Bolivia, Chile and Argentina, the coast of Chile, and from northern Argentina.

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From sacred grain to food of the poor

German naturalist Alexander von Humboldt came across quinoa during a trip throughout South America in the early 1800s. He noted that quinoa was to the economy of Incas as wine was to the Greeks, wheat to the Romans and cotton to the Arabs. Quinoa was the main staple of the Tiwanaku people, a flourishing pre-Incan empire that lived around the southern shores of Lake Titicaca, where quinoa cultivation likely started.

Quinoa was the »mother grain« of the Incas, who believed that mythical bird *Kullku* had brought the first seeds to them. At the beginning of every year, the Inca Emperor planted the first quinoa seeds using a golden digging stick. The area planted to quinoa in the Andes today matches what used to be territory of the Inca Empire.

During the Spanish Conquest, missionaries noticed that Incas used quinoa in religious rituals and discouraged its cultivation. In time, quinoa was socially disparaged as to become food of the poor. The crop survived, mostly in marginal areas, to which it is ideally suited. A renaissance of quinoa began in the 1970s, when outsiders started to appreciate its nutritional value. Quinoa production is now higher than at any time in the recent past.

Bolivia, Peru and Ecuador, together, plant nearly 1000 km² to quinoa, and jointly produce around 78,000 MT. Two thirds of the area planted to quinoa are in Bolivia (63%), one third in Peru (36%) and just 1% in Ecuador. The crop yield per square meter reaches 50 grams in Bolivia, 100 in Peru and 75 in Ecuador.

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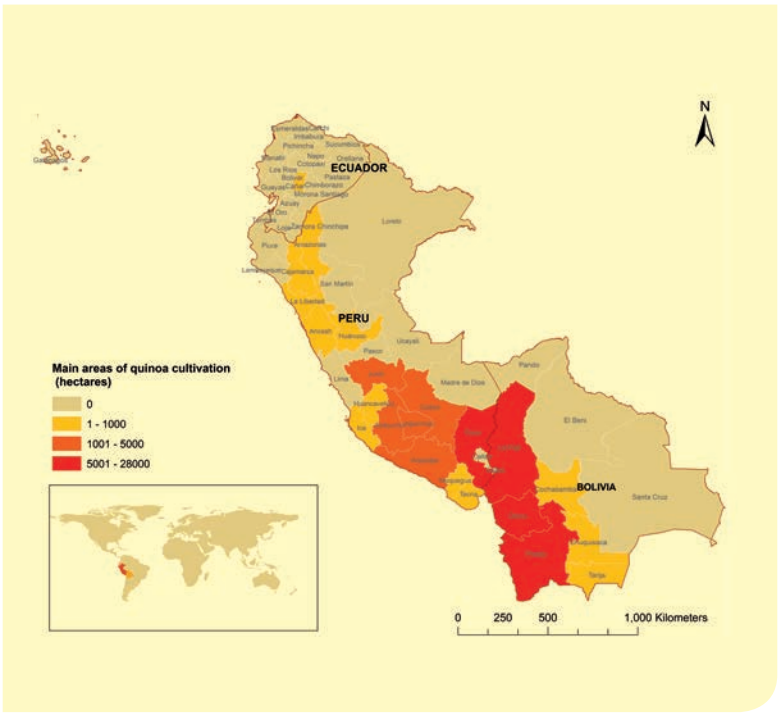

Map: © Marcela Beltrán/Bioversity

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High nutritional value

Quinoa is rich in protein and micronutrients. Depending on the variety, the protein content of the grains can range from 11 to 18%. This is higher than the protein content of rice and wheat, making quinoa optimum for human consumption.

The high nutritional value of quinoa lies in its content of amino acids, the individual components of proteins. Ten amino acids are essential for human metabolism and have to be taken from food because our body cannot synthesize them. Quinoa contains all 10 essential amino acids, including lysine, a key component to normal growth and responsible for a strong immune system.

Due to its high protein contents and excellent amino acid composition, quinoa is the most valuable source of plant protein. It is also rich in fiber, minerals, vitamins and fundamental fatty acids such as linoleic acid or Omega-3 acids. Quinoa is gluten free, which makes it ideal for celiac, vegetarian and vegan consumers. Quinoa's nutrient content is so exceptional, that is NASA´s preferred food for astronauts.

Quinoa grain composition depends on variety, soil characteristics as well as growth and climate conditions. As diverse as the look of the plant is the protein, fat, starch, fiber, vitamin and mineral contents of the grains. For these reasons, quinoa has played a key role in the food and health of farmer families of the Andean highlands, the region where quinoa has traditionally been cultivated.

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Use depends on variety and taste on form of preparation

Traditionally, quinoa used to be eaten at breakfast, lunch and dinner in Bolivia and Peru. Different varieties and forms of preparation were used depending on the desired dish.

There are around 3000 ecotypes of quinoa in Bolivia, all with traits for specific uses and with some disadvantages. Royal White quinoa, the most cultivated, commercialized and exported variety, has big, white but tasteless grains. Yellow grains are rich in starch and good for flour making. Black grains, used by Inca people during funeral rites to lift up their spirits, have an anti depressant effect that has been scientifically confirmed. But more important than variety or grain color is preparation, which determines how quinoa grains finally come to the table.

Quinoa is sold in cities today in a variety of preparations. Quinoa cakes, salads, rolls, crepes and even biscuits can be found in gourmet cafeterias. Popped quinoa is already a popular snack.

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Impact of the quinoa boom in the livelihoods of Andean farmers

Cultivating quinoa is the main source of income for the families of southern Bolivia highlands. Grain price tripled between 1999 and 2008, triggered by export price. The higher income that farmer families are receiving for the grain has increased their livelihoods compared to that of other rural areas of the country. These families can now buy more food, including fruits and vegetables, send their children to school and pay for health care, without having to move to other regions for work or sustenance.

The quinoa boom has is dark side, though, because quinoa is no longer food of the poor in Bolivia and Peru. The domestic price of quinoa grains has increased so much that the poor can no longer afford what used to be their staple. Instead, they eat more rice and pasta to fill up, even if they get fewer nutrients. Even quinoa growing families eat less quinoa than before, because they prefer dishes that take less effort to prepare, even if they are less nutritious.

The distribution of earnings is also uneven. The higher price of quinoa favours transformers, exporters, importers and retail commerce, not so much the farmer families that only perceive a small percentage of theses earnings. To change this situation, quinoa producing countries would have to export grain and products such as flour, cakes, cereal bars and quinoa pasta. This would help growers from Bolivia, Peru and Ecuador to benefit economically, and producing countries could use this additional income to fight poverty.

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Drawbacks of selling more

Quinoa is a successful export product, especially for Bolivia. Almost half of the annual harvest is exported to the US, Canada, Europe, Israel and Brazil. White big grain quinoa is available in organic shops and supermarkets of importing countries; this popularity, however, occurs at the expense of a decrease in variety diversity in the fields. Migration of rural population to cities, over the years, in search for a better life makes the situation worse.

When rural families migrate, the diversity of quinoa varieties in the fields disappears because varieties survive only if they remain in use. Maintaining endangered varieties is not always possible by transferring them to other regions. That is the case of Royal White quinoa, cultivated predominantly in the southern Bolivian highlands, because it cannot grow in the northern soils next to Lake Titicaca.

Cultivation practices have also changed as a result of recent commercialization. In the past, farmers used to grow quinoa on the slopes only, and allowed soils to rest between planting seasons to recover. Today, they grow simultaneously in slopes and valleys, without pause between seasons, which in time decreases yield and erodes soils.

Quinoa cultivation in Peru and Bolivia has to become more sustainable. It is fundamental to use varieties resistant to pests and diseases as well as cultivation practices that increase yield without harming soils or the environment. It is also fundamental to increase grain productivity to reduce prices and allow poor consumers to regain access to their ancestral grain.

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Removing grain husk is a drudge

Quinoa grains are coated in a thin bitter husk that contains saponins, which should be removed to make the grains edible. This task has traditionally been performed by women.

After roasting grains on an iron board set on fire, women place them with some clay in a *saruna*, a large stone recipient similar to a mortar. Then, with their bare feet, they step on the grains until the husk is removed. After that, they throw the grains up in the air to allow the wind to remove the dust with the saponins. This process ends by washing and drying the grains.

Besides being a drudge, quinoa grain processing is painful for women. Removing the saponins of 12 kg of grain with the traditional method lasts 6 hours. Stepping on the hot grains causes blisters and women often complain of back, knee and hip pains.

Partners of Bioversity International and Proinpa Foundation in Bolivia have developed a small machine to process quinoa grains 50 times more quickly. For the joy of women, processing 12 kg of grain can now be done in just 7 minutes. Machines such as this decrease work and may revamp quinoa consumption in the quinoa growing areas.

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Climate change emerges as a new threat

Quinoa blooms where other crops no longer yield. It develops with 300 mm of annual rainfall and withstands wide ranges of daily temperature. For these reasons, it is suitable for the desert lands of the Arab Peninsula, or the semiarid lands of some regions of Kenya.

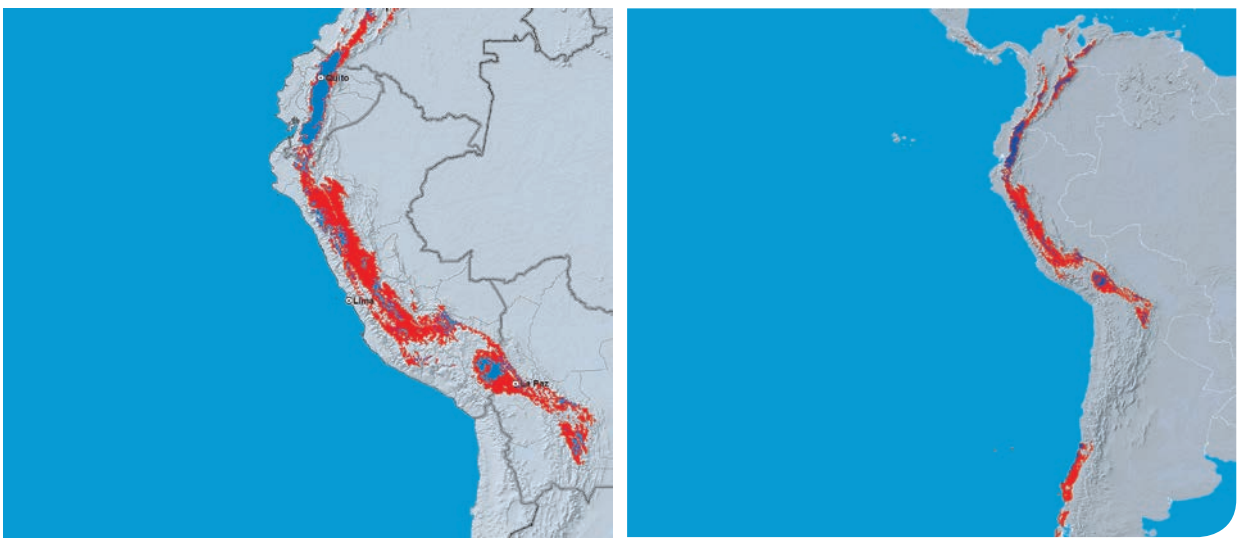
Soil salinity is not an obstacle for cultivation. On the contrary, some ecotypes of Bolivia, Chile and Argentina need saline soils as they originated in the salt lands of these countries.

With the characteristics described, quinoa is ideally equipped to face climate change. And given that it can yield in a short time–some varieties can be harvested in 4 months–it will play a key role in the future food security of the world.

With the help from spatial analysis methods, scientists can predict which regions will be optimum for quinoa cultivation in 40 years time. To predict the future, scientists first find out where quinoa was cultivated in the past and use those data to figure out which conditions are favourable to grow the crop. Data are introduced in climate change models to make predictions. The climatic conditions of many areas of South America where quinoa is grown at present are going to be worse up to the middle of this century.

But even if we have to act before it is too late, hope lies in the huge genetic diversity of quinoa, the pool from where new varieties better adapted to the impact of climate change can be produced. This breeding task should start immediately.

The maps illustrate how the growing conditions for quinoa in South America are going to change. The areas colored in red and blue show where quinoa is cultivated today. In 2050, due to climate change, only the areas marked in blue will be suitable for cultivation. The map on the left clearly shows the effects of climate change in Bolivia, Peru and Ecuador, the main current producers of quinoa.



Maps: © Hannes Gaisberger/Bioversity

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Field trials with improved varieties

Experts believe that if the coat that covers quinoa grains did not contain the bitter saponins, quinoa would be consumed more, even in the rural areas where it is produced. Scientists are working to obtain »sweet« varieties, with a very low content of saponins. INIAP in Ecuador has already launched sweet variety Tunkahuan, whose grains only need to be briefly washed before cooking, without hours of processing effort. The low content of saponins is also a disadvantage, because it attracts more birds, which prefer sweet over bitter grains. And even if this variety requires less preparation for consumption, its cultivation requires more protective measures.

Both INIAF from Bolivia and INIA from Peru are breeding new quinoa varieties. Peruvian scientists, who have recorded and conserved more than 60 varieties virtually unknown until recently, have crossed promising materials to select plants with high yield and protein content. These plants have been multiplied to provide seeds to farmers to test the new varieties in their plots. If these varieties pass the test, they will be planted in the fields of other farmers.

A key role in breeding is played by the multiple quinoa varieties maintained in gene banks of scientific organizations. These varieties contain many traits, important now and in the future.

Farmer families also act as breeders by selecting the most productive plants and by keeping their seeds for the next planting season. When enough diversity is available in the fields, quinoa growers can use it to adapt to changes in growing conditions.

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Seed fairs to showcase diversity

Seeds fairs are a good environment to promote diversity of local quinoa varieties. Farmers attending seed fairs exhibit what they grow in their fields. The more diversity they show, the better reputation they gain in the community because they get a reward for what they keep.

Seed fairs are also places to exchange. Farmers exchange quinoa varieties, get information on new varieties and seed to test them. Unfortunately, these fairs are only held in large towns or cities, requiring that farmers walk from 4 to 8 hours from their small villages to the fair and back home.

Conserving quinoa diversity is not an easy task for farmers because growing different varieties entails extra work. Additionally, if the grains they harvest do not meet the expectations of the market and consumers, they might not even sell the grain harvested. Creating market possibilities for these varieties would be a way to ensure that diversity is maintained. Paying farmer families for conservation would be another.

Diversity loss may put in danger the survival of quinoa because it is a condition to adapt to future challenges. Losing quinoa diversity would also entail a cultural loss, because different varieties take part of numerous traditions in the original regions of cultivation.

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Women, guardians of quinoa diversity

For centuries, farmer families, particularly women, have conserved seeds and by doing this ensured the survival of families, countries and cultures. Even in Europe, during the last century, farmers used to keep their seeds after harvest to plant them in the next season. This changed as a result of the industrialization of agriculture and food production. Today, farmers buy every year seeds produced by commercial breeders. This situation is different in developing countries, where small farmer families continue to depend on their own seed. Seed remains the foundation of traditional production systems and the source of diversity of cultivated plants.

Diversity conservation in developing countries is a task performed mainly by female farmers.

Some plant in their plots different varieties with this aim in mind, but do not receive what they deserve in return. These »guardians of agricultural diversity,« fully committed to this task, not only maintain local crop diversity but the traditional knowledge on the management and use of plants that they also transfer with the seeds to other members of their communities.

Quinoa has many guardians on its diversity, especially around Lake Titicaca. Even if many of them do this for their own good, they appreciate recognition and support for their valuable work of maintaining this diversity. As their task benefits all, governments and society should support and compensate them for what they do.

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A promising future for a versatile crop

Quinoa can be used to make many things, even beer. Quinoa flour is used to make bread and cakes as well as to prepare soups and sauces.

But quinoa is more than a foodstuff. Saponins, discarded as a waste for a long time, are a highly demanded raw material for the industry to make food and natural cosmetics such as soap. Saponins can also be used to prepare pesticides, as they are harmless for mammals and human beings. The pharmaceutical industry is interested in saponins for their bactericide and fungicide properties, and because they facilitate absorption of some medications by the intestine.

Another very promising commercial use of quinoa is to get natural colorants and cold pressed oil from the grains. Ecotypes with very strong colors and high oil grain content have great genetic potential.

The future of quinoa looks promising as it offers farmers families a number of chances to increase their income and enhance their livelihoods. Sustainable ecotourism that would help commercialize quinoa and its diversity as living cultural heritage would also contribute.

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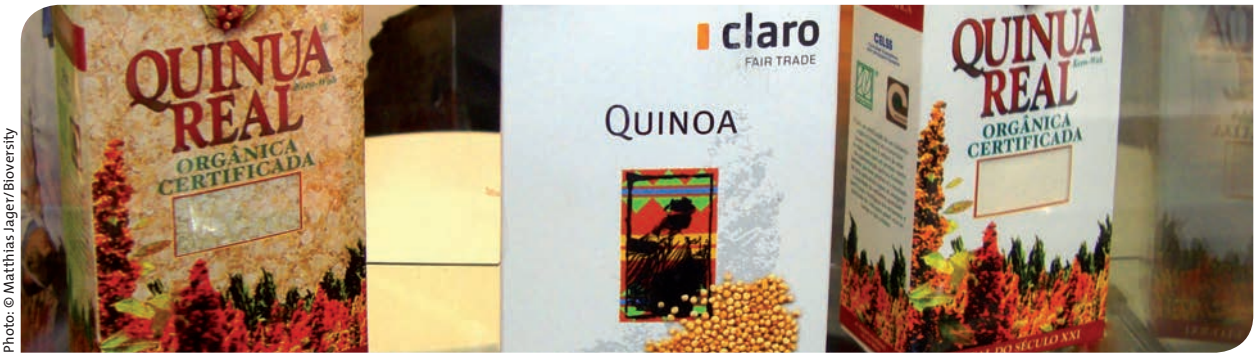

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A deserved place in fair trade

Quinoa is now available in fair trade shops in Europe. Besides the grains, consumers can find quinoa cookies, popped quinoa and chocolate quinoa bars. Even if they are new to fair trade shops, quinoa grains are getting their place among regular consumers of fair trade products.

Fair trade exists to fight poverty and help small farmers. Fair trade organizations work so that famers get direct access to markets in developed countries, by signing contracts in which fair prices are set and known in advance, as well as production standards, fixed delivery volumes and payment dates. Prices in fair trade are continuously adapted to evolving markets and farmers receive a fair trade bonus that they can invest in building schools and medical care facilities, improving water supply or in other projects that benefit their communities. In this way, families of small quinoa farmers can benefit from the quinoa boom and the high prices.

Bolivia and Peru supply nearly the full world market of quinoa through conventional, ecologic and fair trade agreements. But just a small percentage of the total quinoa exported by the South American producers–nearly 12% in 2010–is sold under fair trade. Most of this quinoa comes from Bolivia as well as the organic quinoa and the one sold in organic shops. The small grains are an important export product for Bolivia, being 5th among the agricultural exports of this country.

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Quinoa data and figures

The Quinoa Plant

- Scientific name: *Chenopodium quinoa*
- It belongs to the Chenopodiaceae family, together with spinach and beet; its seeds are the part of the plant mostly used
- It is highly diverse–3000 ecotypes in Bolivia
- Its grains can have 66 different colors

Nutritional Composition

- Protein: 11 to 18%
- Mineral content: Potassium, Calcium, Magnesium, Phosphorus, Iron, Zinc and Manganese
- Vitamins: B1, B2, B3, C and E
- Amino acids: all 10 essential amino acids
- Fatty acids: omega-3 and linoleic acid
- Oil: 2 to 10%
- Gluten free (since quinoa is not a cereal)

Agro climatic Requirements

- It grows at altitudes up to 4500 masl
- It resists temperatures from -8 to +39 °C
- It requires little water–300 mm of rainfall per year are enough

Cultivation

- It has been cultivated for over 6000 years
- It has been originally grown in South America, from Colombia to Chile, but mainly in Bolivia, Peru and Ecuador. It is also planted, in a smaller scale, in the US, Canada, Kenya, India, Nepal, United Arab Emirates, and in various European countries–England, France, Denmark, Sweden, The Netherlands and Italy

Production

- The area planted and the production of quinoa in the 3 main producing countries was, in 2010, as follows:
  63, 010 ha and 36,106 MT in Bolivia
  35,313 ha and 41,079 MT in Peru
  990 ha and 840 MT in Ecuador

Export

In 2009, Bolivia exported 15,116 MT of quinoa and Peru 2,400 MT

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Quinoa Links

Quinoa links

The International year of Quinoa
http://www.fao.org/quinoa-2013/en/

IV Congreso Mundial de la quinua
http://www.congresomundialquinua.com.ec/

Neglected & Underutilized Species
http://www.bioversityinternational.org/research/sustainable_agriculture/neglected_underutilized_species.html

Publications

Biodiversity and Andean grains: balancing market potential and sustainable livelihoods
http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1%5BshowUid%5D=7303

Descriptores para quinua (Chenopodium quinoa Willd.) y sus parientes silvestres
http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1%5BshowUid%5D=7289

Videos

Año Internacional de la Quinua 2013: Un futuro sembrado hace miles de años
http://www.youtube.com/watch?v=IUnAy5NFAyA

Año Internacional de la Quinua 2013
http://www.youtube.com/watch?v=9qCPKGn18XU

Quinua grano de oro, un regalo de los Andes
http://www.youtube.com/watch?v=2Alc46ltIas

Granos andinos: la quinua
http://www.youtube.com/watch?feature=endscreen&v=i6EMEBKEFuM&NR=1

Bolivia: Crazy for quinoa
http://www.youtube.com/watch?v=z4oZtVmWgOw&list=FLGIRaI1_FpiN271fRnaFimA

La quinua a la conquista del mundo
http://www.youtube.com/watch?v=NW8wo-2Zr_0

Photo: © Alfredo Camacho/Bioversity

Together for the conservation of quinoa

This exhibit »Quinoa–from the Andes to the world« is a joint effort of Bioversity International, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the German Federal Ministry of Economic Cooperation and Development (BMZ), in celebration of the International Year of Quinoa (2013).

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