Commodity of the Quarter: Quinoa: Catalyst or Catastrophe?

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Quinoa is a grain-like crop that is rich in protein and minerals; its ability to grow on marginal soils improves its attractiveness as a potential solution to hunger in many areas. Primarily adapted to the high Andes, it is drawing increasing amounts of research scrutiny, as researchers and farmers try to create reasonable agronomic solutions to growing populations and continuing loss of arable land. Since it has become fashionable with vegetarians and vegans in the developed world, it may be argued that the crop is less available to its original growers. Issues of economic and political sovereignty complicate the use and development of the crop in other places.

**Origins**

Quinoa (Chenopodium quinoa Willd.), commonly pronounced KEEN-wa, is one of several closely-related crops originally cultivated in the mountainous regions of Central and South America, particularly in Bolivia, Chile, and Peru (although see Anderson’s lengthy discussion of the difficulties inherent in pinpointing the origin of a crop species (2001). Other species of Chenopodium have been cultivated in what is now part of the United States since prehistoric times (Archer & Hastorf, 2008; Smith, 1984). Quinoa is a leafy annual dicot, with handsome seed heads of various colors (for example, see the photo at https://www.flickr.com/photos/bioversity/6672474921/) which provide the most important crop, the achenes or pseudo-cereal grains. They are threshed from the panicles or seed heads by hand or by commercial processing to remove both the hard seed coat and the inner coating of saponins (Valencia-Chamorro, 2004). The revealed seed grains are small, about the size of common seed beads, and lentil-shaped. Cultivated varieties may have white, purple, red, black,
or brown grains; much of the processed grain available in the United States is white or cream-colored.

In the United States, the most closely related plant that resembles quinoa is the common weed known as lamb’s quarters (Chenopodium album L.), part of the goosefoot family; and in fact the leaves of quinoa can be eaten raw or cooked as a vegetable like the leaves of lamb’s quarters. Quinoa is classified in the division Magnoliophyta, class Magnoliopsida, order Caryophyllales, family Chenopodiaceae (plants.usda.gov/core/profile?symbol=CHQU), although some botanists place it in Amaranthaceae (Vega-Galvez et.al., 2010). Some recent classification schemes have merged the amaranths and chenopods into one family, and certainly there are characteristics in common, to the point that it is sometimes difficult to distinguish among them (New England Wildflower Society, 2014). Chenopodium quinoa resembles its other goosefoot relatives, and resembles at first inspection some of the amaranths, such as various pigweeds. It shares with other members of its order the ability to survive and even thrive in harsh conditions, poor soils, and arid climates (Berry, n.d.).

Quinoa is high in fiber and relatively high in a balanced array of proteins, unlike most true grains from grasses such as maize or wheat (National Research Council (U.S.) & Advisory Committee on Technology Innovation [NRC], 1989). Historically, quinoa was cultivated and grown in Central and South America, specifically in Ecuador, Bolivia, Chile, and Peru; notably it was grown by the Inca, for whom it was an essential part of their diet. “In the Inca Empire, where only the potato was more widely grown, quinoa is said to have been sacred; the year's first furrows were opened ceremoniously with a gold implement” (Quinoa, 2013, para. 1). When the outer husk is removed and the grains are rinsed or polished (to remove saponins, as mentioned, part of the inner seed coat whose thickness and bitter taste may be a reason for the crop’s
resistance to sun and insect damage (Quinoa, 2000); they are usually cooked by boiling, by toasting in a pan with oil and then simmering, or by grinding and baking, usually with other types of flour. Sometimes, the seeds are popped and eaten like popcorn. As with most other grains and grain-like foods, it has also been used to make beer (Strausbaugh & Core, 2006). Bhargava and Srivastava (2013) have produced a book that details how the crop is raised, an array of uses, and the complex chemistry of the plant. As they mention in several chapters, other parts of the plant, such as the leaves, are sometimes served as a vegetable or fed to livestock; the saponins, which are rinsed from the grains, are being used as lubricants, soaps, fungicides, and other products, and the seed oil and starches show promise for an array multitude of uses.

The balance of amino acids that quinoa offers approaches meat in quality (NRC, 1989). Though it doesn’t provide as many grams of protein per volume, it is nourishing and filling, a great attraction, and possesses a valuable ability to grow under marginal conditions, in poor soil, in soils with high salinity, and with little water (NRC, 1989; Oelke, Putnam, Teynor, & Oplinger, 1992). Most often grown at higher altitudes and in soils that would not support corn or wheat, quinoa has provided a staple food for populations whose other food often had to be traded for and transported in due to the inhospitable conditions:

Quinoa is adapted to the cold, dry climates of South American highland regions. It occurs naturally in high altitude, arid areas with poor soils. The plants are typically exposed to drought, frost, strong wind, and full sun, and they can grow near salt lakes. Quinoa can withstand temperatures from 8°C (18°F) to 38°C (100°F); grow from sea level up to 4200 m (13,800 feet); and tolerate poor soils, soil salinity, and a wide range of soil pH. Remarkably, growing in areas of high
evaporative demand, the species can survive with as little as 100 mm of annual rainfall (Small, 2013, p. 172).

Historically, it was commonly planted on beds or terraces, in small family plots, or on waste ground like garbage heaps, with rotations of other crops or fallow time between yields. It is likely that the indigenous peoples began to cultivate quinoa to supplement their diet of potatoes and related tubers (Hellin & Higman, 2005). Kuznar (1993) describes a possible scenario for the ancestral domestication of quinoa as it grew in pens or pastures in manure after having been browsed upon by llamas, goats, or sheep. In the early literature it is often described as being equivalent to cow’s milk in the diet of rats in feeding studies (Eiselen, 1956; Mazzocco, 1934; Simmonds, 1965; White et al., 1955). These early studies have been only the leading edge of a flood of enthusiasm—particularly since the 1980s, the number of publications involving quinoa in some fashion has increased dramatically, with four times as many citations indexed in Agricola and CAB between 1985 and 2015 as between 1965 and 1985.

Quinoa is exciting such notice that the Food and Agriculture Organization of the United Nations (FAO) named 2013 the “International Year of Quinoa.” It is being planted as a crop in Kenya and northern India because of its potential to contribute to food security (http://www.fao.org/quinoa-2013/en/). The crop is being studied as a possible source of lower-cost protein for developing countries and has been planted for testing in Morocco, Italy, Japan, and other countries (Hirich, Choukr-Allah, & Jacobsen, 2014; Isobe, Uziie, Hitomi, Furuya, & Ishii, 2012; Lavini et al., 2014; Walters, Peterson, & Murphy, 2014; Zurita-Silva, Fuentes, Zamora, Jacobsen, & Schwember, 2014).
**Quinoa Industry: Boom in progress?**

While the local populations have harvested and consumed the crop for centuries, interest in quinoa as a food in other countries has blossomed in the last several decades, in part with the rise of interest in vegan, vegetarian, and gluten-free diets (Dreibus, 2014; “Modest Foods,” 1988). Other factors in the growth in the literature on the crop are: (a) the potential use of quinoa as a source of food in areas of food insecurity (NRC, 1989; Ruiz et al, 2014); (b) its hardiness and protein value; c) a potential source of food in space (Adler, 1995); and, (d) the novelty of it. As a relatively bland grain-like food, it can take the place of rice, pasta, grits, or other staples, while providing more fiber, more protein, and often, a better range and amount of minerals, including zinc, calcium, and magnesium (Oelke et al., 1992). Attempts have been made and are being made to grow quinoa in Colorado and Canada (DePillis, 2014) the main areas outside South America where the crop has been established, as well as in Great Britain, and in other countries (Hirich et al., 2014; Valencia-Chamorro, 2004). It’s important to note that the level of production compared to Bolivia or Peru is so low that the FAOSTAT pages don’t list any notable production for the United States in 2013 (http://faostat3.fao.org/download/Q/QC/E).

The plant doesn’t flower if temperatures rise above 95 degrees F; and it does better at higher altitudes, so its range is limited. The variability of the crop’s varieties which were in use when the NRC’s report was written in the 1980’s meant that the crop didn’t ripen at the same rate over a given field, though newer varieties are in development that ripen more consistently and seeding the field more heavily results in a more-even time of ripening (NRC, 1989). New varieties with more standardized ripening, sweeter grains (because of lower saponin content), and a broader range of climate and soil affinity are under development (Valencia-Chamorro, 2004), with the purpose of allowing the tough and nutritious crop to be grown in other places.
(see www.quinoa.com for mention of a Canadian variety, and a profile of a British company at www.britishquinoa.co.uk). A lower content of saponins would be an advantage even in its original range because the need for processing is a limit on the use of the crop by the local inhabitants. Additionally, if the grains are cleaned with water, the washed-off saponin content can be poisonous to snakes, frogs, and other cold-blooded animals (Valencia-Chamorro, 2004); the grains may also be cleaned mechanically, by hand or by machine, but this is more time-consuming. Whether breeding new varieties of Chenopodium quinoa that can survive in other places is an unalloyed benefit remains to be seen given that other related plants such as Chenopodium album L. (lamb’s quarters) and several Amaranth species are weeds in many places.

The trendy nature of the market for quinoa has had both positive and negative aspects. Certainly, growers have benefited from the rising prices that the crop commands, though the various intermediaries may reap more of the profits than the small growers as has happened historically with other crops (Ofstehage, 2012; Painter, 1984). However, somewhat famously, Romero and Shahriari (2011) insisted that the boom has priced the crop out of the market for the local inhabitants. Others argue that the food has been supplanted in some areas because it takes more preparation than other options, such as rice or noodles, which are newly available to a population whose per capita income has risen from tens of dollars to hundreds (DePillis, 2014; Ofstehage, 2012). An intensive discussion of these and other factors was written by Emma Banks (2011) on the blog of the Andean Information Network, which suggests that the issue is much more complex. In addition, one of the founders of Alter Eco, a company that has been much involved in the harvesting, shipping, and marketing of the crop, also contributed to this discussion (Rollet, 2012). Another controversy, typified by the point-counterpoint discussion by
Jacobson (2011, 2012) and Winkel et al. (2012) involves whether the longer-term costs of using row crop production methods involving tractors, pesticides, cultivation, and annual planting, such as soil erosion and increased salinity, is worth the increased cash price of the crop, even when the machines may be provided by the government or NGO funding. The high altitudes and low soil moisture that characterize the areas where quinoa has been produced were more protected when the historical manual cultivation involved methods such as seeding small plots or land not useful for other things, planting by hand, and fertilization with llama, goat, or sheep manure (Kuznar, 1993; Zurita-Silva et al., 2014). The following quote on the website of Fairtrade International provides insight into this controversy:

The more troubling issue that farmers have highlighted has to do with sustainable methods of production. The high price of quinoa has brought many people to the area trying to quickly capitalize on the booming quinoa business. “People who never were in the quinoa business [are] suddenly coming to the region and wanting to grow quinoa [without] really using the traditional practices.” Veldhuyzen said. “The traditional growers have been living from quinoa all their lives and they know that the land needs it. (2013, para. 12-13)

Another significant question that has developed is whether the price and availability of quinoa seed for a crop may drive planting in areas formerly considered marginal, which is likely to reduce biodiversity in such areas, whether in the Andes or in other parts of the world:

As is well known, biodiversity is especially rich and notably threatened in economically poor areas of the world. In regions that are very poor economically,
the desire to escape poverty is so urgent that protection of biodiversity usually has limited priority for residents or their governors. Given that Quinoa can be grown in extraordinarily poor environmental circumstances in very poor economic regions, it follows that habitats in such areas are in considerable danger of being sacrificed. (Small, 2013, p. 177)

In human terms, the greatest quandary is whether the crop can be planted and raised sustainably in the areas where it has historically supported the people, and if the development of varieties that will grow in other places means that the high price currently commanded will drop, leaving the farmers in the high Andes with exhausted soil and nothing to show for the boom over the longer time frame (Hogan & Joyce, 2014).

**The Market for Quinoa**

The market for quinoa, especially organic quinoa, has increased dramatically over the last 30 years, and particularly in the last 7 to 10 years (Hogan & Joyce, 2014). Most of the quinoa sold and used in the United States comes from Bolivia or Peru. The U.S. imports 70% of the quinoa produced in those countries in a given year. The production of quinoa is spreading to other countries in Central and South America, such as Ecuador and Mexico.

Fair-trade marketing, which has been a large selling point for quinoa, particularly for organic quinoa in relation to the fear that Bolivian and Peruvian farmers were being robbed of their ancestral foods in order to provide them to markets in the United States, has been explored by McMurtry, in relation to fair-trade coffee (2009). There are troubling issues such as whether the
price paid at the consumer level is reflected in the price paid to the original farmers, and whether the practice actually provides ecological benefits or is simply a ‘green-washing’:

For if there is no substantive ethical economic content provided in defence of Fair Trade, then its economic and development impacts can be seen as marketing phenomenon substantially indistinguishable from a myriad of possible "socially conscious" products like an "organic Twinkie" (Joan Dye Gussow's term) which claim to provide some ethical good but in fact continue the conditions of production which created the need for that good. (p. 30)

Without sufficient oversight, it is very difficult to determine whether or not most of the individual farmers are benefiting from the increased market and price. There are both formal and informal cooperatives, and there are agents who buy quinoa when the farmers carry their bags to market (Ofstehage, 2012). As mentioned, there are people trying to cash in on the boom, and increasing numbers of people planting quinoa in its traditional ground and in other countries.

**Quinoa Cooperatives and Companies**

There isn’t a large amount of accessible information about these associations, as most are based in Bolivia or Peru, and commonly the available Web sites are in Spanish. However, I have provided several selected organizations below.

**ANAPQUI**
http://www.anapqui.org.bo/ (roughly, National Association of Quinoa Growers)

Anapqui is a fair-trade-certified (in 2001) Bolivian farmer’s association dedicated to quinoa production. Written in Spanish, the web site speaks briefly of the nutritional and medicinal value
of the crop, and includes short cultivation and production information. The organization acts as a cooperative for selling and pricing the crop.

**Alter Eco Foods**  
http://www.alterecofoods.com/alter-eco-quinoa/

Organized in 2002, this company works with approximately 1500 farmers to grow quinoa according to fair trade standards which include requirements for erosion control, retention of part of the crop for the farmer’s use, and other benefits, according to the company’s Web site.

**Ancient Harvest**  
http://ancientharvest.com/about-us/

The company makes the claim of having been the first company to import quinoa to the United States, in 1983. They also claim to have benefited the farmers that they deal with, including building roads to help the crop reach the market.

**NorQuin**  
http://www.quinoa.com

NorQuin is a cooperative of Canadian quinoa farmers who have developed a company to market their products. Participants have developed a variety, called NorQuin Golden Quinoa, which grows in Saskatchewan, Canada, and is likely to be able to grow in other similar climates (http://www.quinoa.com/blog/posts/norquin_quinoa_harvest_2014.html).

**Quinola Mother Grain**  
http://quinola.com/the-cooperative/

Quinola is a company that sells quinoa products, and sponsors a Peruvian cooperative of about 500 quinoa farms and helps them get bring the crop to market.
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