

# *The Benefits of Cultivating Quinoa and the Loss of Genetic Biodiversity*

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**Abstract:** Climate change has brought serious problems which include soil salinity and drought. This poses a threat to crop productivity. More and more people have been aware of the value of planting quinoa. Meanwhile, the protection of quinoa biodiversity should be valued.

## 1. Introduction

Global climate change causes increased temperature, more droughts and floods in some regions, which damages the local ecosystem. It also leads to the large scale of soil salinization and aridity around world (Lavini et al., 2014). This poses a threat to crop productivity, as the living condition of crop has been changed (Ruiz et al., 2013). However, since it is predicted that human population will reach nine billion in the future, there is an increasing need for food. With one billion people suffer from starvation and every minute ten children die of starvation, it remains a challenge to satisfy the demand for food under climate change (Jacobsen, Sorensen, Pedersen, and Weiner, 2013).

The other issue should be concerned is sustainability for food, which means addressing current problems without damaging next generation's living conditions. Consequently, it is necessary to protect arable land and genetic diversity to guarantee ecosystem resilience (Ruiz et al., 2013).

To address these problems, species which can adapt to the climate change and grow in drought or saline soils, have been introduced to countries which are faced with food scarce. Quinoa, an Andean grain crop, are salt tolerant species and has been cultivated for 7000 years even conserve its biodiversity. There are 5 main ecotypes: Highlands, Inter-Andean valley, Salares, Yungas, and coastal lowlands (Fuentes, Bazile, Bhargava and Martinez, 2012). In addition, as a quality food, quinoa provides sufficient nutritional elements such as vitamins (B, C, and E) and some antioxidants. It also has the ability to prevent degenerative diseases (Ruiz et al., 2013).

More and more people have realized the value of quinoa, it has been cultivated in many areas in Europe and subtropical regions of the world since it maintains satisfied yields and provide enough food for local people (Fuentes et al., 2012). Production of quinoa has increased significantly from 1980 to 2011 in Peru, Ecuador, and Bolivia (Ruiz et al., 2013). The genetic diversity of quinoa has been tested in Chilean, which showed the connection between evolution and the change of living environment which started from ancient societies. The urbanization of the Andes put quinoa at a risk of genetic erosion, because the protection of genetic diversity relies on farmers who have moved from rural places to urban areas (Fuentes et al., 2012). Moreover, the increasing prices of quinoa on the international market cause the problem of sustainable production (Jacobsen, 2011).

In the following, a description of the importance of protecting biodiversity of quinoa and methods to address the production problems of quinoa are given based on case studies.<sup>1</sup>

## **2. The Increasing Trend of Cultivating Quinoa and Its Biodiversity**

The increasing population leads to the urgent demanding for food. However, relying on staple crops is not able to address the insufficient of food, because these crops need be irrigated by fresh water and cultivated in arable land. Fresh water is a limited resource because of the intense groundwater use for agricultural irrigation and the climate change. As for arable land would decrease 50 percent by the year 2050 due to drought and salinization. Under these circumstance, it is necessary to identify the certain crops that can adapt to climate change and provide sufficient food for the world without damaging the environment. Quinoa has a good tolerance of drought and salinity soils and can maintain stable yield. Research has been carried out in Syria and results showed that the yield of quinoa under deficit irrigation was almost the same when it was full irrigated (Lavini et al., 2014).

In recent years, people pay more attention on healthy diet including nutrition balance. Quinoa seems to be an ideal choice for people who value nutritious food. Quinoa seeds contain 20 proteinogenic amino acids and proteins which are higher than other cereals. It is also rich in vitamins (B, C, and E) as well as several antioxidants including flavonoids which can lower the risk of cancer and other diseases: coronary heart disease, atherosclerosis, diabetes and so on. Moreover, various minerals such as Ca, Fe, K, Mg, Mn, P, Zn) can also be found in quinoa. As a result, quinoa contributes to address malnutrition and food shortage in undeveloped countries, and can help deal with problems of obesity in the developed countries (Ruiz et al., 2013).

Quinoa has been planted in the Andes of South America for thousands of years. It became increasingly cultivated in different areas of the world including Peru, Ecuador, northern Argentina, northern Chile (Fuentes et al., 2012). Not only because its tolerance to soil salinity, drought and nutrition value, but also its genetic diversity which enable it to adapt to different living environment.

Genetic diversity play an important role in maintaining ecosystem resilience which is a severe challenge under climate change. It can also meet the demand for increasing food production. In order to exist in various weather condition causes by climate change, crops with wide types of genetic resources are needed. Only several crops are able to breed under the changing environment such as drought and soil salinity and provide food for humans. Consequently, these crop breeding process not only need current existing crops, but also a protection of wide range of genetic resources to deal with the change of climate (Jacobsen, 2013). In addition, sustainability also depends on the genetic diversity. It is our responsibility to produce more food to keep pace with growing population without damaging the environment and living conditions so that our future generation could meet their own need (Jacobsen, 2013). As quinoa can be cultivated in salty soil, it reduces the use of arable land and converse more useful land for our next generation (Ruiz et al., 2013). Quinoa can also be plant under deficit irritation, so the usage of water is less than staple crops. Introducing it to areas where suffer from water shortage or drought is a good way to protect water resources.

## **3. Problems of Introducing Quinoa and Solutions**

The benefits and potential of quinoa have been increasingly realized around the world. More and more countries cultivate quinoa as a cover crop. Despite the livable income for farmers, it brings some problems in production due to the increasing export market and price.

The higher price of quinoa pose a threat to its sustainable production .as growing demands for quinoa in world market, the price is increasing as well .In order to earn more profits, farmers have

to change their land to a more intensive cultivation which can improve the quality of quinoa. Through applying the inappropriate technologies and leaving the land fallow, this causes nutrition reduce and wind erosion. Farmers even avoid eating quinoa that they plant and buy cheap but less nutritious food so they have more quinoa to sell and get more interest. What is worse, the large scale of planting quinoa might turn the whole region into a desert (Jacobsen, 2011).

On the other side, because of the urbanization, the migration from countryside to urban centers has become common in some countries. This lead to the genetic erosion of quinoa, because farms play a key role in protecting the diversity of quinoa. Reasons are as follows:1) they protect the genetic diversity of quinoa in their own farmland;2) they know agricultural behavior of every quinoa 3) they understand the complicated networks which can explain the seed fluxes (Fuentes et al., 2012).

Farmers have a better understanding of quinoa and plenty of experience of how to protect the genetic diversity of quinoa. But they fail to recognize the value of diversity at a large spatial scales. It is essential to encourage them to share their traditional knowledge and experience to public, as it can enhance the awareness of conservation of genetic diversity and avoid the genetic erosion (Jacobsen, 2013). Another method is to provide farmers with practical courses about the appropriate soil management and correct use of the tractor and different types of field operations (Jacobsen 2011). Thus genetic diversity of quinoa is likely to be preserved.

The increasing need of quinoa in international markets and export incentives might lead to a loss of seed diversity in the future (Fuentes et al., 2012). Consumers who are also play a key role on the cultivating of quinoa. Their eating and consuming habit affect the productivity of quinoa. Consequently, if they select various kind of quinoa, Chances are that various genotypes and genetic diversity tend to be preserved.

#### 4. Conclusion

Quinoa is an ideal type of crop in order to meet the demand for food. It has been widely cultivated around the world. Although it brings a great amount of profits to the farmers, it also poses a threat to the loss of genetic diversity.

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