# Ex-Situ Conservation of Quinoa: The Bolivian Experience

**Wilfredo Rojas**

PROINPA Foundation

International Quinoa Research Symposium
August 12 – 14, 2013. Washington State University
Pullman, Washington

# Content

- Situation of the global and regional quinoa collections
- The Bolivian Quinoa Collection
- Contributions to *ex situ* management
- Conclusions

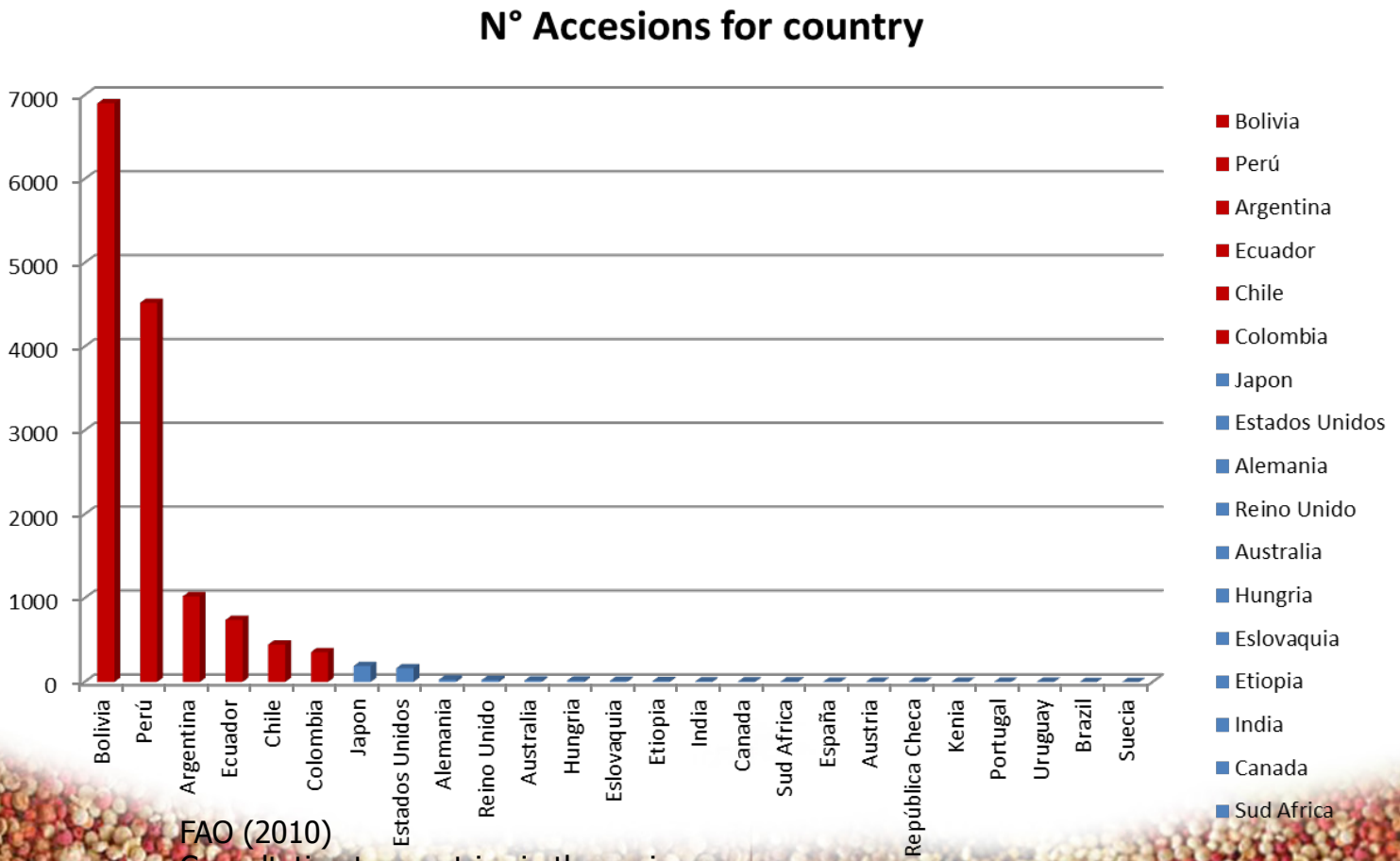
# Content

- Situation of the global and regional quinoa collections
- The Bolivian Quinoa Collection
- Contributions to ex situ management
- Conclusions

# Situation of the Global *Ex Situ* Quinoa Collections

FAO, 2010: There are 16,263 Chenopodium accessions

FAO, Biodiversity International and Gene Banks of Andean Region: 14,495 accesions

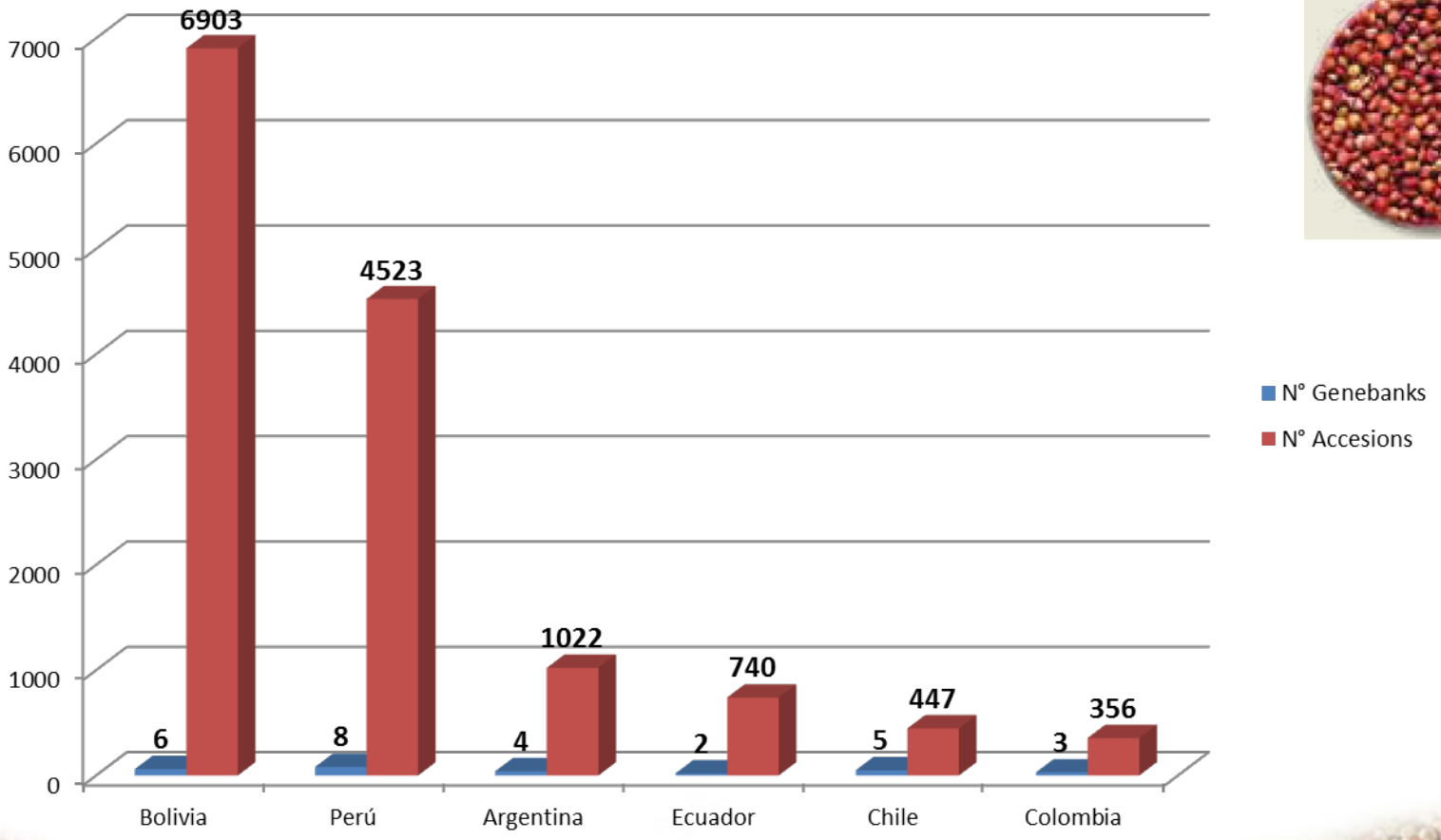



FAO (2010)
Consultation to countries in the region

*Ch. quinoa*
*Ch. berlandieri*
*Ch. petiolare*
*Ch. carnosolum*
*Ch. albun*

# Situation of the *Ex Situ* Quinoa Collections in the Andean Region

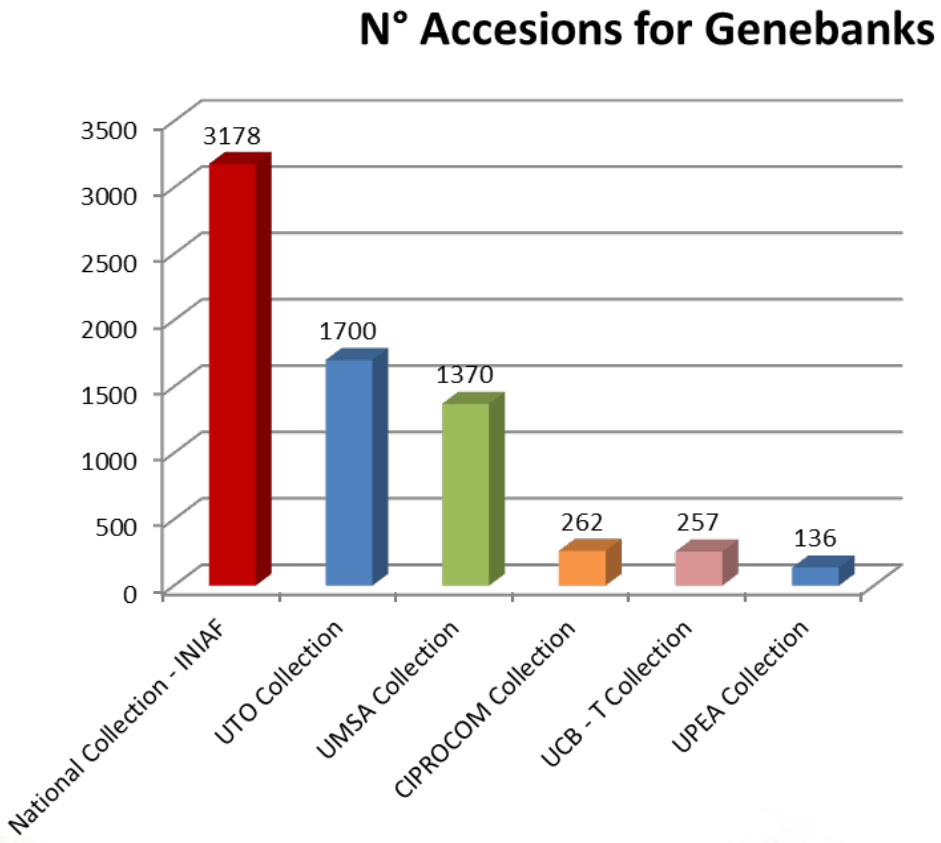
Total number of accesions: 13991 (96.5%)

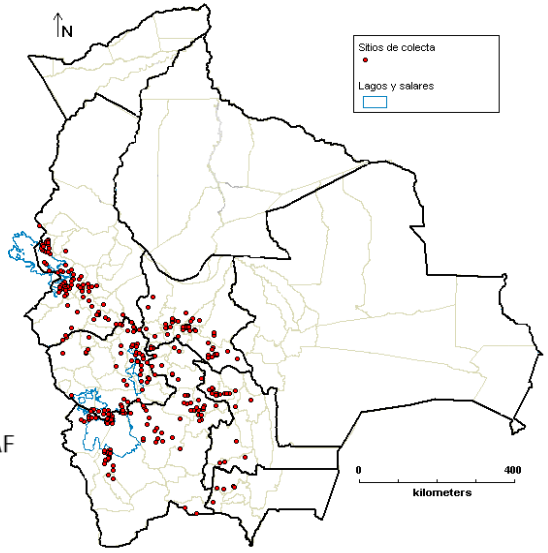



Source: Personal elaboration

# Situation of the *Ex Situ* Quinoa Collections in Bolivia

Total number of accesions: 6903




Source: Personal elaboration

# Content

- Situation of the global and regional quinoa collections
- The Bolivian Quinoa Collection
- Contributions to ex situ management
- Conclusions

# History and administration of the quinoa germplasm collection

This collection was implemented in the 1960's, under administration of IBTA's.

In 1997 with the crisis and closure of IBTA, the quinoa germplasm collectioni is transfered to the Departamental Government of La Paz.

During this period of time no budget was assigned to maintain the collection. The risk to discontinue the quinoa germplasm increased.

# History and administration of the quinoa germplasm collection

Ministry of Agriculture delegated PROINPA the responsibility to manage the quinoa germplasm (National legislation through the letter PDTA-2216-BO-C-N° 418/98)

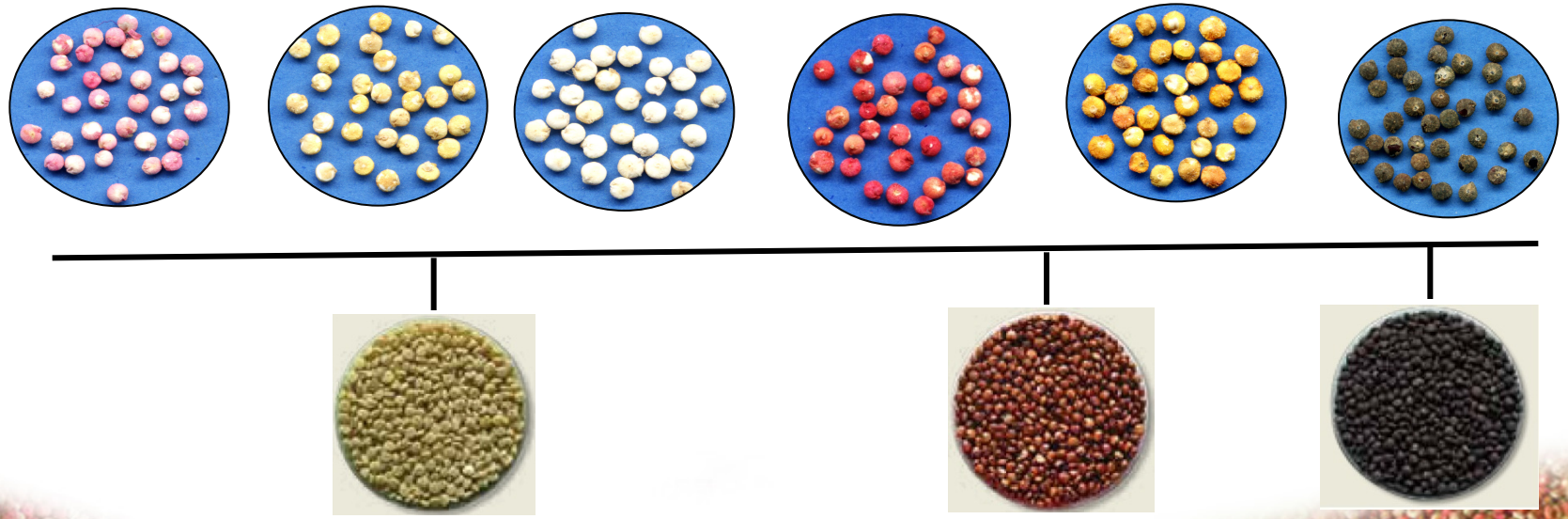
PROINPA was in charge of managing the quinoa germplasm for 12 years (1998 – 2010).

In 2008 the Bolivian goverment created the National Agricultural and Forestry Innovation Institute (INIAF) who is currently in charge of the quinoa germplasm since 2010.

# Broad genetic diversity of quinoa

The 3178 accesions of quinoa represent the largest genetic diversity in the region and the world.

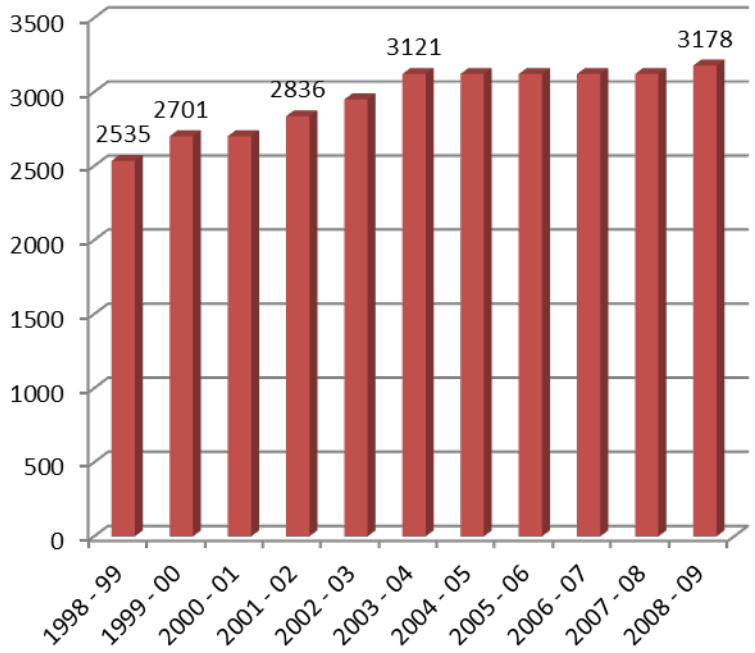
These accessions are source of genes for: early harvesting, biotic and abiotic stress tolerance, morphological diversity.



# Content

- Situation of the global and regional quinoa collections
- The Bolivian Quinoa Collection
- Contributions to *ex situ* management
- Conclusions

# The growth of the quinoa germplasm collection




643 new accesions

## Centralized Collection

## Decentralized Collection

# Protocol for long term storage

**Seed conditioning**
Analysis of the porcentage of purity, germination, and initial humidity

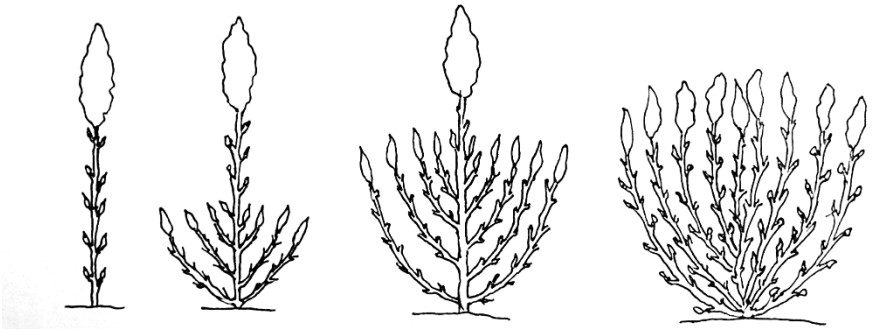
**Reduction of moisture**
From ~ 12% to 3 to 7% (dehumidifier at 20°C for 24 Hrs)

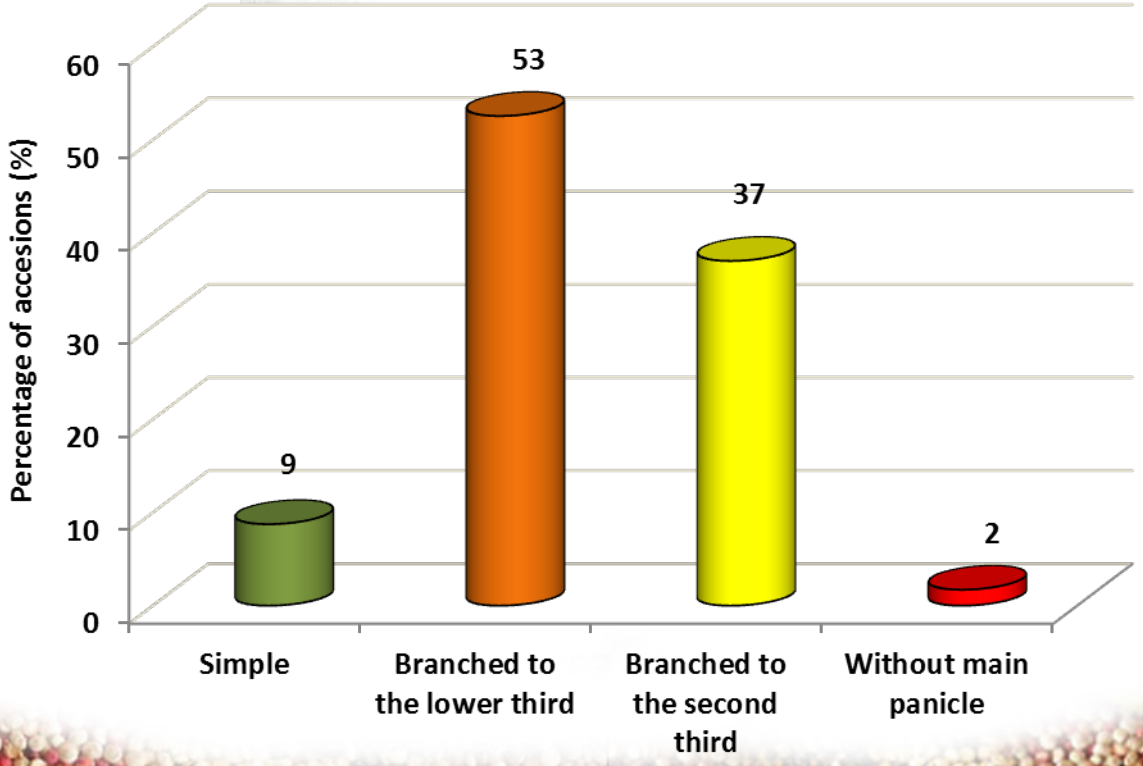
**Vacuum sealing**
In three layer aluminum envelopes to maintain airtightness over time.

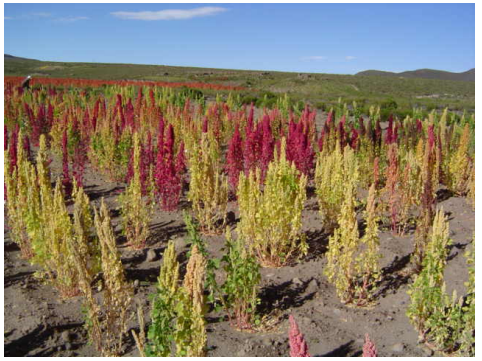
**Storage**
Preserved in cold chambers or refrigerators at a temperature of -20 °C.

# Variation in growth habit

**(N = 2750 accesions)**

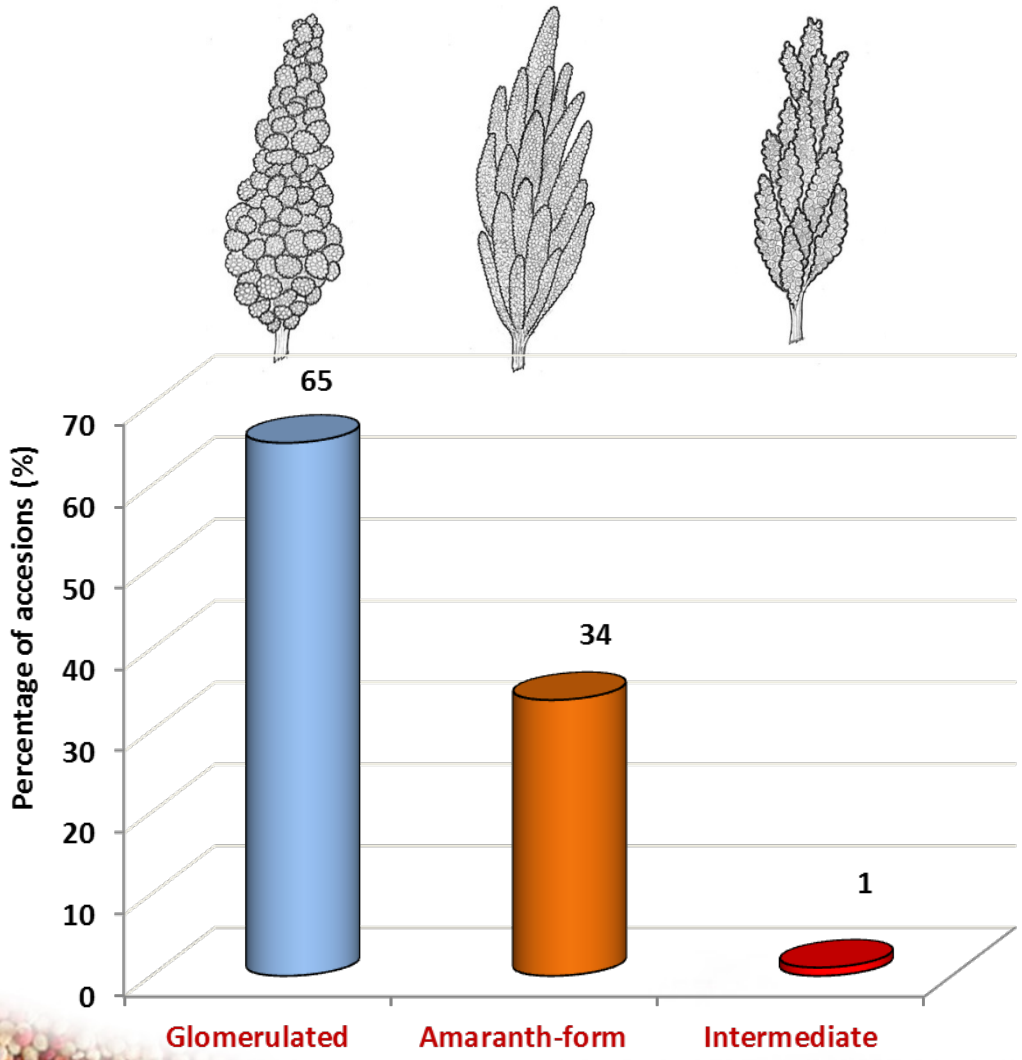




# Variation in shape of panicle

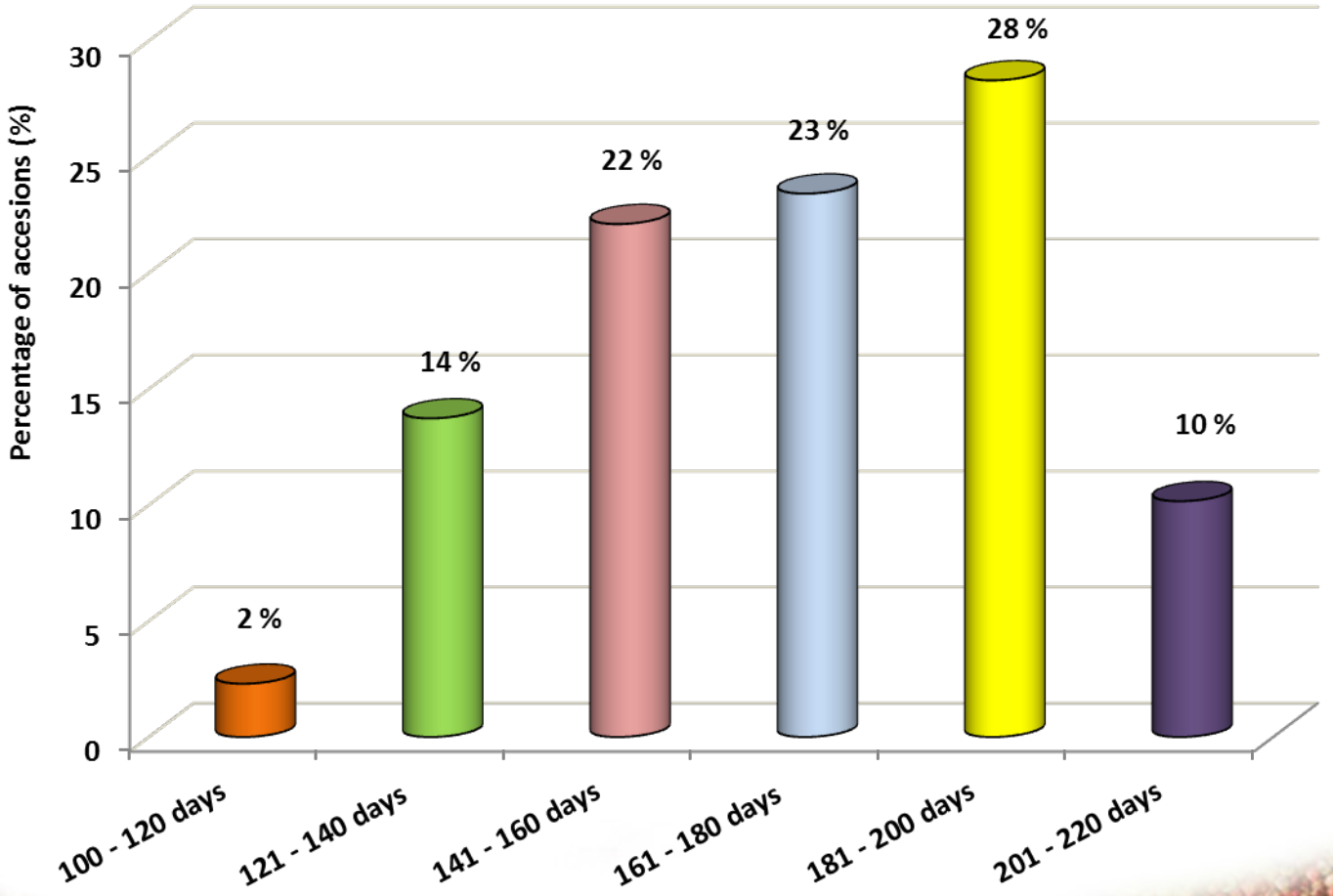
**(N = 2750 accesions)**




| Shape of Panicle | Yield (g/ plant) |
|---|---|
| | Maximum |
| Amaranth form | 438.8 |
| Glomerulated | 420.7 |
| Intermediate | 233.7 |

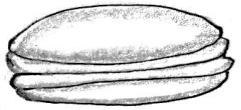
# Variation in fisiological maturity (days)

**(N = 2750 accesions)**

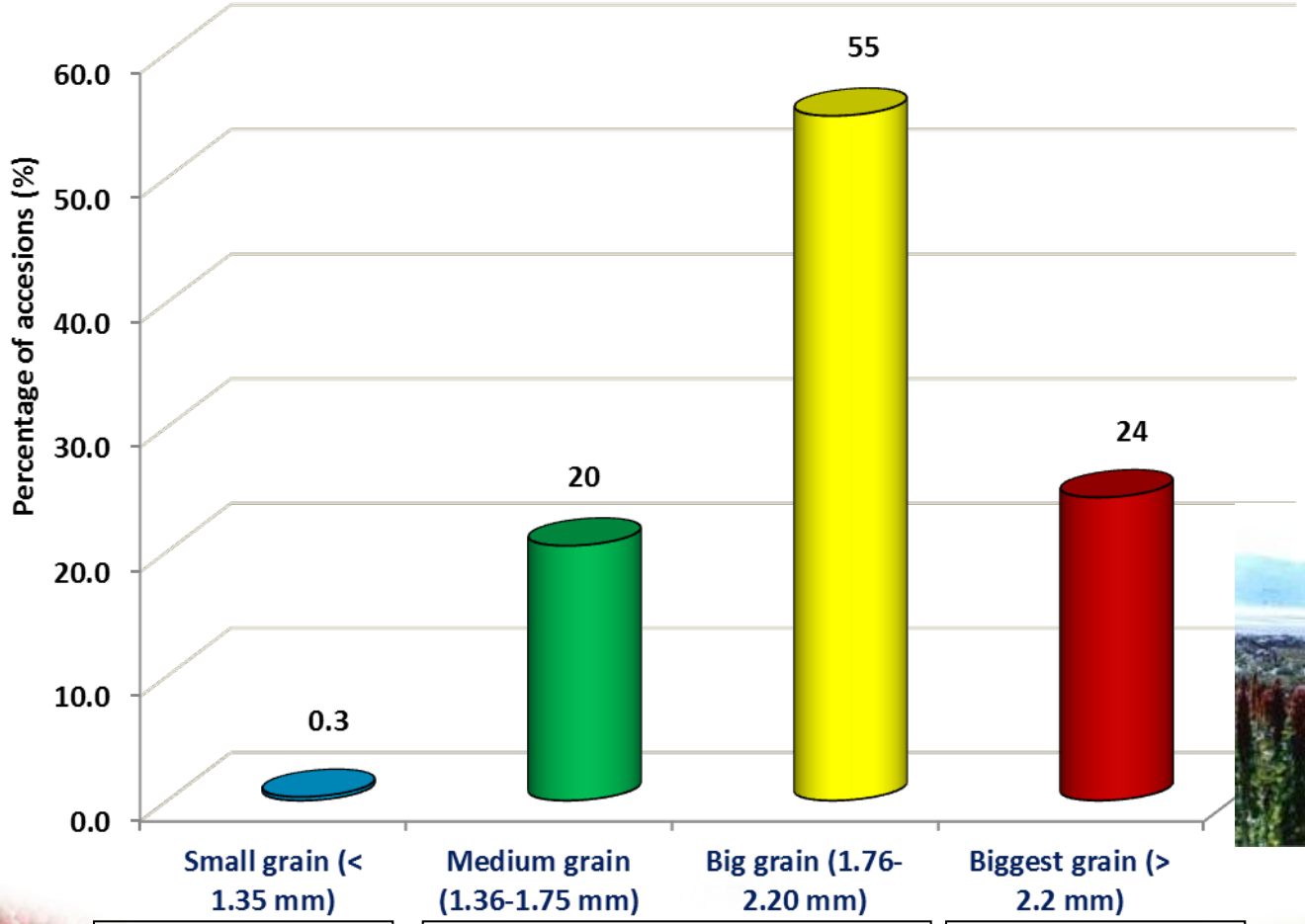


# Variation in grain diameter

**(N = 2750 accesions)**



Grain diameter: 1.03 to 2.7 mm




# Variation in nutritional and agroindustrial value of quinoa

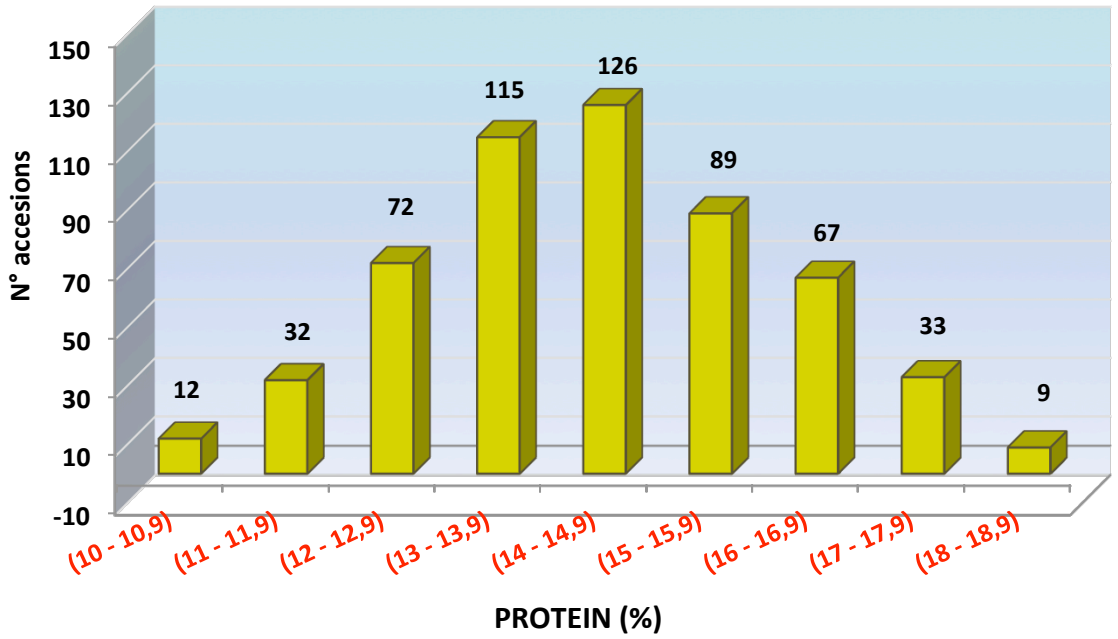
| | Characteristics | Mín | Máx | Average | SD |
|---|---|---|---|---|---|
| N = 555 accesions (2001) | Protein(%) | 10,21 | 18,39 | 14,33 | 1,69 |
| | Fat (%) | 2,05 | 10,88 | 6,46 | 1,05 |
| | Fiber (%) | 3,46 | 9,68 | 7,01 | 1,19 |
| | Ash (%) | 2,12 | 5,21 | 3,63 | 0,50 |
| | Carbohidrates (%) | 52,31 | 72,98 | 58,96 | 3,40 |
| | Energy (Kcal/100 g) | 312,92 | 401,27 | 353,36 | 13,11 |
| N = 266 accesions (2006) | Diameter of granule starch (µm) | 1 | 28 | 4,47 | 3,25 |
| | Reducing sugars (%) | 10 | 35 | 16,89 | 3,69 |
| | Water filling (%) | 16 | 66 | 28,92 | 7,34 |

SD = Standard deviation; Analyzed by LAYSAA, Cochabamba - Bolivia

Source: Rojas et al. (2010)

# Variation in protein content (%)

**(N = 555 accesions)**

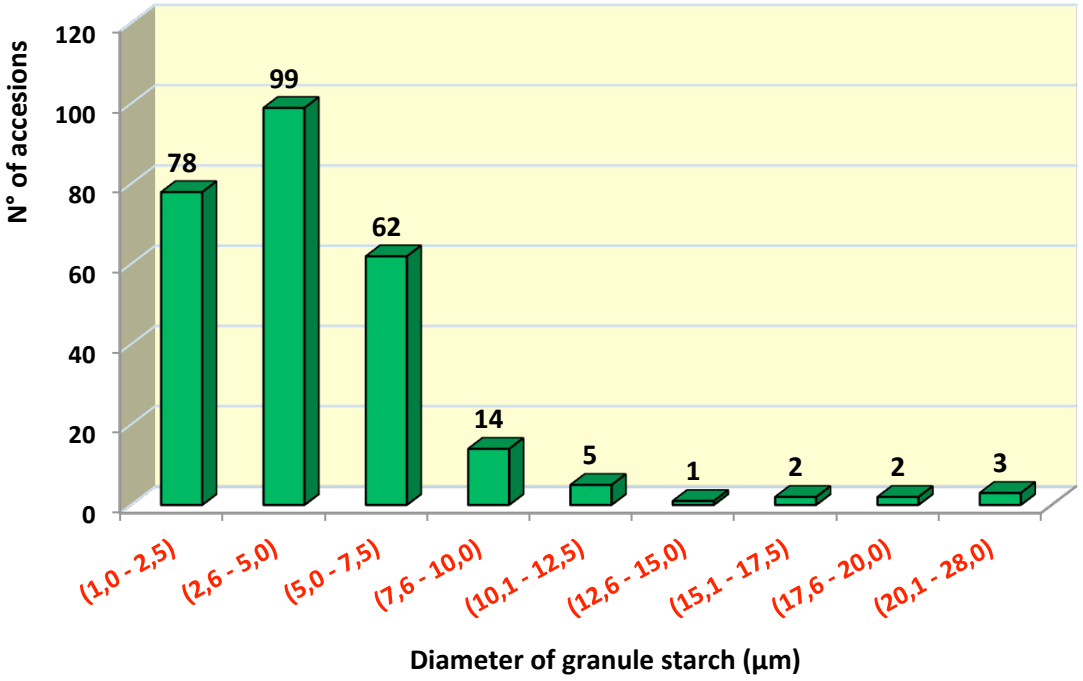


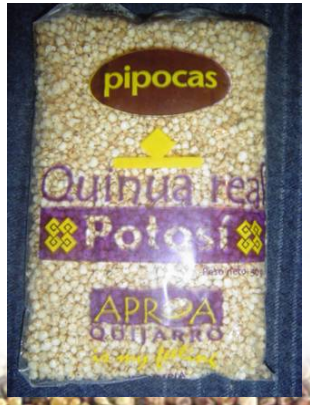

| Grain | Protein | Fat | Fiber | Ash | Carbohidrates |
|---|---|---|---|---|---|
| National Germplasm | 10.2-18.4 | 2.0-10.9 | 3.5-9.7 | 2.1-5.2 | 52.3-72.9 |
| Quinoa* | 11.6-14.9 | 5.01 | 4.14 | 3.36 | 59.74 |
| Weat** | 8.6 | 1.5 | 3 | 1.7 | 73.7 |
| Rice*** | 9.9 | 1.55 | 0.7 | 0.64 | 74.24 |
| Corn* | 9.2 | 3.8 | 9.2 | 1.3 | 65.2 |

* β o,1991 y Morón, 1999 (cited by Jacobsen y Sherwood, 2002)
** Collazos *et al.* (1996)
*** Instituto Nacional de Nutrición (citado por Mujica et al. 2002)

# Diameter of granule starch (µm)

**(N = 266 accesions)**



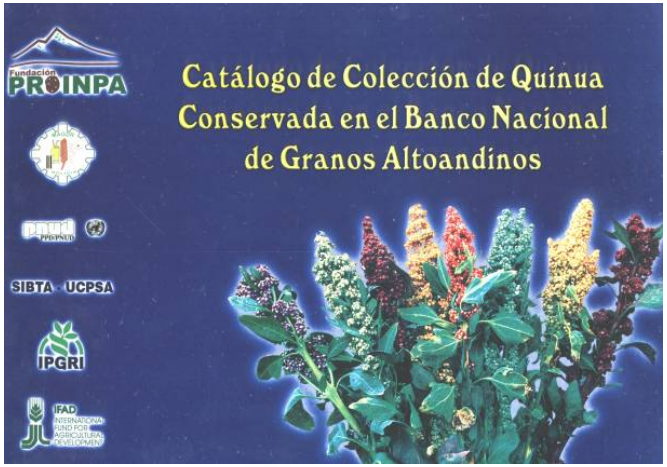

# Percentage of progress in the characterization and evaluation

| Characterization and evaluation (%) | | |
|---|---|---|
| Agro-morfological | Molecular | Nutritive and Agro-industrial value |
| 95 | 86 | 18 |

# Publications.-

Agro-morphological characteristics of 2,701 accesions


IBPGR (1981)




Rojas et al. (2001)


Bioversity et al. (2013)

# Content

- Situation of the global and regional quinoa collections
- The Bolivian Quinoa Collection
- Contributions to ex situ management
- Conclusions

# Conclusions

The management of germplasm requires a clear government policy to guarantee the long term conservation and stability.

Governments should provide adequate and sustained budgets for the management of genetic resources because these resources are valuable and should pass from generation to generation in order to support our own existence as a human species.

One of the most important investments of the government policy should be the human resource capacity building.

# Conclusions

The genebanks need to develop more collaboration with the users including scientists, technicians, and farmers.

We need to promote the improvement of procedures to facilitate the interchange to genetic resources that guarantee the fair distribution of benefits.

The society is also responsible for the maintenance and use of the genetic resources. ***This needs to be part of the education of new generations***.

# Thank You

www.proinpa.org
w.rojas@proinpa.org