Eberswalde University for Sustainable Development

Improved Seeds for Food Security in Developing Countries

Analysis of the seed value chain and necessary improvements on stakeholder level based on two case studies

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2. Case Studies
    a. Major crop: Maize in Ghana
    b. Minor crop: Quinoa in the Andean Region (Peru and Bolivia)

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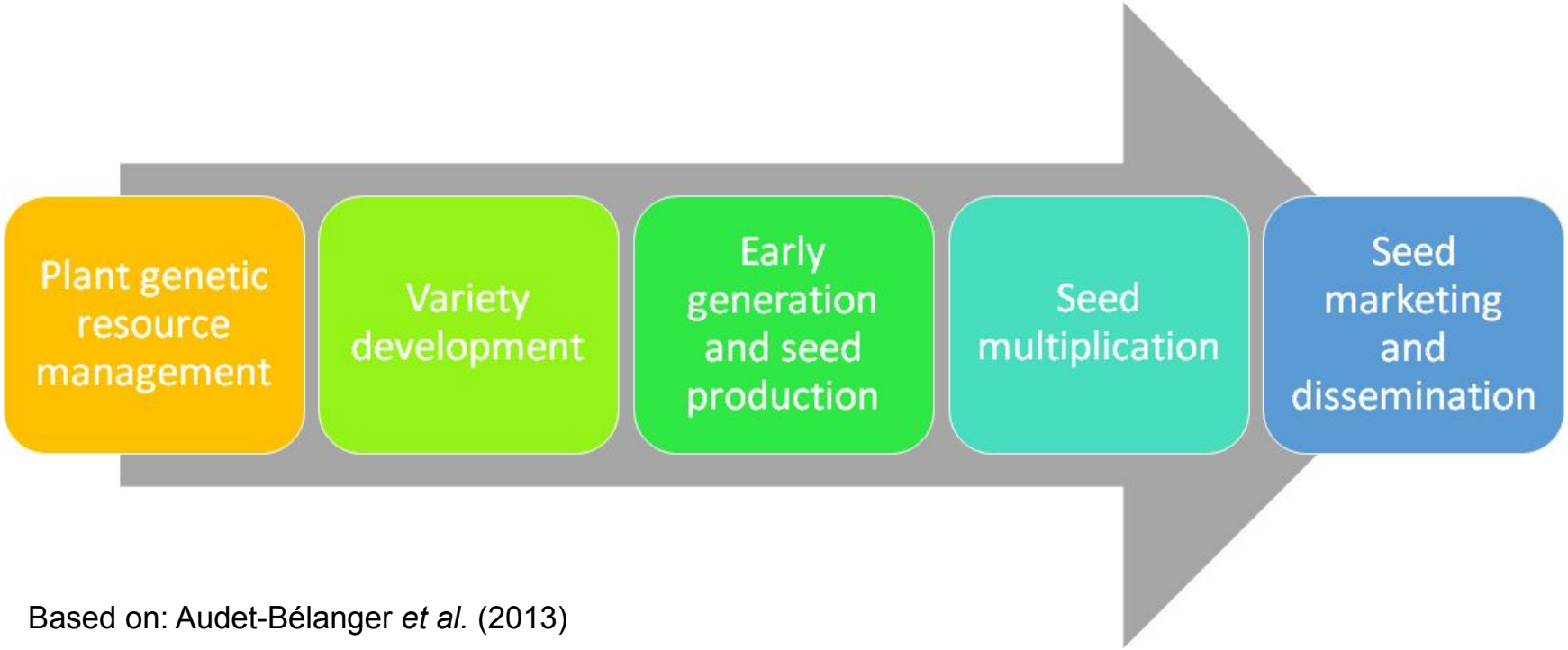
Value Chain Analysis

Assessment of the functioning of the total chain

Seed Value Chain Analysis

Basic activities of the operators



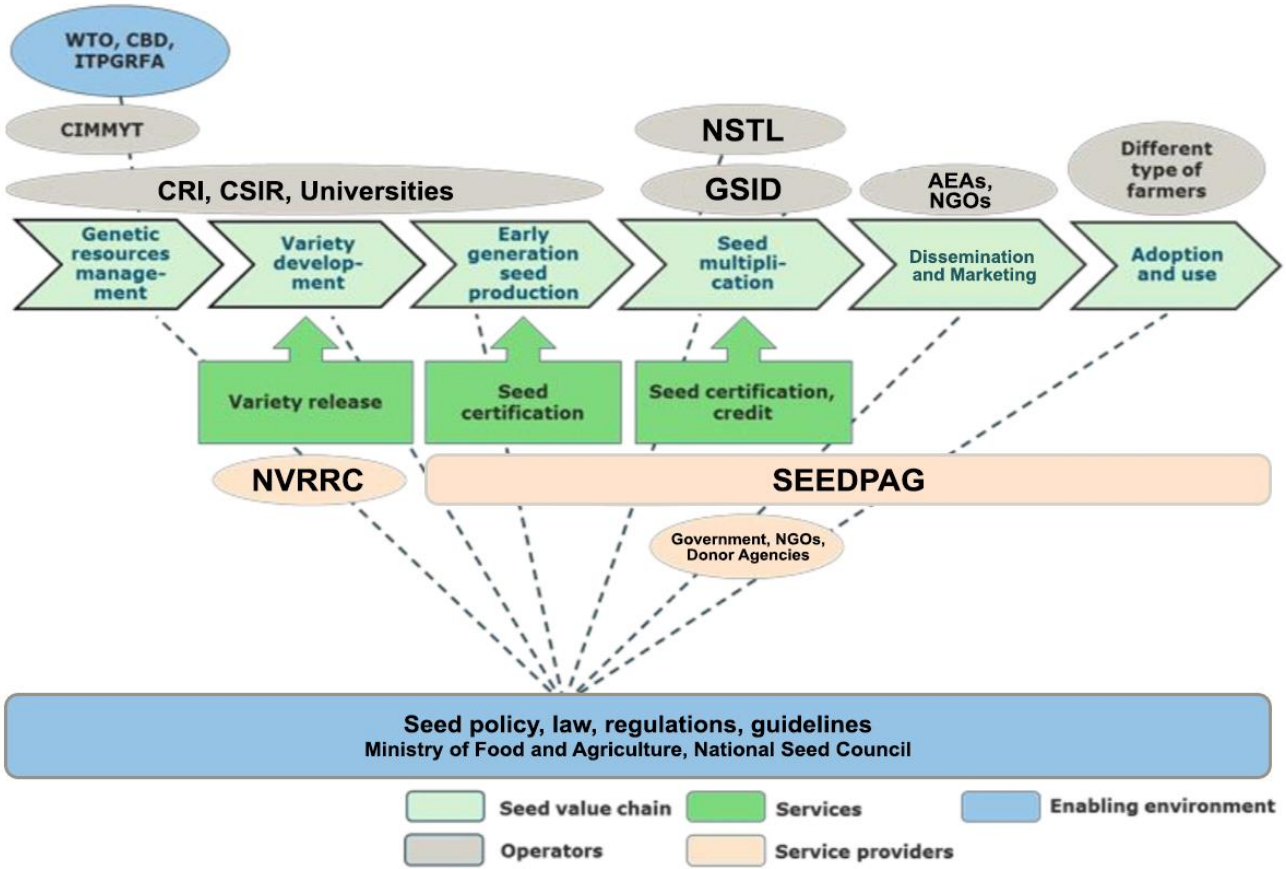
Based on: Audet-Bélanger *et al.* (2013)

Seed Value Chain of (Improved) Maize Varieties in Ghana

Maize in Ghana: An Overview

- **50%** of the total cereal production.
- Introduced in 16th Century by the Portuguese.
- Maize and rice: **70%** of certified seed sales. Maize is the predominant crop in commercial seed system (**60%**). (FAO)
- **95%** of the production of maize seeds are Open-Pollinated Varieties (NASTAG, 2015).
- **80%** of seeds are sourced from informal systems.
- **96%** maize production use the improved “Obatanpa” variety. (Poku et al., 2018)

Seed Value Chain



CBD: Commission on Biological Diversity
ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture
CIMMYT: International Maize and Wheat Improvement Center
CRI: Crops Research Institute
CSIR: Council for Scientific and Industrial Research
NVRRC: National Variety Release and Registration Committee
SEEDPAG: Seed Producers Association of Ghana
NSTL: National Seed Testing Laboratory
GSID: Ghana Seed Inspection Division
AEA: Agricultural Extension Agents
MOFA: Ministry of Farming
NSC: National Seed Council

Audet-Bélanger *et al.* (2013); Sugri et al. (2013)

Public Sector Monopoly

(Poku et al., 2018)

deficient farmer participation → new varieties don't meet demand/needs	missing quality assurance of source seed production → low quality of new commercial seeds	insufficient budget for promotion and marketing of new varieties → lack of awareness

→ participatory approach necessary → private sector to survey farmers	→ share responsibilities with private companies → fees based on cost of government certification	→ exclusive licensing to private sector → research institutions responsible for transfer

→ strengthening of community-based organisations to manage own seed supply

Hybrid Seeds – Solution or Issue?

Positive View

- Supports local food quality, efficiency and sustainability
- Can lower poverty
- High-performance in yield under suboptimal situations/conditions
- Ensure genetic varieties specialized on local agro-ecology desires

Source: theindependentghana.com, 2019

(Gaffney et. al, 2016)

(Mangnus & van Westen, 2018)

Hybrid Seeds – Solution or Issue?

Critical View

study of Masara N'arziki – example of credit-based program

input package = fertilizer, herbicides, and hybrid maize seeds
→ paid back in maize after harvest

issues with hybrid seed-based schemes
→ concentrated on one crop variety (here: maize), no crop rotation
→ higher yield and income not high enough to cover rising cost of input

negative influence on local market: dominated by maize

external factors like labour shortage encourage participation and growing of maize

also: strengthen local community-based initiatives independent from international corporations?

Issues with Mislabelling and Packaging

Deficiencies	**Solutions**
Improper Labeling (Sugri et al., 2013)	Legal requirement of all necessary information included.
Inadequate use of Improved Seeds	Hybrid seeds should have a pictorial warning indicating “Do Not Re-plant” (Sugri et al., 2013).
Improper Storage Facilities	Hermetic techniques, improved storage bags (Darfour & Rosentrater, 2016).
Counterfeit Seeds (Poku et al., 2018)	A way for farmers to recognize legitimacy of the product, such as proper certified labeling procedures.

Seed value chain of Quinoa in the Andean Region of Bolivia and Peru

Global and temporal production of quinoa

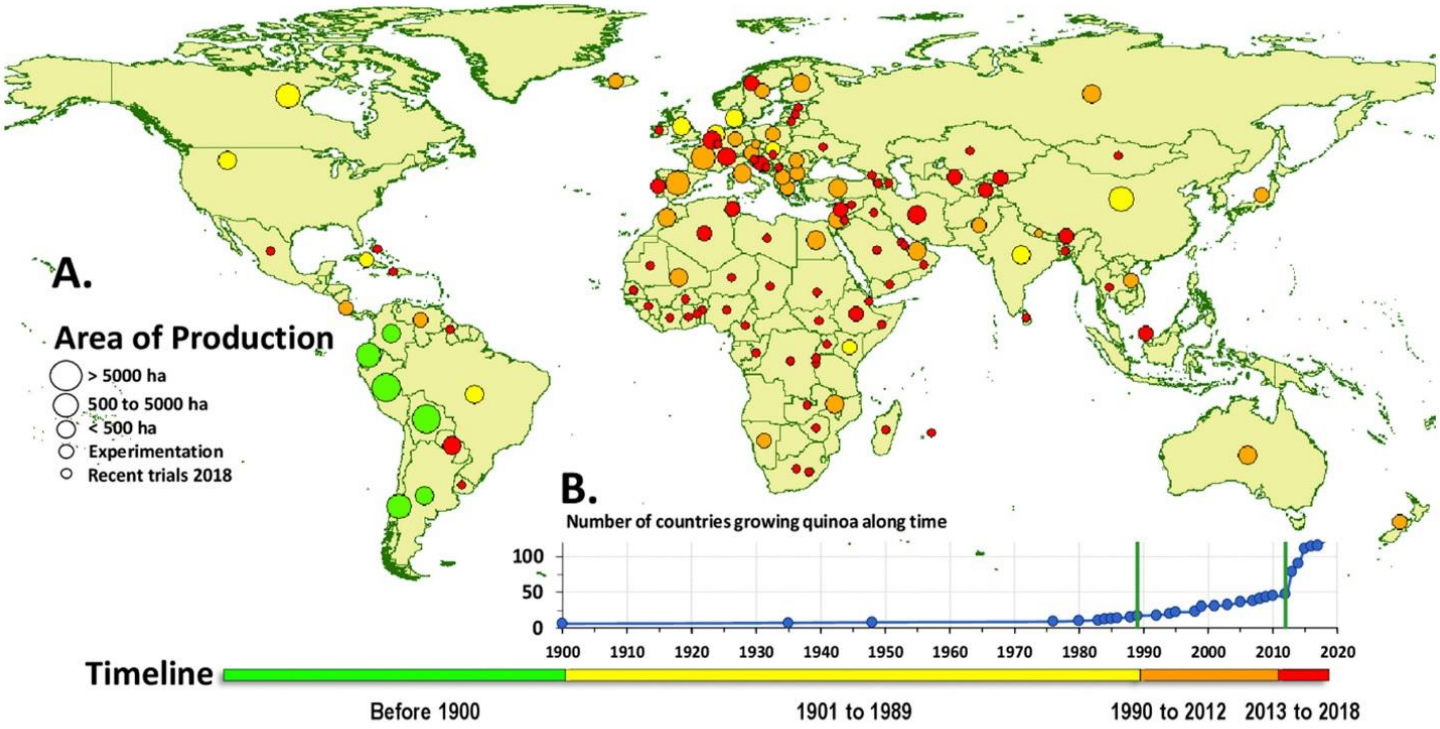


Fig. 1. Global distribution of quinoa along time: (A) areas of production and experimentation with quinoa and (B) number of countries growing quinoa.

Source: Alandia *et al.* (2020, p.2). Basantes-Morales *et al.* (2019)

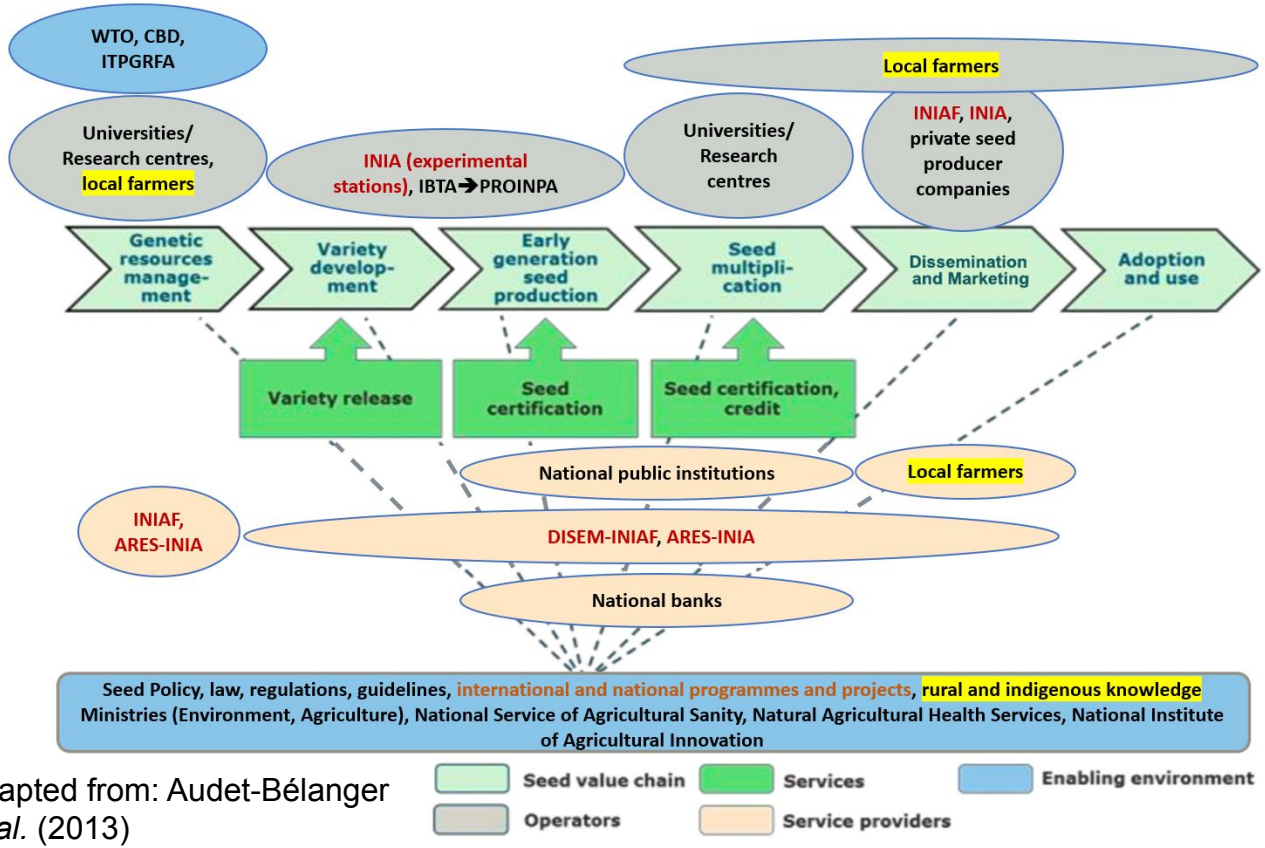
Location of case study

Quinoa in the Andes region: An overview

- excellent nutritional value
- potential to combat food and nutrition insecurity
- resilient, climate smart crop, agricultural versatility
- part of countries' ancestral and cultural heritage
- run by small to middle scale farmers

Avitabile, n. d.; Graf et al., 2015; Ruiz et al., 2014; FAO, 2011

Seed Value Chain - Quinoa (Peru, Bolivia)



Adapted from: Audet-Bélanger *et al.* (2013)

WTO: World Trade Organization
CBD: Commission on Biological Diversity
ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture
INIAF: National Institute of Agricultural and Forestry Innovation (Bolivia)
INIA: National Institute of Agricultural Research (Peru)
Universities: UMSA, UTO, UCB, UPEA, among others,
Research centres: CIBREF, CIPROCOM
IBTA: Bolivian Institute of Agricultural Technology
PROINPA: Foundation for the Promotion and Research of Andean Products
ARES: Seed Regulation Unit
DISEM: National Direction of Seeds

Conservation of genetic resources

Source: Rojas et al., 2013

Source: Biodiversity International/Alfredo Comacha, 2015

Conservation of genetic resources

Forms of Conservation	Ex-situ	In-situ
Definition	external conservation	on-farm conservation
Stakeholders	Genebanks run by agricultural institutions and universities	Farmers/local communities

- ➔ Bolivia: INIAF (National Institute of Agricultural and Forestry Innovation)
- ➔ Peru: Universidad Nacional Agraria La Molina, Universidad Nacional del Altiplano and INIA (National Institute of Agricultural Research)

(Rojas et al., n. d.; Podulosi et al., 2014)

Bottlenecks

- lacking governmental effort on conservation policies
- Gene bank management (e. g. storage conditions, utilization of accessions potential, infrastructure)
- network between and among *in-situ* and *ex-situ*

Padulosi et al., 2014; Rojas et al., 2013

Source: Padulosi, 2014

The Andes region holds 88 % of the worlds quinoa accessions

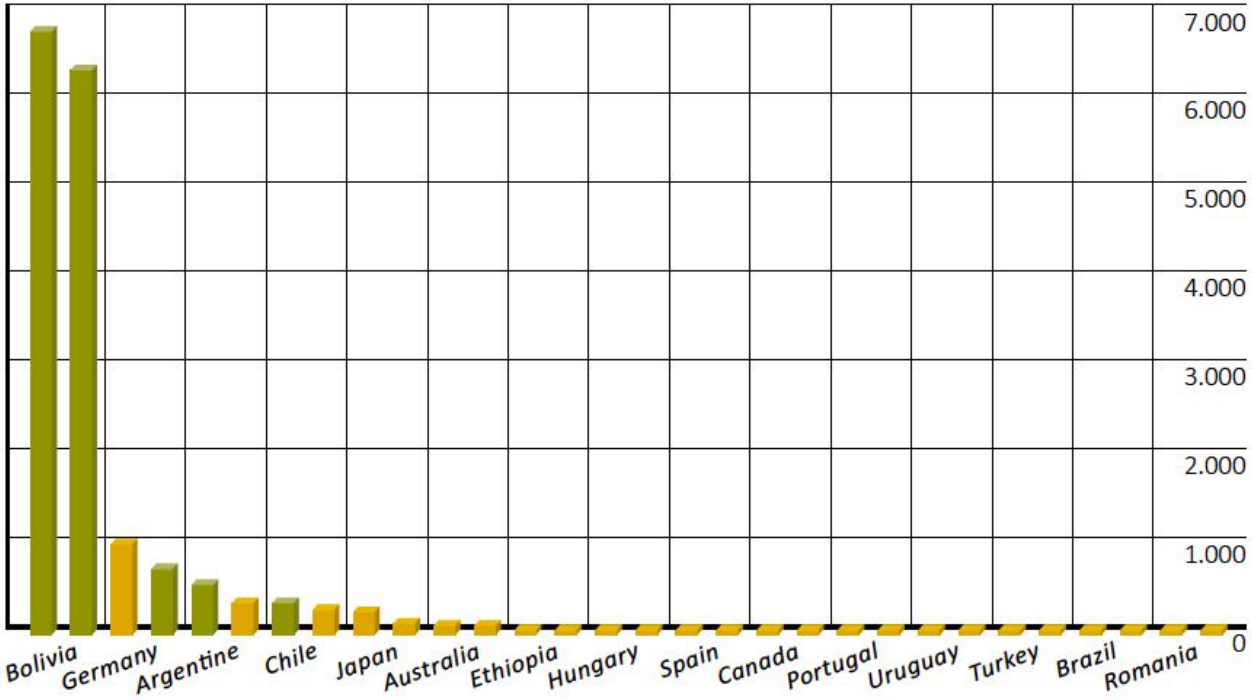


Figure 2. Number of quinoa accessions preserved throughout the world

Source: Rojas et al., 2013

Quinoa breeding (genetic improvement) and its maintenance

- ➔ **Critical aspect for food security**
- ➔ Methods: hybridization and selection
- ➔ Bolivia: 22 varieties (Table)
- ➔ Peru: 29 varieties (INIA experimental stations)
- ➔ Farmers (e.g., Danial *et al.*, 2007)

N°	Variety	Source material		Year	Institution
1	Sajama	0547	0559	1967	IBTA
2	Samaranti	Individual selection		1982	IBTA
3	Huaranga	Selection S-67		1982	IBTA
4	Kamiri	S-67	0005	1986	IBTA
5	Chucapaca	0086	0005	1986	IBTA
6	Sayaña	Sajama	1513	1992	IBTA
7	Ratuqui	1489	Kamiri	1993	IBTA
8	Robura	Individual selection		1994	IBTA
9	Jiskitu	Individual selection		1994	IBTA
10	Amilda	Individual selection		1994	IBTA
11	Santa Maria	1489	Huaranga	1996	IBTA
12	Intinayra	Kamiri	F4(28)xH	1996	IBTA
13	Surumi	Sajama	Ch'iara	1996	IBTA
14	Jilata	L-350	1493	1996	IBTA
15	Jumataqui	Kallcha	26(85)	1996	IBTA
16	Patacamaya	Samaranti	Kaslala	1996	IBTA
17	Jacha Grano	1489	Huaranga	2003	PROINPA
18	Kosuña	1489	L-349	2005	PROINPA
19	Kurmi	1489	Marangani	2005	PROINPA
20	Horizontes	1489	L-349	2007	PROINPA
21	Aynoq'a	Selection L-118		2007	PROINPA
22	Blanquita	Selection L-320		2007	PROINPA

Source: Espíndola and Bonifacio, 1996; Bonicacio et al., 2006; Rojas-Beltrán et al., 2010; Mujica et al., 2004; Mujica, 1992. In FAO, 2011. Basantes-Morales *et al.* (2019). For more information about agricultural research in Bolivia: Cordova (2017)

Breeding programmes

National Programme for Andean Grains and Legumes (INIA-MINAGRI, Peru)

More information:
https://www.inia.gob.pe/pn-granos-andinos-y-leguminosas/

Agrobiodiversity (AGB) programme (Fundación PROINPA, Bolivia)

More information:
https://www.proinpa.org/web/agrobiodiversidad/

Bottlenecks in breeding

- ➔ Programme-dependency for the participation of local farmers
- ➔ No competitive position in the market (technology)
- ➔ Funding limitations
- ➔ Politized agricultural research [Bolivia]

Multiplication of quinoa seeds

Stakeholders:

- Small farmers: Traditional multiplication (“low genetic, physiological and physical quality”)
- National Institutions: Produce, develop, select and multiply quinoa seeds
- Public research centers: Research purposes

Bottlenecks:

- Procedures are conducted in different trial fields
- Lacking accountability of necessary seed attributes for small farmers

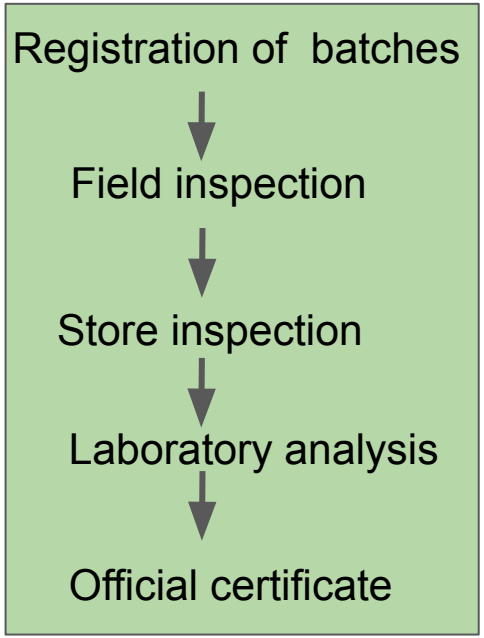
Certification of quinoa seeds

Stakeholders:

- The national service of agricultural sanity
- National Institutes of Agricultural Innovation
- National Agricultural Health Services

Bottlenecks:

- Scarce availability of certified seed (quality and quantity)
- High prices
- Varieties not always adapted to the area
- Lack of national legislations



Distribution of quinoa seeds

Stakeholders:

- Farmers at the end of the chain (seed consumers)
- National Agricultural Institutions (INAF/INIA)
- National/International projects and programs

Bottlenecks:

- Expensive
- Don't meet local conditions
- Lack of familiarities
- Distrust of quality
- Benefits private producers

More Information:
https://www.telesurtv.net/news/Peru-es-el-primer-productor-y-exportador-de-quinua-en-el-mundo-20171225-0060.html

Synthesis: Main bottlenecks in quinoa seed system and possible interventions

⇒ FAO's criteria: Access and affordability, Quality

Cause: non-ideal enabling environment and stakeholder interactions

Deficiencies	**Possible Solutions**
Deficient policy and government support	- Governmental actions passing laws, policies and guidelines
Lack of transparency (value chain)	- Education (workshops)
Missing acknowledgment of farmers necessities	- Involve farmers in the value chain activities
Local farmers have no access to improved seeds	- Promote relationships with external funding

Comparison and Conclusions

Comparison Case Studies (Maize & Quinoa)

Similarities	Differences
- Mostly public stakeholders - Bottlenecks in seed certification, multiplication and distribution - Reliance on informal systems - Information asymmetry and market failure	- Historical background of crops - Conservation of seed varieties: Quinoa: Tradition/Culture, importance for future breedings, Mistrust because of value Maize: International level, more breeding necessary, new crop

Conclusions

- Improved quinoa and maize seeds as an alternative to counter food insecurity
- Genetic diversity and adaptability of seeds (high nutritional value)

- Different analysis focus of the seed value chain:

Maize: Practical, Commercial approach

Quinoa: Traditions, small farmer approach, governance

- Both value chains consists mainly of public actors
- Bottlenecks have to be addressed in order to improve food security
- Important: Integration of farmers in the value chain activities

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