Evaluation of quinoa varieties by farmers and researchers in different agroecological contexts of the Central Highlands of Bolivia.

Eliseo Mamani Alvarez
Research in experimental stations

Participatory evaluation (other methods)

What?

Previous Investigation Process

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V3</th>
<th>V4</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
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<tr>
<td>II</td>
<td>V3</td>
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<td>V2</td>
<td>V1</td>
</tr>
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<td>III</td>
<td>V4</td>
<td>V2</td>
<td>V1</td>
<td>V3</td>
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<tr>
<td>IV</td>
<td>V2</td>
<td>V1</td>
<td>V3</td>
<td>V4</td>
</tr>
</tbody>
</table>

Farmers

Research Technician
So What?

Principles for participatory research

FRN

• Diverse **farmers** participate in the entire research process

• **Research** is rigorous, democratised and useful

• Networks are collaborative and facilitate learning and knowledge sharing

Agroecology (FAO)

• **Diversity** is fundamental in agro-ecological transitions to ensure food security and nutrition while conserving, protecting and enhancing natural resources.

• **Joint creation and sharing of knowledge**
Location

- Arid zone (precipitation from 350 to 400 mm/year)
- Temperature 8.5 to 9.5 °C
Altitude 3900 masl
Small farmers
Main crops in the area are **quinoa** and potato
High variability of quinoa varieties
Process of research with and for farmers

Stages of the research process

- Establishment of the research team
- Initiation of the process and identification of the research problem
- Development of research tools
- Field research
- Agreements on how, when and where to investigate
- Data processing
- Data analysis
- Exchange of knowledge (dissemination of what has been learned)
Identification of the problem and definition of the research topic

Problems

▪ The low productivity of quinoa due to the effects of climate change
▪ The loss of “sweet” (low in toxic saponins that has to be soaked or scraped off) varieties
▪ Variation in demand at rural fairs

Research topic

Evaluate a set of varieties that have the characteristics required by farmers to respond to different biophysical and social contexts
Establishment of research teams

Table 1. Four groups of voluntary farmers

<table>
<thead>
<tr>
<th>Community</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jankosaya</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Sewencani</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Jocopampa</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Capunuta</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

Total 32 volunteer farmers representing their families.

Figure 1. Male and female farmers who participated in the research
Agreements on how, when and where to investigate

Question: What do you want to know or discover about quinoa varieties?

Farmers want varieties:

- Higher production (in local conditions)
- Large grain
- Grains of sweet taste
- The different colors

Objective

“Identify the best varieties of quinoa for different contexts of the Central Highlands Region of Bolivia”
Experimental material

- Study factor: Set of varieties "Quinoa genetic material"
- Treatments: native varieties (ecotypes), improved varieties and improved line
- Experimental units (plots)

1. Maniqueña
2. Pisankalla
3. Pandela
4. Qillu
5. Negra
6. Real Blanca
7. Surumi
8. Kurmi
9. Chucapaca
10. Blanquita
11. Jacha Grano
12. Línea JGAm

800 grams of seeds were delivered for 1000 square meters of plot
## Design of the experiment

<table>
<thead>
<tr>
<th>Variety</th>
<th>Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pisankalla</td>
<td>17</td>
</tr>
<tr>
<td>Jacha Grano</td>
<td>15</td>
</tr>
<tr>
<td>Pandela</td>
<td>14</td>
</tr>
<tr>
<td>Surumi</td>
<td>10</td>
</tr>
<tr>
<td>L-JGAm</td>
<td>9</td>
</tr>
<tr>
<td>Qillu</td>
<td>9</td>
</tr>
<tr>
<td>Chucapaca</td>
<td>8</td>
</tr>
<tr>
<td>Maniqueña</td>
<td>8</td>
</tr>
<tr>
<td>Real Blanca</td>
<td>7</td>
</tr>
<tr>
<td>Kurmi</td>
<td>6</td>
</tr>
<tr>
<td>Blanquitta</td>
<td>6</td>
</tr>
<tr>
<td>Negra</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
</tr>
</tbody>
</table>

Distribution of experimental units (plots)
Defined what to measure, when and by whom

**Question:** How do you know if a quinoa variety is good or bad?

**Variables**
- Plant height
- Panicle Length
- Productive cycle
- Grain yield
- Grain size
- Saponin content

**Covariates**
- Seedtime
- Sown land size
- Maturity date
- Number of plants
- Soil texture (type)
- Rain damage
- Drought damage
- Frost damage
- Grain production
Development of data recording tools.
### Varieties evaluated by farmers

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Farmers who started</th>
<th>Farmers who evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pisankalla</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Jacha Grano</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
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<td>8</td>
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</tr>
<tr>
<td>Real Blanca</td>
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</tr>
<tr>
<td>Kurmi</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Blanquita</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Negra</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>90</strong></td>
</tr>
</tbody>
</table>
Quinoa grain production

- Yield

\[
\text{Yield} = \frac{\text{Production (qq)}}{\text{Sowed area (m}^2\text{)}} \times 10.000 \text{ (m}^2\text{)} = \ldots \text{qq/ha}
\]

Arrobas (@)  pounds (lb)  quintals (qq)  kilograms (kg)

Revision and transformation of units of measurement
Data analysis

- Analysis of data by farmers
The varieties L-JGAm and Chucapaca had higher yields. Farmers prefer L-JGAm for its large grain.

The Jacha Grano, Chucapaca and L-JGAm varieties had better yields. The men preferred Jacha Grano and L-JGAm for their large grain, and the Chucapaca women for their sweet taste.
Sewencani and Jankosaya farmers, observing the graphs, concluded that it was a bad agricultural year due to droughts and frost. They reflected on planting cañahua instead of quinoa, because it is short cycle and with frost tolerance.
Joint analysis of the data of all farmers

Variety yield in municipalities (agroecological zones)
Quinoa varieties yield according to the degree of frost.
Data analysis with farmers from the Jocopampa and Capunuta communities

Yield of quinoa varieties in two communities
Analysis of variance of the yield of quinoa varieties.

<table>
<thead>
<tr>
<th>Factor</th>
<th>GL</th>
<th>SC</th>
<th>CM</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>1</td>
<td>161228</td>
<td>161228</td>
<td>17,1982</td>
<td>0,0001555***</td>
</tr>
<tr>
<td>Cycle</td>
<td>1</td>
<td>375795</td>
<td>375795</td>
<td>40,086</td>
<td>1,205e-07***</td>
</tr>
<tr>
<td>Varieties</td>
<td>10</td>
<td>572684</td>
<td>57268</td>
<td>6,1088</td>
<td>1,033e-05***</td>
</tr>
<tr>
<td>Drought</td>
<td>3</td>
<td>135418</td>
<td>45139</td>
<td>4,815</td>
<td>0,0056023**</td>
</tr>
<tr>
<td>Plant quantity</td>
<td>2</td>
<td>324964</td>
<td>162482</td>
<td>17,3319</td>
<td>3,019e-06***</td>
</tr>
<tr>
<td>Community: varieties</td>
<td>7</td>
<td>165673</td>
<td>23668</td>
<td>2,5246</td>
<td>0,0287595*</td>
</tr>
<tr>
<td>Residuals</td>
<td>43</td>
<td>403113</td>
<td>9375</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis of variance explained the differences in the yield of quinoa varieties between the communities of Capunuta and Jocopampa, by cycle, varieties, drought and number of plants. There is also interaction between the community: variety.
Interaction:
Variety*Community
Conclusions of the experiment

- Quinoa varieties did not behave in the same way in the communities due to the weather (frost and drought).
- The variability of quinoa yield was explained by the biophysical aspects of communities, drought, cycle and variety. There are options by biophysical context.
- The preference for varieties between men and women varies by use.
Reflections of the FRN research process

- The FRN method generated a permanent knowledge dialogue between farmers and research technicians in experimental designs.
- The FRN involved a constant negotiation of needs, concerns and resources with farmers.
- The trials were distributed in farmers' fields, this allowed for analysis of variability.
- It was possible to perform a participatory data analysis with the farmers.
- The FRN allows the joint creation of knowledge between farmers and researchers.
- The results are reliable and accessible in farmers' decision making.
Now what?

Knowledge exchange (communication)

- Farmers share their research lessons, orally.
- The exchange of farmers must be documented (with whom and how the dissemination network expands).

Research methodology

- In the process of research with farmers, new experimentation needs arise (two factors)
- To better explain the variability, more repetitions are desirable.
- It is necessary to choose the variables to be measured well (useful for analysis)
Thanks for your attention