

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

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# What?

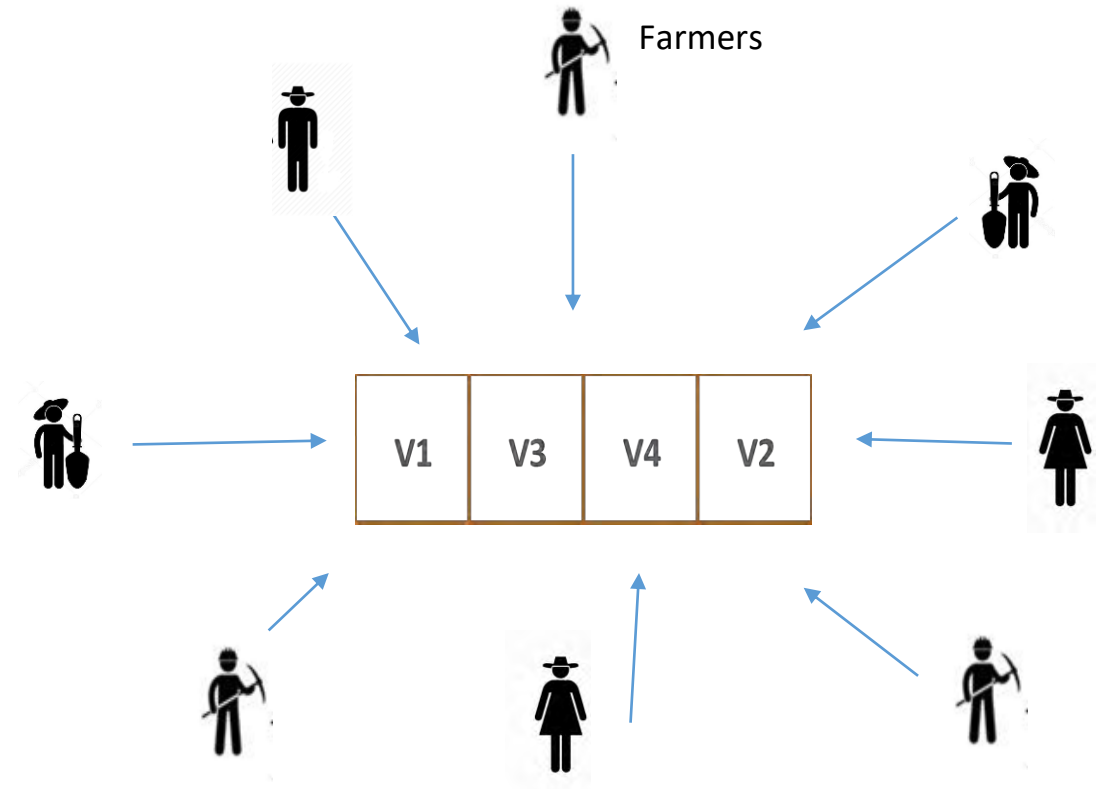
## Previous Investigation Process

I	V1	V3	V4	V2
II	V3	V4	V2	V1
III	V4	V2	V1	V3
IV	V2	V1	V3	V4



Research Technician

Research in experimental stations



Participatory evaluation (other methods)



# 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**

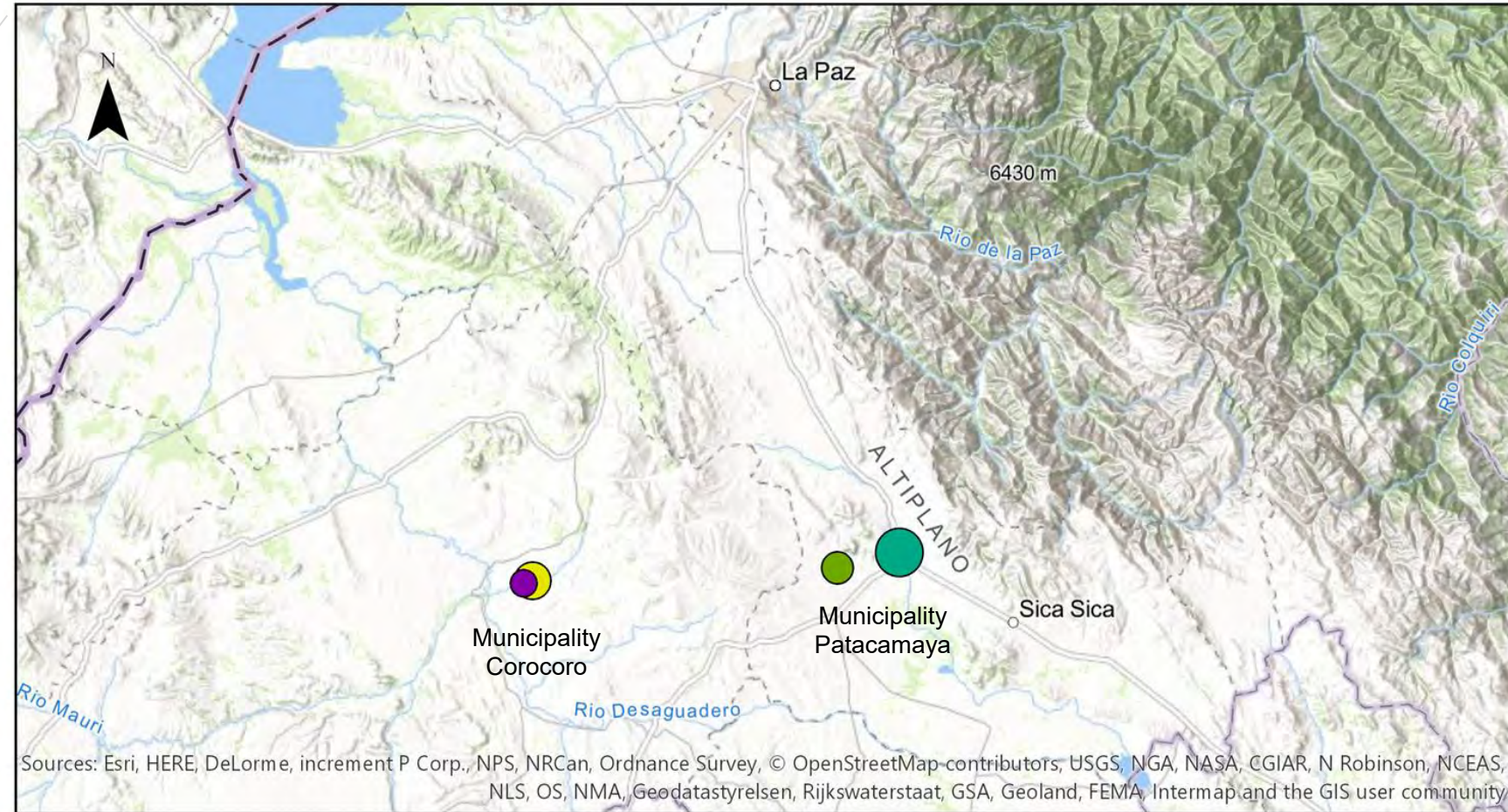
# FARMERS' RESEARCH COMMUNITIES

## Location

- Arid zone (precipitation from 350 to 400 mm/year)
- Temperature 8.5 to 9.5 °C



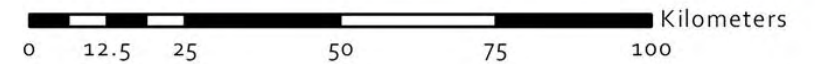
Bolivia



Sources: Esri, HERE, DeLorme, increment P Corp., NPS, NRCan, Ordnance Survey, © OpenStreetMap contributors, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

### Agricultores investigadores por Comunidad

- |             |              |
|-------------|--------------|
| Jankosaya 4 | Sewencani 6  |
| Capunuta 5  | Jocopampa 17 |



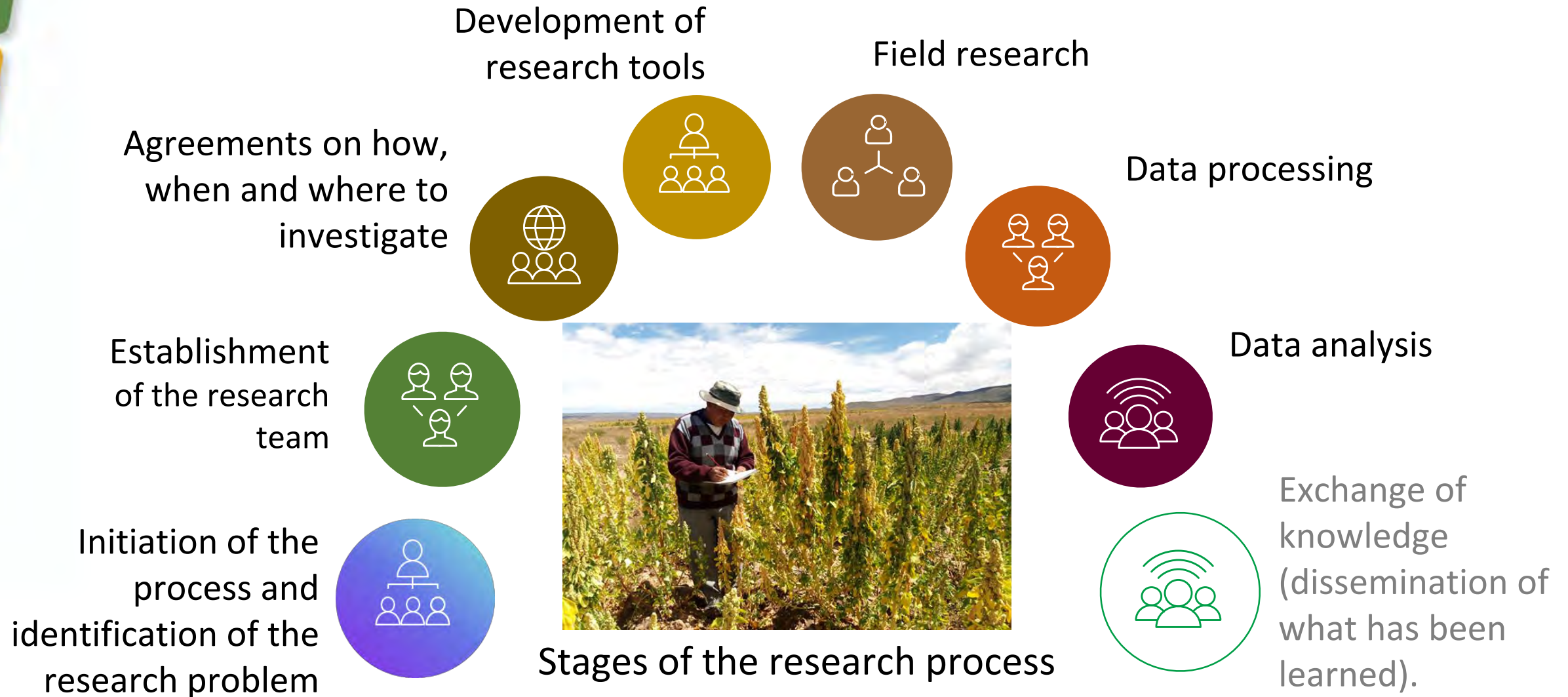
P R O I N P A 2 0 1 9

# Context

- 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



# 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

Comunity	Men	Women
Jankosaya	1	3
Sewencani	6	0
Jocopampa	8	9
Capunuta	5	0
<b>Total</b>	<b>20</b>	<b>12</b>

Total 32 volunteer farmers representing their families.

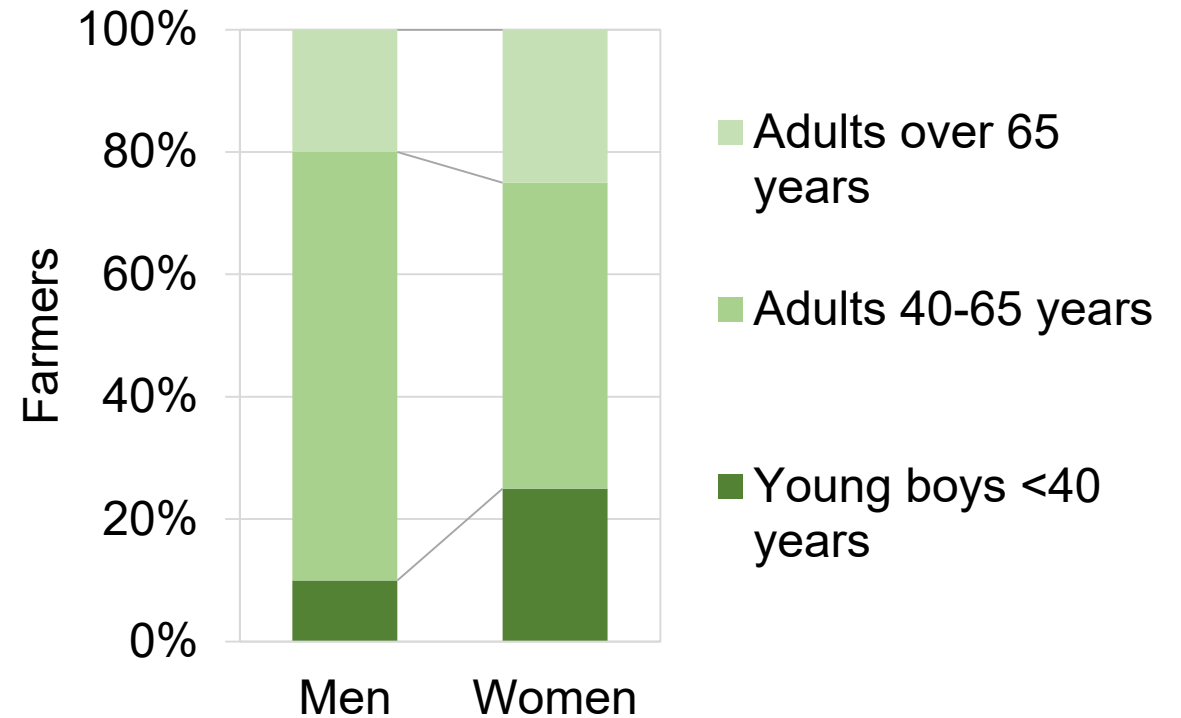


Figure 1. Male and female farmers who participated in the research

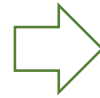


# Agreements on how, when and where to investigate

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)

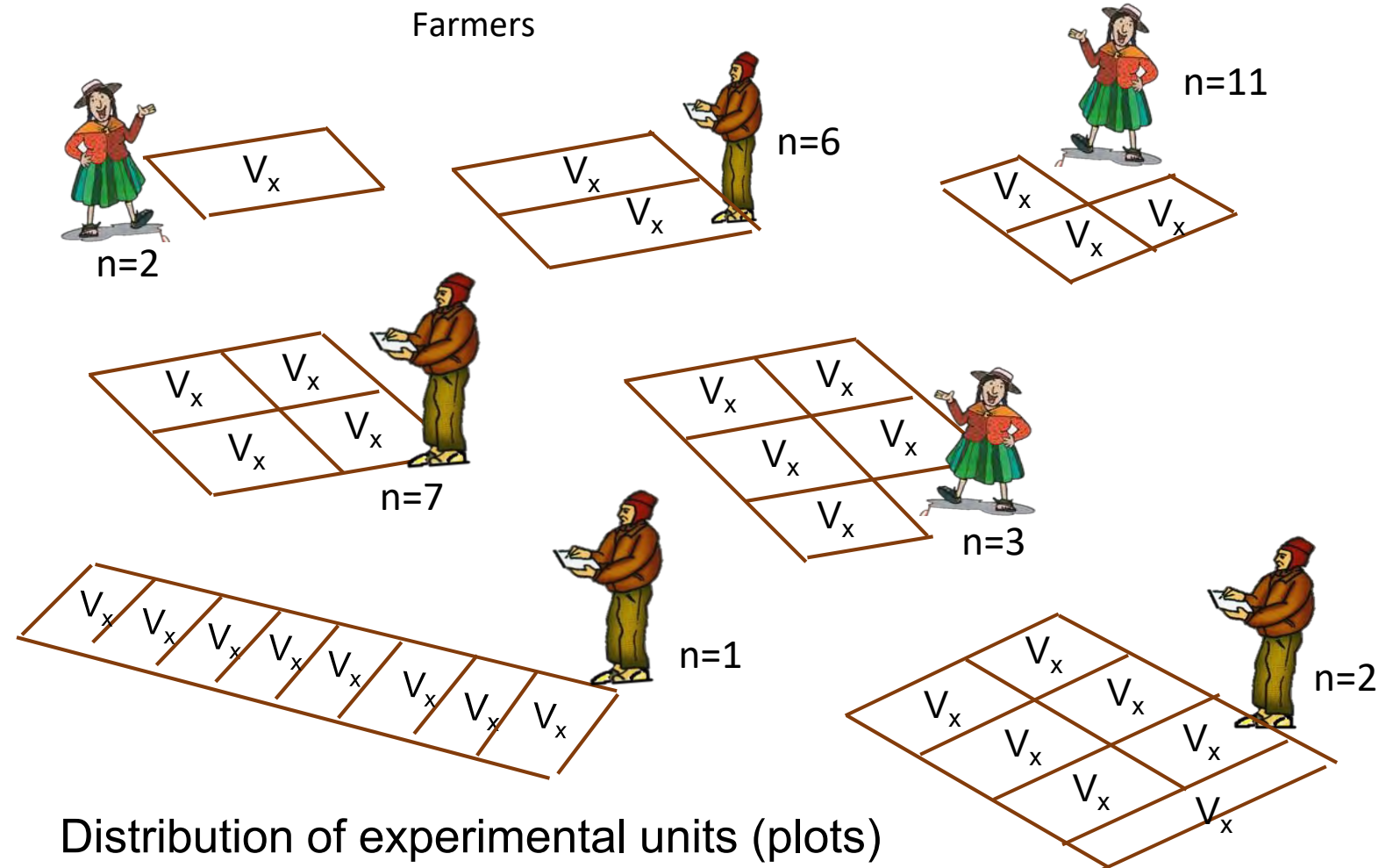
1. Maniqueña
2. Pisankalla
3. Pandela
4. Qillu
5. Negra
6. Real Blanca
7. Surumi
8. Kurmi
9. Chucapaca
10. Blanquita
11. Jacha Grano
12. Línea JGAm



800 grams of seeds were delivered for 1000 square meters of plot

# Design of the experiment

Variety	Farmers
Pisankalla	17
Jacha Grano	15
Pandela	14
Surumi	10
L-JGAm	9
Qillu	9
Chucapaca	8
Maniqueña	8
Real Blanca	7
Kurmi	6
Blanquita	6
Negra	3
<i>Total</i>	<i>112</i>





# 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.

**Investigación participativa de**

## Variedades de quinua

**Tarjeta de evaluación**

Nombre del agricultor investigador: \_\_\_\_\_  
 Comunidad: \_\_\_\_\_ Municipio \_\_\_\_\_

Variedad  Fecha de siembra

Tamaño del terreno sembrado

**Altura de planta** (Medir 5 plantas de quinua con un flexómetro)



Planta 1	<input type="text"/>
Planta 2	<input type="text"/>
Planta 3	<input type="text"/>
Planta 4	<input type="text"/>

**Tamaño de panoja** (Medir 5 panojas de quinua con un flexómetro)



Panoja 1	<input type="text"/>
Panoja 2	<input type="text"/>
Panoja 3	<input type="text"/>
Panoja 4	<input type="text"/>

**Ciclo** (Anoté el número de días que pasaron de la siembra hasta la madurez de la variedad)

	Nada	Poco	Medio	Mucho
Cantidad de plantas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tenía guano el terreno?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
La lluvia afectó?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
La sequía afectó?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Las enfermedades afectaron?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Las heladas afectaron	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Qué tipo de suelo es la parcela?  
 Arenoso  Franco  Limoso  Arcilloso

**Producción** (Anoté la cantidad de quinua ha producido la variedad)

**Tamaño de grano** (Observa los granos de la variedad, elija uno)

Muy Grande  Grande  Mediano  Pequeño  Muy Pequeño



**Sabor de los granos o contenido de saponina**  
 (Pruebe con la boca un poco de los granos de la variedad, y marque)

Amargo o Picante  Intermedio  Dulce

**Rendimiento**  
 (Divida la producción de grano entre el tamaño de terreno y calcule para una hectárea)

# Research in the field

## Varieties evaluated by farmers

Varieties	Farmers who started	Farmers who evaluated
Pisankalla	17	14
Jacha Grano	15	15
Pandela	14	11
Surumi	10	5
L-JGAm	9	8
Qillu	9	6
Chucapaca	8	8
Maniqueña	8	6
Real Blanca	7	6
Kurmi	6	5
Blanquita	6	3
Negra	3	3
<i>Total</i>	112	90



# Data processing

Investigación participativa de  
**Variedades de quinua**

**Tarjeta de evaluación**

Nombre del agricultor investigador: \_\_\_\_\_  
Comunidad: \_\_\_\_\_ Municipio: \_\_\_\_\_

Variedad: \_\_\_\_\_ Fecha de siembra: \_\_\_\_\_  
Tamaño del terreno sembrado: \_\_\_\_\_

Altura de planta (Medir 5 plantas de quinua con un flexómetro)

Planta 1	_____
Planta 2	_____
Planta 3	_____
Planta 4	_____

Tamaño de \_\_\_\_\_ (Medir 5 panajos de quinua con un flexómetro)

Cantidad de plantas \_\_\_\_\_  
Tenía guano el terreno? Nada Poco Medio Mucho  
La lluvia afectó?      
La sequía afectó?      
Las enfermedades afectaron?      
Las heladas afectaron?      
Qué tipo de suelo es la parcela?  
Arenoso  Franco  Limoso  Arcilloso

Producción (Anoté la cantidad de quinua que produjo la variedad)

Tamaño de grano (Observe los granos de la variedad, elija uno)  
Muy Grande  Grande  Mediano  Pequeño  Muy Pequeño

Sabor de los granos o contenido de saponina (Pruebe con la boca un poco de los granos de la variedad, y marque)  
Amargo o Picante  Intermedio  Dulce

Rendimiento (Divida la producción de grano entre el tamaño de terreno y calcule para una hectárea)

\_\_\_\_\_

## Revision and transformation of units of measurement

- Quinoa grain production

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

➔ quintals (qq)

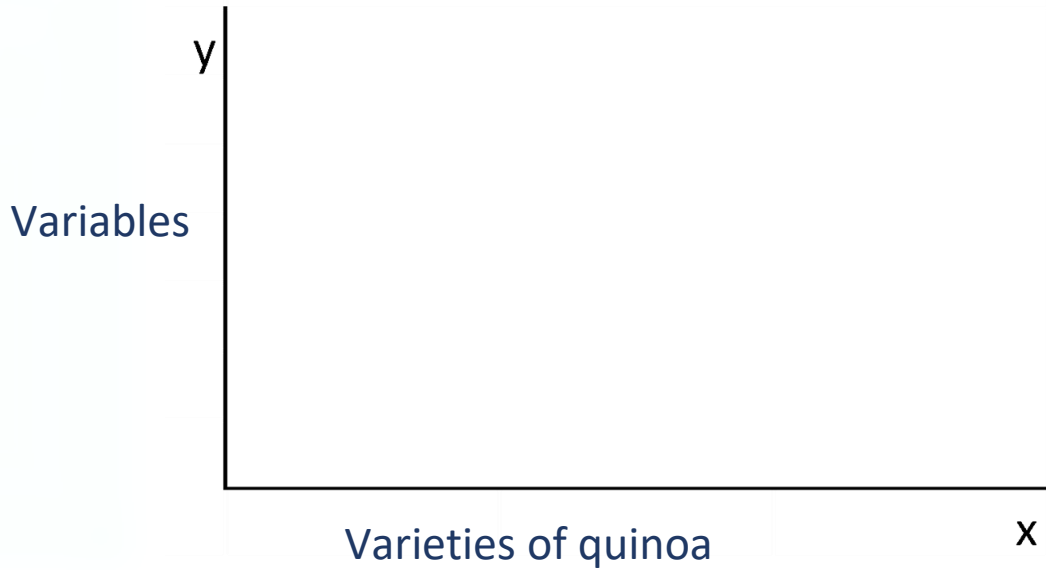
- Yield

$$\text{Yield} = \frac{\text{Production (qq)}}{\text{Sowed area (m}^2\text{)}} \times \frac{10.000 \text{ (m}^2\text{)}}{1 \text{ hectare (ha)}} = \dots\text{qq/ha}$$



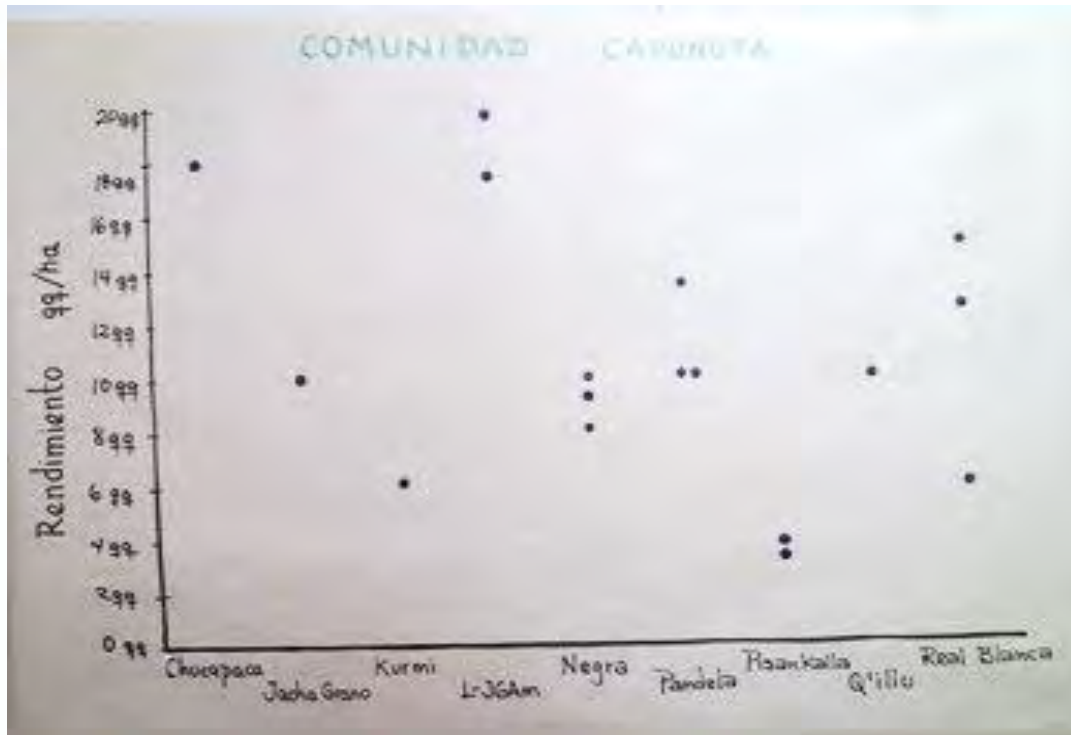
# Data analysis

- Analysis of data by farmers





## Analysis by farmers of Capunuta and Jocopampa

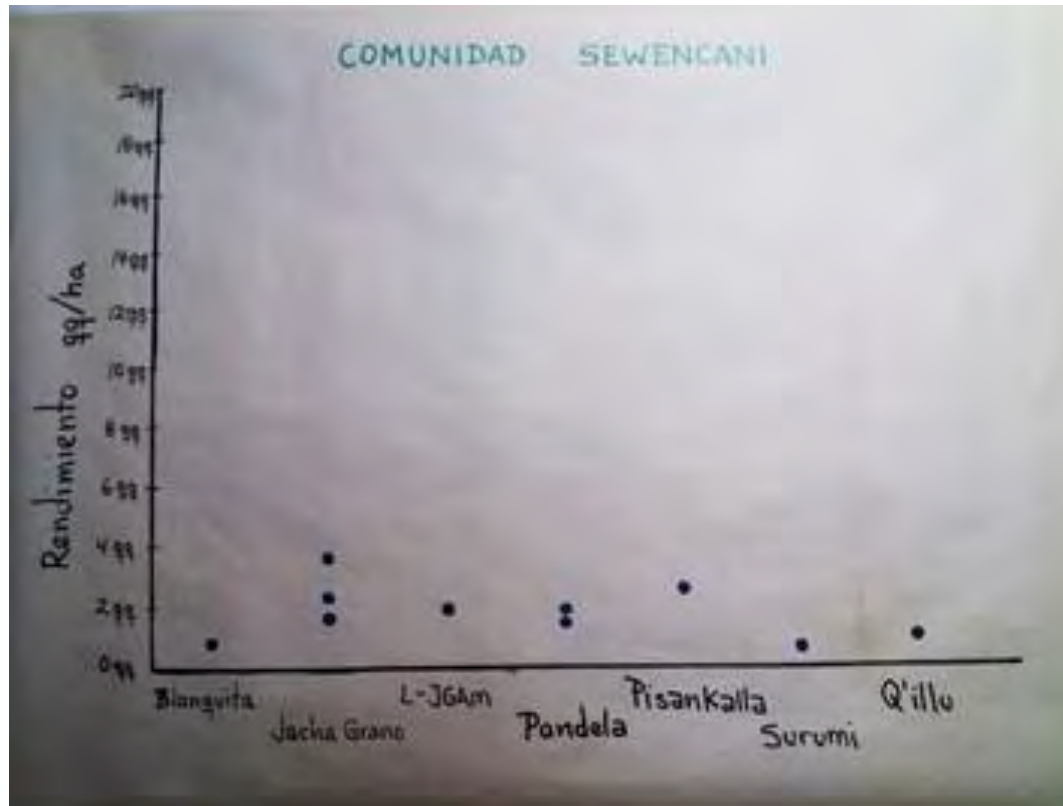


The varieties L-JGAm and Chucapaca had higher yields. Farmers prefer L-JGAm for its large grain.



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.

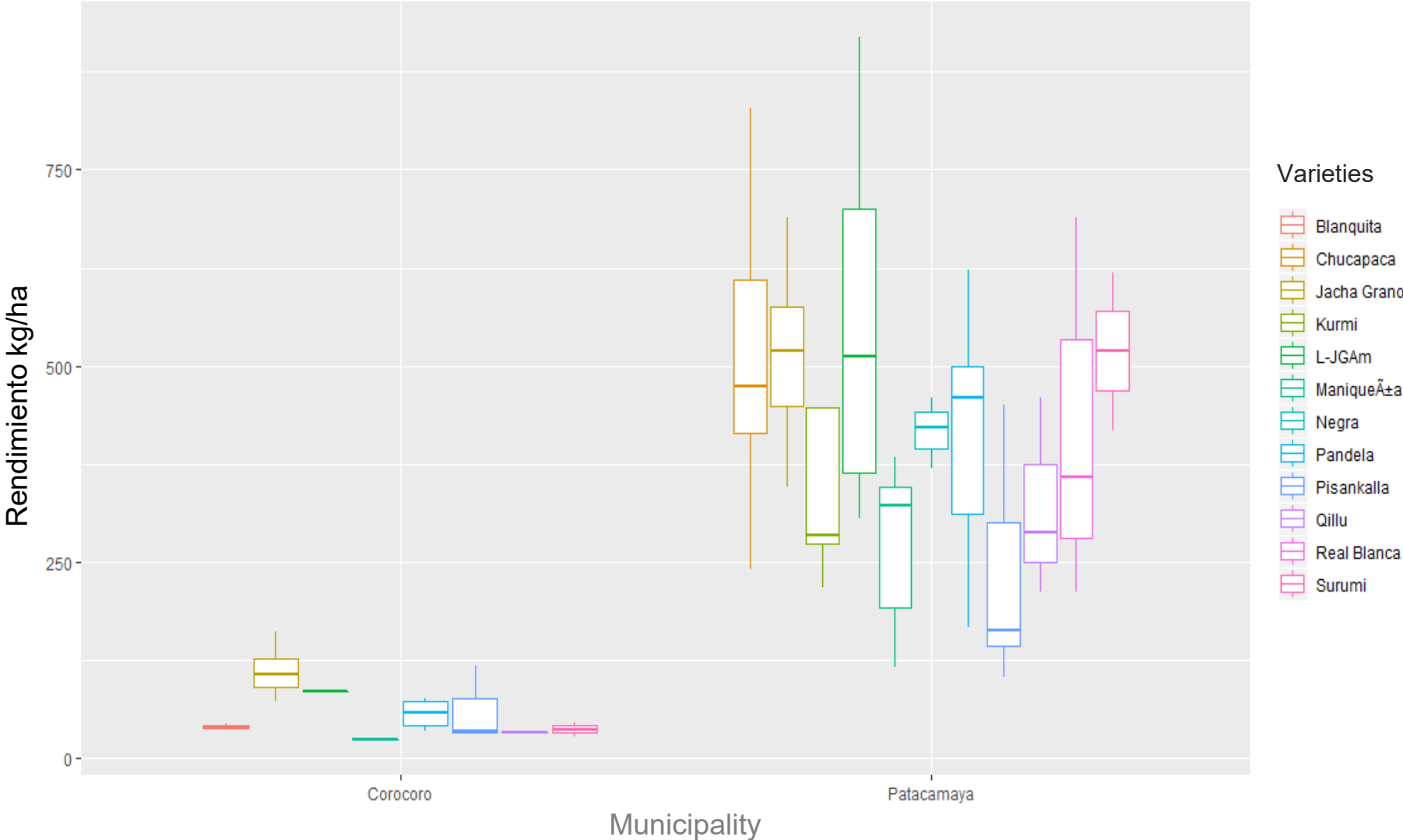
# Análisis de los agricultores de Sewencani y Jankosaya



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.

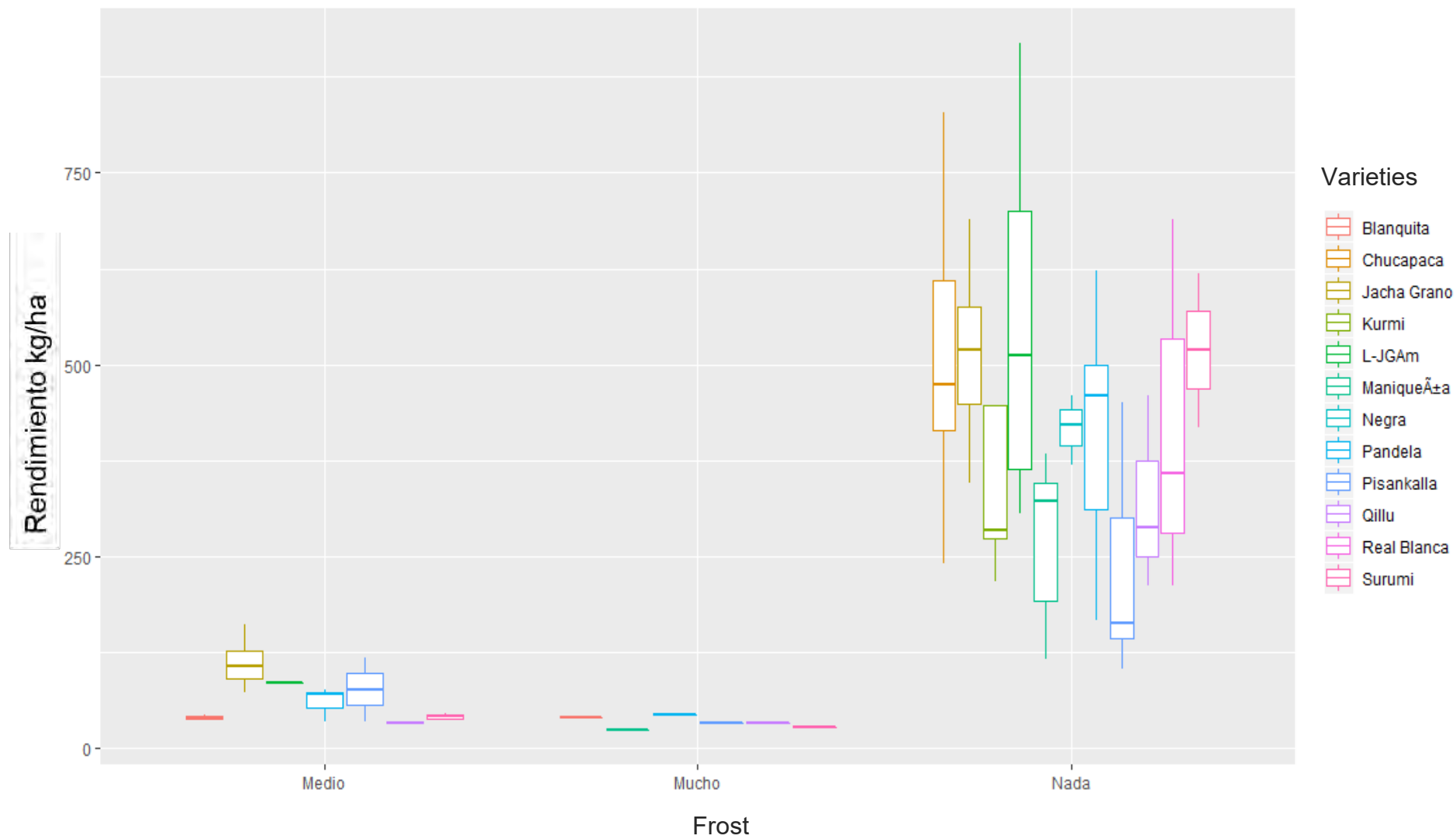
# Joint analysis of the data of all farmers

Variety yield in municipalities (agroecological zones)



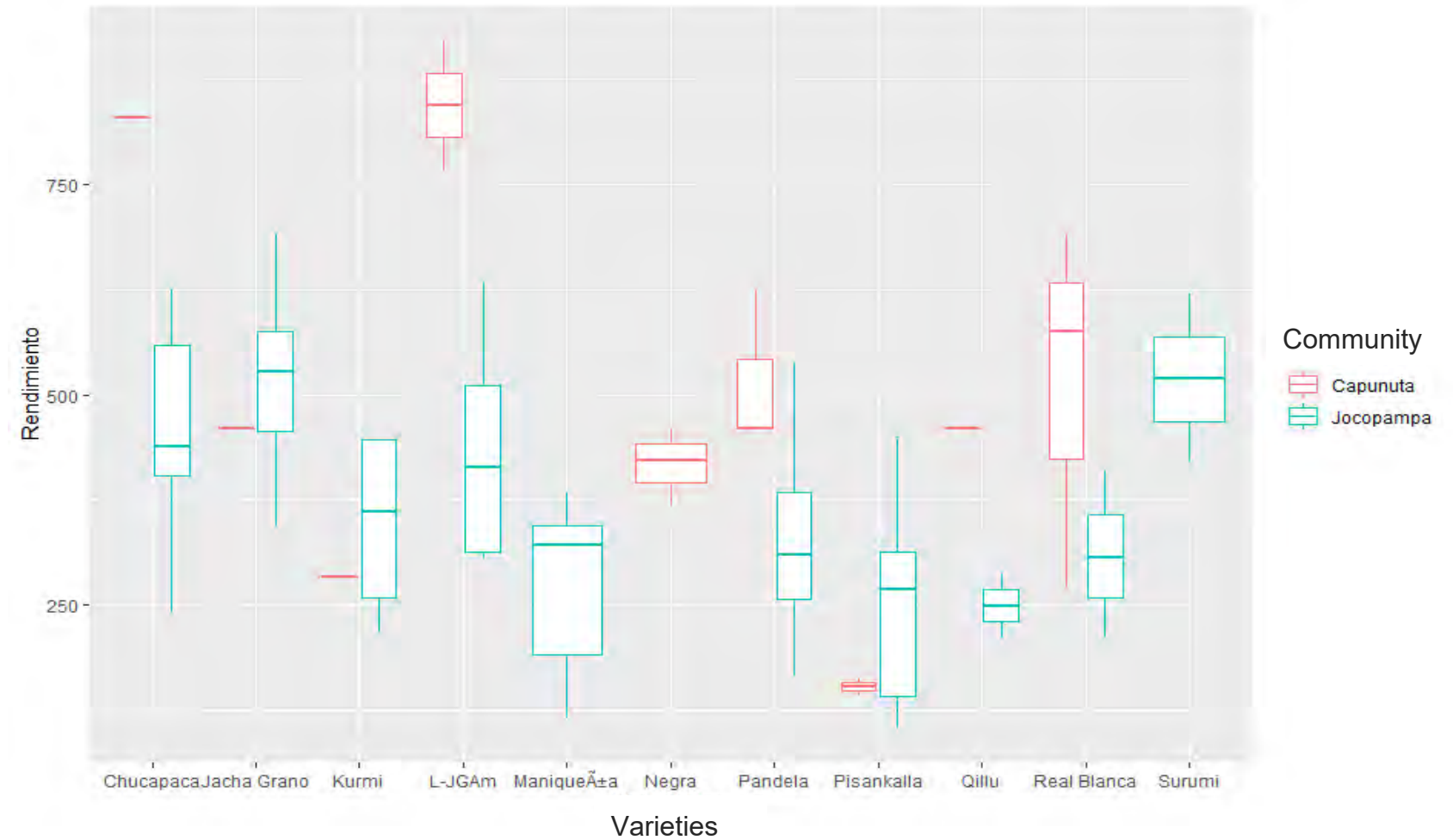


Quinoa varieties yield according to the degree of frost.



# Data analysis with farmers from the Jocopampa and Capunuta communities

Yield of quinoa varieties in two communities

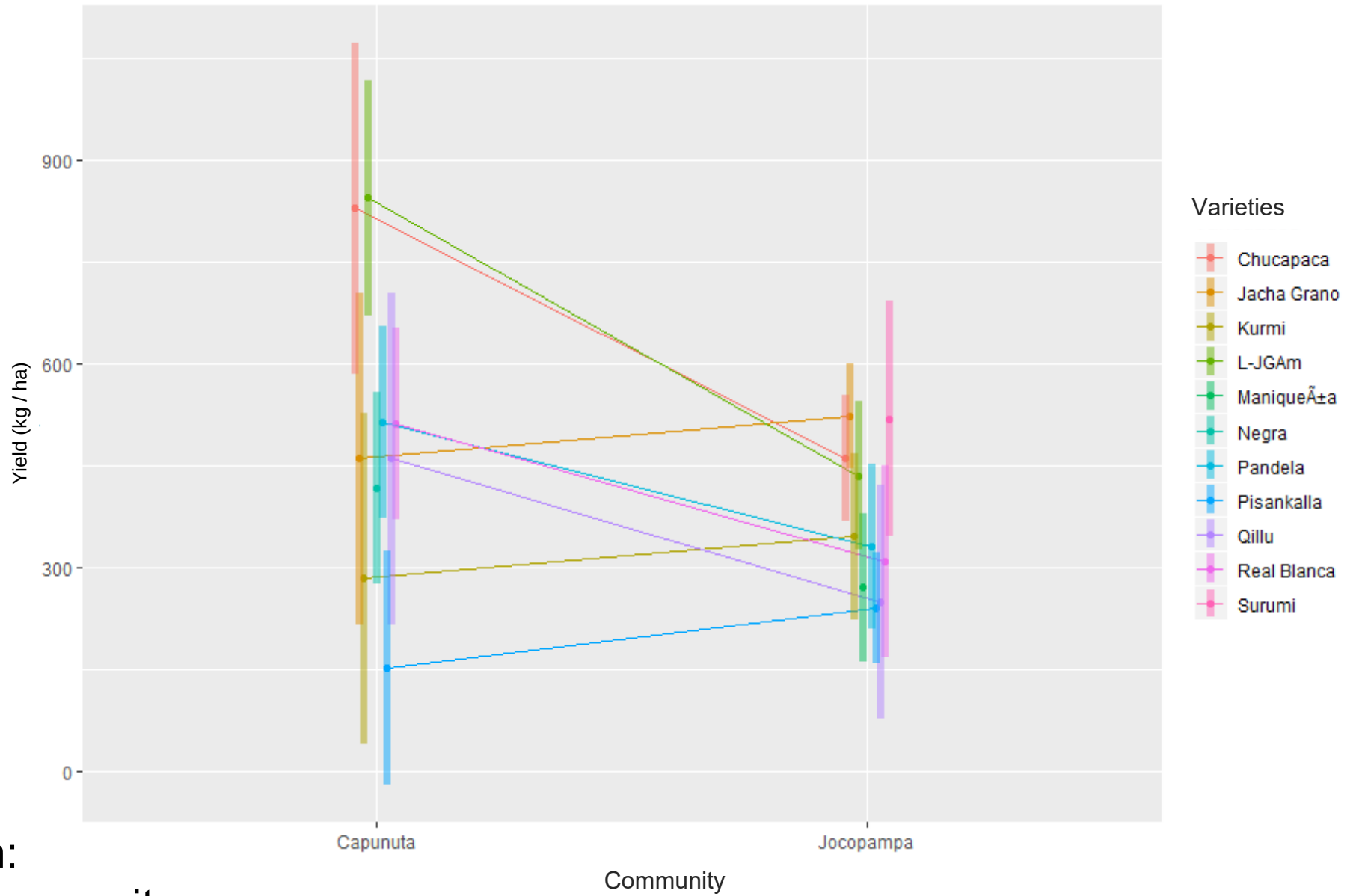


## Analysis of variance of the yield of quinoa varieties.

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

gl=grados de libertad, SC=Suma de Cuadrados, CM=Cuadrado Medio

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.





## 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

