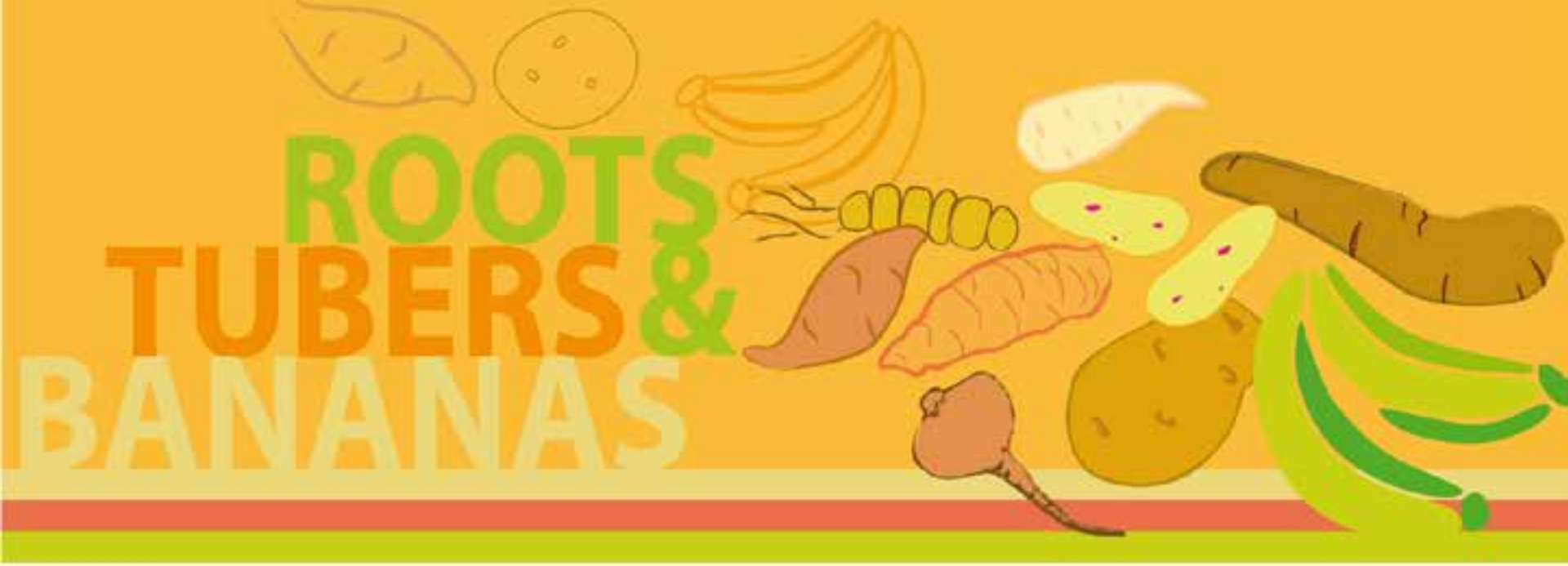


Participatory mapping for the systematic monitoring of biodiversity

Henry Juárez, Severin Polreich, Franklin Plasencia, Alejandra Arce, Raúl Ccanto, Domingo Begazo & Stef de Haan

CGIAR Research Program on Roots, Tubers and Bananas

CENTRO INTERNACIONAL DE LA PAPA
CIP
A member of the CGIAR Consortium

Esri User Conference | July 14–18, 2014
San Diego Convention Center

Session Title: Global Modeling - CGIAR

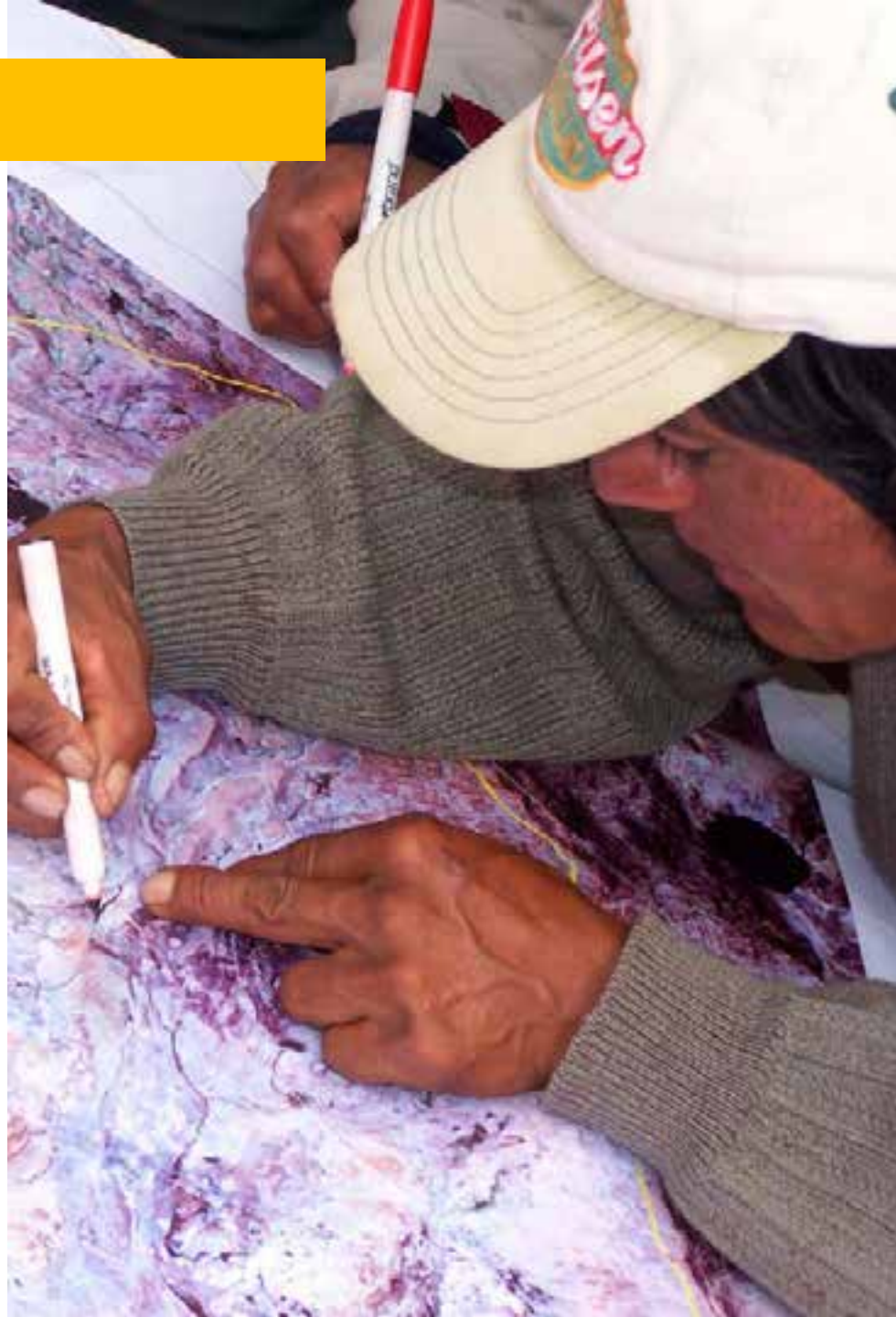
Outline

- Introduction
- The Chirapaq Ñan initiative (“the rainbow route”)
- Participatory mapping + cultivar sampling
- Conclusions

Introduction

Biodiversity…

- ü sustains a **wide variety of genetic traits** very valuable for adaption of the potato genepool.
- ü **threatening (changing) factors** in the Andes (biotic, abiotic, climate change, socio-cultural etc.)
- ü Monitoring for *in-situ* conservation requires **standardized approaches** and common parameters and indicators.



Introduction

Measuring Dynamics at landrace and landscape level:

- ü Survey: landrace level (objective: red list, which are varieties more/less frequent and what is the reason behind)
- ü Mapping landscape level (objective: do landscape relevant changes affect the distribution of **floury-landraces, bitter-landraces and improved varieties** with specific properties
- ü Mixed approach (is the potato diversity (and related indicators) depending on altitude (likely threatened by climate change)

Introduction

Rationale for Long Term-Monitoring:

Most on-farm conservation projects do not allow for systematic comparison of loss or enrichment because:

- ü Lack of historical data does not allows for timeline comparison;
- ü There is little agreement on methods and metrics to be used for baseline research + monitoring;
- ü Researchers still think short-term with a lack of attention to benchmark site selection and accessible databases.

- Total diversity
- Relative diversity
- Spatial diversity
- Threats to conservation
- Collective knowledge

Outline

- Introduction
- The Chirapaq Ñan initiative (“the rainbow route”)
- Participatory mapping + cultivar sampling
- Conclusions

The Chirapaq Ñan initiative (“the rainbow route”)

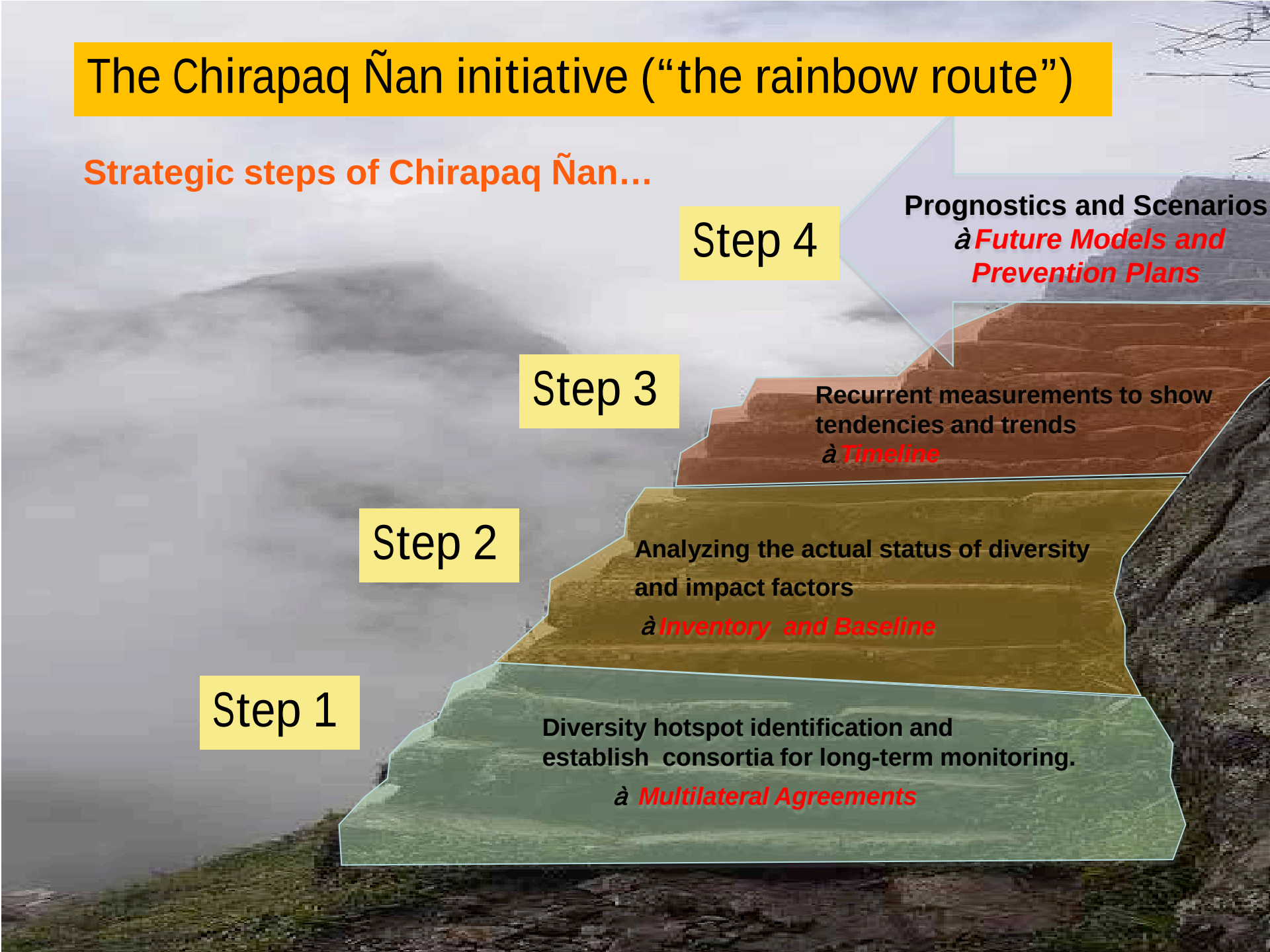
- ü A network for the long-term monitoring of *in-situ* conserved potato genetic diversity in light of socio-environmental change.

- ü An inter-disciplinary approach conserve the dynamic aspects of potato diversity in its center of origin and contributes to the well-being of the farmers who are custodians of the ancestral varieties.

LA RUTA DEL ARCOIRIS
CHIRAPAQ ÑAN

The Chirapaq Ñan initiative (“the rainbow route”)

Strategic steps of Chirapaq Ñan…

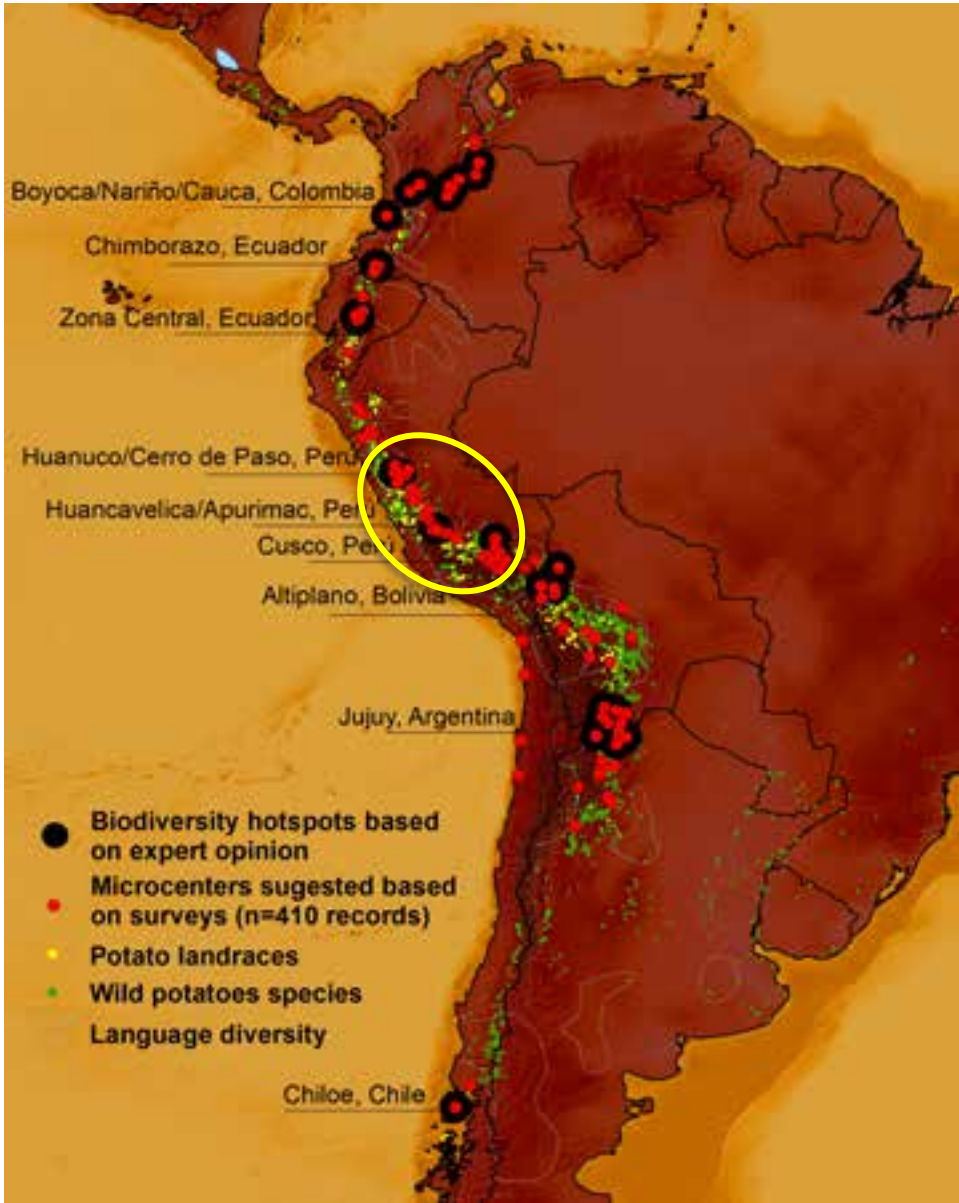


The Chirapaq Ñan initiative ("the rainbow route")

Selection of hotspots:

- ü Passport data
- ü Species distribution
- ü Proximity CWR
- ü Expert opinion
- ü Ethnicity & Language
- ü Geographic distance between hotspots
- ü Partnership strength
- ü Threat level
- ü Others …..

ü We have started in five hotspots (Huancayo, Pasco, Apurimac, Huancavelica & Cusco). The plan is to monitor more hotspots in the near future in Argentina, Bolivia, Colombia, Ecuador and Chile.



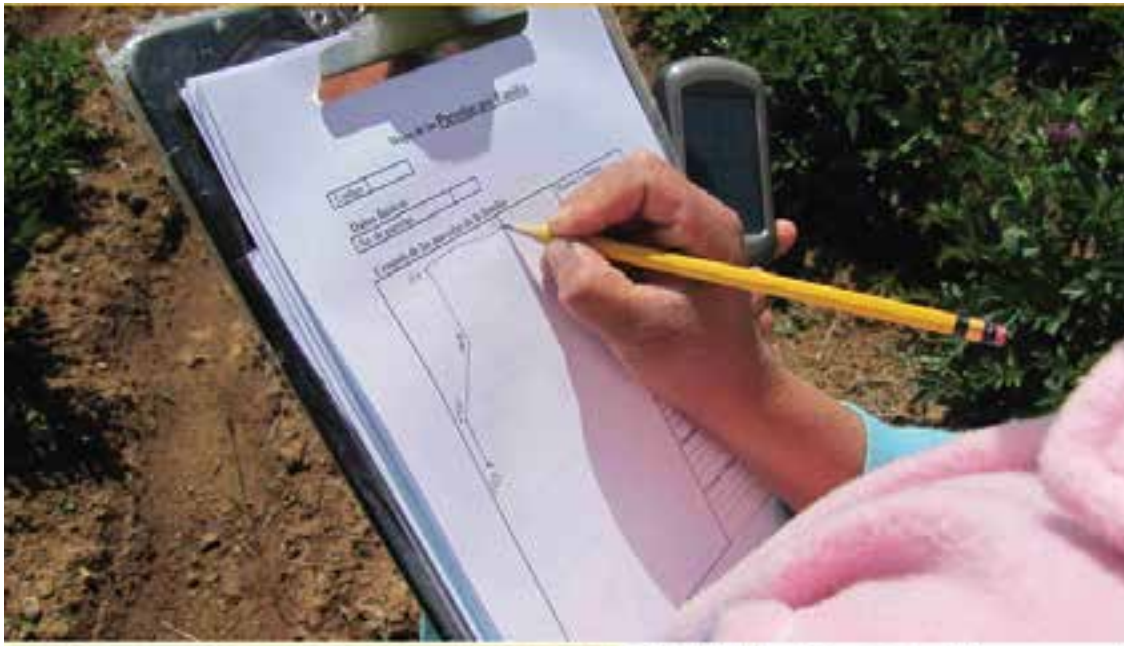
Outline

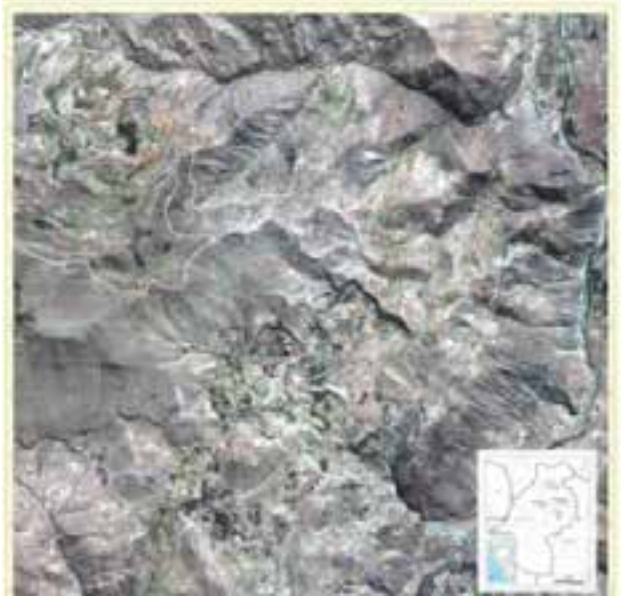
- Introduction
- The Chirapaq Ñan initiative (“the rainbow route”)
- Participatory mapping + cultivar sampling
- Conclusions

Participatory mapping + cultivar sampling

Participatory mapping

- ü Selection of target communities
- ü Talk with community leaders to get their approval for participation and implementation.
- ü Selection of local farmers, training on GPS use, map drawing, survey taking.
- ü Selection of a sample of farmers in the community.
- ü Mapping each field of the family.





Participatory mapping + cultivar sampling

Participatory mapping + cultivar sampling

Cultivar sampling…

- ü Harvesting of each plot to determine its variety content.
- ü A workshop is carried out to define a master list of local names (synonyms)

Participatory mapping + cultivar sampling

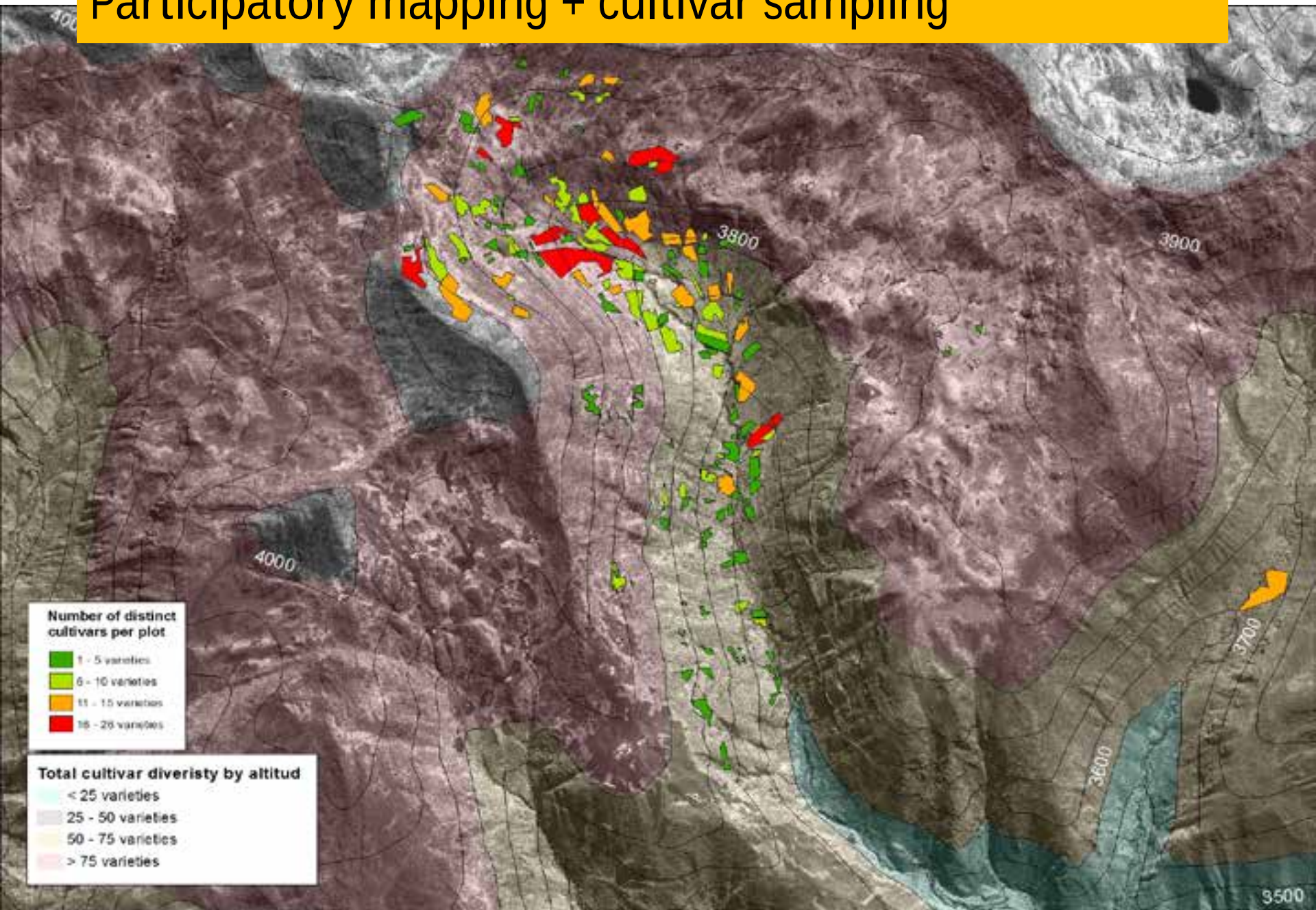
ü Sample size

Region	Communities	Households	Fields
Apurimac	3	141	579
Cusco	3	98	1,775
Huancavelica	3	176	1,063
Junin	4	104	1,098
Pasco	2	147	1,932
5	**15**	**666**	**6,447**

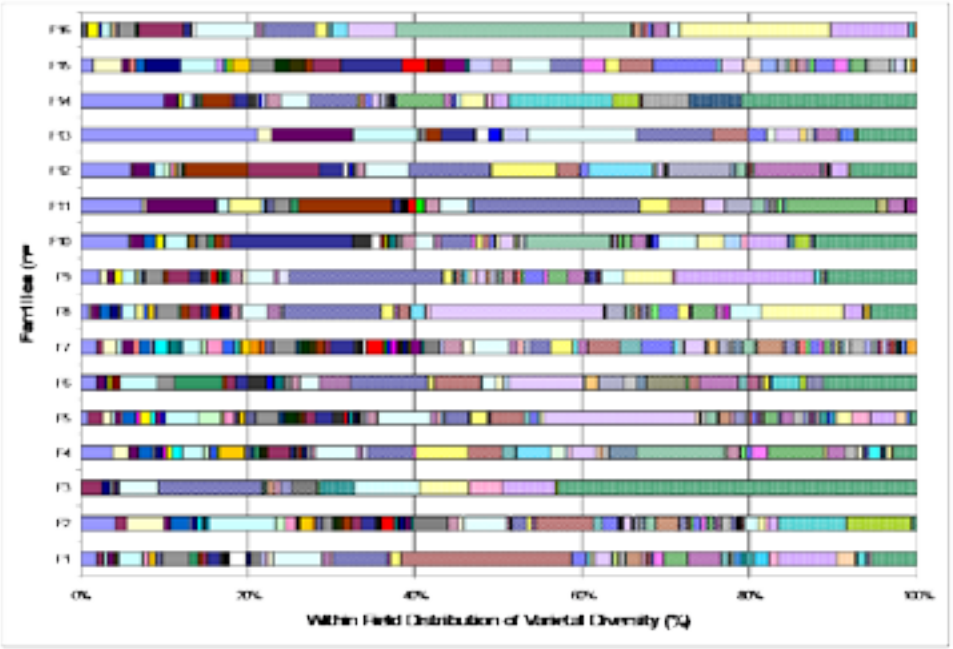
ü Area physically mapped and sampled

Region	Total area (ha)	Native-floury		Native-bitter		Improved	
		Area(ha)	%	Area(ha)	%	Area(ha)	%
Apurimac	27.3	24.3	88.7	2.1	7.8	0.9	3.5
Cusco	38.7	23.0	59.4	4.7	12.2	11.0	28.5
Huancavelica	35.0	29.0	82.9	2.8	8.0	3.2	9.2
Junin	18.2	8.4	46.2	1.0	5.6	8.8	48.2
Pasco	80.9	60.1	74.2	0.0	0.0	20.8	25.7
	200.2	144.7	72.3	10.7	5.3	44.8	22.4

Participatory mapping + cultivar sampling



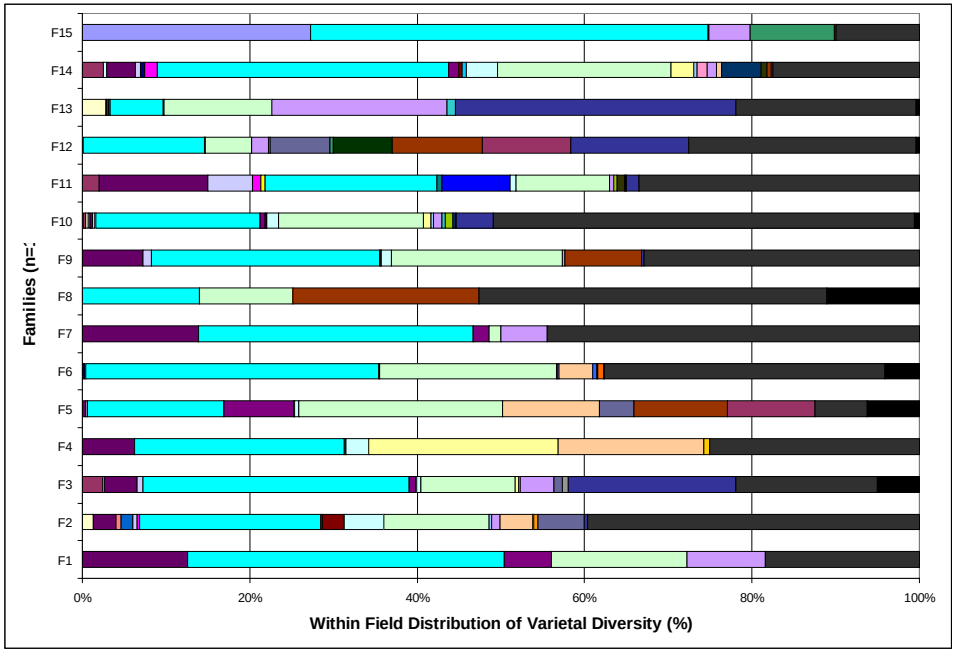
Participatory mapping + cultivar sampling



Villa Hermosa, Huancavelica

Number of plots per family: 9.1

Number of varieties per plot: 32.0



Huayta Corral, Huancavelica

Number of plots per family: 5.1

Number of varieties per plot: 3.2

Participatory mapping + cultivar sampling

Overall Cultivar Frequency (OCF)

ü A measure of **evenness** based on the number of households conserving a specific cultivar

OCF = (CCF community 1 + CCF community 2 + …..) / N communities sampled

Community Cultivar Frequency (CCF) = (Number of households conserving a specific cultivar / total household sample size of the community) * 100%

Very few households	: OCF < 1%
Few households	: OCF < 5%
Many households	: OCF < 25%
Most households	: OCF > 25%

Participatory mapping + cultivar sampling

Overall Cultivar Frequency (OCF)

Region	Cultivar category	N	Very few households	Few households	Many households	Most households
Apurimac	Native-floury	172	71	47	39	15
	Native-bitter	11	5	3	2	1
	Improved	6	0	3	3	0
Cusco	Native-floury	125	42	44	29	10
	Native-bitter	17	4	5	5	3
	Improved	16	1	4	4	7
Huancavelica	Native-floury	174	69	50	39	16
	Native-bitter	13	2	7	3	1
	Improved	12	1	4	5	2
Junin	Native-floury	172	62	64	36	10
	Native-bitter	5	1	1	3	0
	Improved	17	2	3	8	4
Pasco	Native-floury	185	59	55	51	20
	Native-bitter	1	0	1	0	0
	Improved	6	2	2	1	1

Participatory mapping + cultivar sampling

Overall Cultivar Frequency in Huancavelica

Native-floury

Peruanita
Larga
Amarilla
Yana Puqya
Camotillo
Chiqchi Pasña
Aqu Suytu
Puka Wayru
Kuchipa Akan
Yana Winqu
Trajin Waqachi
Dusis
Huamantanga
Suytu Puqya
Allqa Palta
Botiguela
Allqay Walas
Muru Wayru
Witqis
Puka Llumchuy Waqachi
Tantas
Tarmeña
Puka Chiqchi Pasña
Qala Suytu
Wayru Machu
Chungya
Yana Palta
Taragallo
Markina
Yuraq Suytu
Sangre De Toro
Yuraq Puqya
Promesa
Runtus
Yana Ñata
Yuraq Gaspar

Logrogina
Vayo Zapato
Waripa Taklla
Maco
Uqi Ruyru
Angelpa Tantan
Rosada
Prescos
Puka Wakapa Qallun
Imillicay
Yana Wakapa Qallun
Cordovina
Yuraq Wayta
Puka Suytu
Witu
Wara Suru
Qalapa Waran
Wamanpa Uman
Murunki
Leona
Yuraq Ñata
Yana Suytu
Yana Papa

Tongina
Ritipa Sisan
Puka Pasña
Yana Allqa
Caramelo Suytu
Yuraq Pasña
Acero Suytu
Muru Luqu
Alkaraza
Allqa Suytu
Wamanpa Qallun
Azul Ñawi Gaspar
Chileno
Yana Chiqchi Pasña

Yana Murunki
Achanqayra
Qillu Ipillu
Kichka Matanka
Yuraq Wayru
Cocharcas
Yana Pumapa Makin
Bayo Botas
Qolqi Tupu
Walas
Wachwapa Qallun
Yuraq Tuqu
Misipa Makin
Wiripa Takllan
Puka Murunki
Quri Markina
Allqa Ipillu
Allqa Papa
Maswa Papa
Pampa Ustu
Puka Prescos
Uqi Palta
Puka Puqya
Amillica
Azul Reboso
Churquillay
Leonpa Makin
Qillu Camotillo
Yana Pasña
Winqu
Tumbay

Allqa Cordovina
Azul Ñawi Pasña
Cachi Suytu
Gaspar Morado
Kuchipa Chupan
Puka Ñawi Pasña

Qala Wawa
Rosas
Ruyru Puqya
Yana Gaspar
Yana Poncho
Yana Tullu
Yutupa Runtun
Cucharquina
Puka Cocharcas
Puka Markina
Qillu Suytu
Suytu Murunki
Azul Palta
Gaspar Rosado
Llamapa Sullun
Romano Suytu
Sumchillay
Supa Puchquchi
Suytu Dusis
Uqi Puqya
Yuraq Winqu
Allqa Imilla
Alqu Yupi
Asno Qara
Ayrampu
Azul Chiqchi Pasña
Azul Wayta
Casa Blanca
Chikñas Morado
Chiqci Wali
Clavelina
Duraznillo
Guindo Camotillo
Ikichina
Kuchipa Qallun
Liwlipa Runtun
Muru Gaspar

Muru Kututu
Muru Toro
Ojos De Caiman
Puka Camotillo
Puka Dusis
Puka Masa Waqachi
Puka Ritipa Sisan
Puka Sunqu
Puka Sunqu Gaspar
Puka Wara
Qala Wipe
Riti Waqachi
Ruywash
Saywa
Suytu Oca
Suytu Peruanita
Tuqra Papa
Uki Ipillu
Wayry Peruana
Yaku Ñawi
Yana Churchillos
Yana Tarmeña
Yana Wayru
Yuraq Ipillu
Yuraq Llumchuy Waqachi
Yuraq Oca

Native-bitter

Yana Manua
Yuraq Waña
Qanchillu
Yuraq Siri

Azul Qanchillu
Azul Waña
Yana Siri
Yana Waña
Yuraq Manua
Cayhua Siri
Azul Siri

Ruyru Siri
Azul Manua

Improved

Yungay
Canchan
Capiro
Perricholi
Tomasa
Liberteña

Mariva
Revolución
Andina
Amarilis

Renacimiento

Participatory mapping + cultivar sampling

Relative Cultivar Frequency (RCF)

ü A measure of **relative abundance** based on extensive field sampling

RCF = (HCF household 1 + HCF household 2 + …..) / N households sampled

Household Cultivar Frequency (HCF) = (sample size of a specific cultivar / total tuber sample size of the household) * 100%

Very scarce	: RCF < 0.05
Scarce	: RCF < 0.10
Uncommon	: RCF < 0.25
Common	: RCF < 1.00
Abundant	: RCF > 1.00

Participatory mapping + cultivar sampling

Relative Cultivar Frequency (RCF)

Region	Cultivar category	N	Very scarce	Uncommon	Scare	Common	Abundant
Apurimac	Native-floury	172	82	23	16	32	18
	Native-bitter	11	0	4	2	3	2
	Improved	6	0	2	1	1	2
Cusco	Native-floury	125	61	20	18	19	7
	Native-bitter	17	6	3	3	2	3
	Improved	16	2	2	0	5	7
Huancavelica	Native-floury	174	100	18	11	28	17
	Native-bitter	13	1	3	2	4	3
	Improved	12	3	1	0	5	3
Junin	Native-floury	172	95	30	21	16	10
	Native-bitter	5	1	1	0	1	2
	Improved	17	1	4	1	5	6
Pasco	Native-floury	185	116	21	21	15	11
	Native-bitter	1	0	1	0	0	0
	Improved	6	2	2	0	0	2

Participatory mapping + cultivar sampling

Relative Cultivar Frequency in Huancavelica

Native-floury

Larga
Yana Puqya
Peruanita
Amarilla
Camotillo
Huamantanga
Chiqchi Pasña
Puka Wayru
Allqa Palta
Aqu Suytu
Trajin Waqachi
Dusis
Yana Winqu
Yuraq Puqya
Kuchipa Akan
Muru Wayru
Chungya
Taragallo
Vayo Zapato
Yana Ñata
Markina
Suytu Puqya
Botiguela
Allqay Walas
Maco
Tarmeña
Sangre De Toro
Yana Papa
Qala Suytu
Yuraq Wayta
Yuraq Gaspar
Puka Chiqchi Pasña
Rosada
Yana Palta
Puka Llumchuy
Waqachi
Cordovina
Runtus
Witqis
Wayru Machu
Tantas
Imillicay
Waripa Taklla
Yana Allqa
Logrogina
Yuraq Ñata
Qillu Ipillu
Allqa Papa
Pampa Ustu
Yuraq Suytu
Tongina
Promesa
Leona
Angelpa Tantan
Wara Suru
Puka Suytu
Yana Wakapa
Qallun
Muru Luqu
Qala Wipe
Acero Suytu
Achanqayra
Wamanpa Uman
Allqa Suytu
Ritipa Sisan
Caramelo Suytu
Ruyru Puqya
Yana Tullu
Qalapa Waran
Yuraq Pasña
Tumbay
Prescos
Witu
Kuchipa Chupan
Rosas
Yana Chiqchi Pasña
Puka Pasña
Puka Wakapa Qallun
Bayo Botas
Kichka Matanka
Murunki
Walas
Yana Poncho
Yana Suytu
Tuqra Papa
Quri Markina
Uki Ipillu
Yaku Ñawi
Qolqi Tupu
Alkaraza
Gaspar Morado
Yutupa Runtun
Azul Wayta
Riti Waqachi
Azul Ñawi Gaspar
Azul Palta
Liwlipa Runtun
Uqi Palta
Qala Wawa
Puka Ñawi Pasña
Muru Kututu
Uqi Ruyru
Allqa Imilla
Puka Dusis
Puka Sunqu Gaspar
Ayrampu
Puka Camotillo
Puka Wara
Suytu Peruanita
Yuraq Oca
Cocharcas
Azul Ñawi Pasña
Yuraq Llumchuy Waqachi
Winqu
Casa Blanca
Qillu Camotillo
Yana Gaspar
Muru Gaspar
Yana Pasña
Wiripa Takllan
Leonpa Makin
Qillu Suytu
Duraznillo
Allqa Ipillu
Wamanpa Qallun
Alqu Yupi
Azul Reboso
Azul Chiqchi Pasña
Suytu Oca
Chileno
Puka Sunqu
Yana Churchillos
Muru Toro
Puka Murunki
Cachi Suytu
Allqa Cordovina
Chiqci Wali
Saywa
Chikñas Morado
Wachwapa Qallun
Puka Masa Waqachi
Churquillay
Misipa Makin
Ruywash
Puka Ritipa Sisan
Supa Puchquchi
Yuraq Wayru
Yana Murunki
Yana Wayru
Ikichina
Yuraq Ipillu
Kuchipa Qallun
Romano Suytu
Cucharquina
Guindo Camotillo
Yuraq Tuqu
Maswa Papa
Yana Pumapa Makin
Puka Puqya
Ojos De Caiman
Yana Tarmeña
Llamapa Sullun
Asno Qara
Clavelina
Amillica
Uqi Puqya
Wayry Peruana
Yuraq Winqu
Gaspar Rosado
Puka Prescos
Puka Markina
Suytu Dusis
Puka Cocharcas
Sumchillay
Suytu Murunki

Native-bitter

Yana Manua
Yuraq Waña
Yuraq Siri
Qanchillu
Ruyru Siri
Azul Waña
Yana Siri
Yana Waña
Azul Siri
Cayhua Siri
Azul Qanchillu
Azul Manua
Yuraq Manua

Improved

Yungay
Canchan
Capiro
Perricholi
Liberteña
Tomasa
Revolución
Mariva
Amarilis
Andina
Renacimiento

Outline

- Introduction
- The Chirapaq Ñan initiative (“the rainbow route”)
- Participatory mapping + cultivar sampling
- Conclusions

Conclusions

- ü Model can be expanded to other crops and regions:
  - Systematic long-term monitoring provides robust intelligence about landrace conservation status.
  - Baseline research will allow for future time series comparison, genetic gap analysis and spatial distribution mapping.

- ü Participation of custodian farmers, NGO's, governments and indigenous organizations is key – a common language is essential (standardized methods and interdisciplinary communication tools).

- ü Challenge: how reliable are vernacular names? Common names are site-specific and may vary from farm household to farm household.

Awards

Traditional Best International Indigenous

Zooming in on the Secret Life of Genetic Resources in Potatoes: High Technology Meets Old-Fashioned Footwork

By Henry Juárez, Franklin Plasencia, and Stef de Haan
International Potato Center
Lima, Peru

Data Sources

High-resolution IKONOS and QuickBird images combined with participatory mapping and in-depth consultation through interviews and focus group meetings

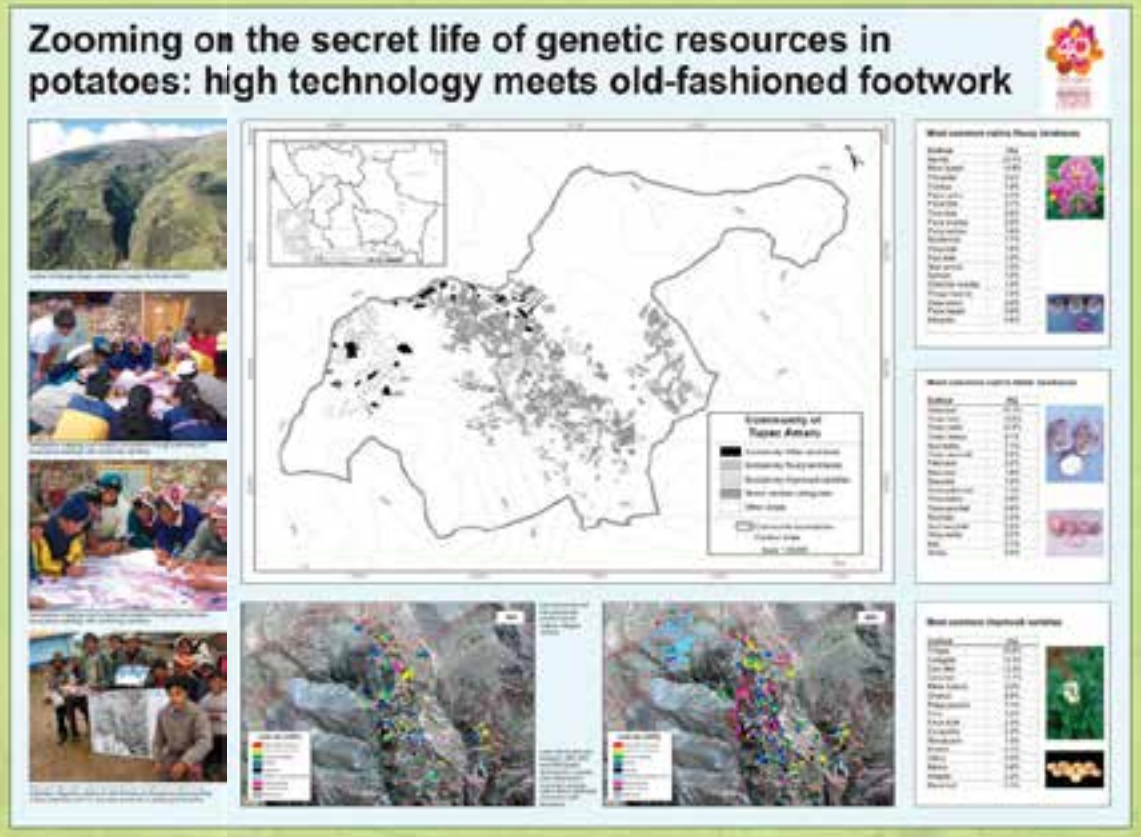
The International Potato Center in Peru—known by its Spanish acronym, CIP—is a research-for-development organization with a focus on potatoes, sweet potatoes, and Andean roots and tubers. Over the past 40 years, its mission has evolved from increasing crop productivity to the more complex challenge of hunger and poverty alleviation with sustainable development. CIP's research has expanded to include issues such as climate change, preserving biodiversity, food security, and improving livelihoods.

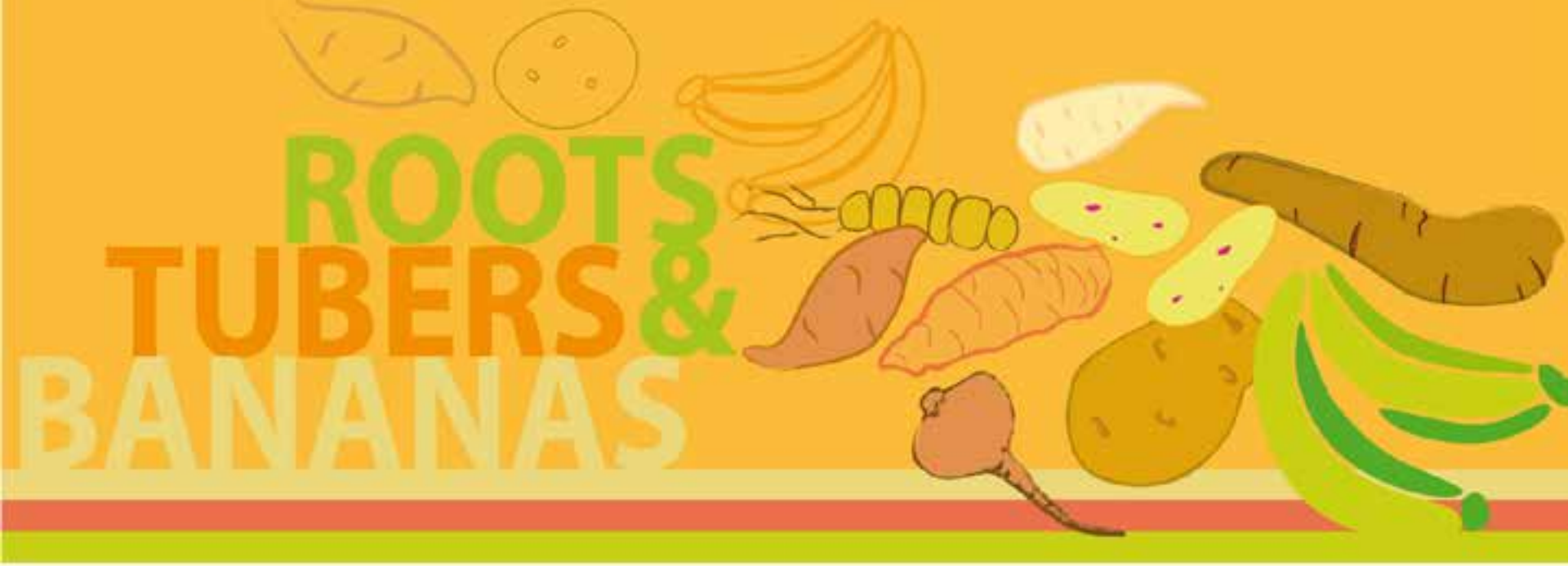
The Peruvian Andes region is one of the richest in potato biodiversity in the world. CIP has identified 3,800 native Andean varieties. The center is rising to the challenge of gathering information, which can be used to exploit and preserve this invaluable resource in the Peruvian Andes. It is employing high-resolution satellite images and participatory mapping to gather vital information about ancient agricultural methods in the Peruvian highlands.

The main research method involved participatory mapping combined with in-depth consultation through interviews and focus group meetings with members of 21 Andean highland communities in Cusco, Huancavelica, and Junín. Each family in the community was asked to identify its own plots of land on the map. Plots are assigned a numerical identifier. The family is then asked a series of in-depth questions including which varieties of potatoes it grows on each plot, when the planting was carried out, and which method of crop rotation was used.

Lino Mamani is a *papa arariwa* (Quechuan for "potato guardian") in the Sacaca farming community near Pisac in the Peruvian Andes. On their land, his and five neighboring communities have established a 12,000-hectare "potato park" where they cultivate and conserve Andean potato varieties. When researchers interviewed him, he described the situation:

> In the old days, the rain came at the right time, the land was very fertile, and the sun used to shine in the right amount. Now we see that the sun is hotter, the rains do not come at the right time, and we have hailstorms and freezing temperatures and droughts like we have never seen before. There is also an increase in insect pests and diseases. The potato varieties that our grandfathers grew down by the river are now moving higher up the mountain slopes. In this land, we have our *apu* [sacred mountains] around us, which help





Gracias

CGIAR

Research Program on Roots, Tubers and Bananas

CENTRO INTERNACIONAL DE LA PAPA
CIP
A member of the CGIAR Consortium