



The “tricot” crowdsourcing methodology for varietal diversification

Bioversity International, Information Services and Seed Supplies

What is the problem we want to solve?



Challinor et al. (2016) *Nat. Clim. Change* 6:954-958

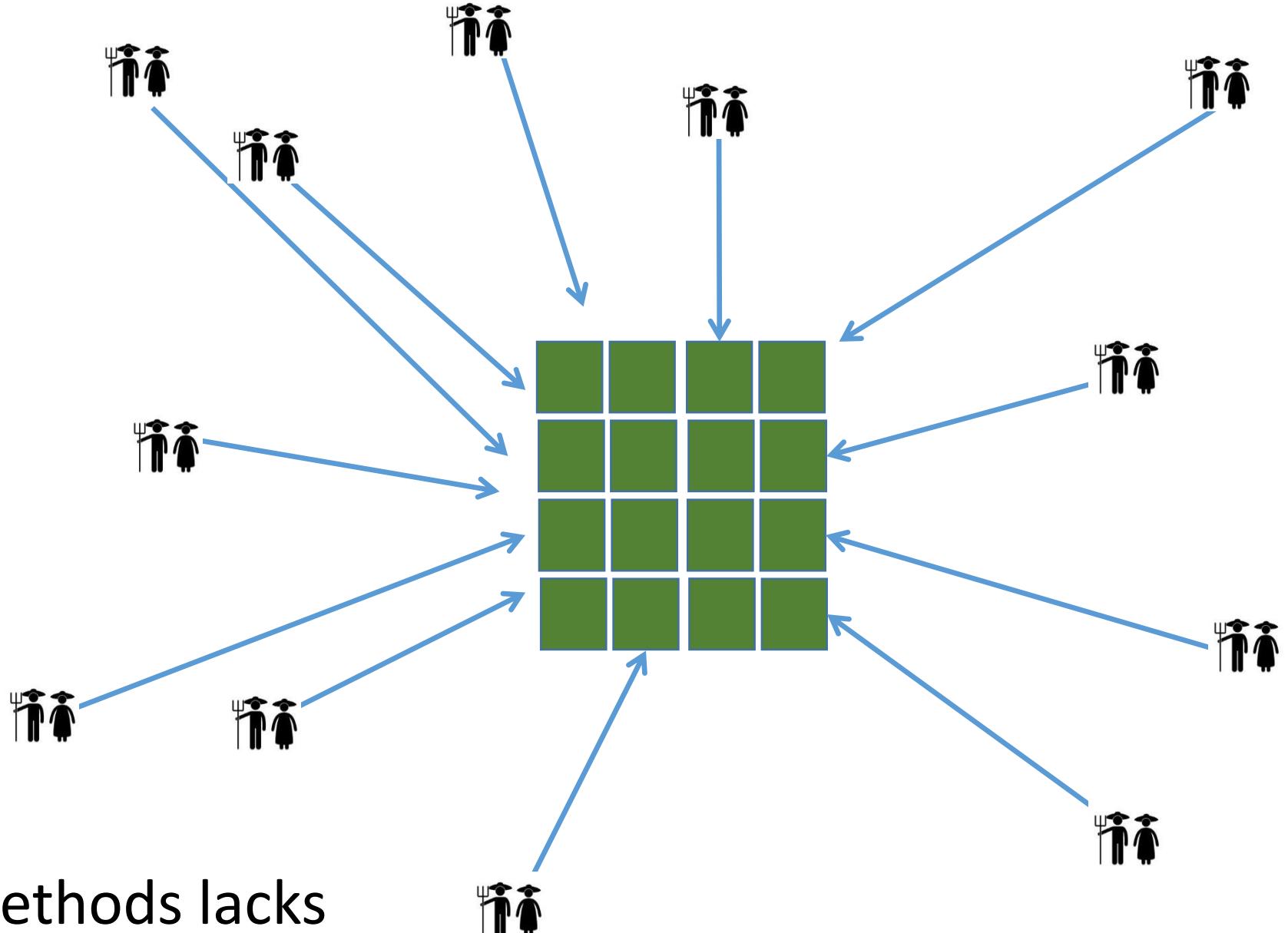
Tollenar et al. (2017) *Nat. Clim. Change* 7:275-278

Deutsch et al. (2018) *Science* 361(6405):916-919

What is the problem we want to solve?

Climate risk management

1. Reduce risks by identifying the best technology for each climatic region
2. Register genotype x environmental interactions and changes in climatic patterns as they occur in the field
3. Identify a diversified portfolio of technologies to reduce crop losses



But, current methods lacks
scalability

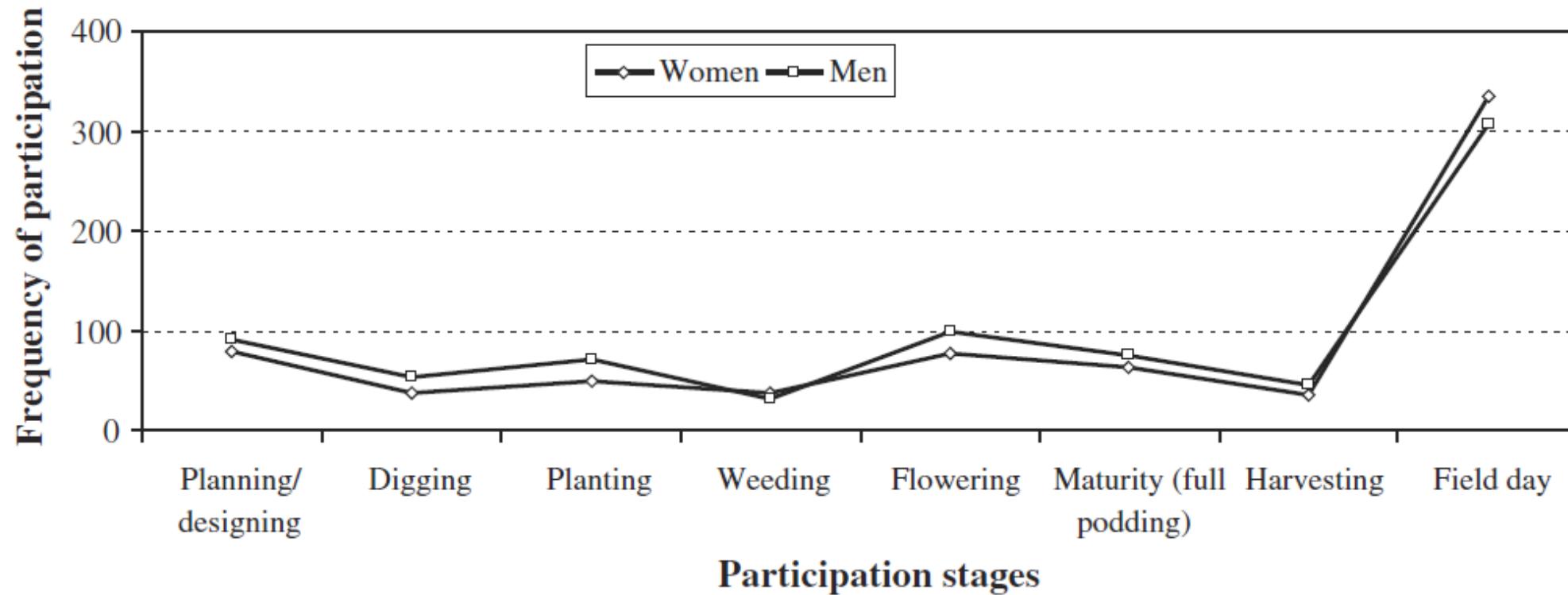


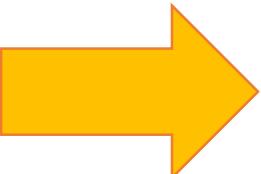
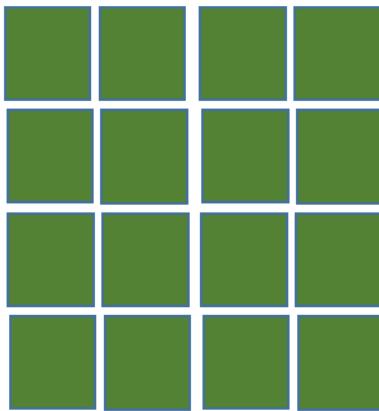
Fig. 4. Participation by gender in key crop stages in three participatory trial sites of western Kenya.

But, current methods lacks scalability

A new agricultural research paradigm

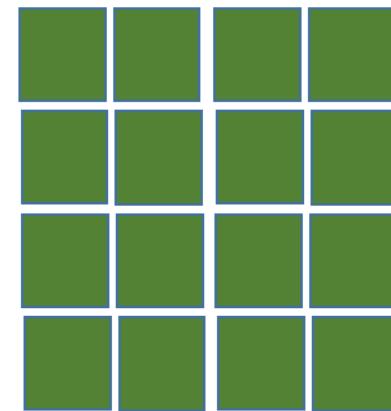
Centralized trial

(Research station)



Centralized trial

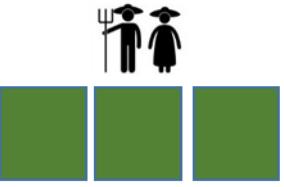
(Collaborating farmers' field)



Managed by
researchers

Managed by
researchers and
one farmer

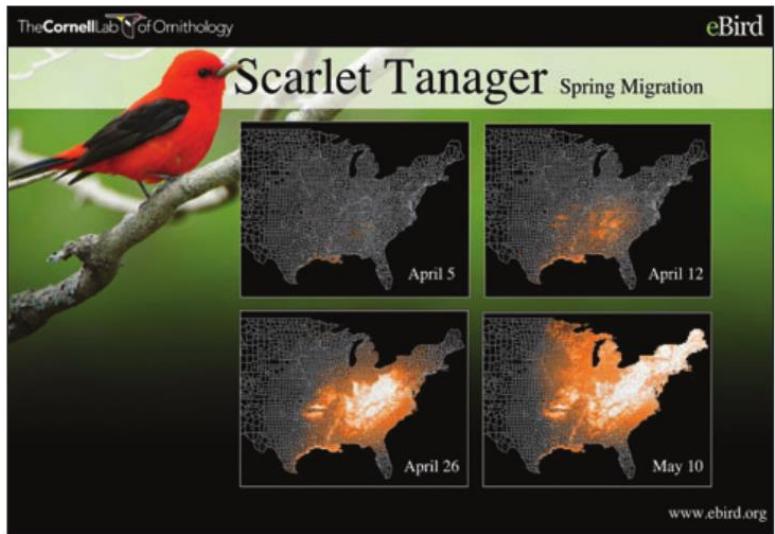
Decentralized trial



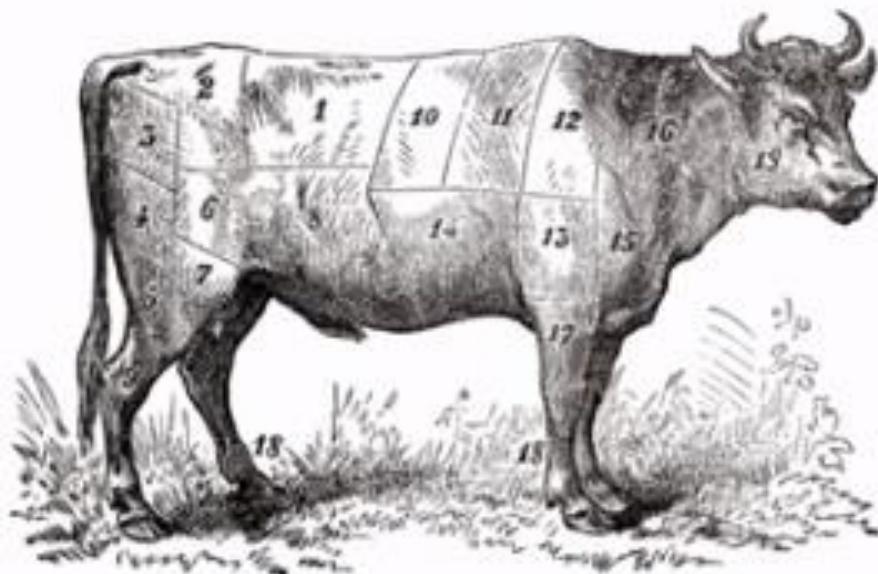
Managed by
many farmers

Citizen science

Scientific research carried out, at least in part, by non-professional scientists



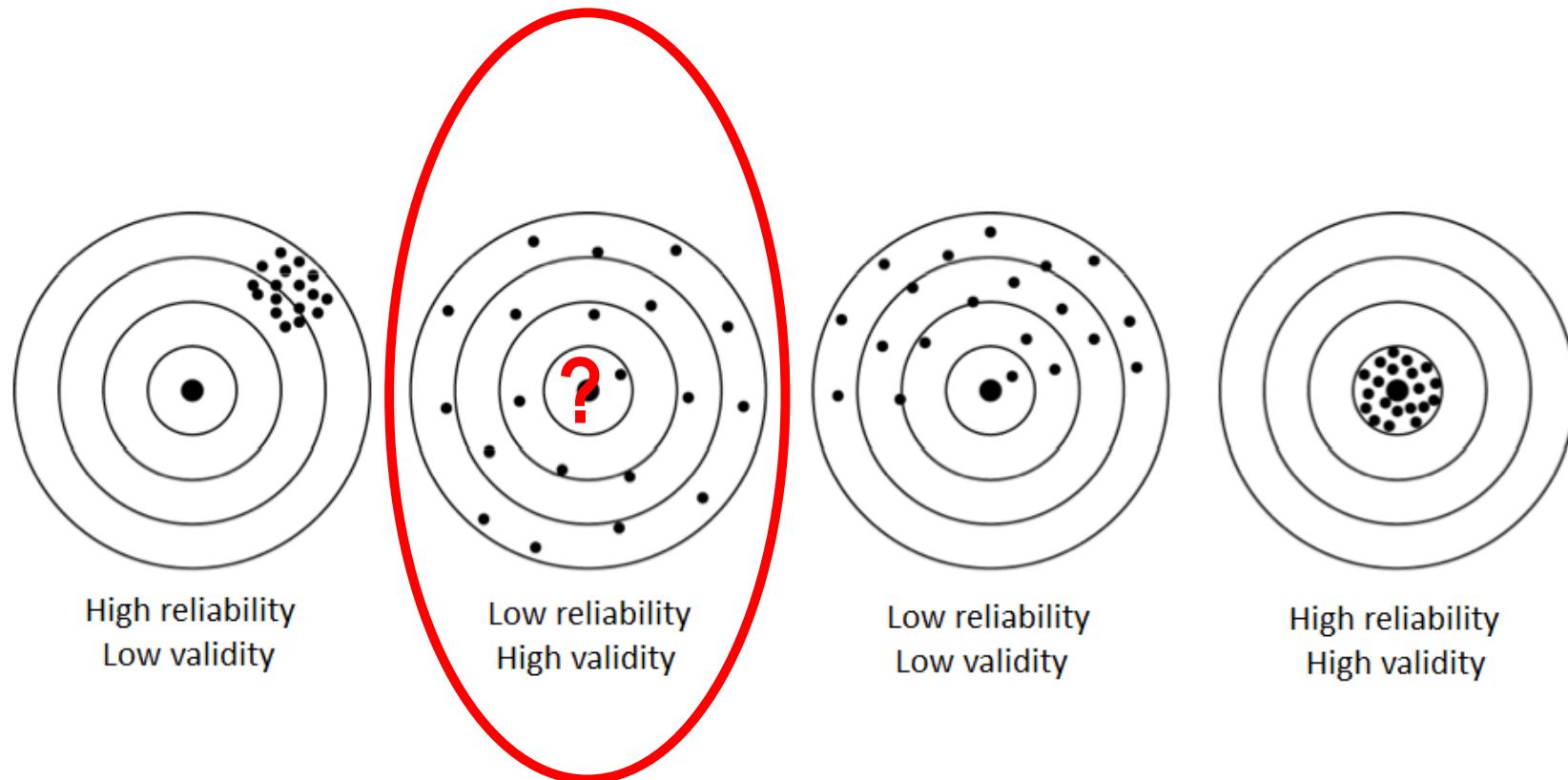
“Wisdom of Crowds”



In 1906, the English polymath Francis Galton visited a country fair in which 800 people took part in a contest to guess the weight of ox.

*average of 800 guesses = 1,197
actual weight of the ox = 1,198*

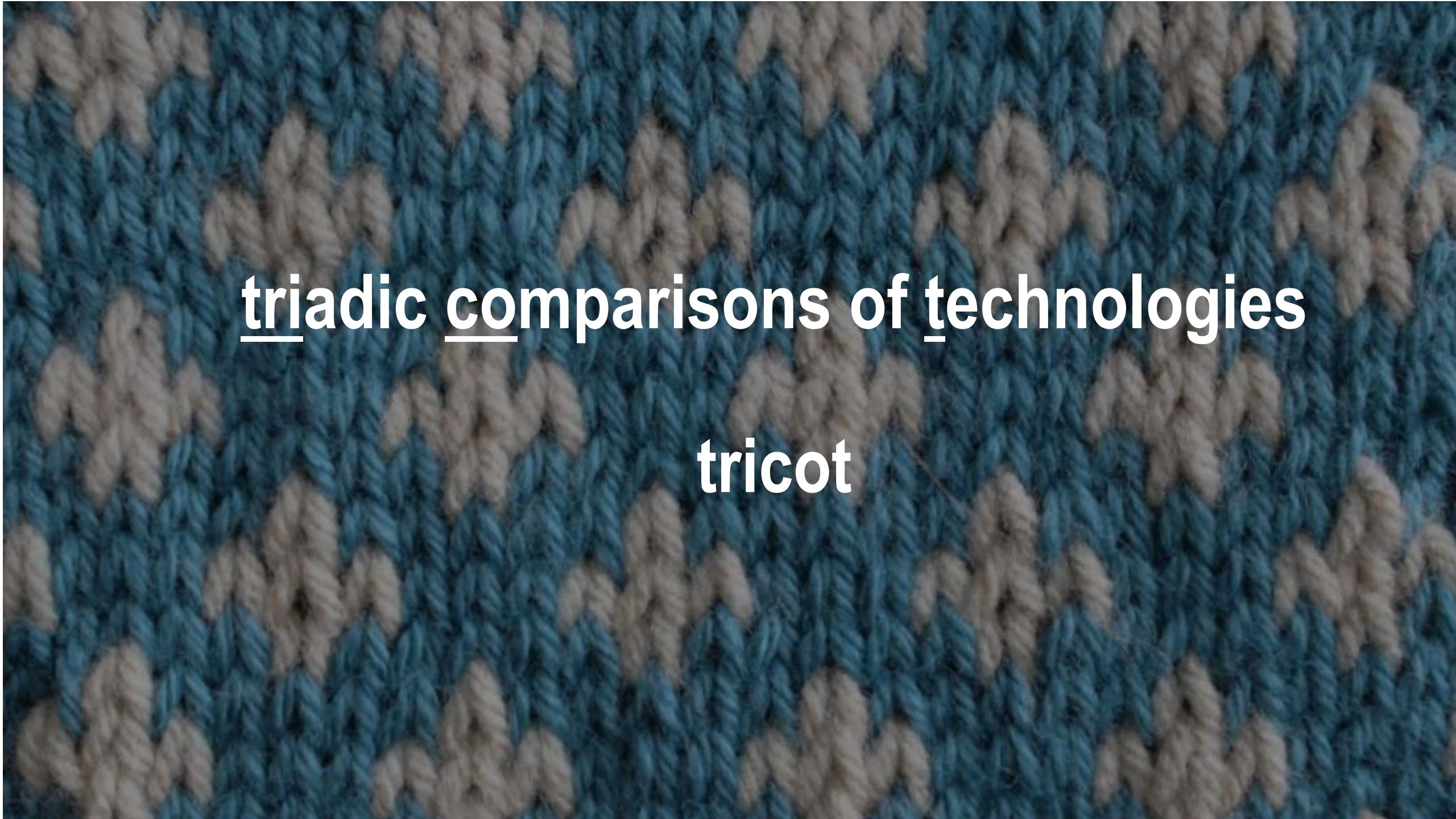
Data accuracy: Reliability vs validity



Exercise – wisdom of crowds



[https://github.com/kauedesousa/ClimMobTools/blob/master/
data/guessing_exercise.csv](https://github.com/kauedesousa/ClimMobTools/blob/master/data/guessing_exercise.csv)

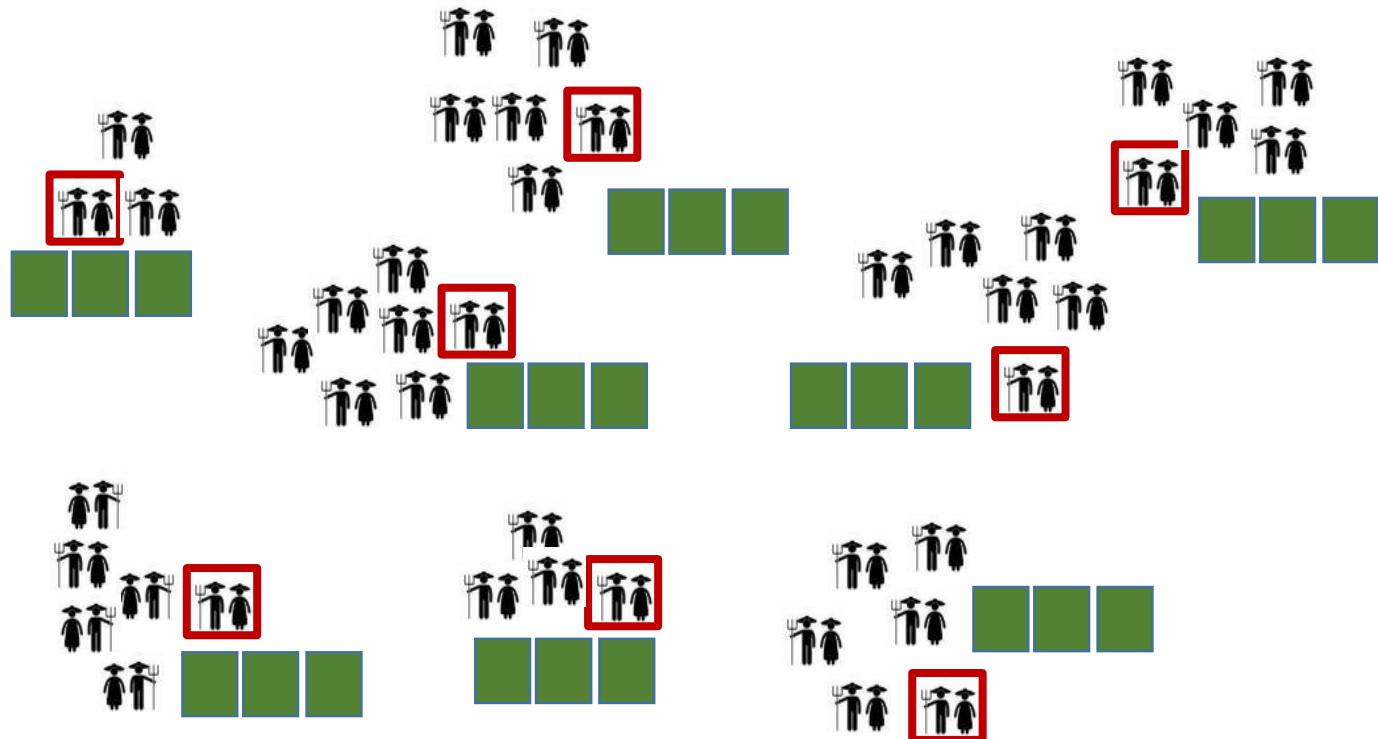


triadic comparisons of technologies

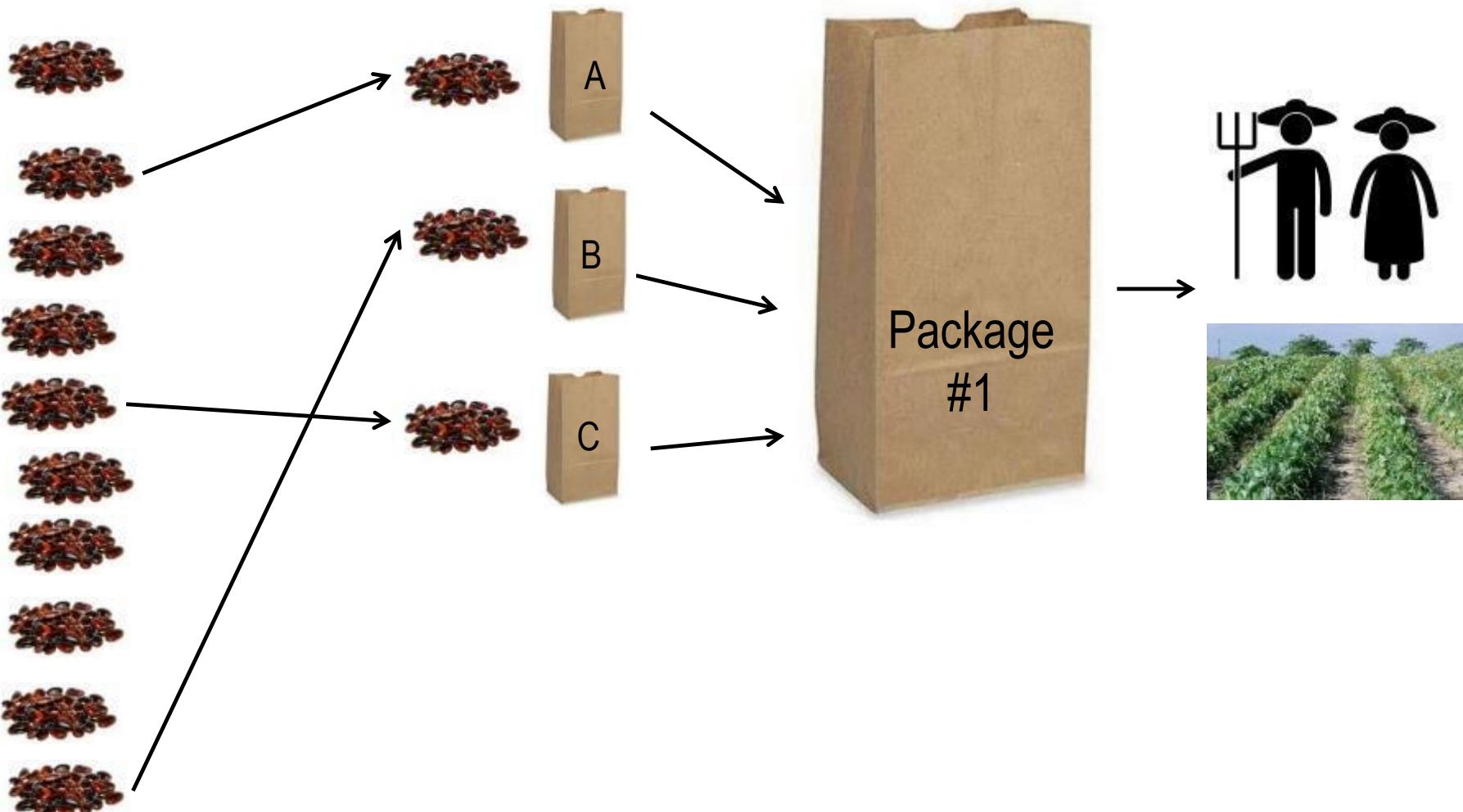
tricot

Distributed variety trials instead of centralized experiments

- Each farmer observes just 3 varieties
- Farmers observe along the entire season
- Under real farm conditions
- Farmers **rank** the varieties, no need for exact measurements



Each farmer receives 3 varieties from a larger pool of pre-selected varieties



Each farmer receives a personal trial package



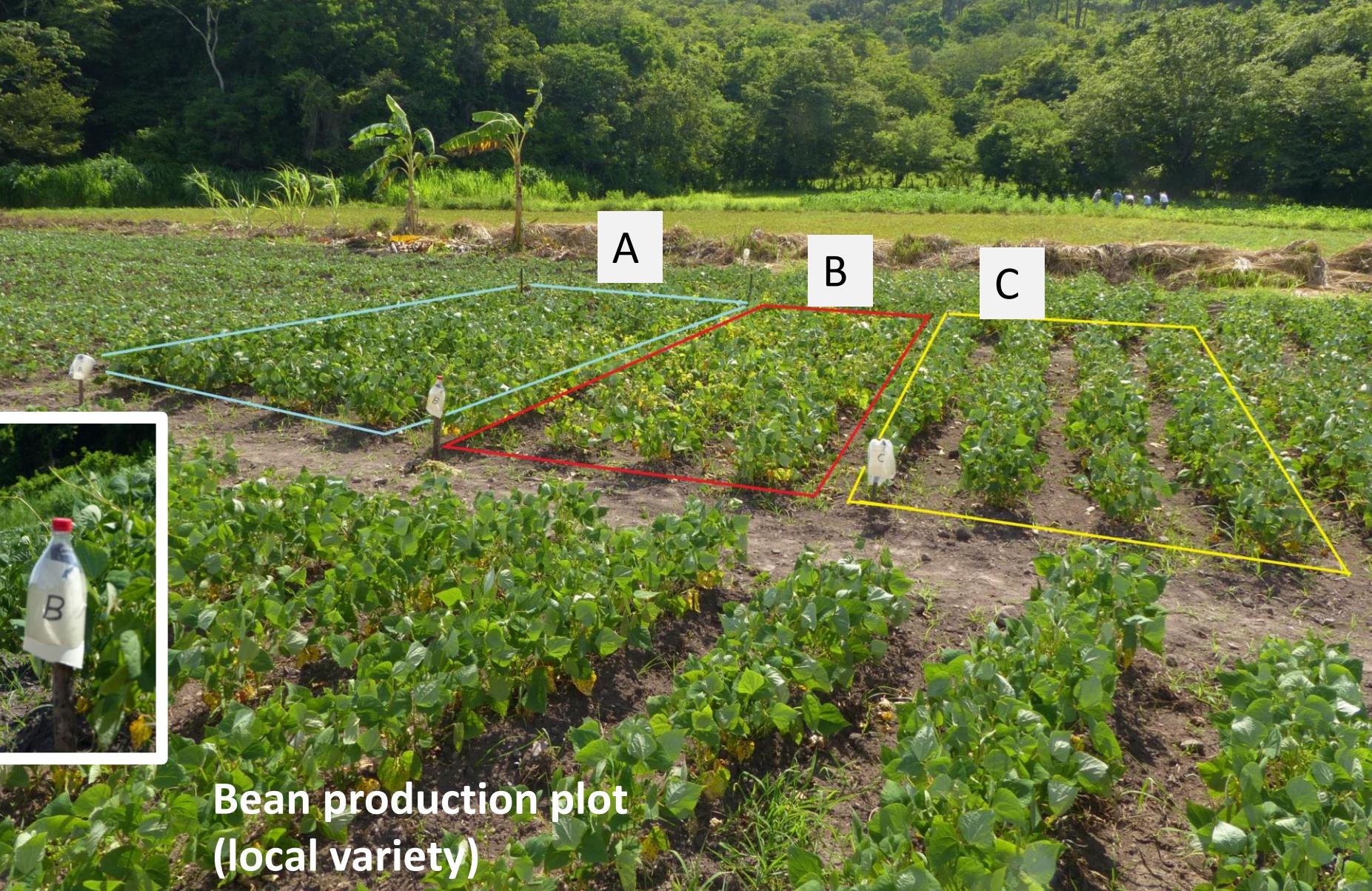
- Small quantities of seed
- 3 different varieties
- According to a randomization scheme
- Observation card to record variety comparisons

Variety randomization in tricot

- Every farmer receives 3 out of 10 - 25 varieties
- Farmer does not know the varieties names at first (just "A", "B", "C")
- Systematic randomization

Package code	Variety A	Variety B	Variety C
Package #1	breadwheat: CSW18	breadwheat: PBW502	breadwheat: HW2045
Package #2	breadwheat: WR544	breadwheat: HD2985	breadwheat: PBW550
Package #3	breadwheat: PBW343	breadwheat: HD2932	breadwheat: RAJ4120
Package #4	breadwheat: HP1633	breadwheat: DBW17	breadwheat: CSW18
Package #5	breadwheat: CSW18	breadwheat: DBW17	breadwheat: HD2932
Package #6	breadwheat: HP1633	breadwheat: HW2045	breadwheat: CSW18
Package #7	breadwheat: HW2045	breadwheat: HD2824	breadwheat: PBW550
Package #8	breadwheat: DBW17	breadwheat: HI1563	breadwheat: RAJ4120
Package #9	breadwheat: HW2045	breadwheat: PBW502	breadwheat: HI1563
Package #10	breadwheat: HD2985	breadwheat: CSW18	breadwheat: PBW502
Package #11	breadwheat: DPW621-50	breadwheat: K0307	breadwheat: HD2985
Package #12	breadwheat: DPW621-50	breadwheat: DBW17	breadwheat: PBW550
Package #13	breadwheat: HP1633	breadwheat: K9107	breadwheat: HI1563
Package #14	breadwheat: DPW621-50	breadwheat: CSW18	breadwheat: K9107
Package #15	breadwheat: DBW17	breadwheat: WR544	breadwheat: HP1633
Package #16	breadwheat: HD2824	breadwheat: WR544	breadwheat: PBW343
Package #17	breadwheat: RAJ4120	breadwheat: DBW17	breadwheat: PBW550
Package #18	breadwheat: HP1633	breadwheat: DPW621-50	breadwheat: DBW17
Package #19	breadwheat: DBW17	breadwheat: PBW550	breadwheat: HD2985
Package #20	breadwheat: HP1633	breadwheat: PBW502	breadwheat: K9107

A tricot trial of common bean (Honduras)



Farmers make simple observations in different criteria



Farmers make simple observations in different criteria



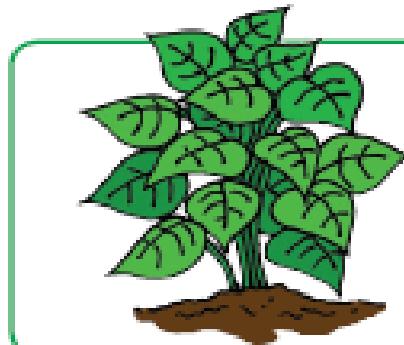
Farmers make simple observations in different criteria

Step #1

After 30 Days

Package number: _____

Date: _____



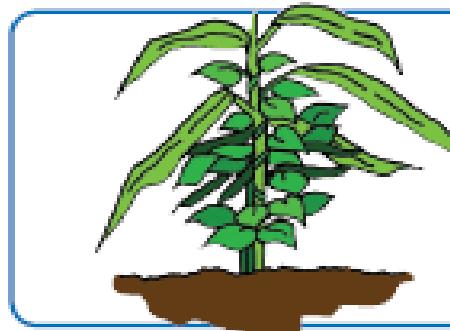
Best leaf development

A B C



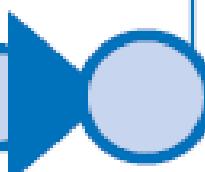
Worst leaf development

A B C



Best in winding

A B C



Worst in winding

A B C



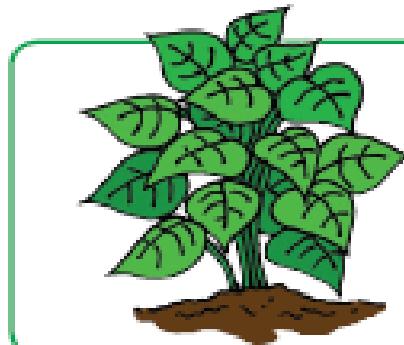
Farmers make simple observations in different criteria

Step #1

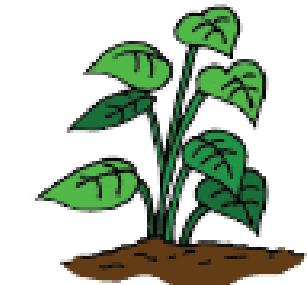
After 30 Days

Package number: FR-35

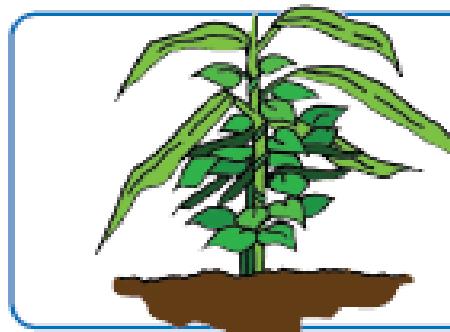
Date: 10 November 2018



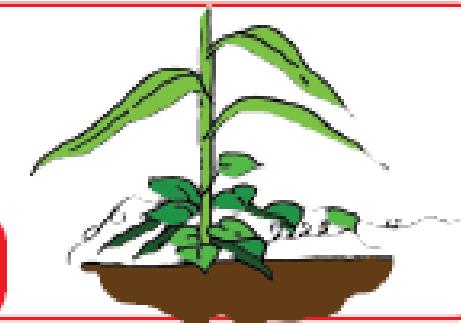
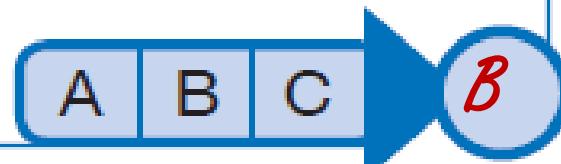
Best leaf development



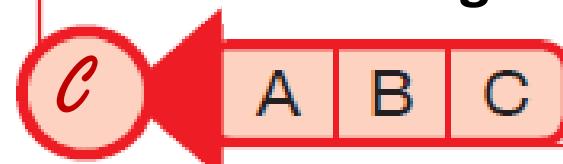
Worst leaf development



Best in winding



Worst in winding



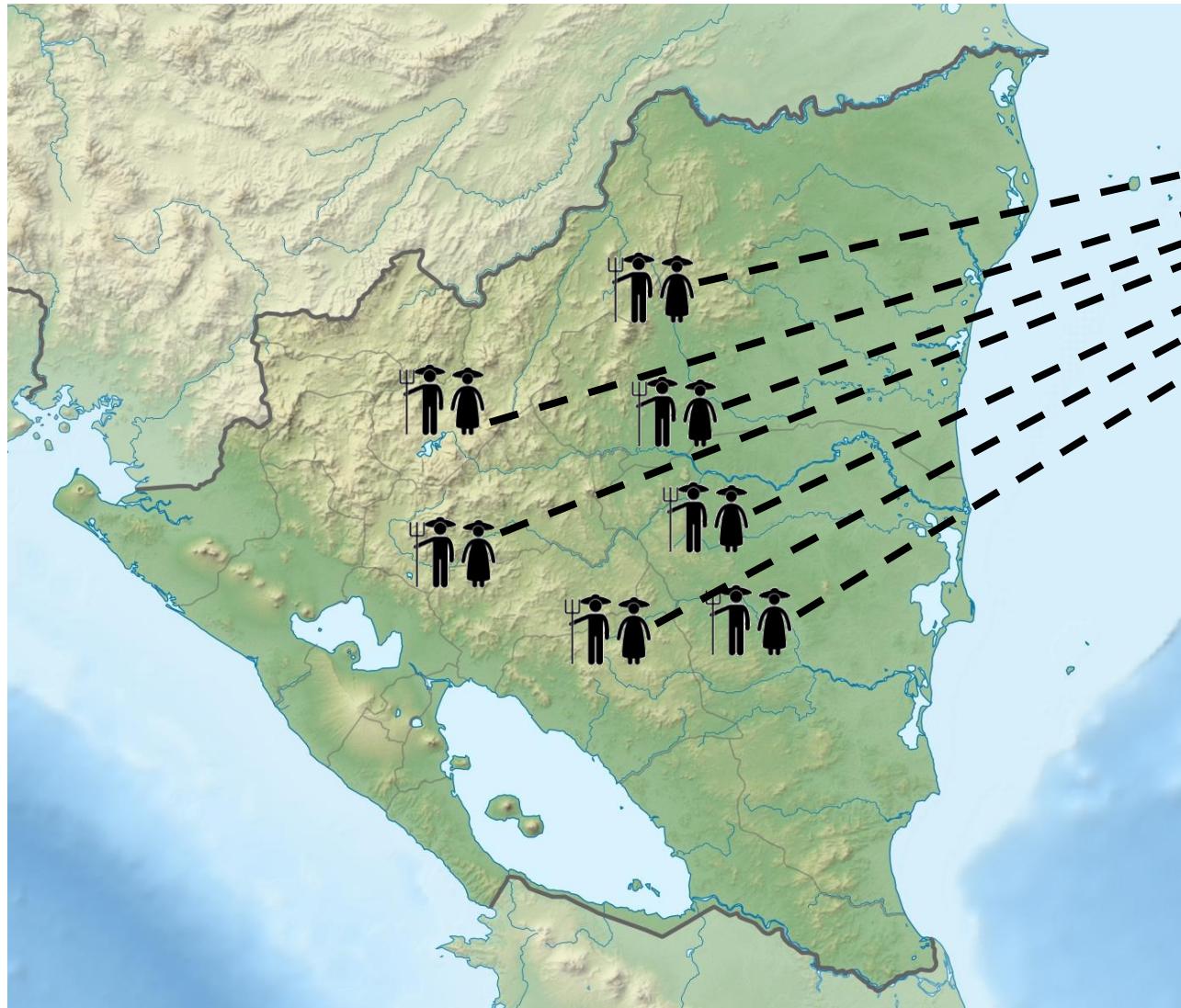
Project managers collect data from farmers, for analysis



- Phone calls
- ODK app
- Type card information

ClimMob

Crowdsourcing climate-smart agriculture



WELCOME TO CLIMMOB
CROWDSOURCING
CLIMATESMART
AGRICULTURE

DESIGN AND ANALYSE AGRICULTURAL TRIALS IN A SMART WAY



MOBILE DATA COLLECTION
Collect data using Android Mobile devices

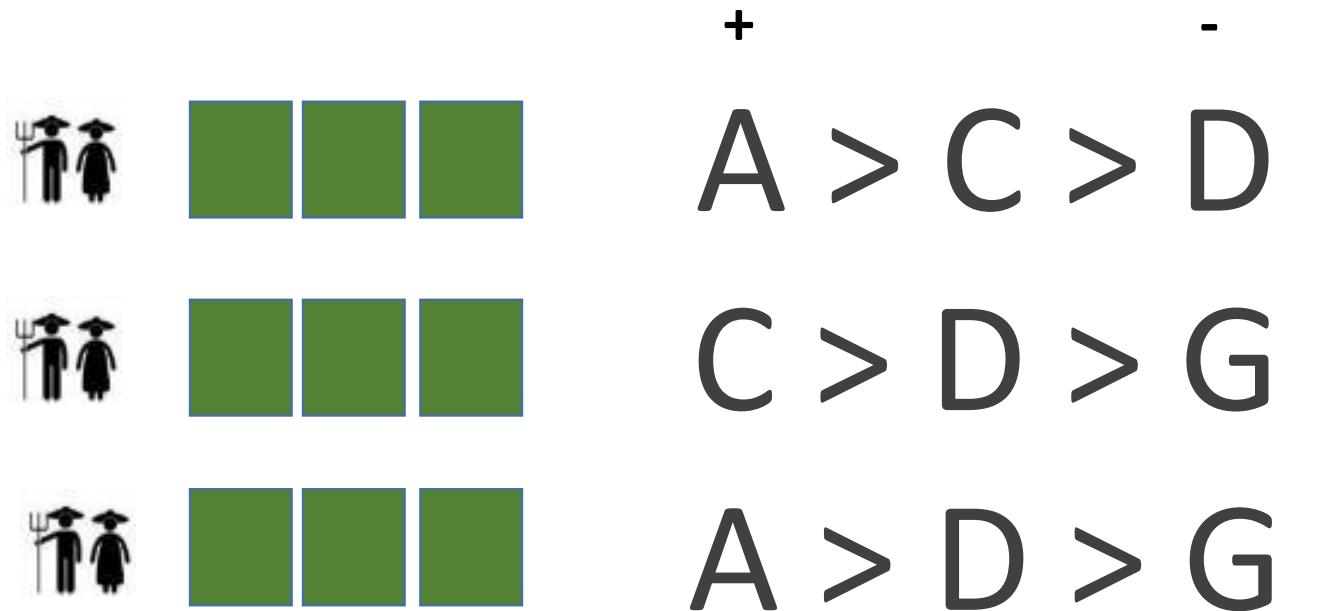
COMPLEX TRIAL DESIGN
Design complex trials not only based in crop varieties but also including factors like fertilizing and management.

SUMMARIES AND STATISTICS
Analyze your trials and report on the findings.

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Combining many partial rankings to the full picture



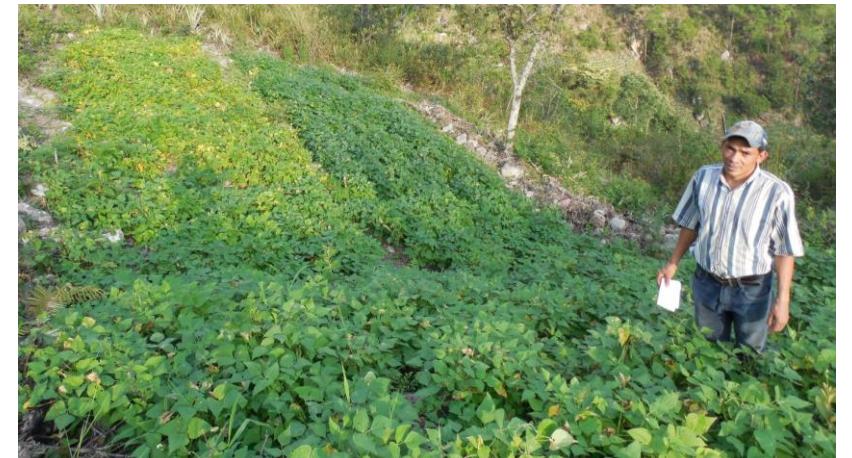
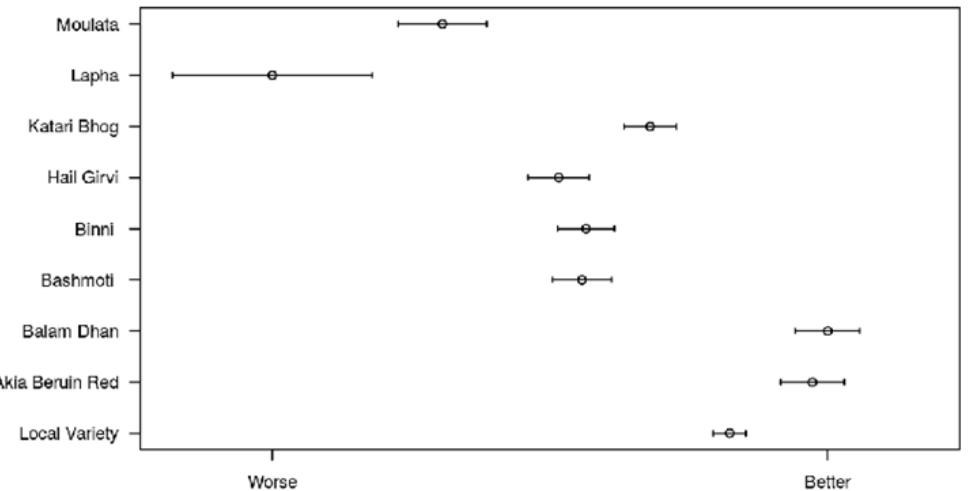
$A > C > D > G$

Model with partial rankings

	ItemA	ItemB	ItemC	performance
1	VarC	VarA	VarE	{NA, VA > VC, NA, NA, NA, NA, VA > VE, NA, VC > VE, NA}
2	VarD	VarC	VarA	{NA, VA < VC, NA, VA > VD, NA, VC > VD, NA, NA, NA, NA}
3	VarD	VarA	VarC	{NA, VA < VC, NA, VA > VD, NA, VC > VD, NA, NA, NA, NA}
4	VarD	VarB	VarA	{VA < VB, NA, NA, VA > VD, VB > VD, NA, NA, NA, NA}
5	VarE	VarB	VarD	{NA, NA, NA, NA, VB > VD, NA, NA, VB < VE, NA, VD < VE}
6	VarC	VarB	VarE	{NA, NA, VB < VC, NA, NA, NA, NA, VB > VE, VC > VE, NA}
7	VarA	VarC	VarD	{NA, VA < VC, NA, VA > VD, NA, VC > VD, NA, NA, NA}
8	VarC	VarD	VarB	{NA, NA, VB < VC, NA, VB > VD, VC > VD, NA, NA, NA}
9	VarE	VarD	VarA	{NA, NA, NA, VA > VD, NA, NA, VA < VE, NA, NA, VD < VE}
10	VarD	VarE	VarB	{NA, NA, NA, NA, VB > VD, NA, NA, VB > VE, NA, VD < VE}
11	VarD	VarC	VarA	{NA, VA < VC, NA, VA > VD, NA, VC > VD, NA, NA, NA}
12	VarE	VarD	VarA	{NA, NA, NA, VA > VD, NA, NA, VA > VE, NA, NA, VD < VE}
13	VarD	VarC	VarA	{NA, VA > VC, NA, VA > VD, NA, VC > VD, NA, NA, NA}
14	VarD	VarC	VarE	{NA, NA, NA, NA, NA, VC > VD, NA, NA, VC > VE, VD < VE}
15	VarB	VarA	VarD	{VA > VB, NA, NA, VA > VD, VB > VD, NA, NA, NA, NA}

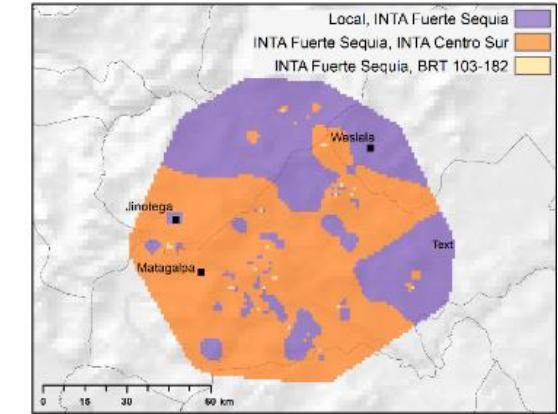
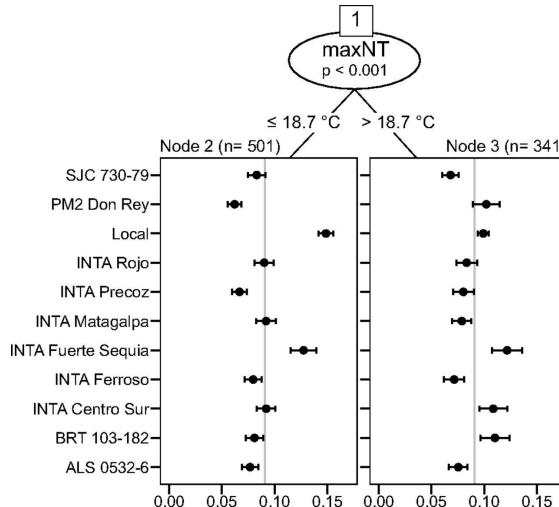
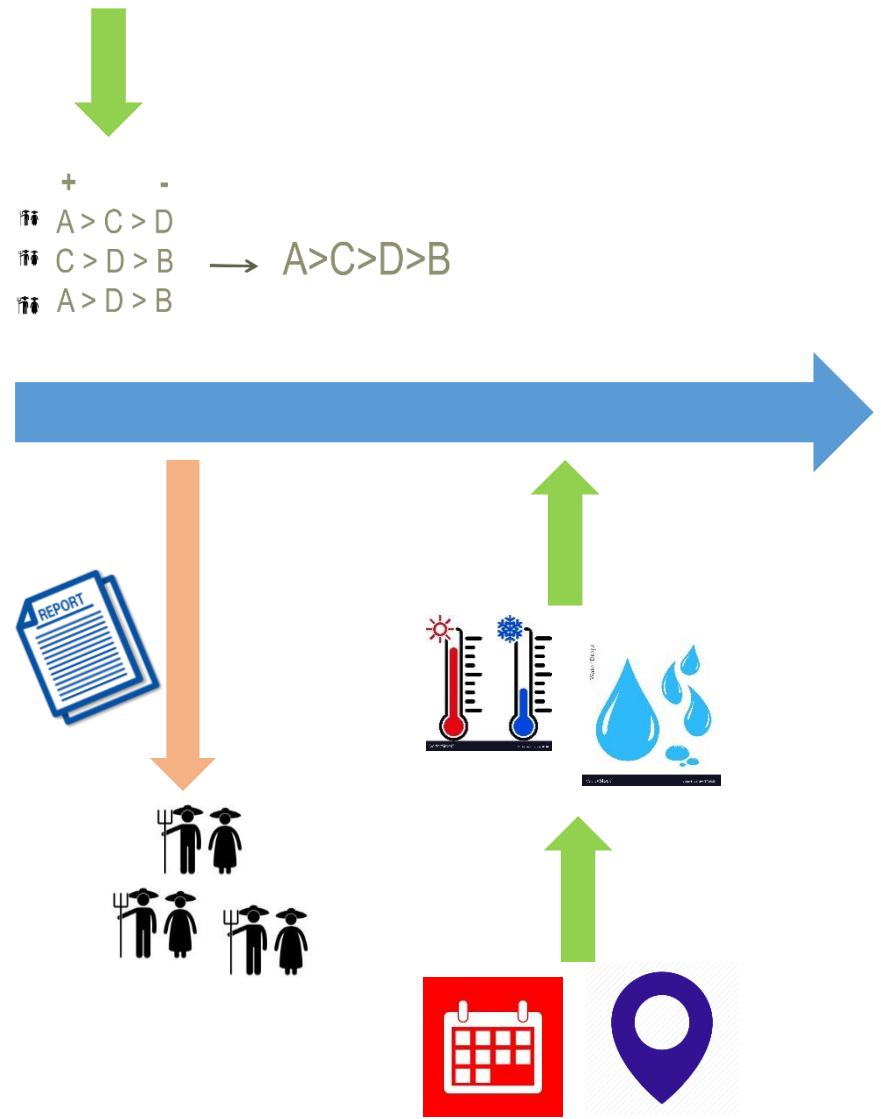
Two levels of learning

- **Local learning** – Farmers use comparative approach and heuristic learning to identify suitable solutions
- **Global learning** – Researchers aggregate results and infer patterns, make decisions about which varieties work where



ClimMob

Crowdsourcing climate-smart agriculture



Local learning

Thank you for participating!

Juan Sola
Nueva Esperanza Concepcion Sur

These are the results of the experiment you contributed to.

You received the following varieties to rank:

Variety	Name
Variety A	Victoria
Variety B	Macuzalito
Variety C	DonKike

You ranked these varieties in the following order:

Characteristic	Best	Second	Worst
Vigor	Macuzalito	DonKike	Victoria
Yield	DonKike	Victoria	Macuzalito

You compared the overall performance of these varieties with your local variety:

Positions	Varieties
Position 1	DonKike
Position 2	Macuzalito
Position 3	Victoria
Position 4	Local Variety

These are the best and the worst varieties you and observers with the similar characteristics received:

Positions	Varieties
Position 1	Chepe
Position 2	Amadeus77
Position 3	Macuzalito
Position 4	Victoria
Position 5	Local Variety
Position 6	DonKike

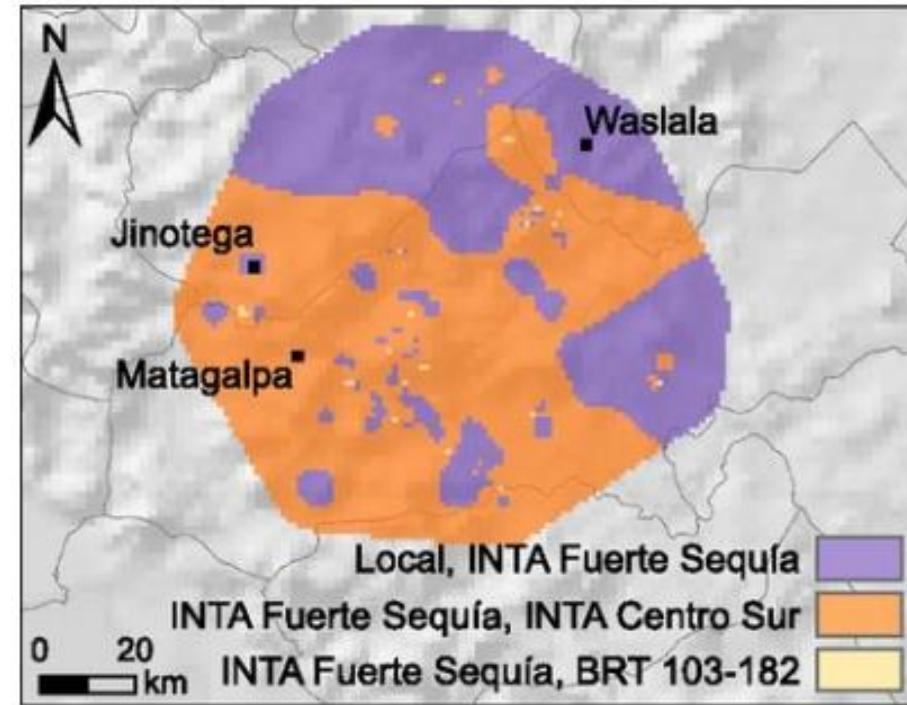
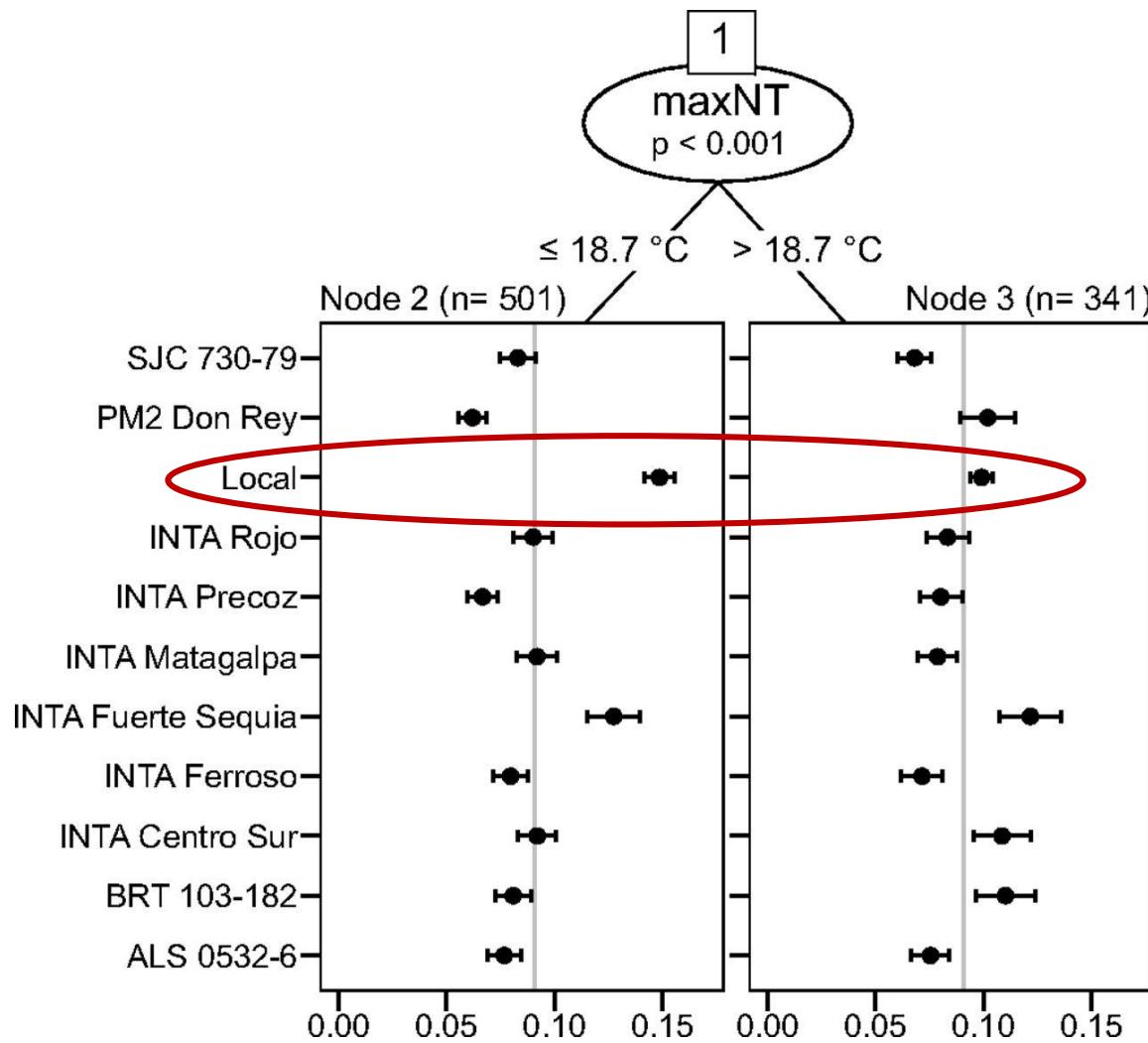
- Farmers learn names of the 3 varieties



- Full variety ranking according to all farmers

A>C>D>G

Global learning



The cycle of tricot research

5. Data are used to evaluate varieties and to detect demand for new varieties and traits



1. A broad set of varieties (10-25) is evaluated



2. Each farmer gets a combination of 3 varieties

6. Farmers receive variety recommendations and can order seeds



4. Project managers collect farmers' observations

3. Farmer plants a trial and makes observations



In summary

- Simple setup – little farmer training needed
 - Research / project staff does not need to supervise or visit trials
 - Results collected remotely through telephone calls
-
- Trials under real farming circumstances
 - Observation along the entire cropping cycle
 - Accurate results thanks to “Wisdom of Crowds”
 - Farmers may quickly identify varieties that fit the conditions at their farm



Thank you!



This is a compilation of several presentations of the members of Bioversity International’s “Information Services and Seed Supplies” Team. If you need to cite it, we suggest the following:

Steinke, J.; Gupta, A.; van Etten, J.; de Sousa, K. (2019) The “tricot” crowdsourcing methodology for varietal diversification.

Other materials used in this training course are available at:

<https://github.com/kauedesousa/agcitsci>

For the editable .ppt files, please send a request to
k.desousa@cgiar.org