

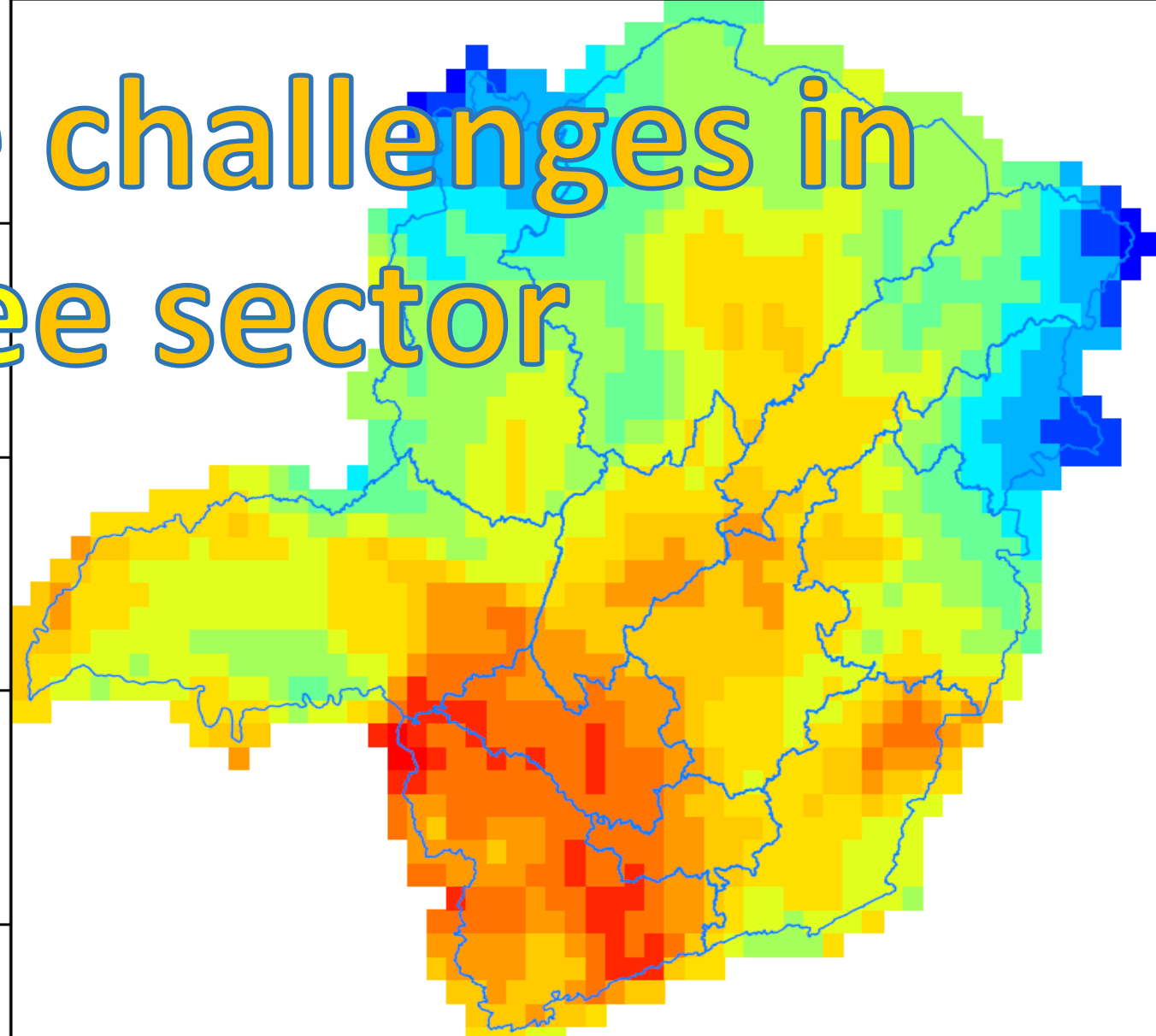
Acute climate challenges in the coffee sector

P. Baker, E. Briggs, L. Pearson

ICO 26th Sept 2014

'Climate change, time for action'

Anomaly – Jan–Feb 2014



Climate change is affecting coffee production

- Three major shocks in the past 6 years:
 - Colombia (2008-2012)
 - Central America (2012 - ?)
 - Minas Gerais (2014 - ?)
- Other countries also affected
 - E Africa
 - Indonesia



It's affecting coffee production in various ways

- Warming causes low marginal coffee to disappear (it's happening but poorly documented)
- **But:** main current effects are from weather shocks – drought, flood
- And indirect effects – pest and disease upsurges (rust now found up to 2000 m asl)



Acute challenges

- **Learnt from our initiative:** CC is already affecting coffee farming – urgent action required in many cases
- Adaptation is needed – but to what?
- It's impossible to make farmers 'bullet-proof' to all possible climate problems
- We have to identify major threats, these are location specific, so we have to do it in a participatory fashion by consulting with farmers, local experts (especially extensionists)
- And then relating to available climatological/meteorological data
- In this way **we 'triangulate' different data sources** to arrive at the most important CC-related issues

Acute challenges

- Adaptation – with what?
- We have assembled a large number of ‘tools’ – various agronomic techniques that can help farmers ameliorate the effects of climate change – e.g. soil covers, shade, ways to deepen root growth,
- And we have been trying these out with farmers and modifying them to suit local conditions

Some of c&c's adaptation work in MG (S de M)

(Lage et al. – mostly drought-related)



Bigger planting bags



Met. data collection



Gypsum applications



Rainwater harvesting



c&c toolbox



Ground cover & mulch



Shade trials



Erosion protection



Wind breaks



Run-off & infiltration

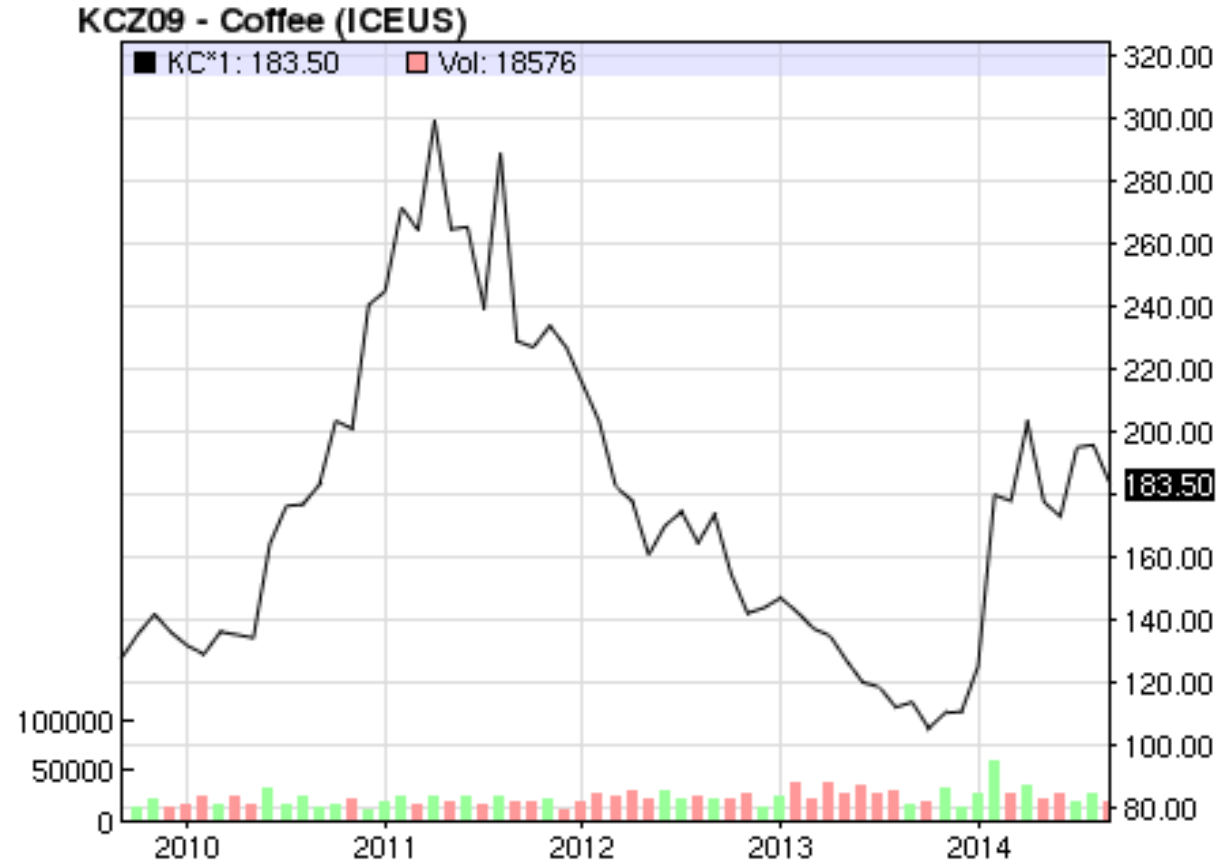
Acute challenges

- Adaptation – how?
- This is now the main challenge: we have got to the point where we can identify likely CC problems, and offer a range of adaptation options
- But how are farmers going to use them?
- How costly are they?
- Which farmers can benefit most?
- Which farmers need to start diversifying out of coffee?
- How do you scale up?

Farmers are facing increasing uncertainties

Price fluctuations

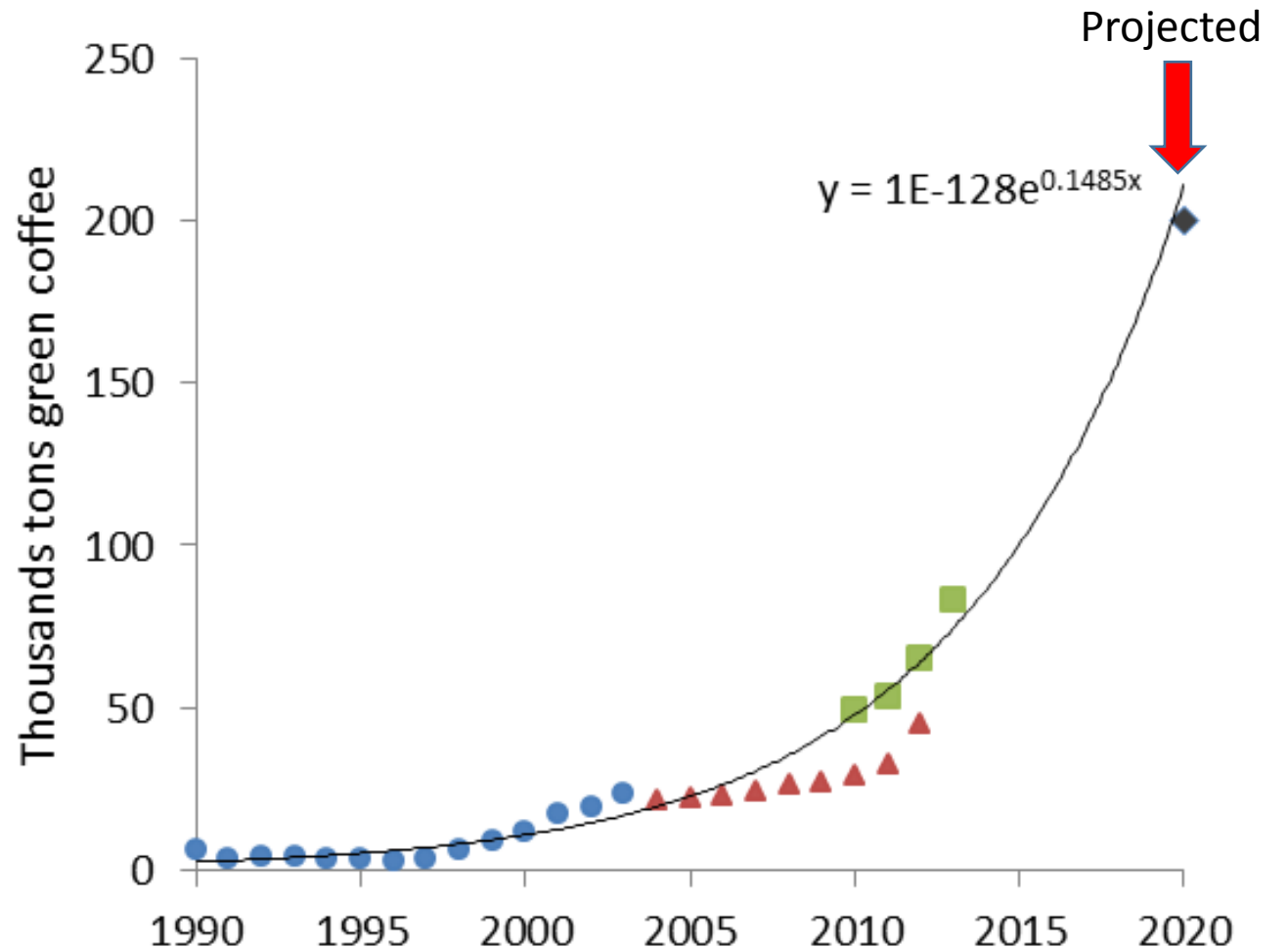
- ~ 100% swings in a few months



Farmers are facing increasing uncertainties

New competition

- E.g. China: 3+ million sacks by 2020?



Farmers are facing increasing uncertainties

Climate uncertainty

- IPCC AR5: For precipitation the models perform poorly; as the IPCC AR5 summary report puts it:
 - *At regional scales, precipitation is not simulated as well, and the assessment is hampered by observational uncertainties.*
- Despite a lot of modelling, accurate mid and long-term projections are not much practical help to farmers
- We can identify and help adapt to current difficulties, but future shocks are largely unknown and probably unknowable

Not just farmers

- We too, as agencies trying to help farmers, have limited understanding of likely future weather events and price regimes;
- We have limited ways to characterise farmers according to their needs and capabilities;
- We cannot have a one-size-fits-all strategy for farmers: in marginal areas farmers will have to be helped to diversify whilst at the other extreme other farmers may be able to intensify and earn adequate/enhanced rewards;
- A major task therefore is how to identify and characterise current farmer livelihoods – some farmers may be already innovating, adapting and doing well (positive deviance) others we know are faring badly, but why and how can we improve their situations?

Practical example of climate-related difficulties faced by coffee farmers

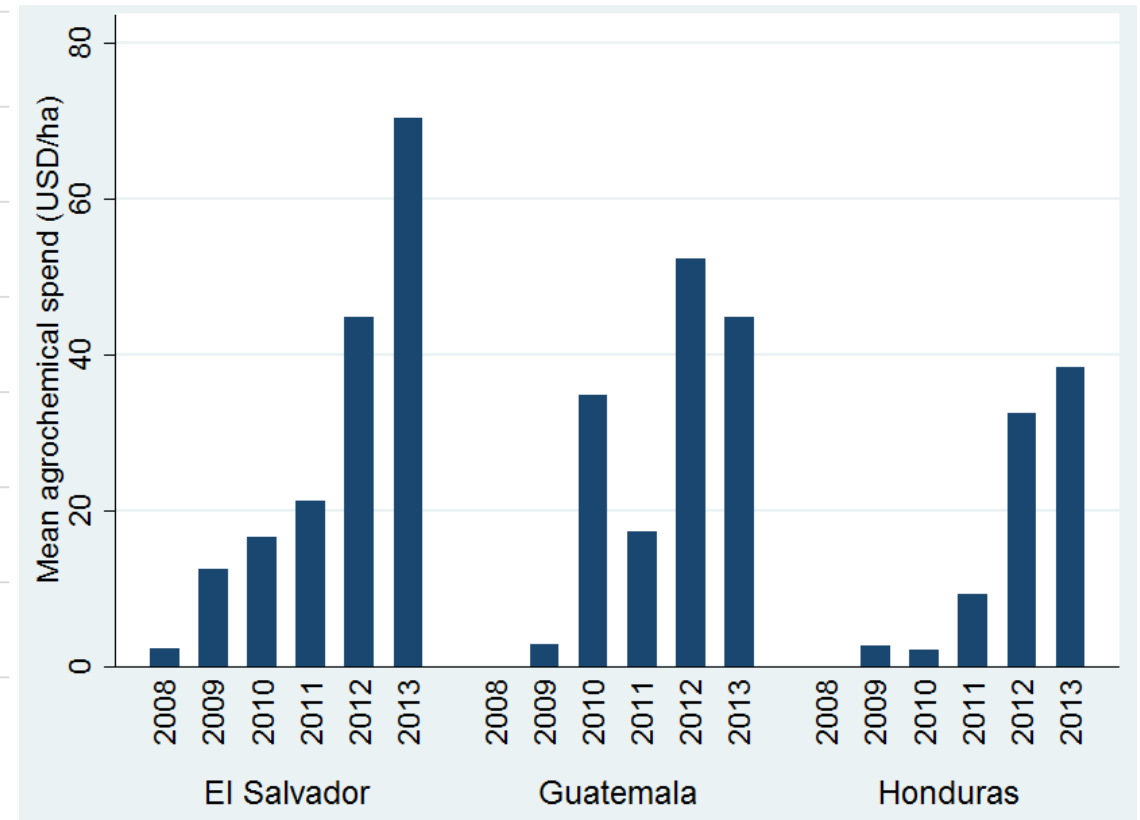
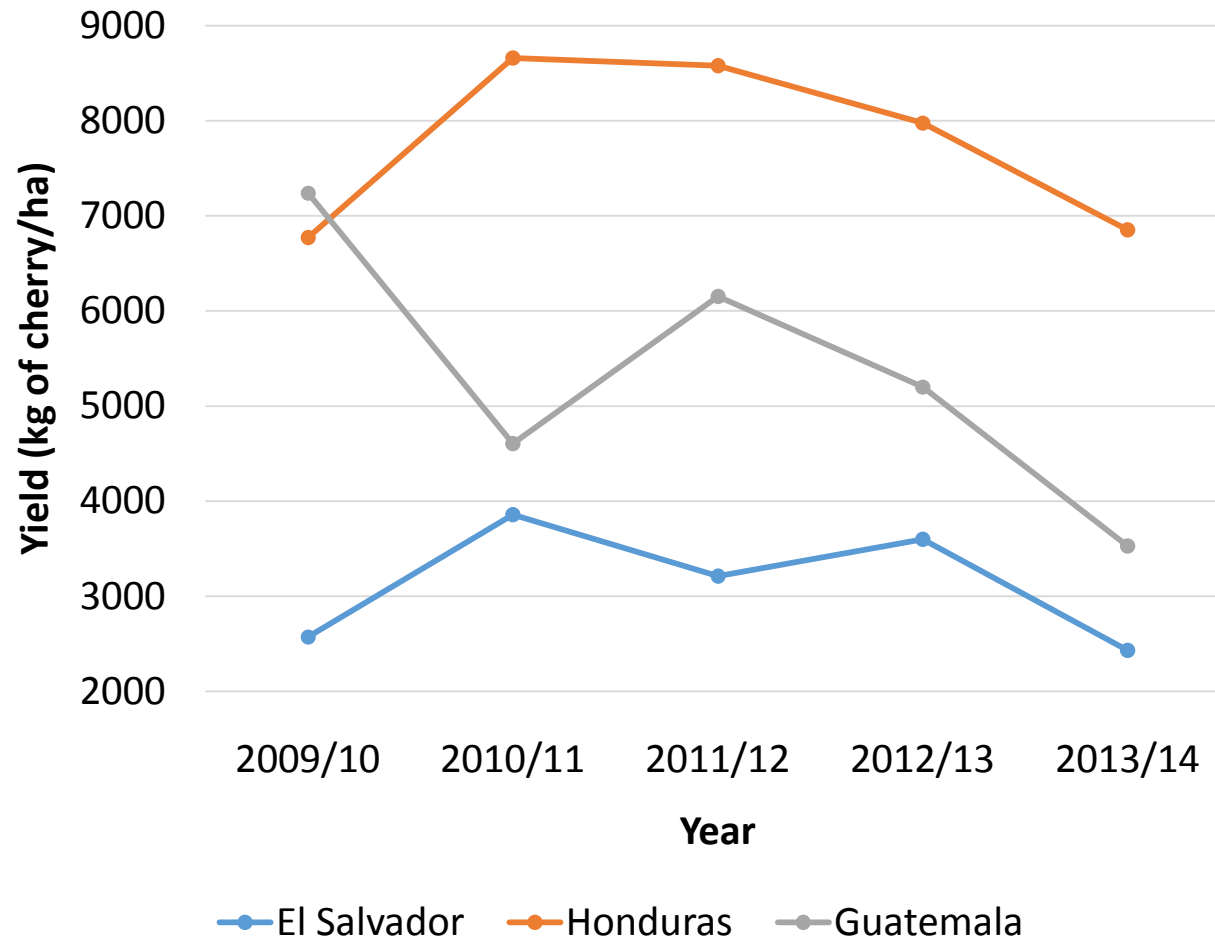
Emily Briggs

MSc. student Imperial College

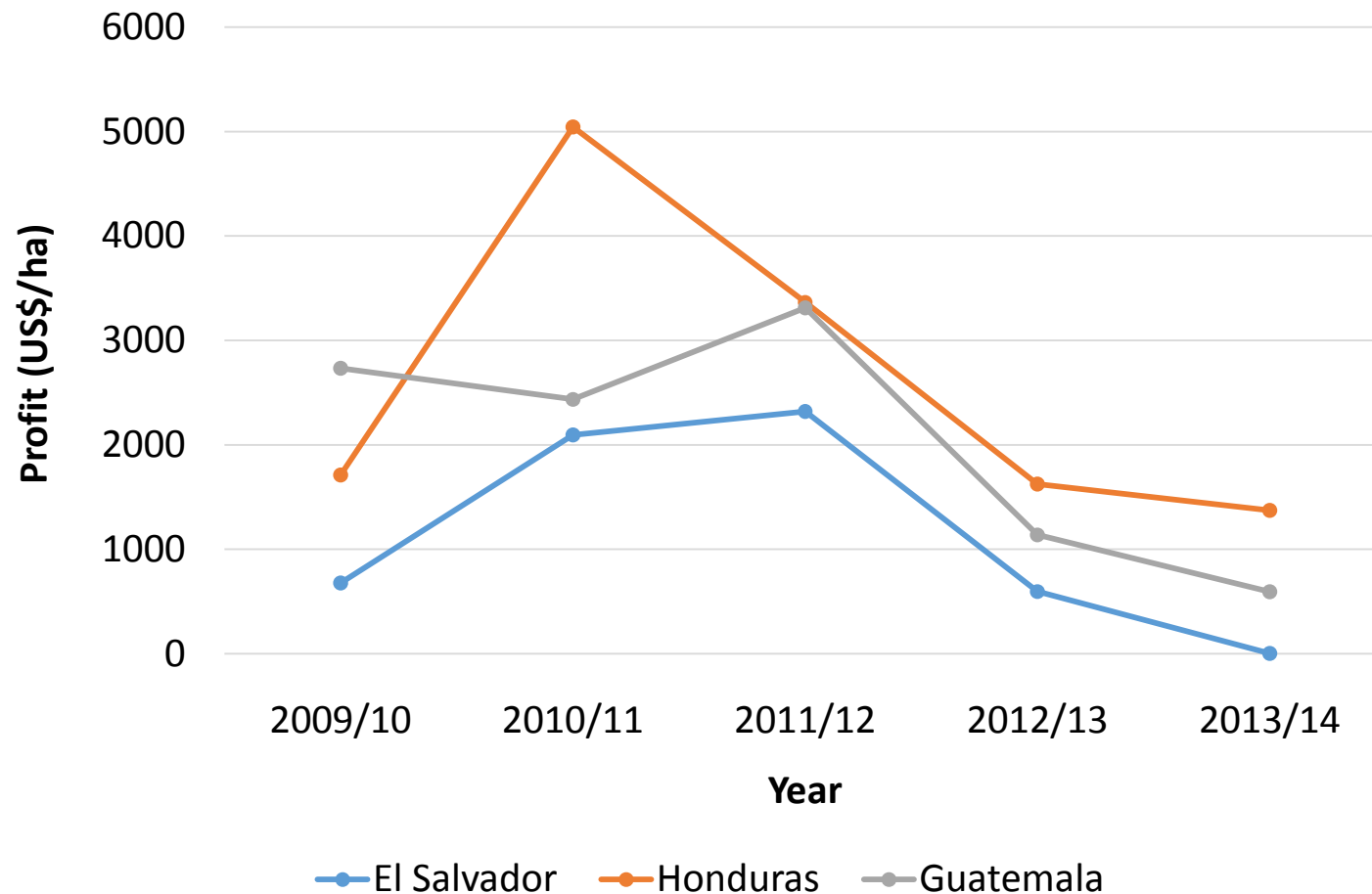
Case study of farmers in El Salvador, Honduras & Guatemala



Falling yields and rising costs

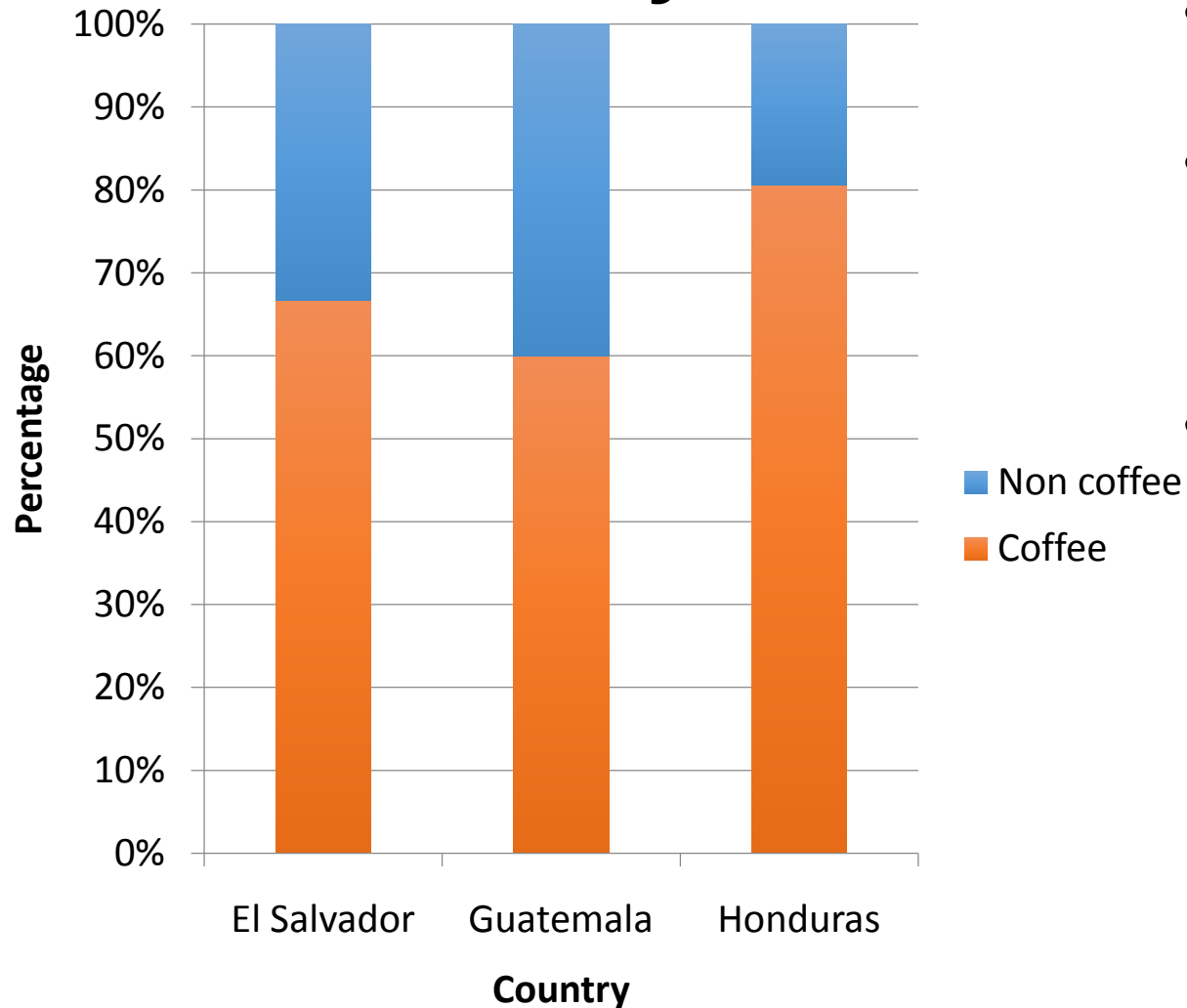


Falling profits from coffee farming



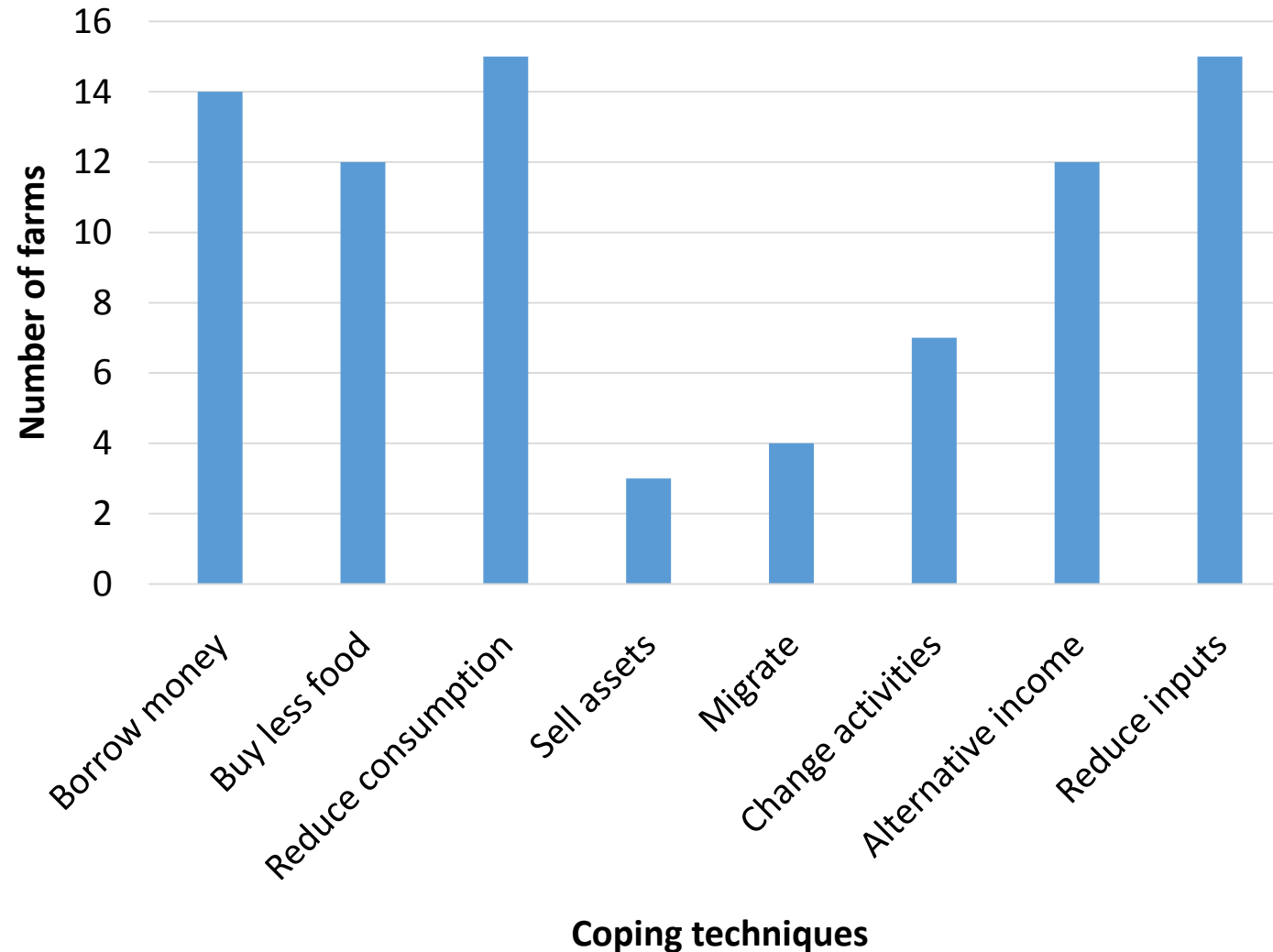
- 66% of surveyed farmers in El Salvador recorded a loss in 2013/14.
- Surplus income after meeting basic household expenses declined by 20-30% in all countries 2013/14.

Dependence on coffee income & vulnerability



- Households in Honduras are highly dependent on coffee as a source of income.
- Higher dependence means higher vulnerability to fluctuations in yield and coffee price.
- Vulnerability is highlighted through food insecurity. Households suffering from food insecurity in 2013:
 - El Salvador: 66%
 - Honduras: 66%
 - Guatemala: 10%

Livelihood strategies: coping and adapting



- Reducing inputs can undermine future yield.
- Reducing food and household expenditure may reduce human capital.
- Does alternative income really reduce vulnerability?
- No households reported diversifying out of coffee.

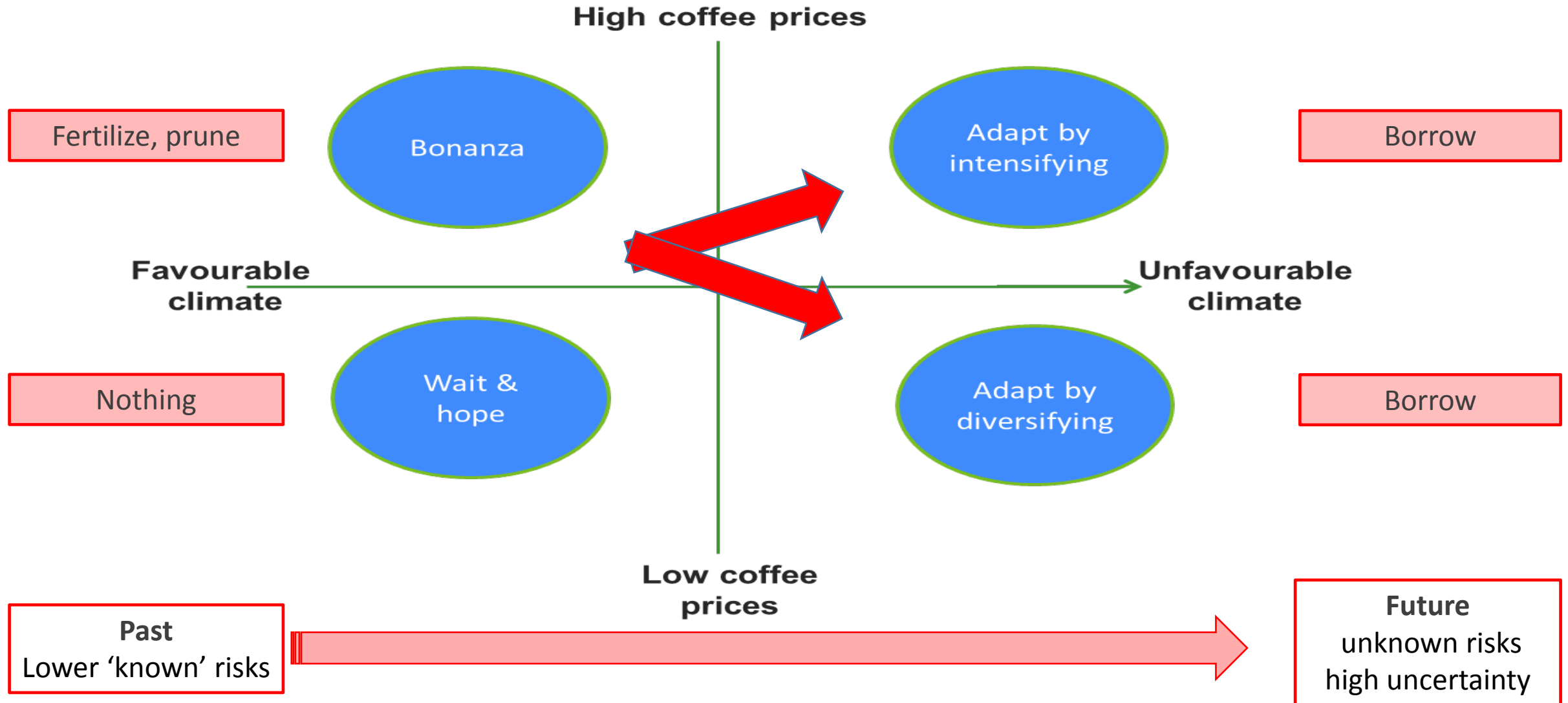
Household wellbeing

Capital	Trend
Natural	
Financial	
Human	
Physical	
Social	

- Overall wellbeing is declining.
- Households with access to finance, remittance and higher income diversification have suffered smaller declines in wellbeing.
- This research has gathered valuable baseline data on household wellbeing and the economics of coffee farming at the farm level.

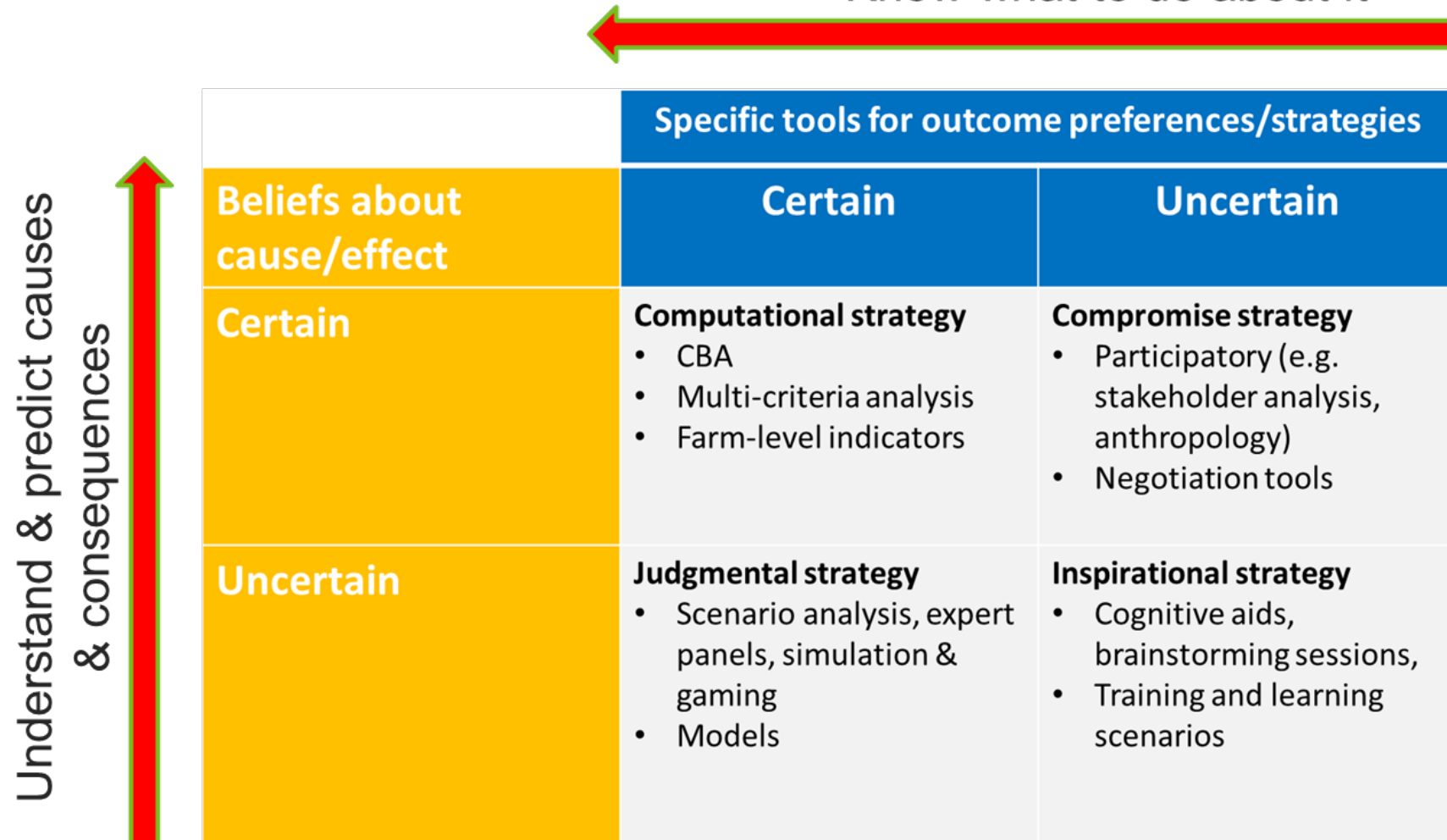
Two major factors affect all farmers

weather and prices



Old strategy no longer works?

Know what to do about it



* After: de Boer *et al* Global Environmental Change 20 (2010) 502–510

Simulations and scenarios

Lee Pearson

PhD student Imperial College

Modelling Risks of Coffee

Income

- Price (USD/kg)
- Supply (kg)
 - Weather
 - Disease
 - Yield
- Etc.

Expenses

- Farming
 - Inputs
 - Labour
- Household
 - Food
 - School fees
 - Health shocks
- Etc.

Planning without considering risks

- Certain predictions with basic sensitivities
- Clear decisions, but is it accurate?
 - Resilience?
 - Roya?
 - Livelihoods?



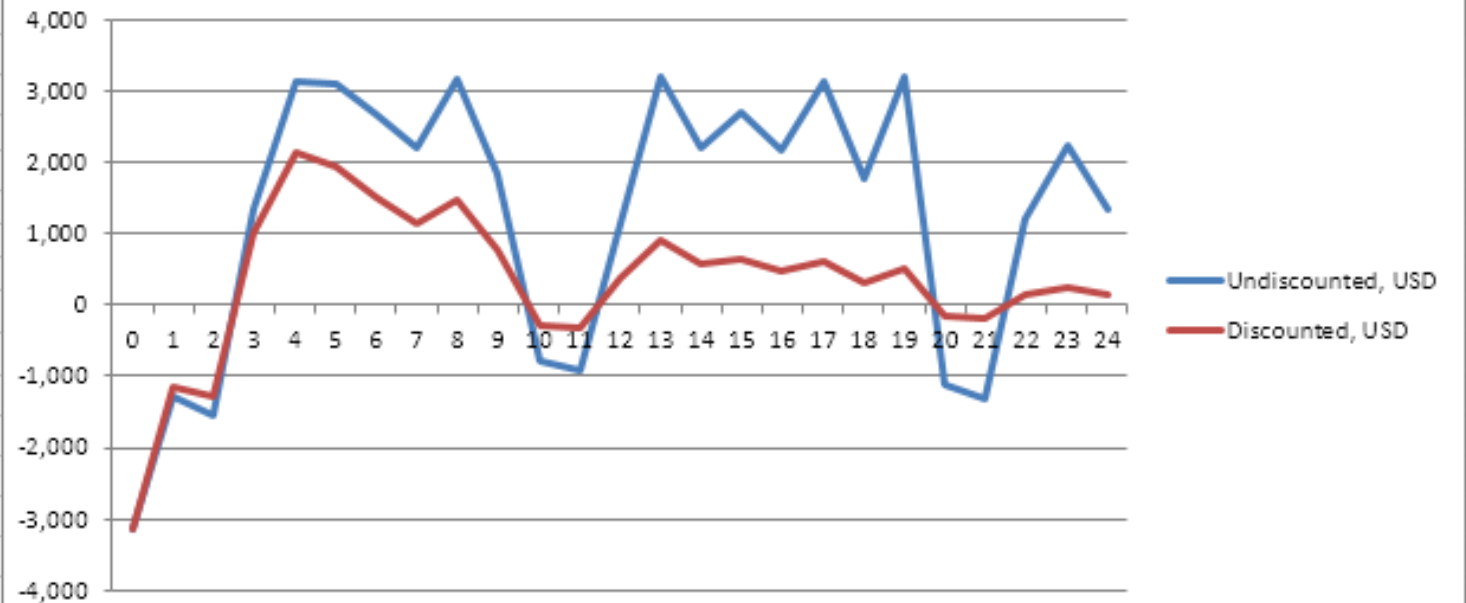
Investment Criteria

Discount Factor:	10	%
NPV:	8,456	USD
IRR:	26.2%	%

Sensitivity analysis

Revenues:	100%
Labor Costs:	100%
Input Costs:	100%

Cash Flow, undiscounted and discounted



• Ability to test assumptions:

- How bad will Roya events every 20 years be? Every 5? Etc.
- How will higher price volatility affect our projects?

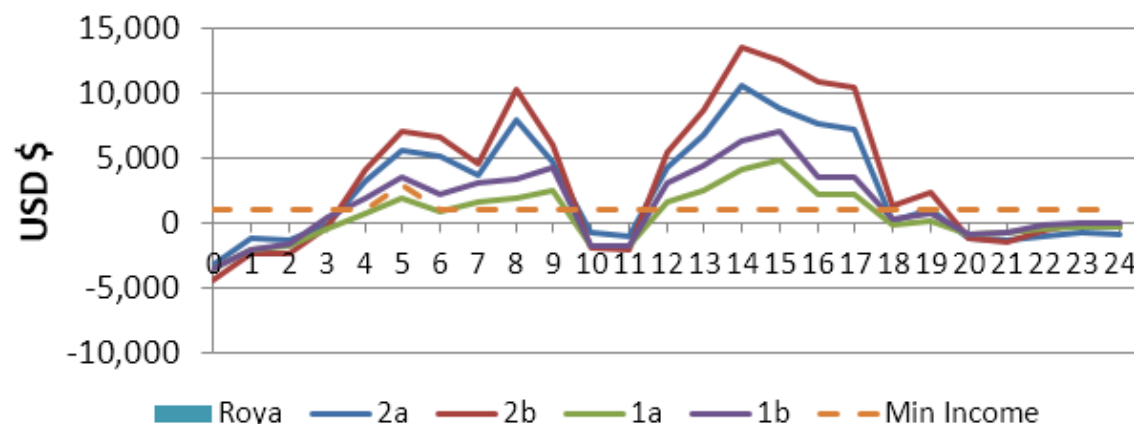
• Ability to compare scenarios:

- GAP vs. traditional
- No organization development vs. bulk sales via farmer organizations

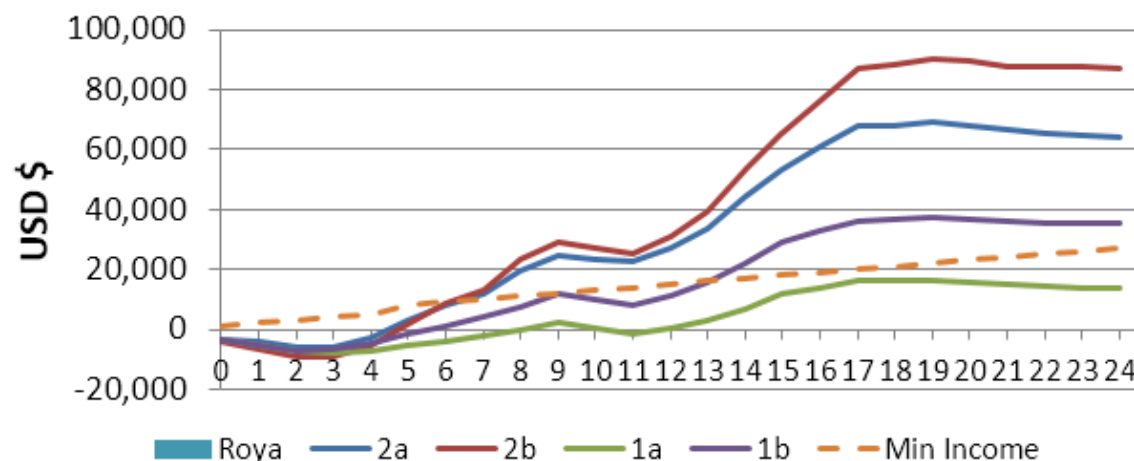
1 SAMPLE RESULTS

	1a	1b	2a	2b
NPV	\$ 767	\$ 9,155	\$ 20,848	\$ 25,926
IRR	11.27%	22.55%	36.00%	31.80%
% years CF>0	52%	64%	56%	60%
% years CF>min	40%	48%	56%	60%

Undiscounted Cash Flow Comparison



Cumulative undiscounted Cash Flow Comparison



MODEL CONTROLS

Parameter Settings

Go to Coffee Plot
Parameters

Go to Risk Parameters

Run Model (1 Sample)

Recalculate New
Sample

Hide Current Sample
Inputs

Run Model (Monte Carlo)

Number
Runs

100

Run Monte Carlo and view
Results

Metrics of alternative choice

1. IRR to compare against
2. NPV of "safe" income
 - Annual income
 - Income growth rate
 - Discount factor

15%
\$ 9,985
\$ 1,000
0%
10%

Update

GRAPH CONTROLS FOR 1 SAMPLE

SHOW

Discounted

Undiscounted

SHOW

- ☒ 1a
- ☒ 1b
- ☒ 2a
- ☒ 2b
- ☒ Roya Events
- ☒ Min Income

Sensitivity

Revenues
Labour Costs
Input Costs

100%
100%
100%

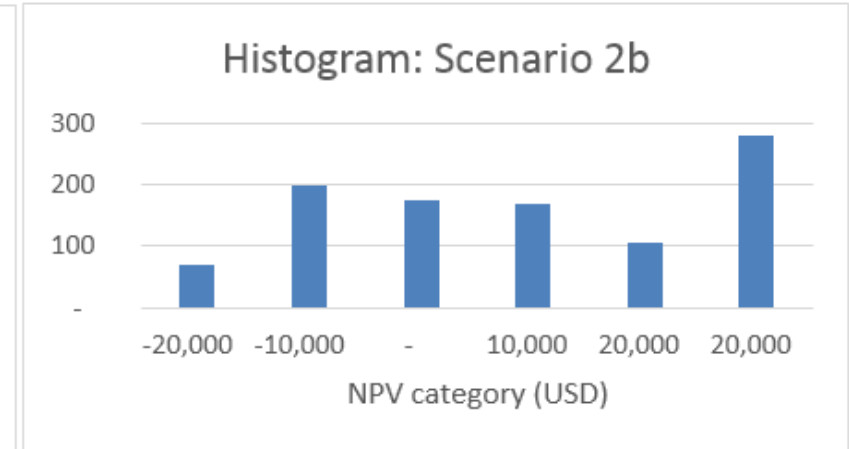
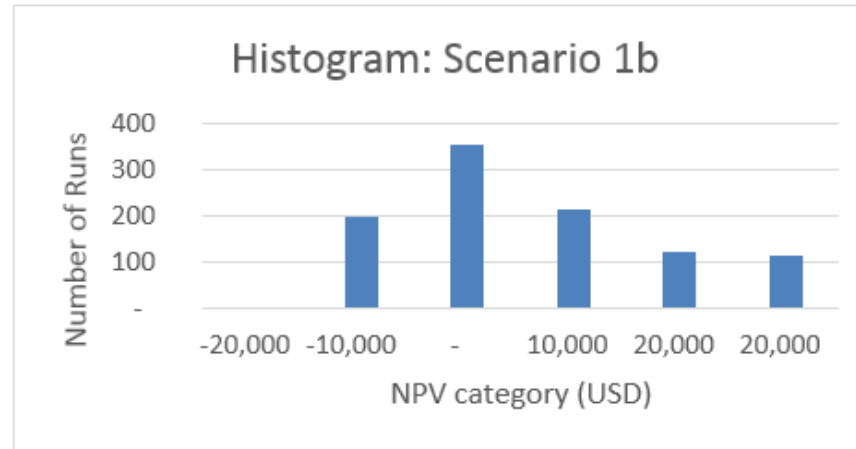
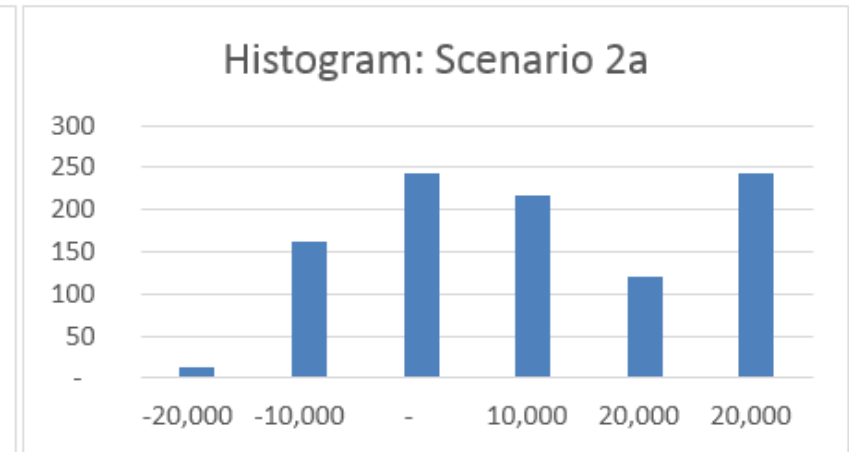
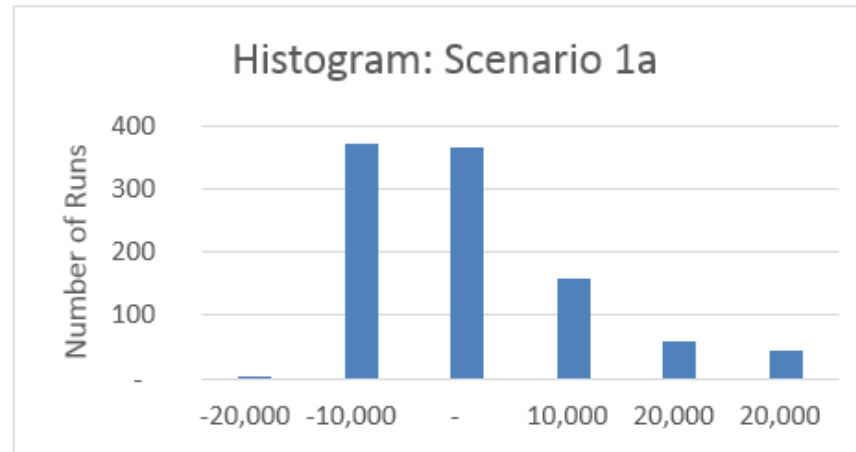
Update
Graph

- Monte Carlo simulation
- Given risks:
 - How often can we expect a project to meet criteria?
 - Which scenario gives lower chance of the downside outcomes?

Results from:
1,000 runs

Scenario	Median NPV	Prob NPV Coffee > NPV "Safe"	Prob IRR > Alternative IRR
1a	\$ (7,056.30)	10%	20%
1b	\$ (1,309.61)	23%	37%
2a	\$ 3,774.26	36%	53%
2b	\$ 3,658.91	39%	50%

Go Back
Gra



Demonstration in Excel



Microsoft Excel
ro-Enabled Works

How do farmers respond to change?

Nicole Westfall MSc
student Imperial College

- A year after heavy attacks by rust
- Farmers have responded
- Few show signs of livelihoods shifts
- Should we be trying to influence them?

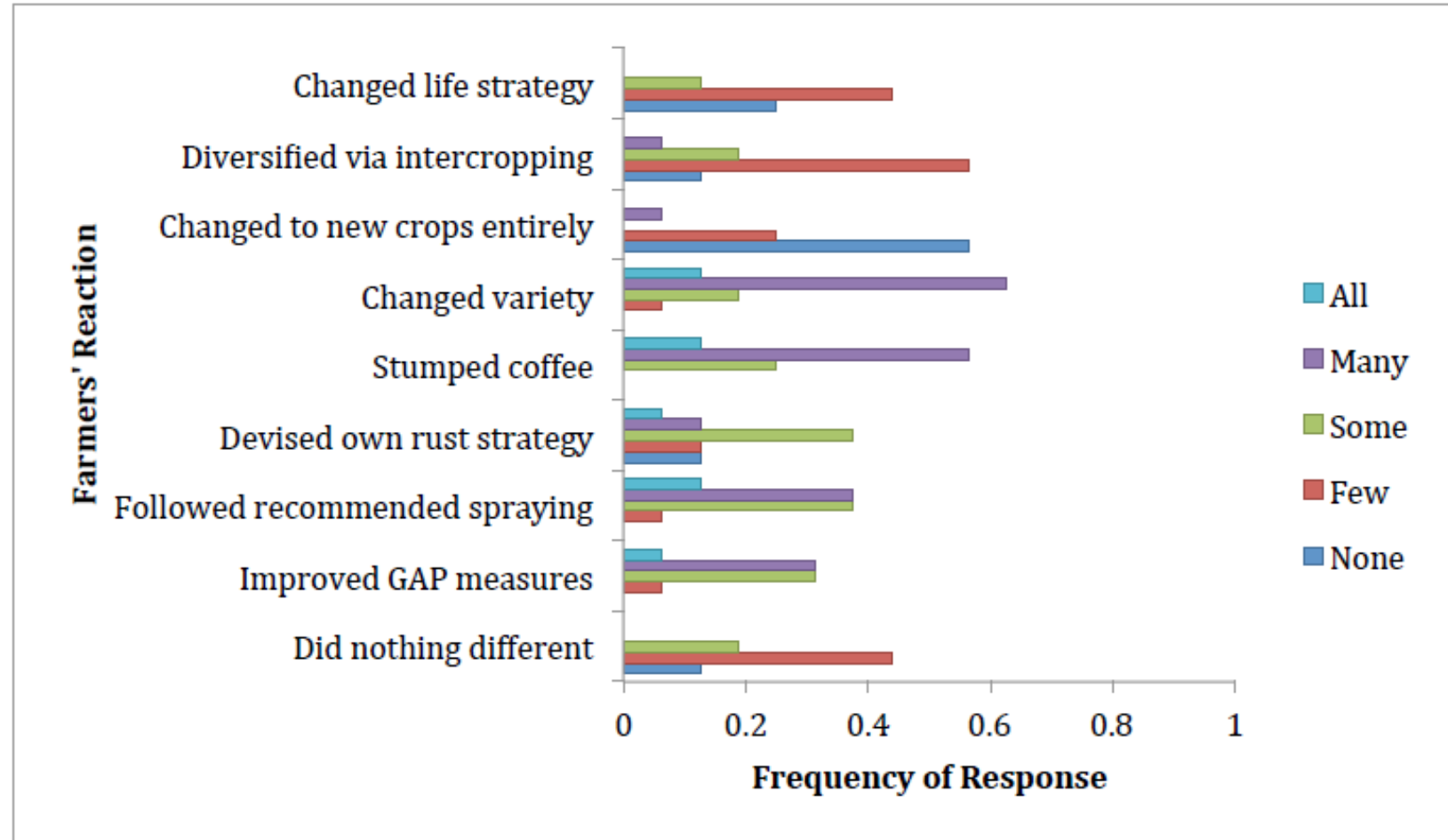


Figure 7: Reactions by farmers heavily affected in the 2012 coffee leaf rust outbreak in the following season (2013) as observed by extension service workers.

Acute challenge: how do farmers make decisions?

- We are just at the start of this
- Classically farmers are risk-averse, slow to react
- With low income and sunk costs in a perennial system they are not well placed to react
- We are going to have to understand a lot more about how farmers think and perhaps how we can nudge them to change, diversify in the future

Towards a decision-support system (DSS)

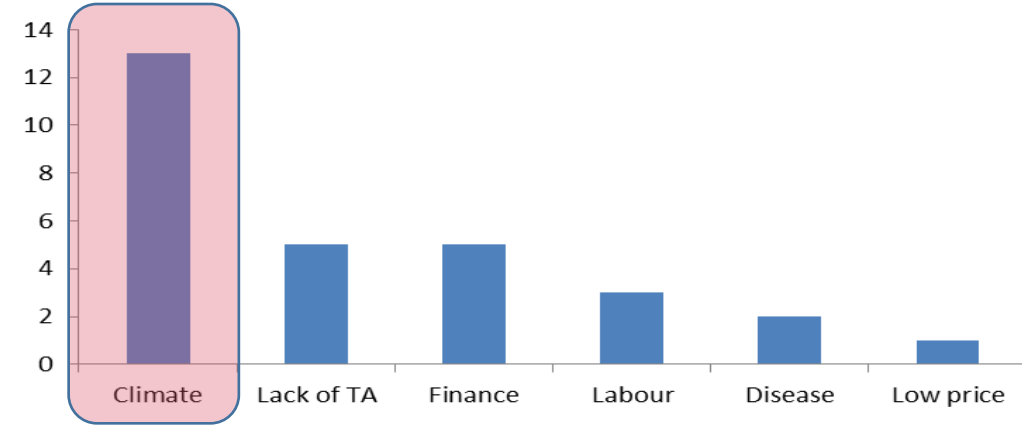
- In the face of such complexity we need not only a systematic approach to identifying and developing practical tools (done at pilot scale)
- We also need clear and robust ways to identify farmers according to needs and capabilities
- We need to develop alternative strategies
- We need to assemble this into a form that is practically useful
- But we don't have time to do it by long-term experiment
- Increased use of surveys, simulations, participatory learning with farmers is the best way

NE Minas – coffee farmers say climate is the most pressing problem

- Farmers around Capelinha rate climate as their main production problem
- Drought is a principal concern
- But is it climate change?
- A major difficulty is to distinguish between isolated or cyclical events and long-term change

Ranking score of production problems

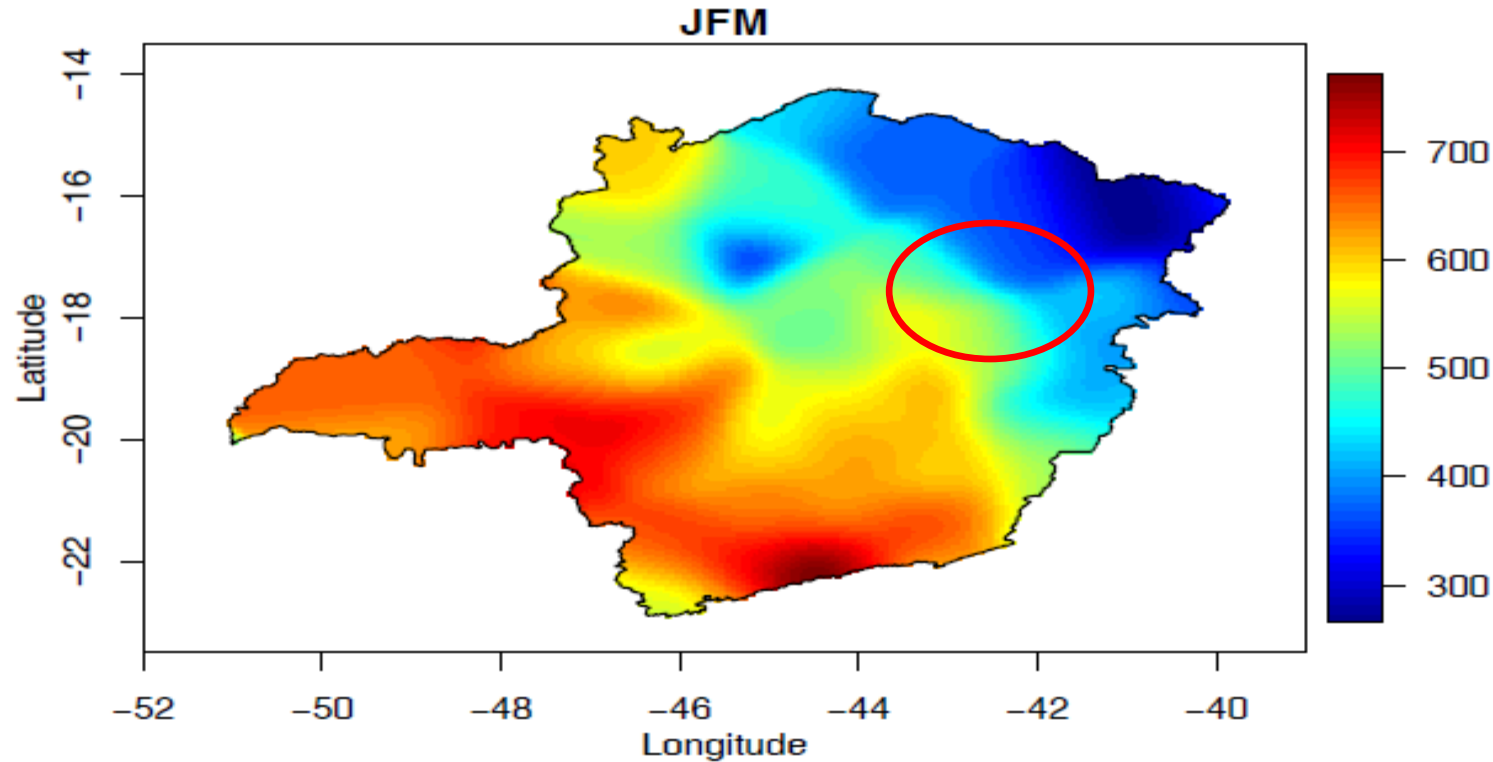
1st problem = 3; 2nd = 2; 3rd = 1



Our work shows long-term changes

Ramiro Ruiz (Uni MG Belo Horizonte)

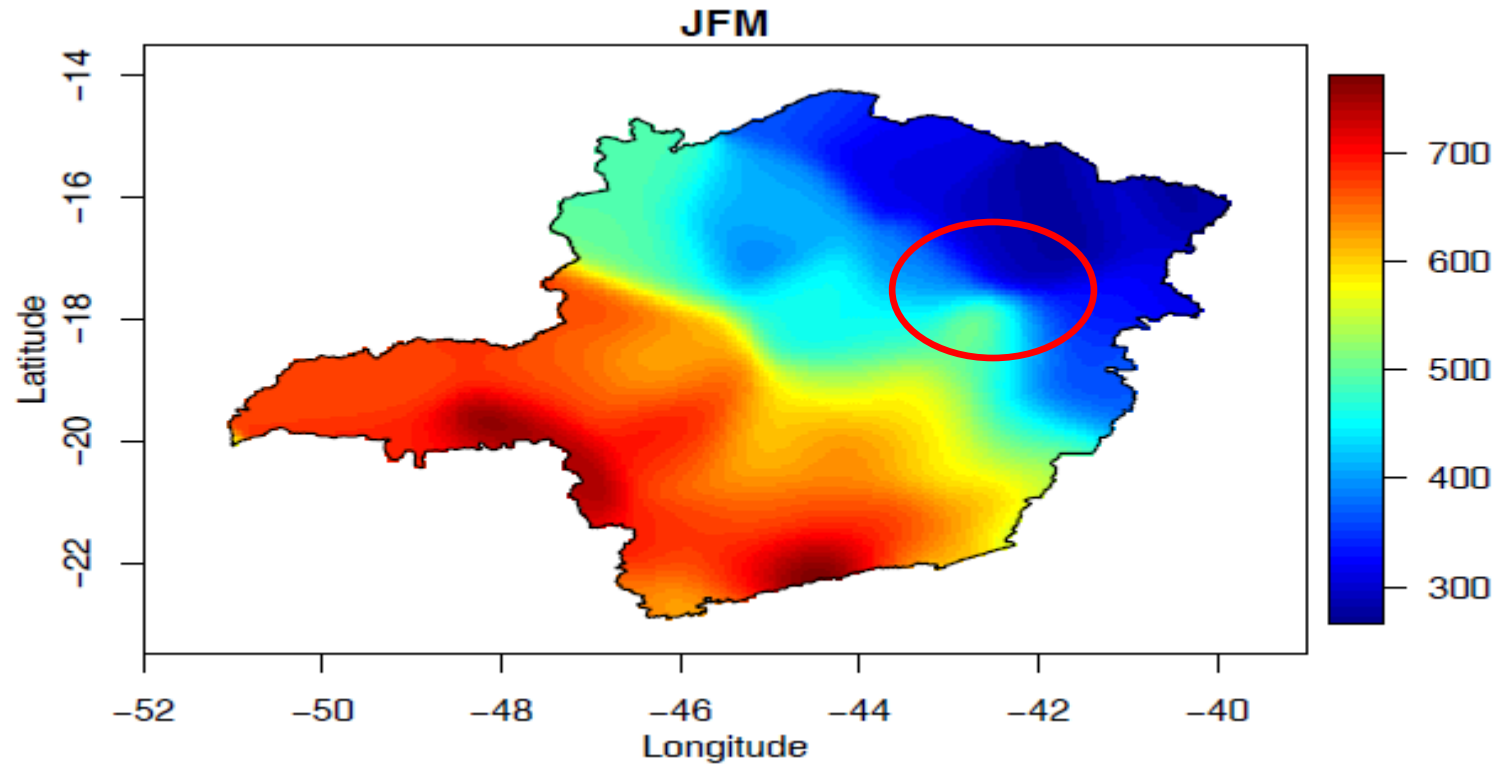
- Jan-Mar rainfall 1961-1980



Our work shows long-term changes

Ramiro Ruiz (Uni Belo Horizonte)

- Jan-Mar rainfall 1981 – 2011 getting drier in NE of Minas



In the NE MG case we can give quite simple advice

- Farmers in NE Minas Gerais are right – it has been getting drier, it's a long term trend
- Modelling into the future suggests this trend will continue
- Farmers have two options
 - Install irrigation
 - Start diversifying out of coffee
- **Unfortunately, in many cases we can't give such clear advice**
- **But this is what we have to do, otherwise farmers won't listen**

Decision making bounded rationality and heuristics

- ✓ High uncertainty
- ¿ Many alternatives
- ✓ Small amount of data

- x Low uncertainty
- ¿ Few alternatives
- x Large amount of data



Make it simple

Make it complex



Gerd Gigerenzer
Max Planck Institute
Berlin

Tools for thought, decision and action

- *In a world of uncertainty you need rules of thumb, called heuristics.*
- *Many of my colleagues ... think that people are basically hopeless when it comes to understanding risk, and we need to nudge them into behaviour from birth to death.*
- *My own research has shown that we can easily teach people and give them the tools.*

[G. Gigerenzer]

Major changes in the coffee knowledge system needed

- Coffee production requires ~ 100 different technologies and techniques (nursery to green coffee)
- In the light of CC **we need to review each step and modify where needed**
- **Coffee production manuals are out of date:** they often deal with a single technology package. They don't deal with uncertainties, livelihood strategies
- At the very least farmers and other stakeholders need to understand the challenges facing them. All too often they simply don't know

Conclusions: coffee is a complex system

- Increasing number of shocks makes management more difficult for farmers
- We simply don't know what or where the next big shock will come
- No single technique or approach is sufficient to analyse the system
- Or offer viable solutions
- We need a wide range of approaches
- We need a wide range of expertise
- This is why we need a joint effort

What is your Plan A, B, C etc?

- Your countries are going to have to take some very difficult decisions
- How do you allocate scarce resources for the best possible outcome for farmers?
- How much coffee? Where? How will you grow it? What support will be needed?

Large number of urgent needs and actions

- c&c initiative has made a good start on characterising the problem and developing a logical, science-based process to help farmers adapt
- But much more needs to be done
- We can't do this by ourselves – major level of collaboration is needed
- Retraining, capacity building, collaborative pre-competitive ventures, strategic planning
- This is urgent, we need to start acting together now

Power, time, gravity, love.
The forces that really kick ass are all invisible.
[D Mitchell; Cloud Atlas]